PROGRAMMING AND SERVICE

7970E HP-IB INTERFACE MANUAL

Manual Part No. 07970-90919
Microfiche No. 07970-90920

HEWLETT PACKARD

HEWLETT-PACKARD COMPANY
P.O. BOX 15, BOISE, IDAHO, U.S.A.

TABLE OF CONTENTS

I GENERAL INFORMATION

II PROGRAMMING

III THEORY OF OPERATION

IV MAINTENANCE

V PARTS AND DIAGRAMS

ILLUSTRATIONS

TABLES

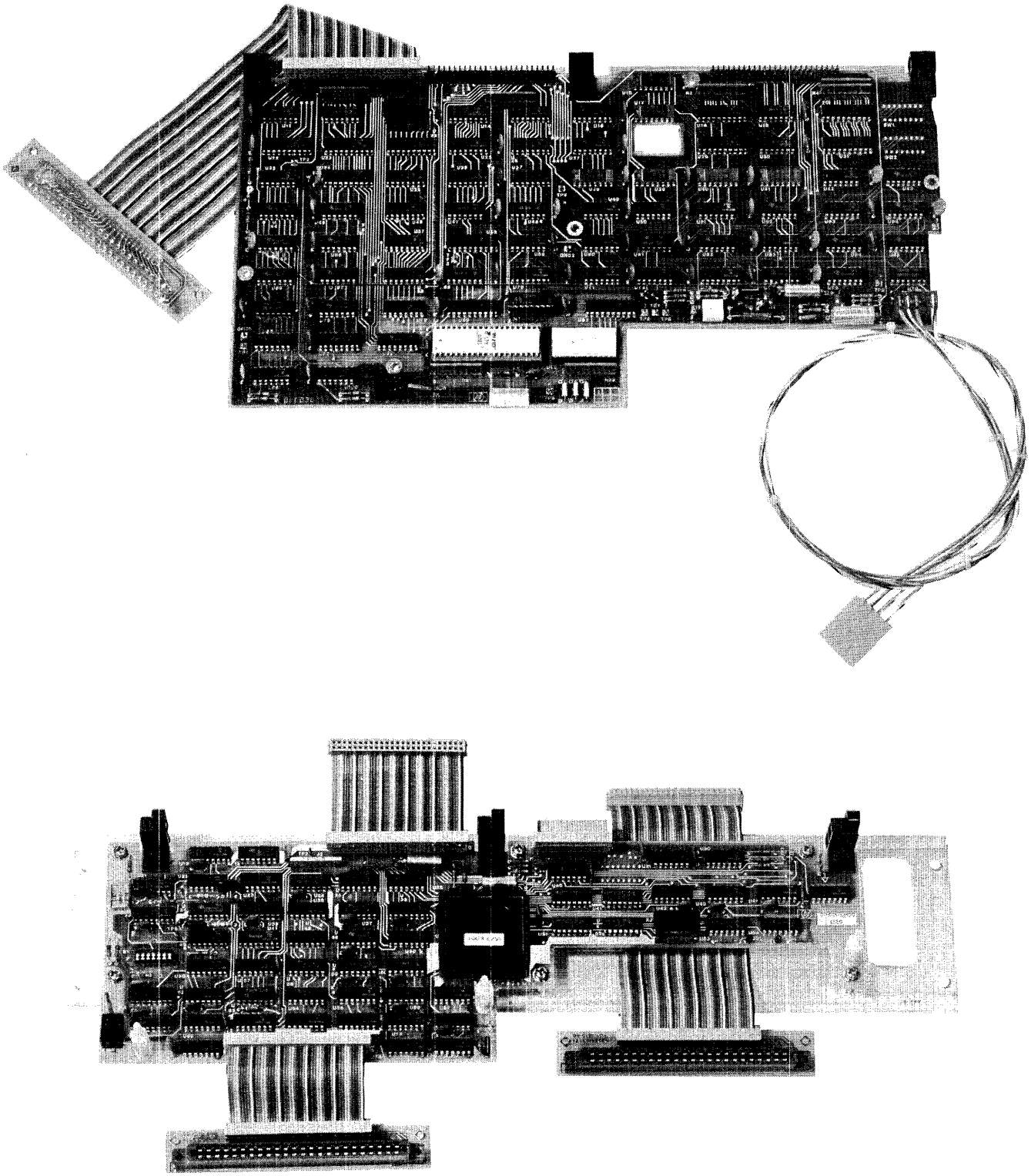


Figure 1-1 7970E HP-IB INTERFACE PCA's

I GENERAL INFORMATION

1-1 INTRODUCTION

This section covers information which includes the introduction, description, identification and specifications for the 7970E HP-IB Interface. The manual covers general information, programming, maintenance, theory of operation, and replacement parts and schematics for the 7970E HP-IB Interface assembly. If more specific information on the Hewlett-Packard Interface Bus is required refer to IEEE-488 1975.

1-2 DESCRIPTION

The 7970E HP-IB Interface allows the user to connect a 7970E (1600 bpi, 9TK, PE) Magnetic Tape Drive to a Hewlett-Packard Interface Bus system. The slave interconnection normally made with the 7970E is also available with this HP-IB option. This allows the connection of multiple tape drives to a system without the expense of multiple HP-IB Interface Assemblies.

The 7970E HP-IB Interface is a factory installed option only and is not available for field installation. For the 7970E Tape Unit to operate with the HP-IB Interface, a modification to the Read Mother Board is required. Also, the interface will respond incorrectly if used with Read Control PCA's numbered 07970-62040.

The HP-IB Interface consists of a Control PCA, Write Formatter PCA, Back Panel/Switch PCA, and miscellaneous cables (See HP-IB Interface Assembly, Exploded View, page 5-3). The two major PCA's, Control and Write Formatter Boards, contain the necessary electronics for tape motion and data transfer control. The HP-IB Interface is capable of operating at any of the six standard tape speeds.

1-3 IDENTIFICATION

Printed circuit assemblies (PCA's) are identified by a part number and an alphanumeric code consisting of a letter, a series code, and a division code stamped or etched on the assembly (eg. A-1716-46). The letter identifies the version of the etched

trace pattern of the unloaded printed circuit board. The four digit series code pertains to the electrical characteristics (circuit design) of the loaded PCA. The division code identifies the Hewlett-Packard division that manufactured the assembly. If the series numbers of the PCA's do not agree with the series numbers shown on the schematic diagrams in this manual, there are differences between the HP-IB Interface and the information in this manual. These differences are described in updating supplements available through HP Sales and Service Offices.

1-4 SPECIFICATIONS

The HP 7970E HP-IB Interface is listed by Underwriter's Laboratories, Inc. in the following catergories with respective guide designations: Electronic Data Processing Equipment (EMRT), Teaching and Instruction Equipment (WYFW), and Office Appliance and Business Equipment (QOAT).

The Canadian Standards Association has certified this 7970E HP-IB Interface as Data Processing Equipment.

This Tape Unit was designed to meet most European Safety and RFI/EMC standards for Electronic Data Processing Equipment effective prior to 1 July 1978. Any questions concerning regulatory agency compliance should be directed to the local Hewlett-Packard Sales and Service Offices.

The Specifications for the 797E HP-IB Interface are listed in Table 1-1.

Table 1-1 SPECIFICATIONS

* Electrical Characteristics

Power required: +5v @ 2.5 amps
+12v @ 75 ma
-12v @ 50 ma
All power comes from the standard 7970E power
115 or 230 (+/- 10%) Vac
50 to 66 hz, single phase
400 VA, maximum (on high line)

* Mechanical Characteristics

Size: Approx. 36 cm x 18 cm (14 in x 7 in) PCA's

Weight: Less than 0.9 kg (2 lb.)

Compatibility: This interface requires a change in the read mother board. The interface will respond incorrectly if used with 7970E Read Control PCA's numbered 07970-62040.

Interface Cable: Standard HP 300 requirements (Interface cable not supplied with the HP-IB Mag Tape Interface).

* Environmental Specifications

Operating Temp: 0 to 55 Deg. C (32 to 131 Deg. F)

Relative Humidity: 20 to 80% (Non-condensing)

II PROGRAMMING

2-1 INTRODUCTION

This section contains information on the HP-IB system, HP-IB Tape Functions, Programming Requirements, Buffer Requirements, 7970E Tape Controller Commands, End Commands, Tape Controller Status, Device Specified Jump, and Operator Controls and Indicators.

2-2 HP-IB DESCRIPTION

The Hewlett-Packard Interface Bus is a carefully defined instrumentation interface which simplifies the integration of instruments, calculators, and computers into systems. It minimizes compatibility problems between devices and has sufficient flexibility to accommodate future products.

The HP-IB employes a 16 line bus which is composed of three handshake lines, five lines for management (control), and eight lines for data transfer. The 7970E Magnetic Tape implementation of HP-IB does not use the SRQ or REN control lines.

For a device to communicate on the bus, it must be in one of three modes, Controller, Talker, or Listener. The Talker and Listener modes are used by the tape unit. The tape unit will not operate as a controller. To receive data, the unit must be in a Listen mode and to send data it must be in a Talk mode.

A bus device must be placed into the Talk or Listen mode with a primary command. The primary commands, My Talk Address (MTA) and My Listen Address (MLA), direct the device to be a Talker or a Listener and is the first command sent to the the device. Immediately following the primary address, a secondary address (secondary command) must be sent. This secondary command informs the device to interpret the subsequent data in a particular manner.

The HP-IB Standard provides two ways for a bus device to request service. The first method, serial polling, is initiated when a bus device, requiring service, asserts the Service Request (SRQ) line low. When the controller looks at the SRQ line and sees it

low, it begins a serial poll sequence. This sequence involves serially polling (addressing) each device on the bus to find the unit requiring service. With this polling method, the bus will operate with up to 30 devices but is somewhat slow in that the bus controller must address each device serially until it locates the one requesting service. A faster method of polling is parallel polling which limits the number of devices on a bus to eight. This method is used by the tape interface. With the Parallel Poll method, each device on the bus has a switch selectable address of 0 thru 7, called the fundamental address and corresponds to one of the eight DIO lines (8 thru 1). The bus controller must periodically initiate polling, as the SRQ line is not used with the Parallel Poll (PP) technique. The bus controller does not receive any signal from the unit to indicate the unit needs servicing. poll, all devices on the bus which require service assert their respective DIO lines low (logic 1). The controller knows immediately the fundamantal address of the devices requiring service by which DIO line is asserted. A primary address imbedded in the primary command is used to address the command to the correct unit. For a device to become enabled to talk or listen, the primary address must equal the fundamental address.

The Tape Drive also functions as an Extended Talker (TE). This instruction utilizes a unique addressing sequence. The primary address recognized with this TE is 31(decimal). The secondary address required for this talker function to become active is the device's fundamental address. Addressing device 31 to talk will cause each device to enter a standby state awaiting its unique secondary address to become a talker. In the secondary address (01100DDD where DDD equals the fundamental address), the unit will become a talker and issue two bytes of identification information. This information describes to the controller what type of device is at that address location, such as a printer, storage device,ect.. The identify sequence ends with an Address To Talk to Device 30(decimal), which places the device back into an idle state.

2-3 HP-IB TAPE FUNCTIONS (Tables A-1 thru A-3)

In addition to the standard handshake capability, the 7970E HP-IB Interface recognizes the following HP-IB functions:

2-4 Talker and Listener

The Talker and Listener HP-IB functions are required by the device to operate in the Talker or Listener mode. Both Talker and Listener require the corresponding Untalk or Unlisten commands, or Interface Clear (IFC) signal.

2-5 Extended Talker

The Extended Talker (TE) function responds to the primary address of 31(decimal). This is used as an IDENTIFY command sequence to provide two bytes of status for HP 300 protocol. It must terminate with an Address To Talk to Device 30(decimal) in order to put the tape unit back into the idle condition (See Table A-1 for 2-byte information).

2-6 Parallel Poll

The Mag Tape interface assumes a dedicated fundamental address of 0 thru 7 (switch selectable) and asserts the corresponding DIO Line 8 thru 1 for a response to a Parallel Poll from the bus controller. The following conditions result in a request for service by the Mag Tape (i.e. Parallel Poll response asserted):

a. Power Restored - For any Master in which the interface is connected (IDENTIFY should be performed in order to determine specific capability).

b. Off-Line to On-Line Sequence

c. Completion of the following commands:
   1. Rewind and Rewind-Off-Line (The tape unit will respond to a Parallel Poll to acknowledge receipt of the command. Following an End command, the tape unit will automatically be selected, the device number placed in Status Register #2, and will respond to a Parallel Poll after completion of rewind. No rewind poll response will be issued for the Rewind-Off-Line command.
   2. Forward Space/Backspace a Record/File
   3. Write Gap
   4. Read Record
   5. Read Record Backward
   6. Write Record
   7. Write File Mark
   8. Device Select

d. Data Transfer Required (Reading and Writing data)

e. Write Enable Error

f. Tape Runaway

g. DEVICE CLEAR

Note: The assertion of the units DIO line corresponding to it's fundamental address, is the response given to a Parallel

Poll by the bus controller, refered to as a Parallel Poll response.

2-7 Serial Poll

No Serial Poll (SRQ) capabilities will be provided.

2-8 DEVICE CLEAR/SELECTED DEVICE CLEAR

The Device Clear/Selected Device Clear(DCL/SDC) commands are used to initialize the tape unit to a predefined state. They both have the same meaning to the tape unit, and may be preceded by a secondary command and the Device Clear data byte (predefined state). The hardware and firmware are actually reset only upon receipt of the DCL or SDC messages. The data byte (predefined state) is thrown away by the interface. Upon completion of a Device Clear command, the interface issues a parallel poll response.

2-9 PROGRAMMING REQUIREMENTS

The following represents the general software/HP-IB requirements for interfacing the 7970E HP-IB to a Hewlett-Packard Interface Bus System:

2-10 Commands

In order to issue commands to the tape interface, its current state must be a listener. If it was previously addressed to talk, it must receive an Untalk (UNT) message or an Interface Clear (IFC) message. The IFC, when received by the tape interface, performs an untalk or unlisten, depending on the prior state of the device.

After the Listen Address (MLA) has been sent to the tape unit, the next message expected is a secondary command (table A-2). At this point, the bus should be put into the data mode and a single byte of data (DAB) placed on the bus. This data byte contains the actual controller commands required by the device (table A-4). The command sequence of HP-IB messages is:

(UNT/IFC) Depending on previous state of device
MLA (table A-2)
MSA (table A-2)
DAB (tables A-4,A-5) If required.
(UNL) Optional

2-11 Reset Commands

The reset commands return the tape to an idle state, waiting for the next operation to start. The three clear or reset commands are explained below:

Interface Clear

The Interface Clear (IFC) command is used only to unlisten or untalk the tape unit, unaddress the CHI (see section 3-4 for an explanation of CHI). It is not used to reset any of the interface hardware. If a complete reset of the tape unit interface is desired (hardware and firmware) the IFC must be followed by a Selected Device Clear (or Device Clear).

Device Clear

This command is used to reset the interface to a given known state (Power Up). Either a Device Clear (DC) or Selected Device Clear (SDC) may be used with or without a secondary command and data byte.

(UNL/IFC)
MLA
MSA (table A-2)
DAB
DC or SDC
SERVICE REQUEST (PP)
UNL (optional)

Untalk/Unlisten

The Untalk and Unlisten commands untalk or unlisten the tape unit. This involves unaddressing the CHI chip, but does not reset any of the tape drive electronics.

