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TEXAS INSTRUMENTS

# TM990

**TM 990/601 & TM 990/602  
Kit Configuration**



**MICROPROCESSOR SERIES™**

**User's Guide**

PRINTING REVISION

This printing incorporates the following revision level:

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TABLE OF CONTENTS

SECTION	TITLE	PAGE
1.	INTRODUCTION	
1.1	General.....	1-1
1.2	Manual Organization.....	1-5
1.3	System Memory Configuration.....	1-5
2.	INSTALLATION	
2.1	General.....	2-1
2.2	Unpacking.....	2-1
2.3	Kit Setup.....	2-1
2.3.1	Attach Power Supply to TM 990/510 Chassis.....	2-1
2.3.2	PRES.B Hookup to a Push Button Switch.....	2-3
2.3.1	Set Up and Connect the Disk Drive to Floppy Disk Controller.....	2-4
2.3.4	Connect System Terminal.....	2-5
2.3.5	Printer Hookup.....	2-12
A.	BOARD AS-SHIPPED CONFIGURATIONS	
A.1	General.....	A-1
A.2	TM 990/303A Disk Controller.....	A-1
A.3	TM 990/101MA Microcomputer Board.....	A-2
A.4	TM 990/203-23 Dynamic RAM Board.....	A-3
B.	CHASSIS AS-SHIPPED CONFIGURATION	
C.	SYSTEM TROUBLE SHOOTING	
C.1	Disk Problems.....	C-1
C.2	System Does Not Boot.....	C-2
C.3	Partial System Boots.....	C-3
C.4	Terminals.....	C-4
C.5	Printers.....	C-5
C.6	Miscellaneous System Problems.....	C-6

## LIST OF ILLUSTRATIONS

FIGURE	TITLE	PAGE
1-1	TM 990/601 System Configuration.....	1-3
1-2	TM 990/602 System Configuration.....	1-4
1-3	System Memory (RAM) Configuration.....	1-5
2-1	Terminal Strip on Card Cage Backplane.....	2-2
2-2	Connecting TM 990/527 Disk Cable to P4 of TM 990/303A.....	2-6
2-3	TM 990/527 Cabling Between Controller and Disk Drives.....	2-6
2-4	Jumper Locations on the Shugart SA 800 Disk Drive.....	2-8
2-5	Jumper Locations on the CDC 9404B Disk Drive.....	2-10
2-6	Jumper Locations on the QUME DT-8 Disk Drive.....	2-12
A-1	Jumper Locations on TM 990/303A Board.....	A-2
A-2	Jumper Locations on TM 990/101MA Board.....	A-4
A-3	Switch S1, S2, S3, and S4 Settings on Memory Board.....	A-5
A-4	Jumper Locations on TM 990/203-23 Memory Board.....	A-6
B-1	Location of Etch To Cut on TM 990/510 Chassis Backplane.....	B-1

## LIST OF TABLES

TABLE	TITLE	PAGE
2-1	Power Requirements for Kit Boards.....	2-2
2-2	Suggested Shugart SA 800 Disk Drive Jumper Settings.....	2-7
2-3	Suggested CDC 9404B Disk Drive Jumper Settings.....	2-9
2-4	Suggested QUME DT-8 Disk Drive Jumper Settings.....	2-11
2-5	CPU-Board Connector P2 Pin Assignments.....	2-13
2-6	CPU-Board Connector P3 Pin Assignments.....	2-13
A-1	TM 990/303A Disk Controller Jumper Settings.....	A-1
A-2	TM 990/101MA Microcomputer Jumper Settings.....	A-3
A-3	TM 990/203 Dynamic RAM Board Jumper Settings.....	A-5

## SECTION 1

### INTRODUCTION

#### 1.1 GENERAL

This manual describes the specifications and installation of the TM 990/601 and TM 990/602 kits.

Listed below is a short checklist (with reference to the section where each instruction is fully described) for the installation of the TM 990/601 and TM 990/602 kits. The items with an asterick are unique to the TM 990/601 kit.

- Unpack the TM 990/601 or TM 990/602 kit and verify contents. See section 1.1.
- Hook up the power supply to the backplane of the chassis and verify the voltage levels. See section 2.3.1.
- Optionally hook up the PRES.B line on the backplane to a push button switch mounted to the front of the chassis. See section 2.3.2.
- Set up jumpers on the under side of the floppy disk drives. See section 2.3.3.
- Power up floppy disk drives and verify operation.
- Turn off power to the floppy disk drives. Connect the TM 990/527 ribbon cable from the floppy disk drives to the TM 990/303A board which is in the top slot of the chassis. See section 2.3.3.2.
- Connect the EIA cable from the CRT to the P2 connector on the TM 990/101 CPU board (3rd slot in the TM 990/601 kit) or to the EIA connector on the back of the TM 990/522 enclosure (for the TM 990/602 kit). See section 2.3.4.
- Turn on the CRT and make sure it is on line.
- Turn on the disk drives.
- Insert the system diskette in floppy disk drive 1.
- Turn on the power to the chassis.
- A typical system should boot in off the system disk in approximately 35 to 45 seconds. (This booting time is totally dependent upon the operating system being used, and the user should refer to the respective software installation manual for details.) If this does not happen, turn the power to the chassis off and refer to Appendix C, Troubleshooting.