2-12 Status Requests

The status is obtained from the device in a manner similar to the command sequences. The primary difference is that the tape unit must be in a talk mode before it can send status information. The following bits are reset automatically after the status has been read: Multiple Track Error, Command Rejected, Single Track Error, Tape Runaway, Command Parity Error, Data Error and Power Restored. The status request sequence of HP-IB messages is:

```
(UNL/IFC)
 MTA (Table A-3)
 MSA (Table A-3)
 DAB (Table A-6)
 DAB
 DAB
(UNT) (optional)
```

2-13 Power On and Identify

The tape unit powers up in a reset state. The DIO corresponding to the device's fundamental address will be asserted for a Parallel Poll response after interface initilization has been completed. The system controller should acknowledge the device's request and subsequently enable all Parallel Poll responses and issue an IDENTIFY request (TE function). The Parallel Poll response (Request-for-Service) is cleared on the aevice when the DSJ is read or with an End command (See table A-5). The sequence of HP-IB messages is:

```
(UNL/IFC)
 MTA 31 (octal)
 MSA (Device's Fundamental Address)
 DAB (Identify bytes sent to
 DAB  Controller, table A-1)
 MTA 30(octal)
 MTA (table A-3)
 MSA (Request DSJ,table A-7)
 DAB (DSJ)
(UNT)
```

2-14 Read Data from Tape

In order to read data from the tape, several command sequences are required. The first requires the tape to be in a listen mode, followed by a secondary command and data byte request to read a Record. When the tape is capable of handling the data transfer, a Parallel Poll response is issued by the tape interface and the DSJ set to 0 if no significant errors occur. After the record data has been transferred and an EOI placed on the bus, an End command must be issued by the user to clear the Parallel Poll response. The End command, DIO 1 set, must follow the EOI indication within 2 msec. If the controller is capable of sending the next command to the tape drive in under 100 microseconds from the handshake of the END command, the controller must read the byte count from the interface and discard the returned bytes. This is necessary to assure command execution integrity. When transferring a multi-burst record, the END command is only needed after the EOI unless reading fewer bytes than the record con-

tains, in which case the end would follow the last burst of data required. The Parallel Poll response will be reset automatically when the DSJ is read for other than the final burst. The sequence of HP-IB messages for a single burst is:

```
(UNT/IFC)
 MLA (table A-2)
 MSA (Table A-2)
 DAB (Read Record, table A-4)
 UNL
 Service Request by Tape Unit
 MTA (table A-3)
 MSA (Address DSJ, table A-3)
 DAB (DSJ Status, table A-7)
 MSA (Read Data, table A-3)
 DAB (Data Record
 DAB  from tape,
  :   tagged
 DAB  with EOI)
 MTA  (table A-3)          This sequence is needed
 MSA  (table A-2)          for high performance
 DAB  (Byte count          controllers only.  It
 DAB   discard data bytes) does not affect final
 UNT                       byte values.
 UNL
 MLA (table A-2)
 MSA (table A-2)
 DAB (End, Table A-5)
 UNL
 Service Request by Tape Unit
 MTA (table A-3)
 MSA (Address DSJ, table A-3)
 DAB (DSJ Status, table A-7)
(UNT)
```

A typical sequence for a multiple burst record is:

```
(UNT/IFC)
 MLA (table A-2)
 MSA (table A-2)
 DAB (Read Record, table A-4)
 UNL
 Service Request by Tape Unit
 MTA (Address DSJ, table A-3)
 MSA (Address DSJ, table A-3)
 DAB (DSJ Status, table A-7)
 MSA (Read Data, table A-3)
 DAB (64 bytes from
  "   Tape, not
 DAB  tagged with EOI)
 UNT
```

```
Service Request by Tape Unit
MTA (table A-3)
MSA (Address DSJ, table A-3)
DAB (DSJ Status, table A-7)
MSA (Read Data. table A-3)
DAB (64 bytes from
  "    tape not
DAB   tagged with EOI)
UNT
Service request by Tape Unit
  "
  "
Service Request by Tape Unit
MTA (table A-3)
MSA (Address DSJ, table A-3)
DAB (DSJ Status, table A-7)
MSA (Read Data, table A-3)
DAB (Less than, or equal to
DAB   64 bytes from Tape,
DAB   tagged with EOI)
UNT
MLA (table A-2)
MSA (table A-2)
DAB (END, with DIO 1 set, table A-5)
UNL                    ________
MTA (table A-3)              This sequence
MSA (table A-2)              required only for
DAB (   Byte count           high preformance
DAB   discard data bytes)__  controllers.
UNT
Service Request by tape unit
MTA (table A-3)
MSA (Address DSJ, table A-3)
DAB (DSJ Status, table A-7)
(UNT)
```

2-15 Write Data to Tape

This function requires command sequences similiar to the Read Data function (see above) but without the END command. The first requires a Write Record sequence followed by a service request acknowledge (Parallel Poll) and data transfer sequence. The record data must be available on the bus when the motors have reached speed (see 2-19, Byte value 5, for timing details). The End Command following the EOI is not required to reset the Parallel Poll response for a Write Sequence. The HP-IB messages for a single burst are:

```
(UNT/IFC)
 MLA (table A-2)
 MSA (table A-2)
 DAB (Write Record, table A-4)
 UNL
 Service Request by tape unit
 MTA (table A-3)
 MSA (Address DSJ, table A-3)
 DAB (DSJ Status, table A-7)
 UNT
 MLA (table A-2)
 MSA (Write data, table A-2)
 DAB (Data record
 DAB  to tape
  :   tagged
 DAB   with EOI)
 UNL
 Service Request by tape unit
 MTA (table A-3)
 MSA (Address DSJ, table A-3)
 DAB (DSJ Status, table A-7)
(UNT)
```

The HP-IB messages for a multiple burst are:

```
(UNT/IFC)
 MLA (table A-2)
 MSA (table A-2)
 DAB (Write Record, table A-4)
 UNL
 Service Request by tape unit  (1st Burst)
 MTA (table A-3)
 MSA (Address DSJ, table A-3)
 DAB (DSJ Status, table A-7)
 UNT
 MLA (table A-2)
 MSA (Write data, table A-2)
 DAB (Data
 DAB  record
  :   to tape
 DAB   64 byte burst)
 UNL
 Service Request by tape unit  (2nd Burst)
 MTA (table A-3)
 MSA (Address DSJ, table A-3)
 DAB (DSJ Status, table A-7)
 UNT
 MLA (table A-2)
 MSA (Write data, table A-2)
 DAB (Data
 DAB  record
```

```
 :    to tape
DAB    64 byte burst)
UNL
Service Request by tape unit  (Nth Burst)
MTA (table A-3)
MSA (Address DSJ, table A-3)
DAB (DSJ Status, table A-7)
UNT
MLA (table A-2)
MSA (Write data, table A-2)
DAB (Data record
DAB  to tape
 :    tagged
DAB    with EOI)
UNL
Service Request by tape unit
MTA (table A-3)
MSA (address DSJ, table A-3)
DAB (DSJ Status, table A-7)
UNT
```

2-16 Loopback

In order to assure correct operation of the HP-IB communication link (CHI and microprocessor), all data bytes are received by the interface from the controller, stored internally in the buffer, and echoed back to the controller when requested to do so. Detection of "stuck" data or control lines as well as a faulty CHI or Nano Processor is possible by exercising the I/O system at normal operating speeds. The HP 300 recommended data patterns result in a complete exercising of 13 of the 16 HP-IB signal lines. Internally, the loopback operation exercises the CHI, bus transcivers, microprocessor, and handshake logic all at operating speed. It must be noted that the Loopback information stored in the buffer must be read back before it is destroyed with Read or Write tape commands. The HP-IB messages are:

```
(UNT/IFC)
 MLA (table A-2)
 MSA (HP-IB Loopback, table A-2)
 DAB (Bit patterns
  :    256 bytes
 DAB  tagged with EOI)
 UNL
 Service Request by Tape Unit
 MTA (table A-3)
 MSA (HP-IB Loopback, table A-3)
 DAB (Data bytes to controller
  :
 DAB  tagged with EOI)
```

```
UNT
MLA (table A-2)
MSA (DSJ Command, table A-2)
DAB (table A-7)
(UNL)
```

Note: The interface echoes back 129 bytes of data. The 129th byte is tagged with EOI.

2-17 Byte Count

The interface allows the user to obtain the number of bytes of data read from, or written to tape after completion of the record. The user obtains the byte count by placing the interface in a talk mode, issuing the proper secondary (see table A-3) and handshaking two bytes of information. The first byte represents the most significant value of the binary count, while the second byte represents the least significant value. The HP-IB messages are:

```
(UNT/IFC)
MTA (table A-3)
MSA (Byte Count, table A-3)
DAB (Most significant binary value)
DAB (Least significant binary value)
UNL (Optional)
```

2-18 BUFFER REQUIREMENTS

The interface buffer size is 128 bytes with Parallel Poll response capability after 64 bytes and operates at a speed of 2 usec/byte (500 KHz). This allows for an average of 64 bytes per burst. If a 64 byte burst length is used, the time between bursts is approximately 64/(s * 1600) seconds, where s is the drive speed in inches/sec. This represents a Critical Response Time (CRT) of about 0.89 msec for a 45 inches per second drive (1600 bpi). Critical Response Time refers to the time period beginning when the microprocessor initiates the Parallel Poll response, and ending when the bus controller returns the first byte of data to the interface.

2-19 7970E TAPE CONTROLLER COMMANDS

Many of the functions performed by the computer interface/ controller (13183A for the HP21XX or 30215A for the HP3000) are implemented within the tape unit with an HP-IB interface. These

Tape controller functions must be preceded by the secondary address (MSA) 01100001 (with Tape in Listen mode), which indicates the following data byte (DAB) represents a command (See 2-10 Commands) to be performed by the tape drive.

Note: In the following section, references are made to asserting a "Parallel Poll response". It is assumed that on recognition of the Parallel Poll that the user will clear the Parallel Poll response by either reading the "DSJ" vector, which is normally the case, or by issuing the "End" command with DIO "1" asserted. If a non-controller command (byte value not equal to one of those listed below) is sent, the tape interface will simply ignore the command, set command reject status, set DSJ=1, and a Parallel Poll response will be asserted. If the drive is rewinding, off-line, or busy, the same response will accur when a motion command is issued to that tape drive.

Also note that all controller functions, with exception of the Device Select and Rewind-off-line commands, complete their sequence with a Parallel Poll response. Next the DSJ should be read. If equal to "0", the task was successfully completed. If equal to "1", unexpected status occurred and the user should read "Status". The following defines the Tape Controller commands for the command register byte value indicated below:

0 = Reserved

1 = Select Unit 0

When the Unit Select capability is available to an operator, this command selects tape drive "0" as indicated by the operator selectable buttons 0 thru 3, located in the corner of the tape drive front panel. The command also assigns the information contained in Status Register #1 and #2 to Unit 0 and disables all Parallel Poll responses from other units. If Unit 0 has not been selected, the status for register #1 and #2 will only indicate Off-Line. The unit will respond with a Parallel Poll once it has been selected.

2 = Select Unit 1

Similar to "Select Unit 0"

3 = Select Unit 2

Similar to "Select Unit 0"

4 = Select Unit 3

Similar to "Select Unit 0"

5 = Write Record

This command allows the user to write information to tape and automatically write a record mark following the information. After the Write Record command has been received by the tape interface, and before the tape motors are up to speed, a Parallel Poll response is asserted with the DSJ set to 0 The user has approximately 0.375/s sec (8 msec for a 45 ips drive) before data must be placed on the bus (assuming the motors were completely stopped). "S" is the speed of the drive in inches/sec. If the motors were not stopped when the Write Record command was received, the user has a minimum of 0.6/s sec (the time required to write a 0.6 inch nominal interrecord gap) to place data on the bus after the Parallel Poll response is initially asserted by the interface (approximately 13 msec for a 45 ips drive).

Data may be transfered via either Burst mode or Block mode.

Burst Mode - Data is transfered in bursts of 64 bytes each. The last burst consists of 64, or fewer, bytes with the last byte tagged with EOI. The interface indicates it is ready to accept the next burst via a Parallel Poll response. When the interface has responded to a Parallel Poll, the user is responsible for clearing the Parallel Poll in the interface. Clearing the Parallel Poll is implemented either by reading the DSJ vector or by issuing an "End" command with DIO 1 asserted. (Data transfer rate less than or equal to 2us/byte)

Block Mode - Data is transfered in blocks of any length (2048 bytes maximum recommended). The initial 128 bytes will be transfered at 2us/byte. All successive bytes are transfered at tape drive speed,where data rate = 1/(1600*s) in seconds/byte, and s=tape speed in inches per second. During block mode, all Parallel Poll responses after the initial PP response should be ignored. Following the last data byte tagged with EOI,the "End" command should be sent with DIO "1" asserted. All Parallel Poll responses that follow should be recognized.

For both modes, in a time period greater than the CRT (Critical Response Time, see 2.18, Buffer Requirements), after the EOI has been accepted by the interface, a final parallel poll response will be asserted indicating the task is completed. Next, the user should read the DSJ vector; if DSJ = 0, no errors were found in the write operation. If the DSJ = 1, it is recommended that status be examined and diagnosed.

6 = Write File Mark (EOF)

This command causes a File mark to be written on tape. The EOF bit in the status word is set to 1 to confirm this operation.

7 = Write Gap

This command allows the user to forward space and erase approximately 3.75 inches of tape. Oftentimes this is useful if a section of tape is found where multiple re-tries fail for a Write operation. The user can then skip over the portion of defective tape and proceed with the Write operation.

10 = Read Record

This command is used to transfer information from tape to the user, until a Record Mark or File Mark (EOF) is found. Data may be accepted from the drive by one of two methods, Burst Mode or Block mode.

Burst Mode - Each time the buffer has 64 bytes of data ready to be bursted to the user, a Parallel Poll response is issued with the DSJ set to 0. The user has about 64/(1600*s) sec (CRT) to initiate the transfer ("s" is the drive speed in inches/sec). This amounts to about 0.89 msec for a 45 ips drive. If data transfer is not initiated within the CRT, a timing error results indicating an overrun of the buffer has occurred. The last burst will contain 64 or less bytes with the last byte tagged with EOI. Note that the user has the responsibility of clearing the PP response for each burst, either by reading the DSJ vector or sending the "End" command with DIO "1" set.

Block Mode - The user must still initiate data transfer within the "CRT" from the first Parallel Poll. The interface can then transfer data continuously at 2us/byte for the first 128 bytes, then at tape drive rate = 1/(1600*s) seconds/byte for all remaining bytes of data (s is the drive speed in inches per second). The last byte will be tagged with EOI. Note that the has the responsibility of clearing the Parallel Poll response.

For either mode of data transfer, the user must send the "End" command, with DIO "1" set, following the byte tagged with EOI. A Parallel Poll response will be set sometime greater than the CRT (See 2.18, Buffer Requirements) and after the EOI transfer. This final Parallel Poll indicates completion of the operation. It is now up to the user to read the DSJ vector; if DSJ = 0 no errors occurred in the read operation, if the DSJ = 1 it is recommended that the user read status. The status will indicate why the read was not successful.

11 = Forward Space Record

When this command is received by the tape interface, the tape is moved in a forward direction. When a Record Mark (End-of-Record) is detected, a Parallel Poll response is asserted with the DSJ set to 0. If a File Mark (EOF) or End-of-Tape (EOT) is encountered, the DSJ is set to 1. A Parallel Poll response for the EOF is asserted when motion finally stops. The interface then waits for an additional command. No data is transferred during a Forward Space operation. The drive motion stops when a Record Mark or EOF is detected but continues running when an EOT is encountered. If no EOF or record is encountered within 25 ft., the tape runaway status and DSJ is set to 1, tape motion is stopped and a Parallel Poll response is asserted.

12 = Backspace Record

Similar to Forward Space Record. However, if a Beginning-of-Tape (Load Point) or Filemark (EOF) is encountered, the DSJ is set to 1. Tape motion stops in all cases.

13 = Forward Space File

Similar to the Forward Space Record. The final position of the tape is immediately following the End-of-File mark just read and just preceeding the next Record or File Mark. The DSJ is set to 0 and the Parallel Poll response is asserted. If an EOT is detected the DSJ is set to 1, status is set, and motion continues. If a Record Mark is encountered, the DSJ is not affected and motion continues until either a File Mark is found or enough tape has passed for the tape runaway condition to be met.

14 = Backspace File

Similar to the Forward Space File/Record. Motion stops after the first File Mark or Beginning-of-Tape (Load Point) is detected in a reverse direction. At that point the Parallel Poll response is asserted. If a BOT was encountered, the DSJ is set to 1. Otherwise it is set to 0.

15 = Rewind

This command causes the transport to start rewinding the tape at 160 ips. A Parallel Poll response is sent by the interface to acknowledge that the rewind is being executed. When BOT is detected, the tape is positioned at the Load Point marker and halted.

16 = Rewind and Go Off-Line

Similar to Rewind except that the selected unit is taken offline. Note, that tension is still applied to the tape. This command will not unload the tape. No Parallel Poll response is issued at the completion of this command.