Included in these kits are the following modules and associated documentation:

TM 990/601 KIT

- TM 990/510 Chassis with the following modules installed:
  - TM 990/303A Floppy Disk Controller Module (slot 1)
  - TM 990/203-23 Dynamic RAM Module (slot 2)
  - TM 990/101MA-3 Microcomputer Module (slot 3)
- TM 990/527 Cable (connects disk controller to 8-inch disk drive)

TM 990/602 KIT

- System Enclosure
- Power Supply and fan (within enclosure)
- TM 990/510A Chassis inside enclosure with the following modules installed:
  - TM 990/303A Floppy Disk Controller Module (slot 1)
  - TM 990/203-23 Dynamic RAM Module (slot 2)
  - TM 990/101MA-3 Microcomputer Module (slot 3)
- TM 990/527 Cable (connects disk controller to 8-inch disk drive)
- TM 990/538 Cable (internal connection between CPU board and chassis backpanel for EIA hookup)

Figures 1 and 1-2 show the various kits and the positioning of the boards and cables. Kit features include:

- Kits are preconfigured and tested at the factory to ensure operation with a minimum of setup time.
- Hardware ready to plug into user-supplied disk drive(s), terminal, and system printer.
- TM 990/602 kit comes with power supply; TM 990/601 requires user-supplied power supply.
- Documentation supplied on all modules, allowing user to tailor system to a desired setup.
- Floppy controller board comes set up for standard-size diskette (however, it can be configured for mini-size). Controller firmware allows system bootstrap initialization via powerup or by switch-actuated reset. Cable provided for standard-size disk drive.
- 64 K bytes of RAM:
  - 4 K bytes of TMS 4045 static RAM on microcomputer board
  - 60 K bytes of TMS 4116 dynamic RAM on memory board