17 = Read Record Backward

This command is similar to the Read Record in the forward direction. It should be emphisized that the actual data that is read will be opposite to that which was read in the forward direction, i.e. bytes 1,2,3,...,n-1,n read in the forward direction will be read as n,n-1,..,3,2,1 in the reverse direction. The bits within the bytes will not change. The Parallel Poll response and DSJ are identical to the Read Record. All status and DSJ vectors are set under the same conditions as the Read Record command with the following exception, if the Read Record Backward is issued and the tape drive is at Load Point or backs into Load Point, the status will reflect Load Point, the DSJ will be set to 1 and a Parallel Poll response will be asserted.

2-20 "END" COMMANDS/SERVICE REQUEST REGISTER (see table A-5)

The "END " command was implemented to allow the user control of features included in the interface without affecting the status and DSJ vectors. The result is increased flexibility to the user. Each DIO Line references the following command (See 2-10 Commands) as indicated below:

1 : Clear Parallel Poll Response (Service Request) for selected device only = 1.
No Action = 0.

This bit is used to programmatically clear the Parallel Poll response issued by a device. Parallel Poll responses are also cleared automatically whenever a DSJ is requested by a user. It should be noted that PP responses associated with devices comming on-line will be inhibited. The DSJ will not be affected by the assertion of this bit.

2 : Stop Polling for Data/Inhibit Parallel Poll responses for read bursts for selected device = 1.
No Action = 0.

This command is used to inhibit Parallel Poll responses by the selected device while a Read from tape is in progress, e.g. the

user wants to recognize the first few bursts of a multi-burst record and ignore all subsequent data. This command only remains valid for the duration of the current Read Record operation. A Parallel Poll response will be sent at the end of the record with the DSJ set to reflect the appropiate action for the data read. A timing error will not result for the terminated portion of the record. However, if a timing error did occur in the recieved portion of the record, it will be indicated.

3 : Enable Parallel Poll responses for all
devices connected to the interface = 1.
No Action = 0.

Whenever a Parallel Poll response is asserted for a selected device and a given motion command, any "On-Line PP responses associated with Status Register 3 or rewind completions are inhibited until re-enabled by this command.

4 : Reserved

5 : Reset DSJ Register to 0 = 1.
No Action = 0.

This bit is used to programmatically clear the DSJ Register for the selected device. The DSJ is also automatically reset whenever a DSJ is requested by a user.

6 : Reserved

7 : Reserved

8 : Reserved

2-21 TAPE CONTROLLER STATUS

When the bus controller requests the status (See 2-12, Status Requests) from the tape controller, the tape's response is to return three status bytes from the HP-IB Interface's three status registers (see taple A-7). The status information for each register is listed below:

2-22 Status Register #1 (see table A-6)

Each DIO Line (1 thru 8) references one bit of status as listed below:

1 : On-Line = 1
Off-Line = 0

Indicates the current status of the selected device indicated by bits 6 and 7 of Status Register #2.

2 : Multiple Track Error (MTE) = 1
No Multiple Track Error =0

This bit, when set during a Read or Write, indicates that two or more data tracks were in error. It will be reset automatically after the status has been read. During a Read operation, data coming from the transport to the HP-IB tape interface will terminate when a MTE occurs. The last byte of data (which will be ignored) will be tagged with an EOI. The Parallel Poll response will be asserted and the DSJ set to 0 for the existing burst of data (less than 64 bytes of data currently held in the buffer). When the End-of-Record is detected, the Parallel Poll response will again be asserted to indicate that another command can then be accepted. The DSJ is also set to 1 at that time. During a Write operation, the data transfer will be normal. The DSJ will be set to 1 for the final PP response. Note a Single Track Error (STE) will also occur whenever a MTE occurs.

3 : File Protected (Not Write Enabled/Write Ring Missing) = 1
File Unprotected (Write Enabled/Write Ring Present) = 0

If a Write is attempted when the File Protect = 1, the DSJ is set to 1, the Parallel Poll response is asserted and the Write aborted.

4 : Command Rejected = 1
Command Accepted = 0

Any attempt to perform a motion operation on a selected device while a rewind or other operation is in progress will cause the the command to be rejected. Also, if a write operation is attempted on a write protected drive the command will also be rejected. The DSJ is then set to 1 and the Parallel Poll response is asserted. The Command Rejected bit is reset automatically after the status has been read.

5 : Single Track Error (STE) = 1
    No Single Track Error = 0

If a single track error occurs during a Read or Write operation, the error is corrected in the device (tape transport), and the STE and DSJ bits are set to 1. The Parallel Poll response is asserted at the end of the Read/Write operation (after the EOI has been received). Note that after a Write with an STE, the actual data on tape is in error. Although the device can correct this error during a Read, the chances for a Multiple Track Error are increased. These MTE's are not corrected by the device. It is recommended that a record be rewritten whenever an STE is detected after a Write operation. The STE bit is reset automatically after the status has been read.

6 : End-of-Tape (EOT) = 1
    NOT END-OF-TAPE = 0

When an EOT is detected on the selected drive, the EOT status is set to 1 and the DSJ set to 1 for the final Parallel Poll response. Motion normally continues. The EOT status will remain and DSJ asserted to 1 for each completion of an operation until the EOT marker on the tape has been read during a reverse motion.

7 : At Load Point (LP) =1
    Not at Load Point = 0

This bit is set when the selected device is at Load Point.

8 : At End-of-File (EOF) = 1
    Not at End-of-File = 0

This bit is set when the selected device has detected an EOF on tape.

2-23 Status Register #2 (see table A-6)

Each DIO Line bit references a command as indicated below:

1 : Interface Busy = 1
    Interface Not Busy = 0

When the currently selected device is executing a motion command other than Rewind, the HP-IB tape interface will be considered busy. If a rewind is in progress for the currently selected

device, the user may select a different device and initiate motion. If a motion command is issued to a device currently in a rewind mode, the command rejected bit will be set to 1, the DSJ will be set to 1, and the Parallel Poll response asserted. The user can request status regardless of the setting of the interface busy bit.

2 : Tape Unit Busy = 1
    Tape Unit Not Busy = 0

This bit, when set, indicates that a motion command is in progress. It could be used to determine when the drive would be available for additional commands.

3 : Rewinding = 1
    Not Rewinding = 0

This bit is set when a Rewind command is received by the tape interface. It is reset when the transport is at Load Point and ready to accept additional motion commands or it is Off-Line (because of Rewind and Off-Line command).

Note, for slave operation, when more than one unit complete their operation at the same time, priority is given to the unit with the lowest unit select number (0, then 1, ect.).

4 : Tape Runaway = 1
    Not Tape Runaway = 0

When set, this bit indicates that the selected device has "read" approximately 7.6 meters (25 ft) of tape without detecting a byte of data (ignoring noise bytes). At that point tape motion will stop, the DSJ set to 1, and the Parallel Poll response asserted. Tape Runaway is detected for Read/Write Record and Forward or Backward Space Record/File commands. This bit is reset automatically after the status has been read.

5 : Data Timing Error (DTE) = 1
    No Data Timing Error = 0

This bit indicates when a Read/Write timing error (overrun/underrun) has occurred, (i.e. the tape transport was required to accept or provide data on the bus and data was not available or not previously accepted by the user). The DSJ is set to 1 for the final Parallel Poll response issued for the Read/Write. The DTE is reset automatically after status has been read.

6 : Selected Tape Unit Least Significant Bit
7 : Selected Tape Unit Most Sigificant Bit

These two bits represent, in binary notation, the tape unit that is currently selected (0 thru 3). All of the status bits in Registers 1 and 2 represent the status of the selected tape unit.

8 : Reserved

2-24 STATUS REGISTER #3 (see table A-6)

Note: Tape unit "On-Line" bits only indicate that a device has come on-line and has not yet been serviced (addressed). Devices that are on-line and have been serviced (addressed) will not have their "On-Line" bits asserted (i.e. when "On-Line" bit = 0, a tape unit may be either On-Line or Off-Line). Status Register #1 should be tested for the desired Unit in order to determine the actual status.

Each DIO Line bit represents the status indicated:

1 : Tape Unit 0 "On-Line" = 1 (See Note above)
Tape Unit Not "On-Line" = 0 (See Note above)

Tape Unit 0 is associated with the Unit Select buttons located in the lower front of the tape drive, or with internal strapping pins on the Control and Status board. When the tape drive associated with unit 0 in the Master or Slave chain goes from an off-line to on-line status, this bit is set. If the Parallel Poll responses are enabled for all devices (by having issued the End command with DIO 3 asserted), the DSJ is set to 1 and the PP response asserted. The Unit Select number is inserted automatically into Status Register #2 (DIO Lines 6 and 7) and the status updated for the new tape unit. If the Parallel Poll responses are not enabled, the associated action is inhibited until enabled. Parallel Poll responses for all devices (except the unit currently selected -- indicated by DIO Lines 6 and 7 of Status Register #2) are inhibited automatically whenever a new Unit Select command is performed. When all desired motion commands are finished, the user must re-enable the PP responses via the "End" Command. This "On-Line" bit is reset automatically by the HP-IB Tape Interface when the Unit Select number is inserted into Status Register #2 by the tape interface. The Priority of the "On-Line" Parallel Poll responses will be 0 thru 3 where 0 is the highest priority.

2 : Tape Unit 1 "On-Line" = 1
    Tape Unit 1 Not "On-Line" = 0

Similar to Tape Unit 0.

3 : Tape Unit 2 "On-Line" = 1
    Tape Unit 2 Not "On-Line" = 0

Similar to Tape Unit 0.

4 : Tape Unit 3 "On-Line" = 1
    Tape Unit 3 Not "On-Line" = 0

Similar to Tape Unit 0.

5 : Command Parity Error = 1
    Normal Command Parity = 0

This bit is set to 1 whenever DIO lines 1 thru 8 contain EVEN parity as received by the tape unit interface for a command transaction. Normal Command Parity is represented by an odd number of 1's on DIO lines 1 thru 8.

6 : Power has been restored = 1
    Normal power condition = 0

This bit is set to 1 whenever power is applied to the interface, either during the normal power up sequence with the On/Off switch or during a power fail/recovery sequence. In either case, when power is restored to the interface, a Parallel Poll response is asserted and the DSJ set to 1. When the status is read by the user, this bit is reset automatically by the HP-IB Interface. This status bit could also be used to indicate that an IDENTIFY should be performed by the user.

7 : Reserved

8 : Reserved

2-25 DEVICE SPECIFIED JUMP (DSJ) (see table A-7)

The DSJ register currently has two values, 0 and 1. When a value of 0 is returned for a DSJ request, the indication is that a

normal completion of a command has occurred. Additional status is not necessary. When a value of 1 is returned, additional status information should be obtained and checked. Attempting to execute a prior command has resulted in an error, abnormal termination, or unexpected results (e.g. EOT, BOT for Forward Space/Backspace Record/File).

III THEORY OF OPERATION

3-1 INTRODUCTION

Their are four major areas within the interface, control and logic, CHI, buffer, and write formatter section (see figure 3-1) Each section interacts with the others to allow transfer of drive commands, status information, and data to and from the HP-IB bus for 7970E operation. The following description assumes some knowledge of HP-IB and HP 300 protocal.

3-2 CONTROL AND LOGIC

The microprocessor (NANO) provides control for interface/tape operations by interperting bus commands and monitering interface and tape operations. The processor maintains in its 16 internal registers the operating status, programmed activity, buffer information and data routing information. This information, together with HP-IB Bus commands received from the CHI, and program instructions contained in the PROM, allow the microprocessor to generate the required instructions for interface/tape operation. The processor provides the necessary timming for certain operations (Gap, Interrecord Gap, ramp times, ect...) by sampling the output of a crystal controlled timing circuit. The control section I/O registers provide interfacing to the tape drive through the Control and Status board (FWD, REV, HSFWD, SELECT, ect...), the Read Mother board (TM, EOB, STE, IDB, ect.), and the Write Mother board (SWS, WC, ect.).

3-3 BUFFER

The buffer provides 128 bytes of storage to allow equalization of the different data transfer rates between the HP-IB bus and the tape unit. The tape unit (45 ips at 1600 bpi), can handle data at 72 KHz while the bus transfer rate is 500 KHz rate. When data is transfered from the bus to the tape unit for storage, the buffer is initially filled with one 128 byte burst at 500 KHz. The tape begins removing this data from the full buffer. When the buffer data is reduced to the 1/2 full point, a 1/2 full flag (Parallel Poll response) indicates to the bus controller that the buffer will accept a 64 byte data burst to refill the buffer.

This operation continues until all data has been transfered. The last data byte will be tagged with an EOI to indicate the end of data transfer. Movement of data from the tape storage to the bus is the reverse of the above procedure, that is, the buffer is filled by the tape and emptyed by the bus.

3-4 CHI

The CHI (chip for HP-IB interfacing) interfaces the HP-IB interface assembly to the HP-IB bus. It controls the handshake operation which verifies each data or command byte sent across the bus. It should be noted that the word "data" can refer to either data information for storage on tape or command data which includes commands and status information used for the operation of the tape unit. The CHI will direct the transfer of data (data), after initialization by the processor, to the buffer or automatically relay HP-IB bus commands and data (commands) to the processor. The CHI provides service requests when the interface has been addressed and a level of interpretation to the HP-IB commands on the bus.

3-5 Write Formatter

The Write Formatter provides timing signals for the processor and tape unit, accepts write commands from the processor, generates identification bursts, pre- and postambles, Tape Marks on command, and provides write formatter status signals for the processor. The synchronization timing signals consists of Write Clock (WC) timing signals for the tape unit and Twice Data Frequency (2DF) timing signals for the processor. The write command signals from the processor consist of Write Enable, Write Identification Burst, Write Tape Mark, Write Preamble, and End-of-Data signals. The status signals applied to the controller consist of Ready signals and Data Accepted signals.

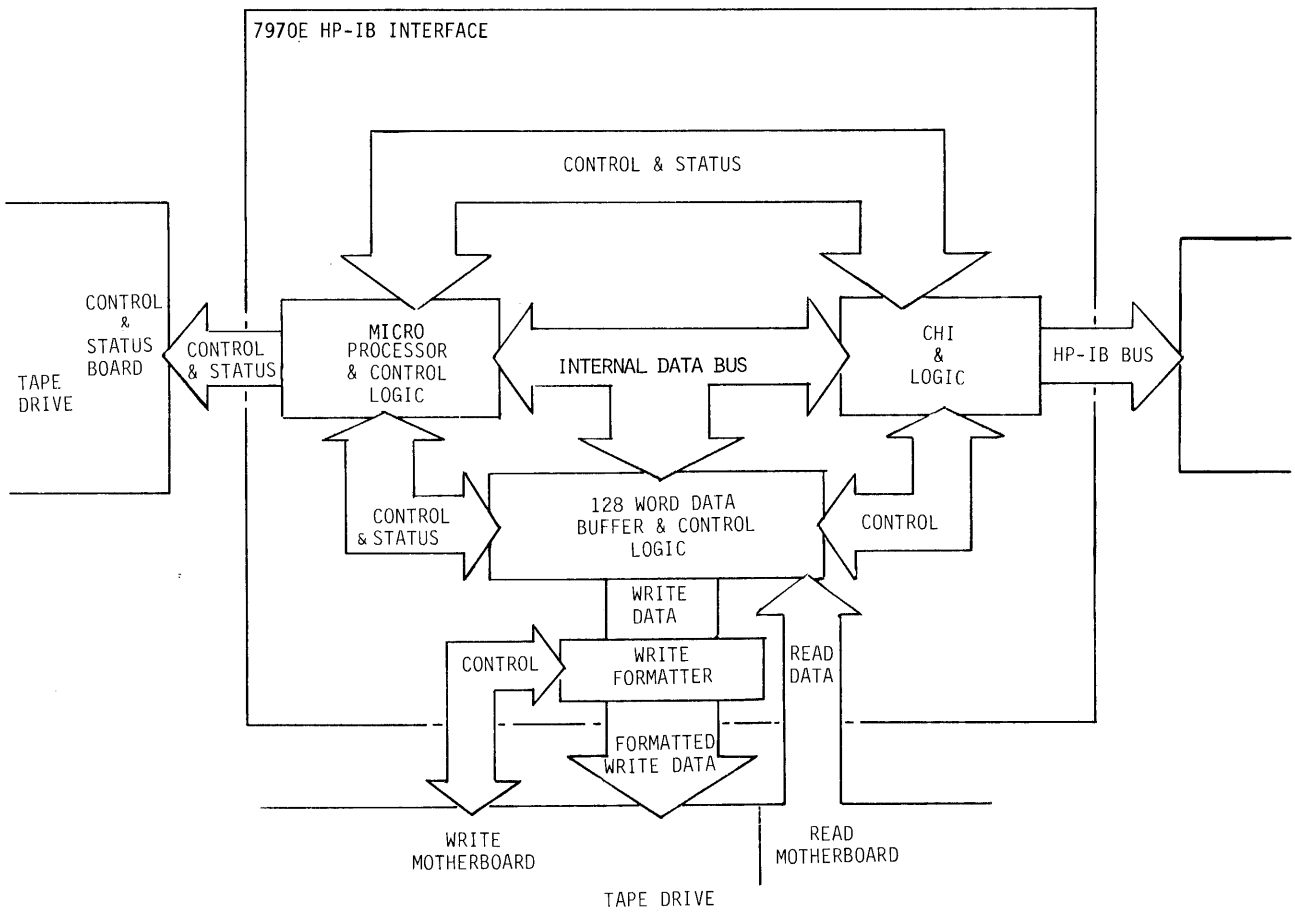


Figure 3-1 7970E HP-IB INTERFACE BLOCK DIAGRAM

3

IV MAINTENANCE

4-1 INTRODUCTION

This section covers operator controls and indicators, trouble-shooting, installation/removal, and slave operation of the 7970E HP-IB Interface.

4-2 OPERATOR CONTROLS AND INDICATORS

The only specific HP-IB control available to the technical operator is a switch selectable "Fundamental Address" located on the rear of the transport. It is used to select an address between 0 and 7 which corresponds to the HP-IB Parallel Poll lines eight thru one.

The controls and indicators normally used with the 7970E (Reset, Rewind, On-Line, Load and Unit Select) are fuctionally identical with the HP-IB option.

4-3 TROUBLESHOOTING

Due to the complexity of the 7970E HP-IB Interface, no component level field troubleshooting should be attempted. The Interface is factory tested and installed. If its operation is in question, the system diagnostic containing a Loopback test should be run. Performing the Loopback test (see 2-16, Loopback) for the tape drive will test a substantial portion of the Interface electronics. The Loopback test does not test the Interface's tape motion or formatter electronics. If an error is indicated during testing, a visual check of the interface should be made to eliminate the possibility of a poor connection and/or incorrect set-up. Check the following items:

a. Make sure all cable connectors are aligned correctly and securely seated.

b. The FUNDAMENTAL ADDRESS thumb switch should be set to the correct address.

c. The speed plug on the Write Formatter Board should be in the correct operating speed position.

. All IC's and jumpers seated in sockets should be secure.

After the above checks are made, re-run the diagnostic Loopback Test. If the error is still present, or the interface's operation is still in question, the Interface assembly should be replaced.

The interface assembly should be returned on the Blue Stripe Exchange Program. The Blue Stripe number for the 7970E HP-IB Interface is 07970-69381. When returning the Interface, be sure to return the entire assembly, which includes all items shown on page 5-3 (HP-IB Interface Assembly).

4-4 INSTALLATION/REMOVAL

The Interface PCA's and the back plate are installed as a single assembled unit. To remove the interface proceed as follows:

a. Shut power off.

b. Remove the power connector J6 from the Control Board. Remove the screw, located by IC U90, on the Control Board. To release the barbs at the ends of the plastic standoffs, compress and work the barbs through their holes as the control board is pulled upward. The control board is hinged allowing it to swing upward for access to the Formatter PCA. Swing the Control PCA upward.

c. Remove the interface-to-tape drive cable connectors from the tape drive Control and Status Board, Read Card Cage, and the Write Card Cage.

d. From the back of the tape unit, remove the HP-IB cable and the four screws which secure the HP-IB Interface Assembly back panel to the tape unit.

e. From the back of the Tape Drive, remove the Interface Assembly by rotating it as it is pulled outward.

To install the interface assembly, reverse the above procedure. Also, check the speed plug on the Write Formatter PCA to ensure that it is in the speed position that matches the operating speed of of the tape unit.

4-5 HP-IB CABLE INSTALLATION

The HP-IB cable is attached to the back of the interface assembly located at the back of the tape drive. To connect the cable , insert it into the cable socket and tighten the two thum screws. When the tape unit is installed in a Lo-Boy cabinet, remove the front panel of the cabinet for access to the back of the tape unit. For more information on the Lo-Boy cabinet refer to the Lo-Boy Cabinet manual part no. 07970- 90921.

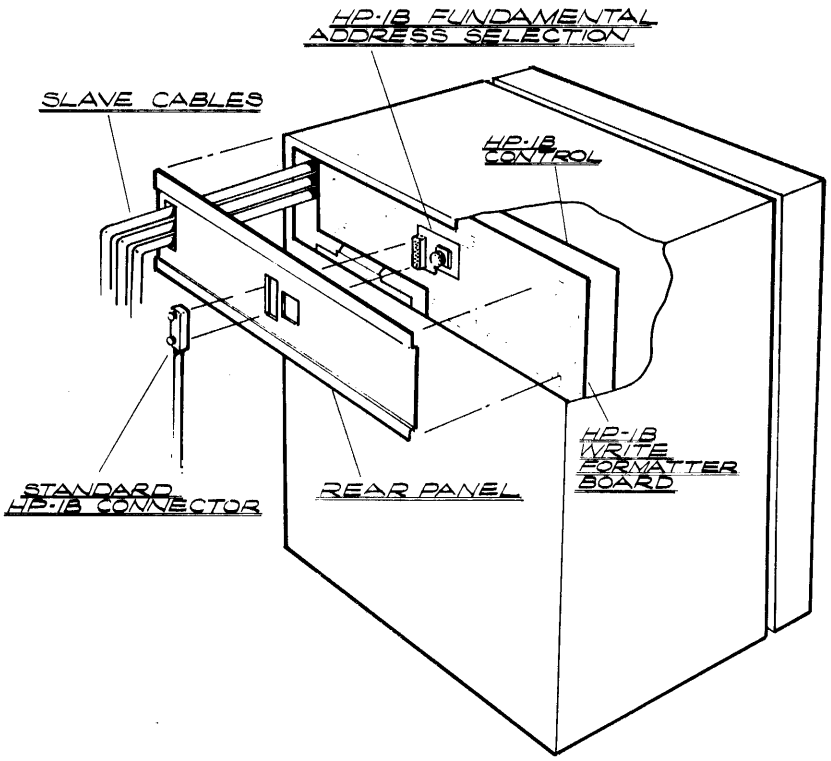


Figure 4-1 CABLE CONNECTION

4-6 SLAVE OPERATION

HP-IB Magnetic Tape slave operation is identical to the slave operation of the standard 7970E Unit. The only variation is the slave cables are routed differently (see figure 4-1). Refer to the 7970B/E Operating and Service Manual for slave operation information. Fiugure 4-2 shows the cable connection for multi-unit operation.

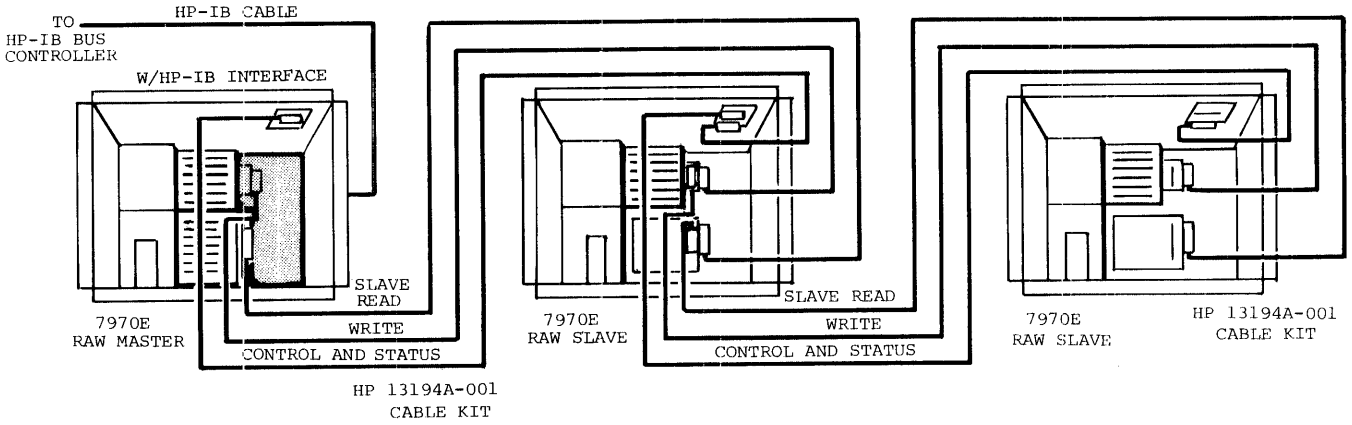


Figure 4-2 7970E HP-IB MULTIUNIT OPERATION

V PARTS AND DIAGRAMS

5-1 INTRODUCTION

This section of the manual contains location diagrams, illustrated parts breakdowns (IPB's), and replaceable parts lists for the 7970E HP-IB Interface. Special product configurations or changes made since the printing of this manual are described by updating supplements supplied with this manual.

5-2 DESCRIPTION OF PARTS LIST

The heading for each parts list contains all assembly parts numbers (with applicable series codes) covered by that list. The first entry of the parts list indicates the main assembly on which the list is based.

The columns in the parts list furnish the following information for each part:

a. REF. DES./INDEX NO. This column lists the reference designator or index number (callout number) which identifies each part in the appropriate logic diagram, parts location diagram, or IPB. Asterisks are entered to the left of any entry which varies from the basic parts lists. Entries are arranged alphanumerically.

b. DESCRIPTION This column gives the name and a brief description of the part.

c. HP PART NO. This column lists the Hewlett-Packard part number for each part.

5-3 PARTS ORDERING PROCEDURE

To order parts from Hewlett-Packard, or to obtain further information about parts, address the order or inquiry to the nearest Hewlett-Packard Sales and Service Office. When ordering from Hewlett-Packard give the following information on each part:

a. Model and serial number.

b. Hewlett-Packard part number.

c. Description of part.

d. Circuit reference designator or index number, if applicable.

e. If the part is installed on a PCA, give the series code which is stamped or etched on the PCA.

4.4 PARTS AND SCHEMATICS

All HP-IB Interface Assembly Parts Lists, Parts Location, and Schematics are provided in the following section which is divided into three sections. These three sections include the HP-IB Interface, The Control PCA, and The Write Formatter PCA.

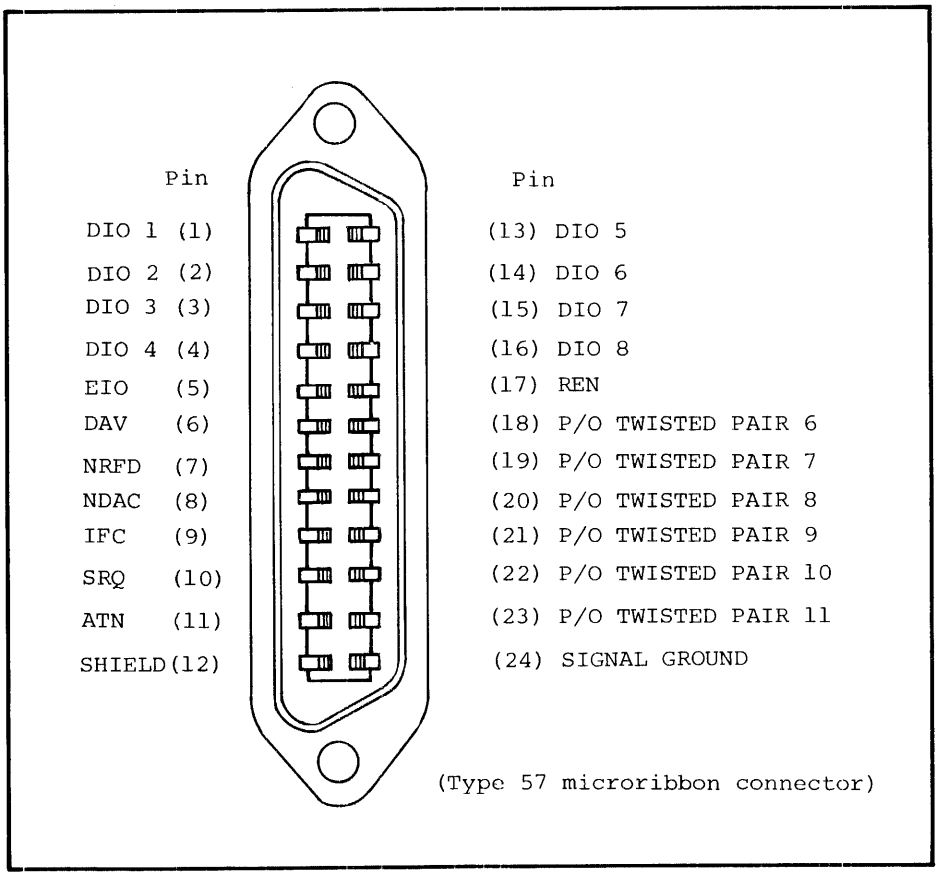
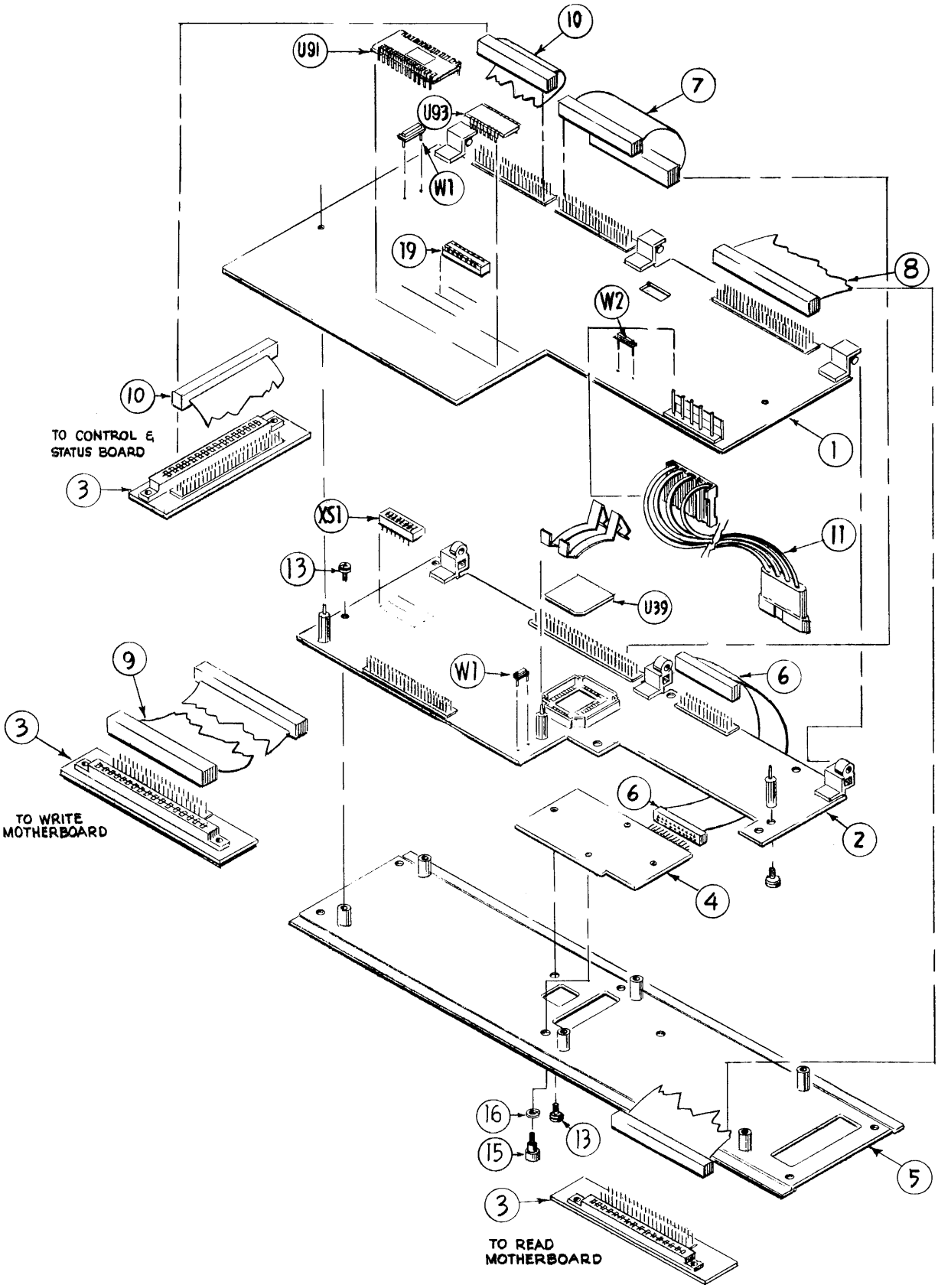
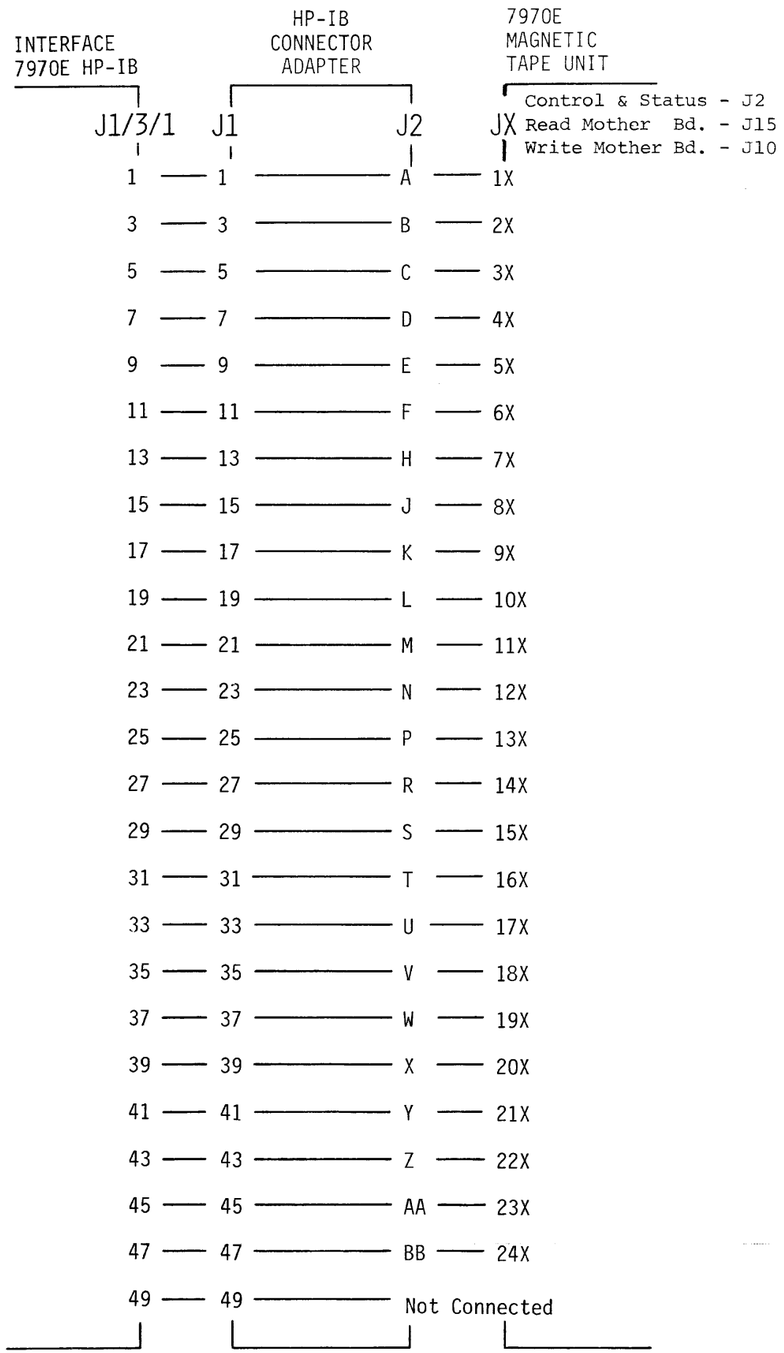


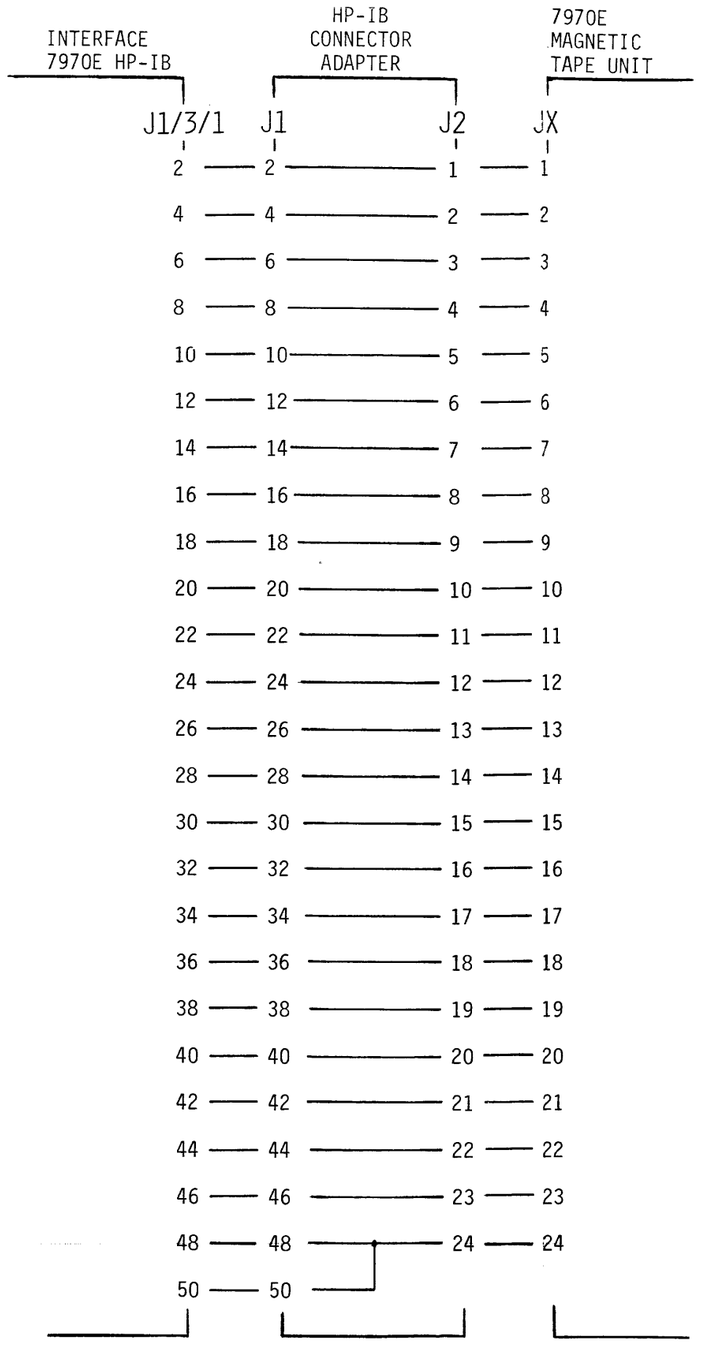
Figure 5-1 HP-IB Connector

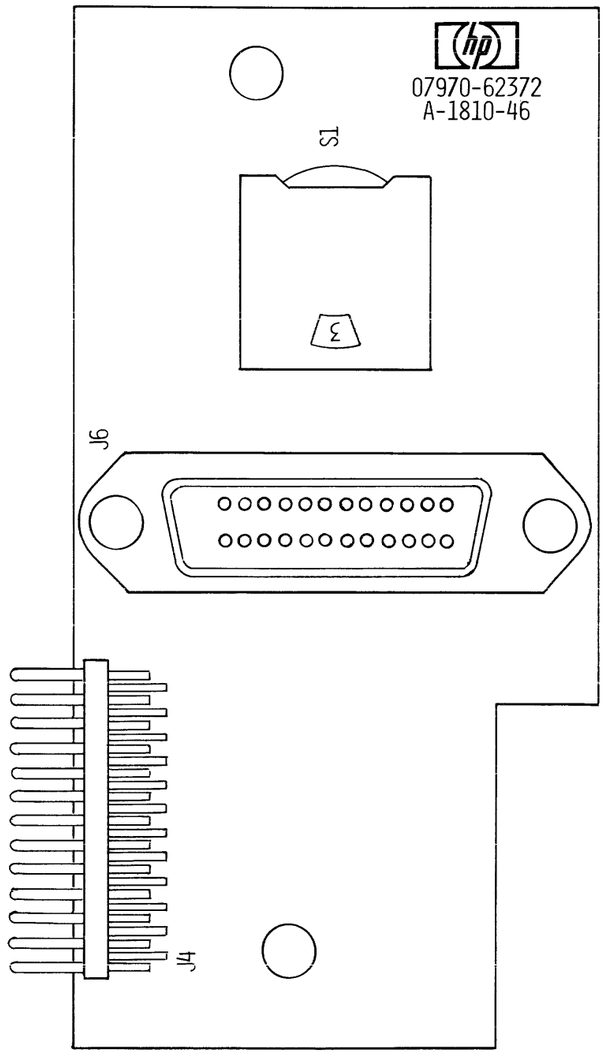


07970-62381 HP-IB INTERFACE ASSEMBLY
Series 1829 Exploded View

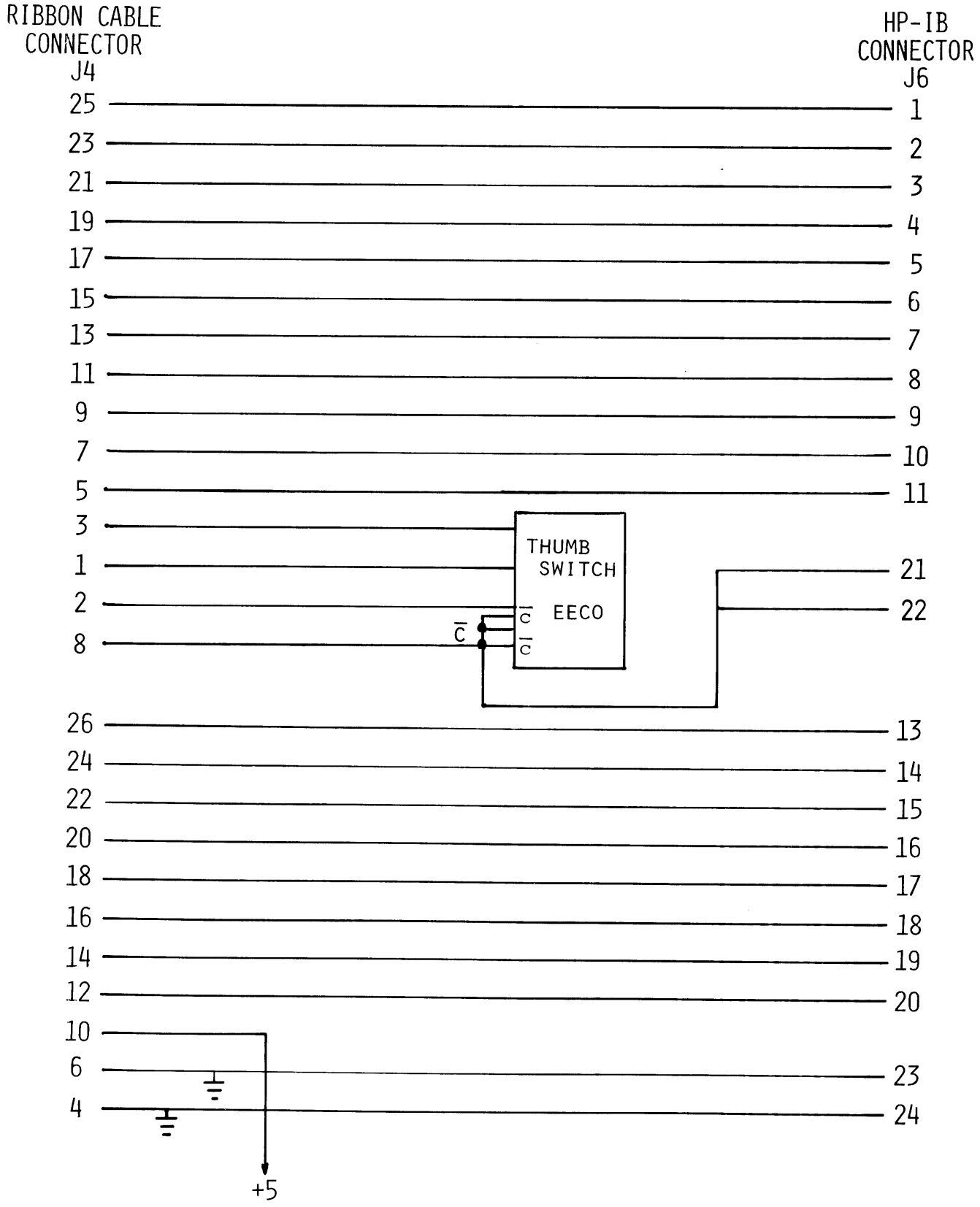
REF. DES./ INDEX NO.	DESCRIPTION	PART NO.
1	PCA: Control	07970-62369
2	PCA: Write Formatter	07970-62370
3	PCA: HP-IB Conn. Adapter	07970-62371
4	PCA: Switch Adapter	07970-62372
5	PANEL: HP-IB Back	07970-01293
6	CBL ASSY: HP-IB Interconnect	07970-62374
7	CBL ASSY: Board Interconnect	07970-62375
8	CBL ASSY: Read Mother	07970-62376
9	CBL ASSY: Write Mother Bd.	07970-62377
10	CBL ASSY: Control Status	07970-62378
11	CBL: Power Conn.	07970-62379
13	SCREW: 6-32 X .25PAN	2360-0193
15	STANDOFF HEX	0380-0644
16	WASHER: #10 SP. LK.	2190-0034
17	STANDOFF: Plastic	0380-1150
18	COVER: Chi Socket	1200-0651
19	RESISTOR Pack	1810-0307
U39	IC: CHI LSI	1AA7-6001
U91	IC: NANO PROC.	1820-1692
U93	PROM	07970-62390
W1,W2\W1	JUMPER	1258-0124
XS1	SHUNT Dip	1251-4292


INTERFACE
7970E HP-IB
HP-IB
CONNECTOR
ADAPTER
7970E
MAGNETIC
TAPE UNIT
Control & Status - J2
Read Mother Bd. - J15
Write Mother Bd. - J10
J1/3/1
J1
J2
JX
1 — 1 — A — 1X
3 — 3 — B — 2X
5 — 5 — C — 3X
7 — 7 — D — 4X
9 — 9 — E — 5X
11 — 11 — F — 6X
13 — 13 — H — 7X
15 — 15 — J — 8X
17 — 17 — K — 9X
19 — 19 — L — 10X
21 — 21 — M — 11X
23 — 23 — N — 12X
25 — 25 — P — 13X
27 — 27 — R — 14X
29 — 29 — S — 15X
31 — 31 — T — 16X
33 — 33 — U — 17X
35 — 35 — V — 18X
37 — 37 — W — 19X
39 — 39 — X — 20X
41 — 41 — Y — 21X
43 — 43 — Z — 22X
45 — 45 — AA — 23X
47 — 47 — BB — 24X
49 — 49 — Not Connected

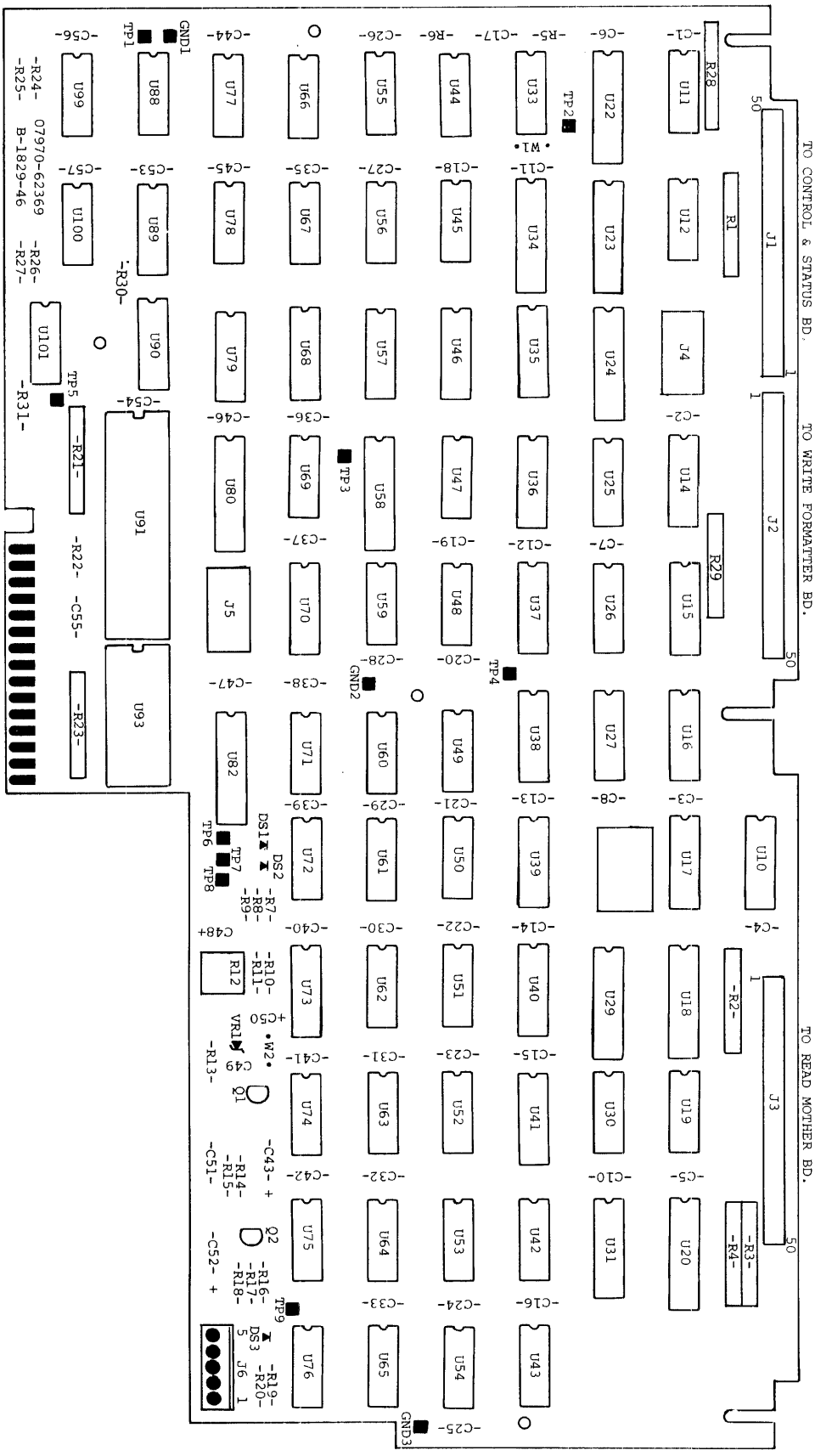

INTERFACE
7970E HP-IB
HP-IB
CONNECTOR
ADAPTER
7970E
MAGNETIC
TAPE UNIT
J1/3/1
J1
J2
JX
2 — 2 — 1 — 1
4 — 4 — 2 — 2
6 — 6 — 3 — 3
8 — 8 — 4 — 4
10 — 10 — 5 — 5
12 — 12 — 6 — 6
14 — 14 — 7 — 7
16 — 16 — 8 — 8
18 — 18 — 9 — 9
20 — 20 — 10 — 10
22 — 22 — 11 — 11
24 — 24 — 12 — 12
26 — 26 — 13 — 13
28 — 28 — 14 — 14
30 — 30 — 15 — 15
32 — 32 — 16 — 16
34 — 34 — 17 — 17
36 — 36 — 18 — 18
38 — 38 — 19 — 19
40 — 40 — 20 — 20
42 — 42 — 21 — 21
44 — 44 — 22 — 22
46 — 46 — 23 — 23
48 — 48 — 24 — 24
50 — 50



SWITCH ADAPTER 07970-62372
Parts Location Series 1810
5-6



07970-62372 SWITCH ADAPTER
Series 1810 Schematic
5-7



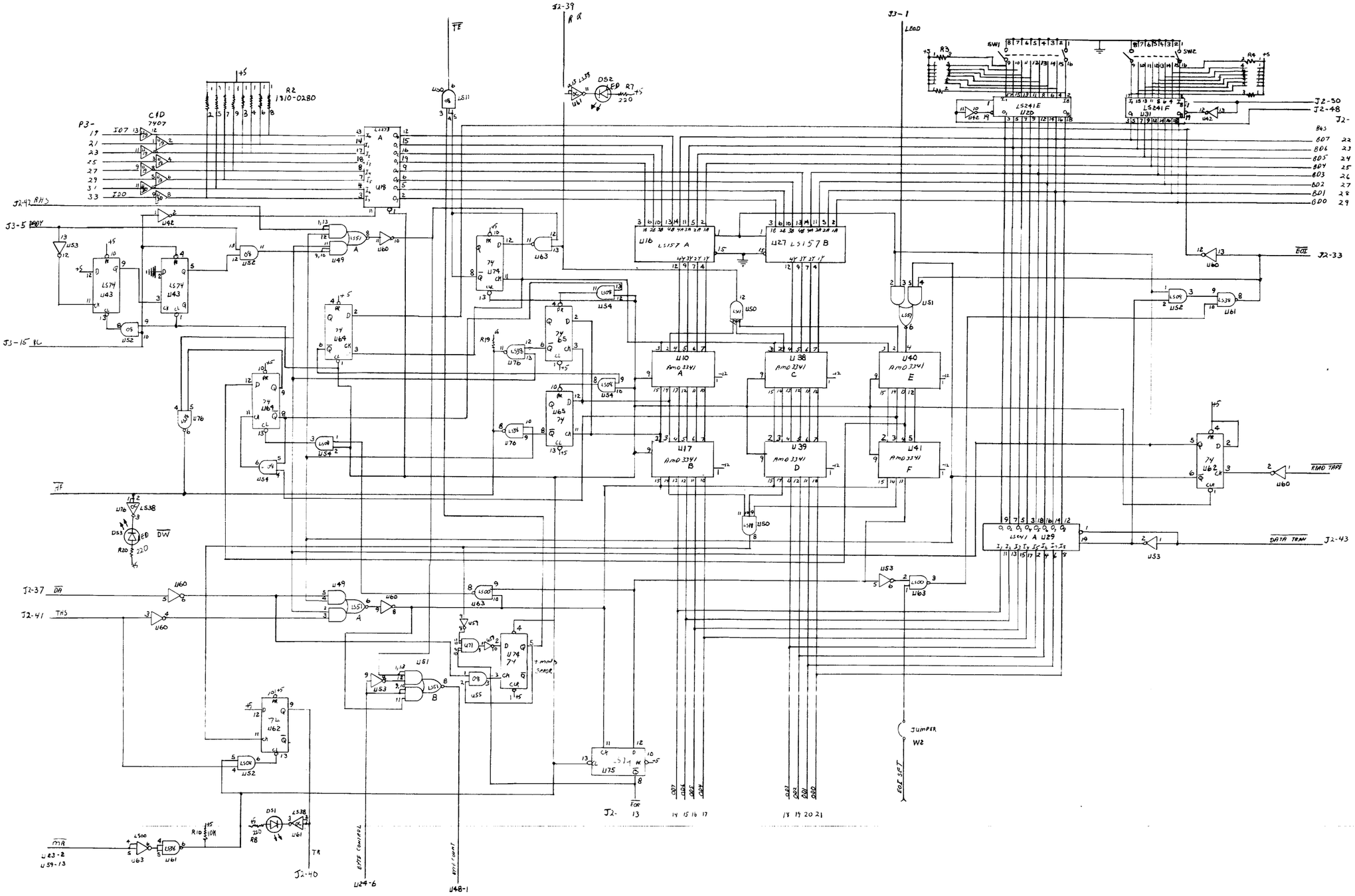
CONTROL PCA 07970-62369
Parts Location Series 1829
5-8

07970-62369
Series 1829

CONTROL PCA
Schematic (1 of 2)
5-9

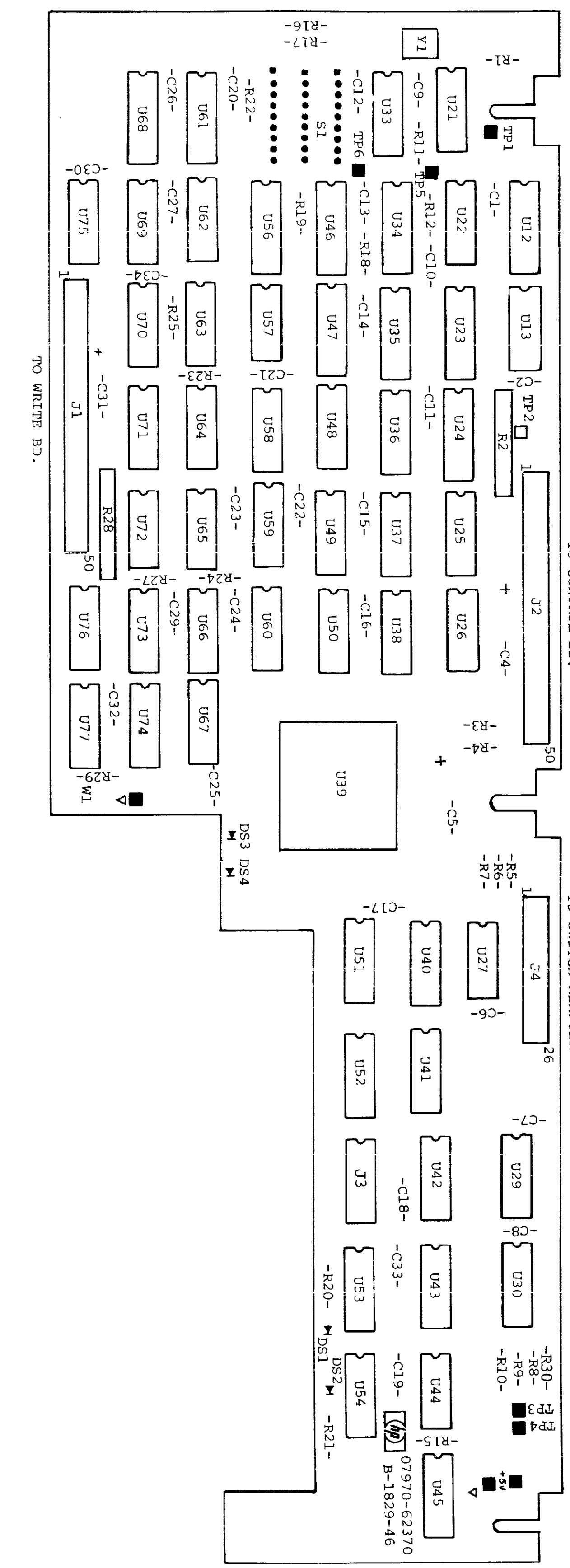
REF. DES./ INDEX NO.	DESCRIPTION	PART NO.
U47,48,69	IC: 74LS393	1820-1464
U49,51	IC: 74LS51	1820-1210
U50,72	IC: 74LS11	1820-1203
U52,54,55	IC: 74LS08	1820-1201
U,61,76,77	IC: 74LS38	1820-1209
U63,100,101	IC: 74LS00	1820-1197
U70,73	IC: 74LS390	1820-1991
U71	IC: 74LS21	1820-1205
U88	IC: 74LS14	1820-1416
U89,90	IC: 74LS138	1820-1216
U91	NANO Processor	1820-1692
U93	PROM: Sgnt. 825191	07970-62397
U99	IC: 74LS05	1820-1200
VR1	DIO: Ref, 6.91v	1902-0049
W1,2	JUMPER	1258-0124
XU91	SOCKET: 40 Pin	1200-0659
XU93	SOCKET: 24 Pin	1200-0541

REF. DES./ INDEX NO.	DESCRIPTION	PART NO.
C1-8, 10-16, 18-33, 35-42, 44-47, 53-57, 51	CAP. 0.01ufd 100V	0160-2055
C17	CAP: 4.7ufd	0180-2683
C43	CAP: 100ufd	0180-2207
C48-50	CAP: 3.3ufd	0180-2664
C52	CAP: 68ufd	0180-269
DS1-3	LED: 300VDC 50ma	1990-0404
J1-3	CONN: 50 Pin	1251-5544
J4-5	SOCKET: 16 Pin	1200-0423
J6	CONN: Power	1251-5506
Q1	TRANSISTOR: 2N3906	1853-0036
Q2	TRANSISTOR: 2N3904	1854-0215
R1-4, 21,23,24	RES: Pack 10k	1810-0280
R5,6,9,10,11,19 22, 25-30	RES: 10k 5% .25W	0683-1035
R7,8,20	RES: 220 5%, .25W	0683-2215
R12	RES: Var 1.21K 1% .5W	2100-3211
R13	RES: 1.21K 1% .5W	0757-0821
R14,18	RES: 1k, 5%, .25W	0683-1025
R15	RES: 2.2K 5% .25W	0683-2225
R16	RES: 1.5K 5%	0683-1525
R17	RES: 4.7K 5% .25W	0683-4725
TP1-8, GND1-3	TERM Stud Br	0360-1813
U10,17, 38-41	IC: 3341	1818-0093
U11,12,19,30	IC: 7407	1820-0668
U14,15,25,26,35 35,46,57,68,79	IC: 74LS395	1820-1446
U16,27	IC: 74LS157	1820-1470
U18,22-24,34	IC: 74LS273	1820-1730
U20,29,31,58,80 82	IC: 74LS241	1820-1918
U33,42,53,59,60	IC: 74LS04	1820-1199
U36,37	IC: 74LS257	1820-1438
U43,44,45,56,62 64-67,74,75,78	IC: 74LS74	1820-1112

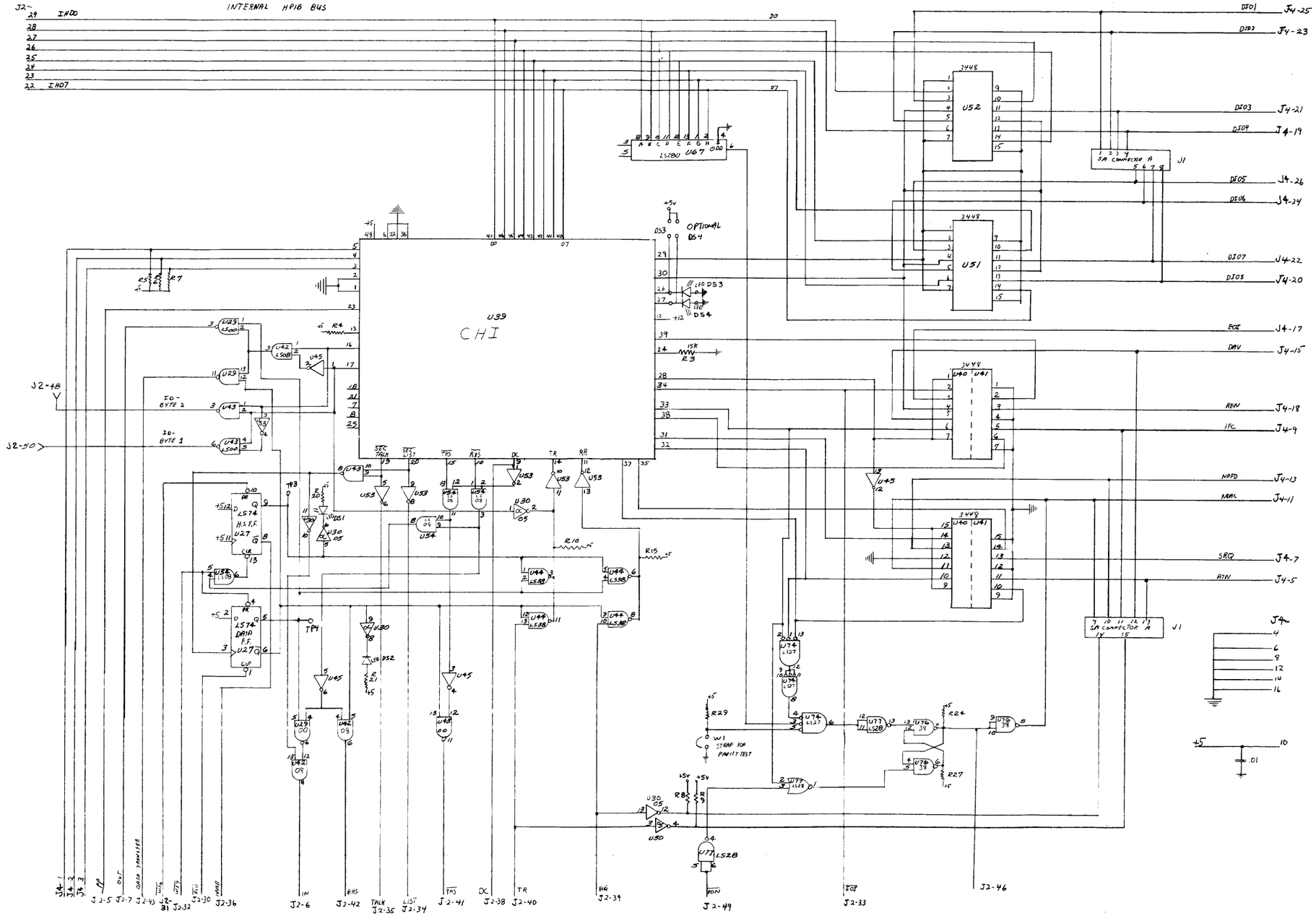


07970-62369
Series 1829

CONTROL PCA
Schematic (2 of 2)
5-11



WRITE FORMATTER PCA 07970-63370
Parts Location Series 1829



07970-62370 WRITE FORMATTER PCA
Series 1829 Schematic (1 of 3)
5-13

2-13 EOR — R2 -6 — U70 — IE/SLT

STATE 7 — U64 LS09 — U59 LS86 — J

U49 74LS74 PRE D CLK CLR — I

F

TMD+PAD, STATE 4 — U38 LS00 — H

STATE 3, STATE 6 — U38 LS00

B 720 KHZ — U58 LS08

STATE 7 — U70 — U48 LS54 — U36 LS00 — SCC

C, D, E, LDB — R19 — U57 LS21

IDCOUNT

STATE 0 — U70 — 2DF

DF — U64 LS08 — G

RDY — U69 LS00

2-9 EN — R2-5 — U70 — R23 10K, R25 1M, C31 100 UFD — U64 LS09

SWS — U63 LS02

2-10 WPA — R2-4 — U62 LS00 — U63 LS00 — STATE 0 — U62 LS00

2-11 WID — R2-2 — U62 LS00 — U69 LS00

2-12 WTM — R2-7 — U70 — U61 LS112 PRE J CLK K CLR — 2DF, STATE 0

STATE 3

U56 LS138 — STATE 0, STATE 1, STATE 2, STATE 3, STATE 4, STATE 5, STATE 6, STATE 7 — R22 — SA, S2

U61 LS112 — U68 LS112 — U68 LS112

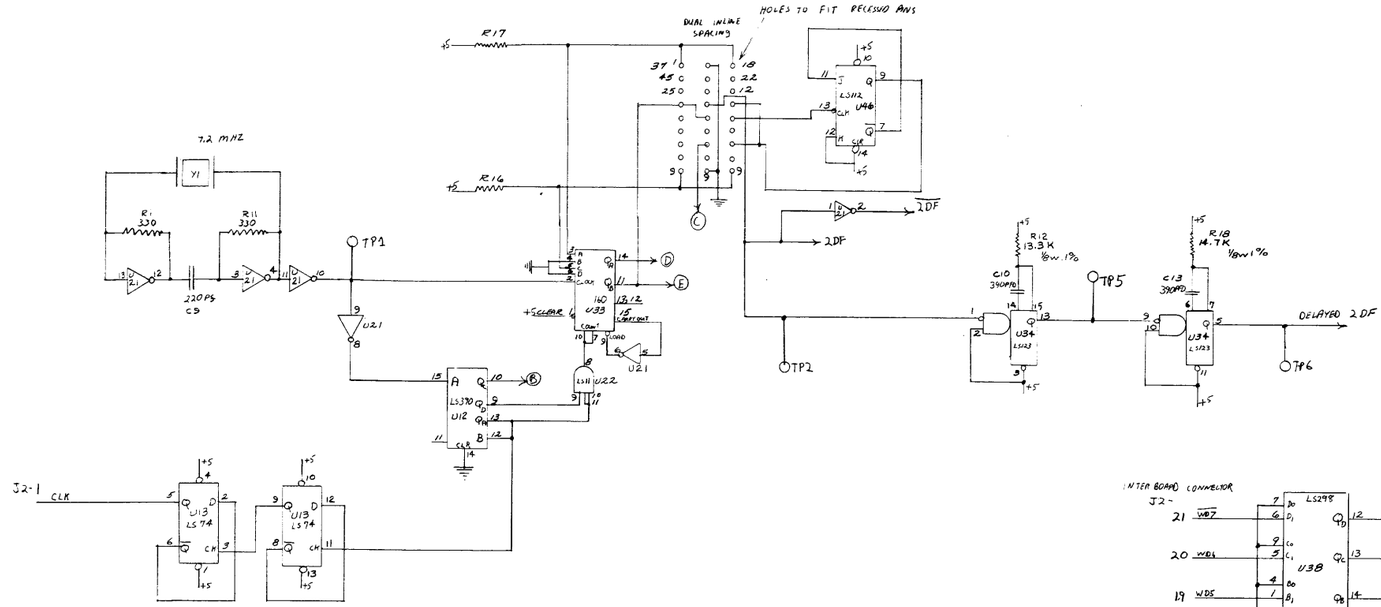
STATE 1, STATE 2 — U62 LS00 — U70 — STATE 4, STATE 5 — U71 LS10 — CNTEN

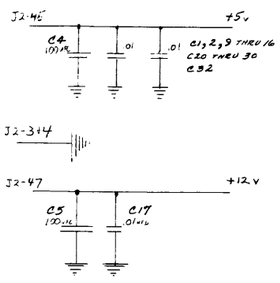
DF, STATE 0 — U37 LS32 — U71 LS10 — U63 LS02 — U64 LS04 — A — CLCNT

SWS — U78 LS00 — STCNT

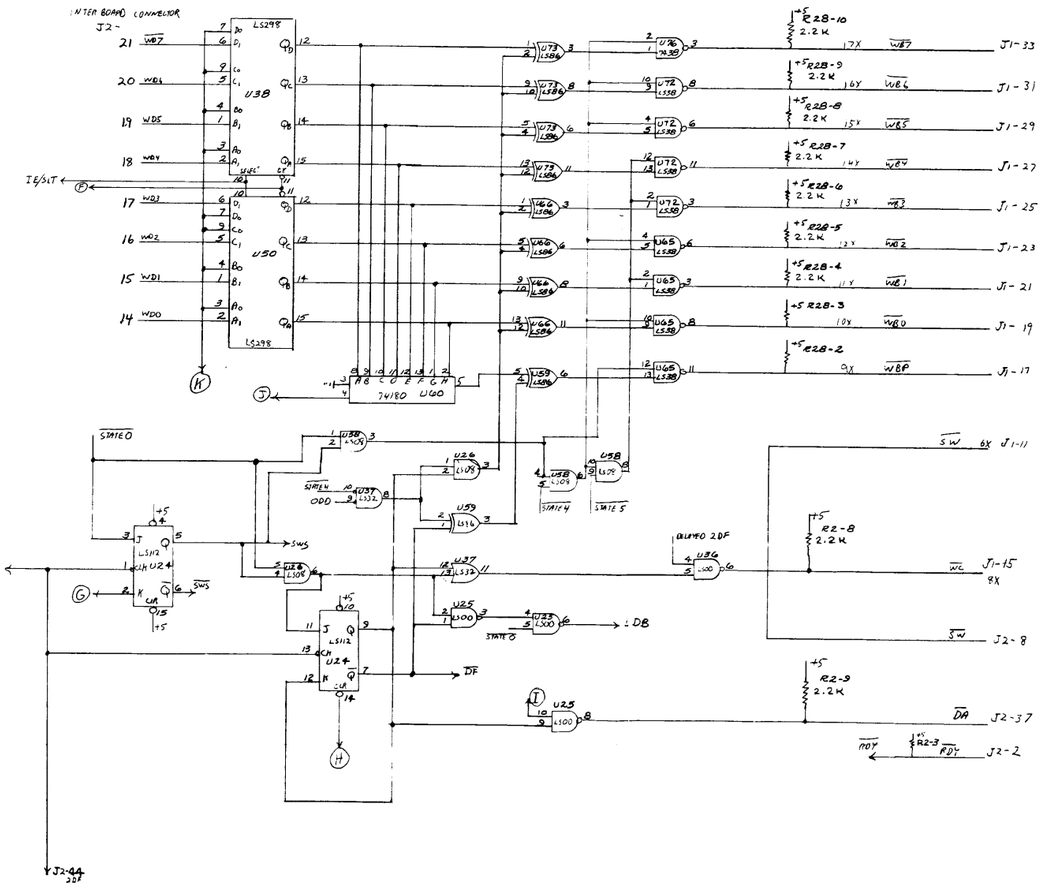
STATE 4, STATE 5 — U75 LS00

WRITE FORMATTER PCA 07970-62370
Schematic (2 of 3) Series 1829
5-14





ALL UNMARKED RESISTORS ARE 10K AND IN RESISTOR PACKS 1810-0277



REF. DES./ INDEX NO.	DESCRIPTION	PART NO.
U44,65,72	IC: 74LS38	1820-1209
U47	IC: 74LS190	1820-1279
U48	IC: 74LS54	1820-1285
U56	IC: 74LS138	1820-1216
U57	IC: 74LS21	1820-1205
U59,66,73	IC: 74LS86	1820-1211
U60	IC: 74180	1820-0435
U63	IC: 74LS02	1820-1144
U67	IC: 74LS280	1820-1634
U71	IC: 74LS10	1820-1202
U74	IC: 74LS27	1820-1206
U76	IC: 7438	1820-0621
U77	IC: 74LS28	1820-1273
XU56	SOCKET: IC 16 Pin	1200-0423
XU39	SOCKET: IC 48 Pin	1200-0650
XY1	STRAP: Crystal	8151-0014
Y1	CRYSTAL: 7.2MHZ	0410-0449

REF. DES./ INDEX NO.	DESCRIPTION	PART NO.
C1,2, 6-8,11 11,12, 14-32 29,30,32-34	CAP: 0.01ufd	0160-2055
C4,31	CAP: 100ufd	0180-2207
C5	CAP: 47ufd	0180-2249
C9	CAP: 220pfd	0160-0134
C10,13	CAP: 390pfd	0140-0200
DS1,2,3,4	LED	1990-0404
J1,2	CONN: 50 Pin	1251-5544
J3	SOCKET: IC 16 Pin	1200-042
J4	CONN: 26 Pin	1251-4605
R1,11	RES: 330 5% .25W	0683-3315
R2,28	RES: Pack 2.2k	1810-0277
R3	RES: 15K 5% .25W	0638-1535
R4-10,15-17,19 22-24,27,29,30	RES: 10k 5% .25W	0683-1035
R12	RES: 13.3K 1% .125W	0757-0289
R18	RES: 14.7K 1% .125W	0698-3156
R20,21	RES: 220 5% .125W	0683-2215
R25	RES: 47K 5% .25W	0683-4735
TP1-8 GND1-3	PINS: Test	0360-1831
U12,23	IC: 74LS390	1820-1463
U13,27,49	IC: 74LS74	1820-1112
U21,45,53,70	IC: 74LS04	1820-1199
U22	IC: 74LS11	1820-1203
U24,35,46,61,68	IC: 74LS112	1820-1212
U25,29,36,43,62 69,75	IC: 74LS00	1820-1197
U26,42,54,58,64	IC: 74LS08	1820-1201
U30	IC: 74LS05	1820-1200
U33	IC: 74160	1820-0899
U34	IC: 74LS123	1820-1423
U37	IC: 74LS32	1820-1208
U38,50	IC: 74LS298	1820-1444
U40,41,51,52	IC: HP3448	1820-1972

APPENDIX A

****
*
* Note: (DIO 1 thru 8 Corresoond to HP 300 IMB Lines 15 thru 8) *
*
****

Table A-1

Tape Unit Identify Bytes

DIO Lines	
Byte #1	Byte #2
1 = 1	1 = 1
2 = 0	2 = 1
3 = 0	3 = 0
4 = 0	4 = 0
5 = 0	5 = 0
6 = 0	6 = 0
7 = 0	7 = 0
8 = 0	8 = 1

Table A-2

Available Commands

Listen Mode

(MLA = 00100DDD)*

MSA = 01100000	Data byte(s) to follow represent data to be written to tape.
MSA = 01100001	Data byte to follow represents the actual command to be performed by the tape unit.
MSA = 01100111	"End" Command/Service Request Acknowledge - Data byte to follow represents an "End" Command/Service Request Register for the tape unit (See Table A-5).
MSA = 01110000	Device clear - resets the interface
MSA = 01111110	Data bytes to follow represent information (64 bytes) to be saved for future echoing, "HP-IB Loopback".

Note: The low order 4 bits of the secondary address (MSA) represents the HP 300 Command Instruction Modifiers.

* DDD = Device's "Fundamental Address"

Table A-3

Available Status

Talk Mode

(MTA = 01000DDD)*	
MSA = 01100000	Data byte(s) to follow represent data to be read from tape.
MSA = 01100001	The three data bytes to follow represent the status registers from the tape unit, (See Table A-6).
MSA = 01100010	The two data bytes to follow represent the number of bytes read/written for the last record. The first is the most significant value of the count.
MSA = 01110000	Data byte to follow represents Device Specified Jump from tape unit (See Table A-7).
MSA = 01111110	Data bytes to follow represent information received (64 bytes) with "Loopback" Command.

* DDD = Device's "Fundamental Address"

Table A-4

Command Register
(See 5.3.1.1 for details)

Value (Octal)	Value (Octal)
0 = Reserved	10 = Read Record
1 = Select Unit 0	11 = Forward Space Recore
2 = Select Unit 1	12 = Backspace Record
3 = Select Unit 2	13 = Forward Space File
4 = Select Unit 3	14 = Backspace File
5 = Write Record	15 = Rewind
6 = Write File Mark (EOF)	16 = Rewind and Go Off-Line
7 = Write Gap	17 = Read Record Backward

Table A-5

"End"Commands/Service Request Register

(See 5.3.1.2 for details)

DIO Lines

1 = "End" Command/Clear Parallel Poll Response (Service Request) for selected device only.

2 = Stop polling for data/Inhibit PP response for Read bursts for selected device

3 = Enable Parallel Poll Response (Service Requests) for all devices connected to the interface.

4 = Reserved

5 = Clear DSJ Register for selected device only.

6 = Reserved

7 = Reserved

8 = Reserved

Table A-6

Status Register #1
(See 5.3.2.1 for details)

DIO Lines	
1	= ON-line
2	= Multiple Track Error(s) (MTE)
3	= File Protected (Not Write Enabled; No Write Ring).
4	= Command Rejected
5	= Single Track Error (STE).
6	= End-of-Tape (EOT).
7	= Load Point (LP) / Beginning-of-Tape (BOT)
8	= End-of-File (EOF).

Status Register #2
(See 5.3.2.2 for details)

DIO Lines	
1	= Interface Busy
2	= Tape Unit Busy
3	= Rewinding
4	= Tape Runaway
5	= Data Error (Timing)
6	= Selected Tape Unit LSB
7	= Selected Tape Unit MSB
8	= Reserved

Status Register #3
(See 5.3.2.3 for details)

DIO Lines	
1	= Tape Unit 0 has been placed On-Line
2	= Tape Unit 1 has been placed On-Line
3	= Tape Unit 2 has been placed On-Line
4	= Tape Unit 3 has been placed On-Line
5	= Command Parity Error
6	= Power has been restored
7	= Reserved
8	= Reserved

Table A-7

Device Specified Jump Register (DSJ's)
(See 5.3.2.4 for details)

Value	Action
0	= No special action required
1	= Status Request should be performed.

Change 1
AUG 1979

Manual Part No.: 07970-90919
Print Date: SEP 1978

CHANGE TO:
7970E HP-IB INTERFACE
PROGRAMMING AND SERVICE MANUAL

CHANGE DESCRIPTION

This change to the manual reflects design changes to the HP-IB interface for the 7970E Magnetic Tape Unit.

CHANGE INSTRUCTIONS

Insert page 3-5/3-6 at the end of section three; insert pages 5-17/5-18 and 5-19 at the end of section five.

P.O. Box 15, Boise, Idaho 83707, Tel. 208-376-6000, TWX 910-970-5784

Europe: 1217 Meyrin-Geneva, Switzerland • Cable "HEWPACKSA" Tel. (022) 41.54.00

Printed in U.S.A.

3-6 POWER SEQUENCE

The power sequence assembly is provided to insure that the HP-IB interface will not compromise tape integrity as a result of power failures. This data loss is caused by improper recovery of the HP-IB interface microprocessor from these power interruptions. The power sequence PCA will shut down the HP-IB interface processor and switch the 7970 tape unit to the off-line condition if the supply voltages to the HP-IB interface drop below acceptable levels. This process will prevent a data loss because of power line drop outs or power supply failures. To provide this shut down, the +12, -12, and +5 supply voltages from the power distribution assembly are fed into +12, -12, and +5 volt comparators on the Power Sequence PCA. If a power line drop out occurs and these voltages drop below their acceptable levels, the comparator output will go high (see Figure 3-2). A high output from any

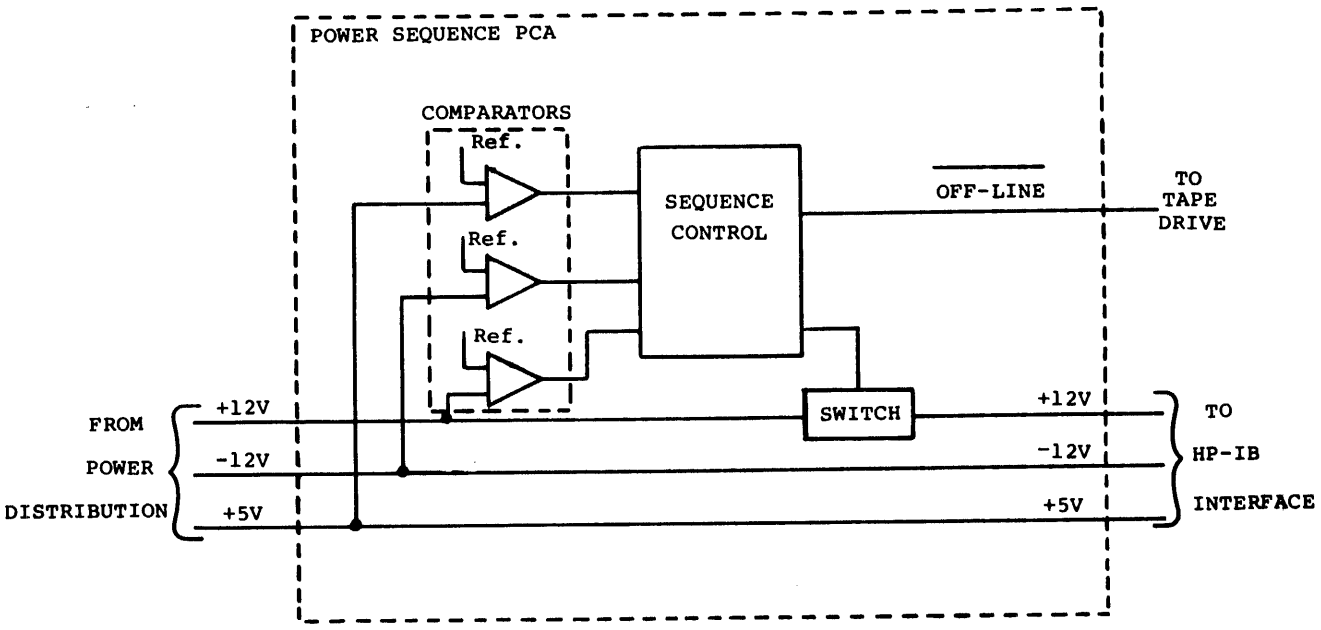


Figure 3-2. POWER SEQUENCE BLOCK DIAGRAM

comparator will initiate the sequence control circuits to immediately switch off the +12 supply voltage (refer to Figure 3-3) to the microprocessor on the interface and set the OFF-LINE signal line low which will transfer the tape unit to the off-line state (the ON-LINE light on the operator switch panel on the tape drive goes out.

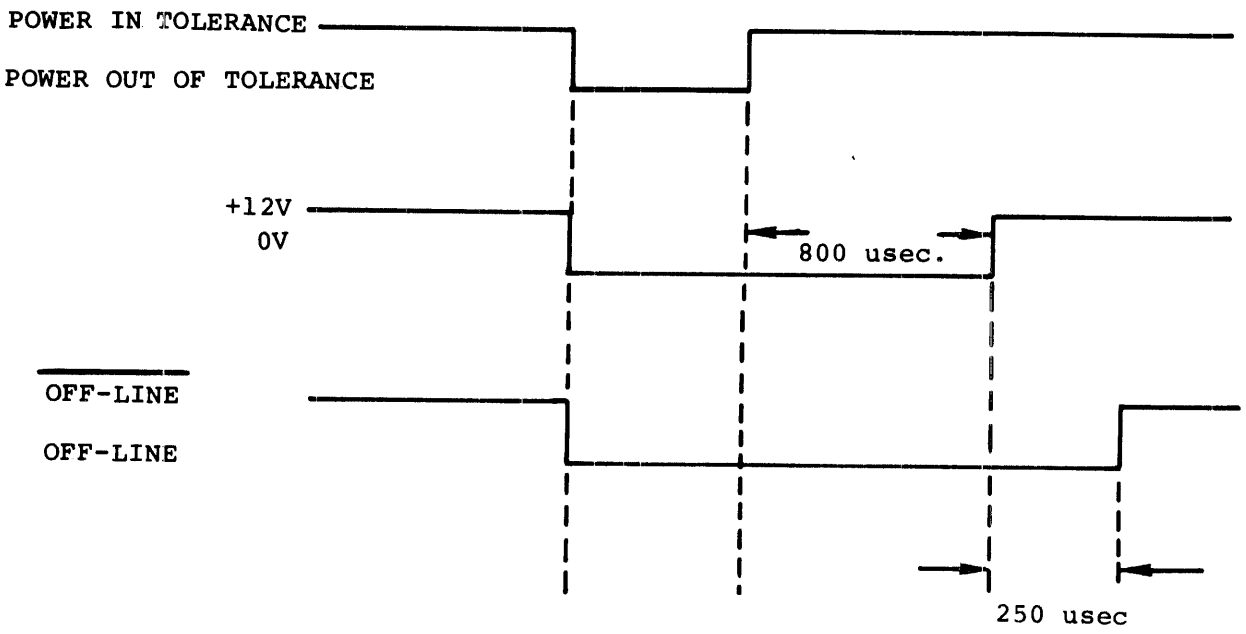
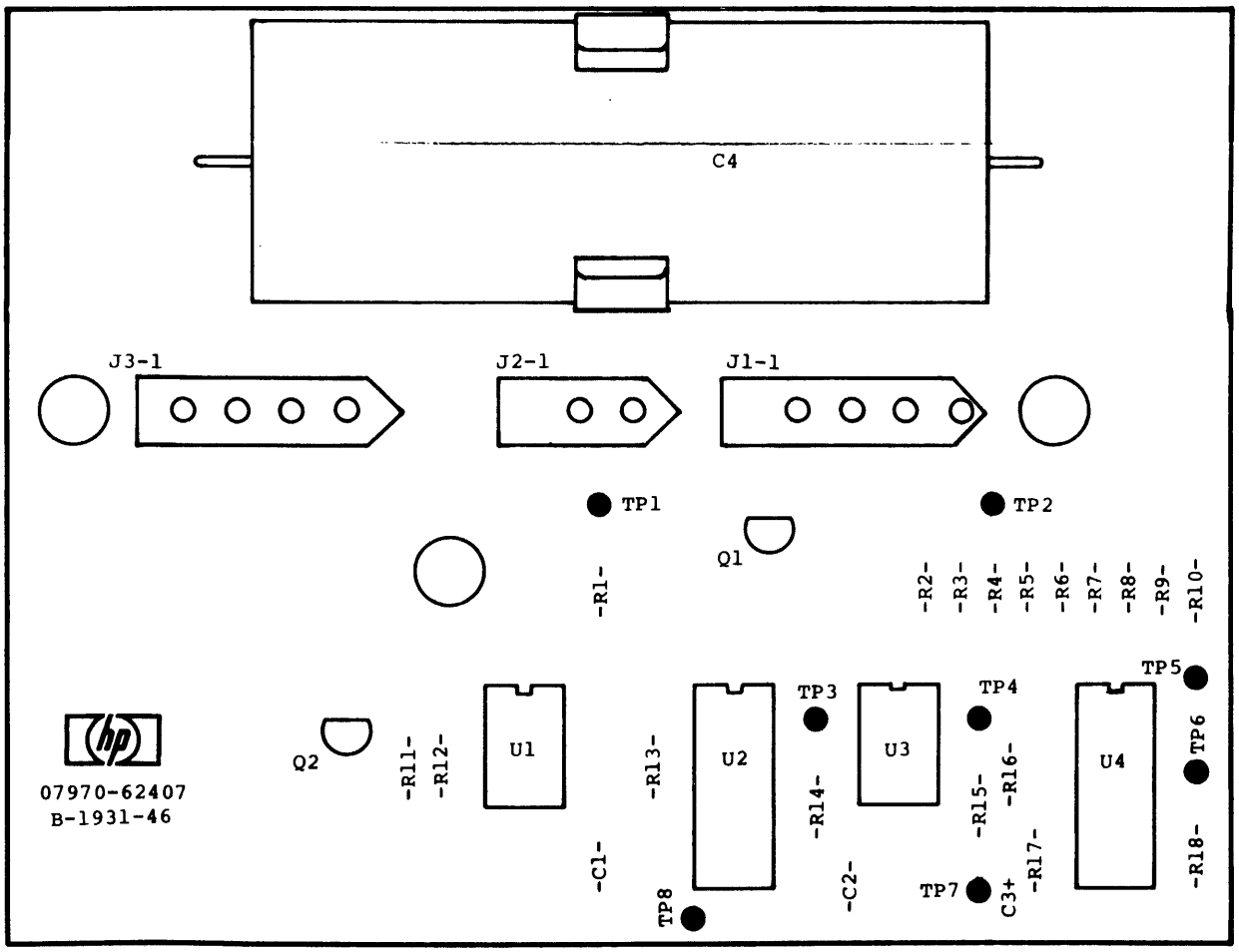
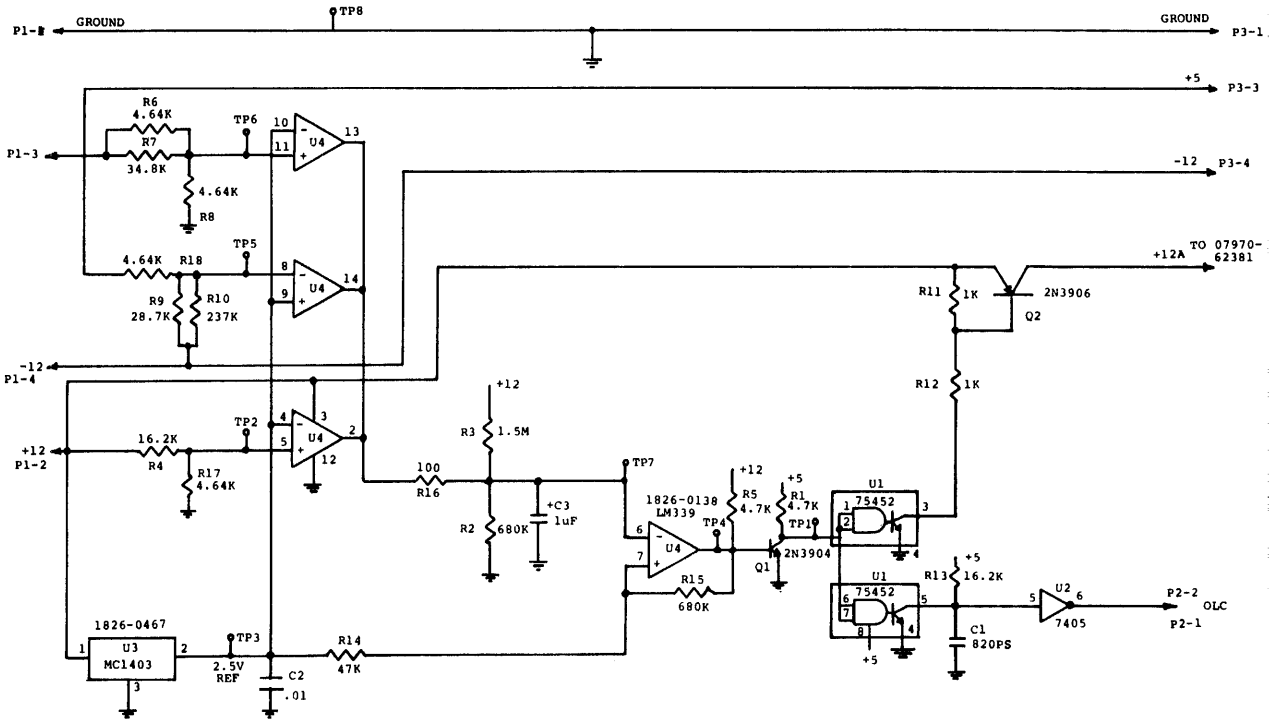


Figure 3-3. POWER SEQUENCE WAVEFORM TIMING DIAGRAM

As the +12, -12, and +5 voltages return to acceptable levels the Power Sequence PCA will switch the +12 back on to the interface and approximately 250 microseconds later, switch the OFF-LINE signal high again. The operator must manually place the tape unit back on line by pressing the ON-LINE switch on the 7970E front switch panel.


C4
J3-1
J2-1
J1-1
TP1
TP2
Q1
-R1-
-R2-
-R3-
-R4-
-R5-
-R6-
-R7-
-R8-
-R9-
-R10-
TP5
TP3
TP4
TP6
Q2
-R11-
-R12-
U1
-R13-
U2
U3
U4
-R14-
-R15-
-R16-
-R17-
-R18-
-C1-
-C2-
TP7
TP8
C3+
07970-62407
B-1931-46

REF. DES./ INDEX NO.	DESCRIPTION	HP PART NO.
C1	CAP: 820pfd	0160-2009
C2	CAP: 0.01ufd	0160-2055
C3	CAP: 1ufd	0180-2764
J1	CONN: Molex	1251-5728
J2	CONN: Molex	1251-5251
J3	CONN: Molex	1251-5727
Q1	XSTR: 2N3904	1854-0215
Q2	XSTR: 2N3906	1853-0036
R1,5	RES: 4.7K 5%	0683-4725
R2,15	RES: 680K 5%	0683-6845
R3	RES: 1.5K 5%	0683-1555
R4,13	RES: 16.2K 1%	0757-0447
R6,8,17,18	RES: 4.64K 1%	0698-3155
R7	RES: 34.8K 1%	0757-0123
R9	RES: 28.7K 1%	0698-3449
R10	RES: 237K 1%	0698-3266
R11,12	RES: 1K 1%	0683-1025
R14	RES: 47K 5%	0683-4735
R16	RES: 100 5%	0683-1015
TP1-8	TERM.	0360-1682
U1	IC: SN75452	1820-0799
U2	IC: SN7405	1820-0175
U3	IC: MC1403	1826-0467
U4	IC: LM339	1826-0138
C4	CAP: 3000ufd 40vdc	0180-2395


P1-2
GROUND
TP8
GROUND
P3-1
+5
P3-3
R6
4.64K
R7
34.8K
TP6
U4
P1-3
4.64K
R8
-12
P3-4
TP5
4.64K
R18
R9
28.7K
R10
237K
TO 07970-
62381
+12A
R11
1K
2N3906
Q2
-12
P1-4
R12
1K
+12
TP2
16.2K
R4
R17
4.64K
+12
P1-2
R3
1.5M
100
R16
TP7
+C3
1uF
R2
680K
1826-0138
LM339
+12
R5
4.7K
+5
R1
4.7K
TP4
TP1
U1
75452
Q1
2N3904
R15
680K
U1
75452
+5
R13
16.2K
U2
7405
P2-2
OLC
P2-1
C1
820PS
+5
1826-0467
U3
MC1403
TP3
2.5V
REF
R14
47K
C2
.01

9/78
Printed in U.S.A.
07970-90919