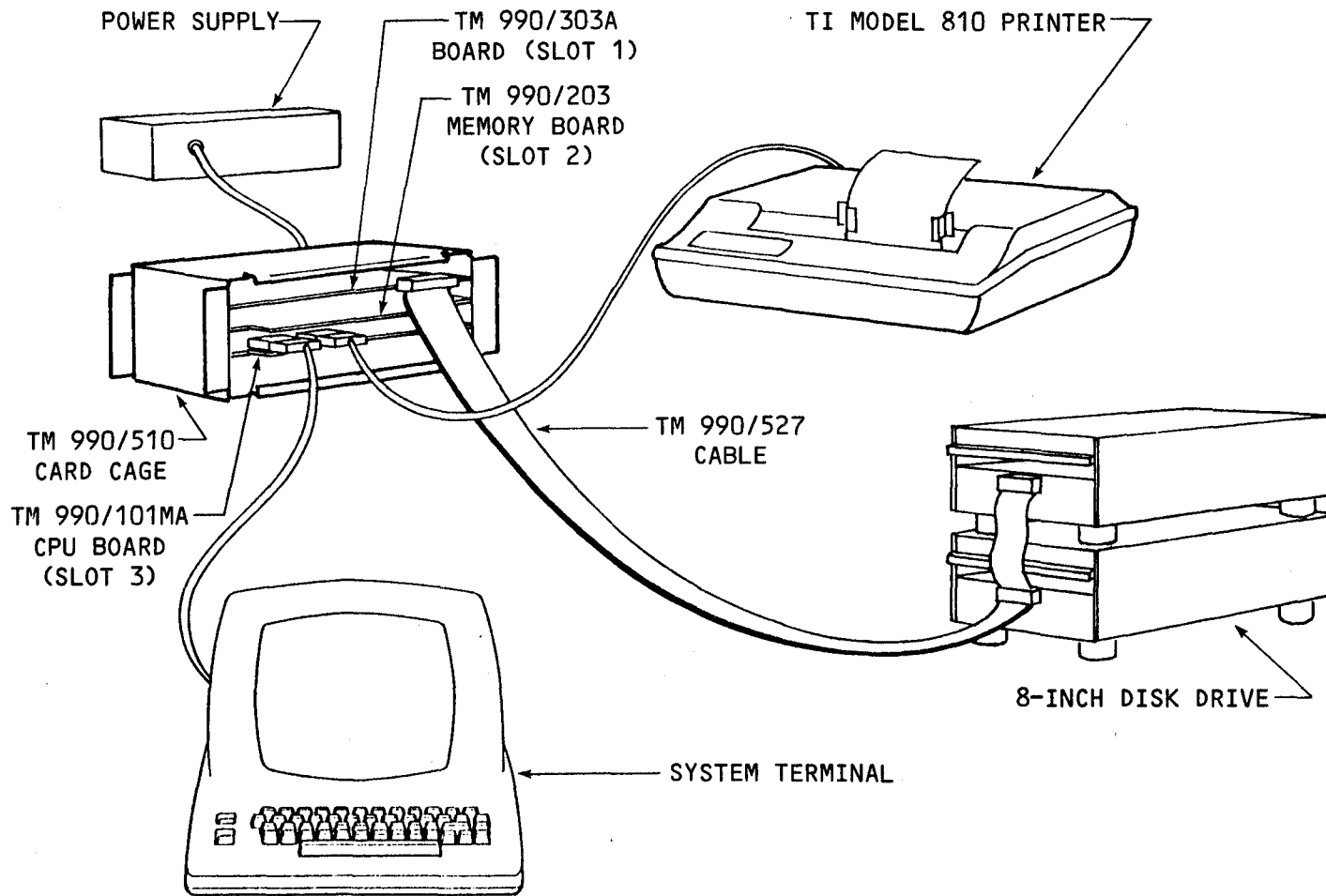


FIGURE 1-1. TM 990/601 SYSTEM CONFIGURATION



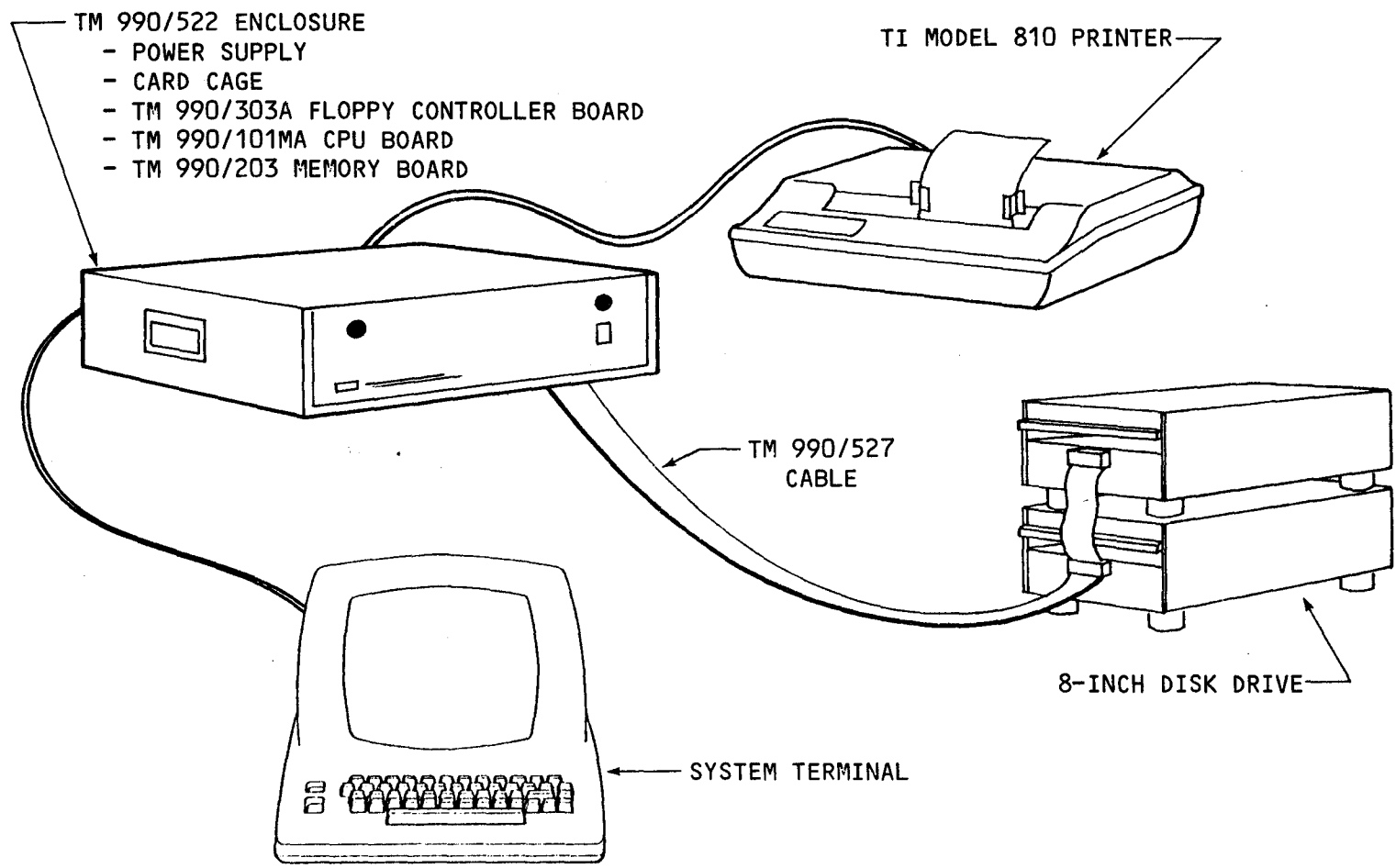


FIGURE 1-2. TM 990/602 SYSTEM CONFIGURATION

## 1.2 MANUAL ORGANIZATION

This manual is divided into two sections and two appendices:

- Section 1 covers general information on the kits.
- Section 2 covers installation data necessary to configure the kits to the user's peripherals.
- Appendix A provides as-shipped configuration data for the boards in the system.
- Appendix B explains the as-shipped card cage configuration.
- Appendix C is a troubleshooting section.

## 1.3 SYSTEM MEMORY CONFIGURATION

Figure 1-3 shows the as-shipped system random-access memory (RAM) configuration. Note the partitioning on both the TM 990/101MA microcomputer and the TM 990/203 dynamic RAM expansion board.

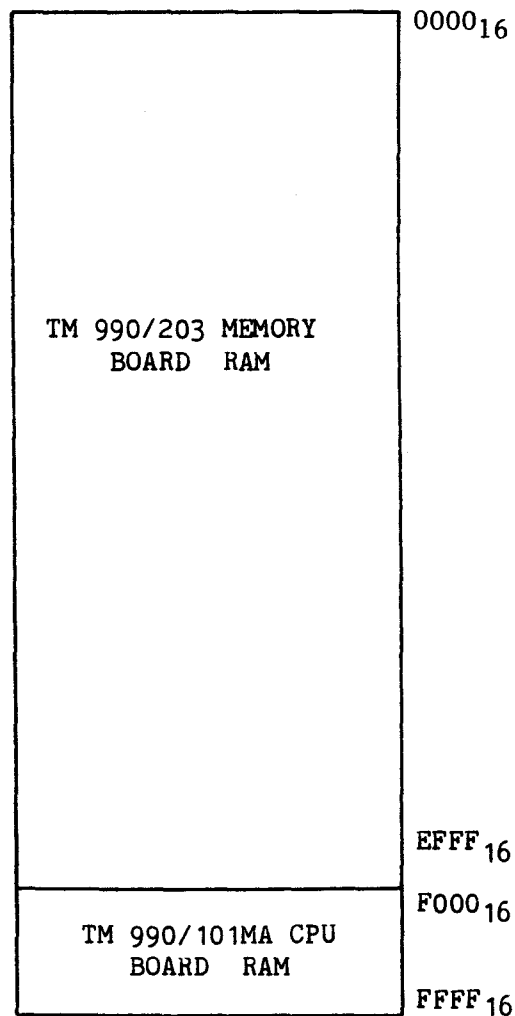


FIGURE 1-3. SYSTEM MEMORY (RAM) CONFIGURATION

## SECTION 2

### INSTALLATION

#### 2.1 GENERAL

This section explains how to correctly install the TM 990/601 and TM 990/602 kits. Both come ready to be interconnected with user-provided peripherals. In addition, the TM 990/601 requires a user-provided power supply. Boards in both systems have been configured for hookup as shown in the figures in Section 1 (connection in Figure 1-1 or 1-2 and memory map as shown in Figure 1-3).

Appendix A contains tables of factory-set jumper and switch settings for the kit should the user wish to configure boards purchased direct from the factory rather than in the kit. In addition, a complete set of manuals has been provided on each module in the kit, further explaining switch and jumper settings, programming information, theory of operation, etc.

#### 2.2 UNPACKING

While unpacking the kit, keep all packing materials until the system is assembled and verified operational. Note any breakage shown on the the carton as well as any internal breakage that could have occurred in shipping. Report any discrepancies to your distributor.

#### 2.3 KIT SETUP

This section covers connection of peripheral components supplied by the user:

- Power supply (TM 990/601 only)
- Disk drive(s)
- Terminal
- Printer

If installing a TM 990/602 kit, it is not necessary to read the power supply installation procedure in section 2.3.1; proceed to section 2.3.3.

##### 2.3.1 Attach Power Supply to TM 990/510 Chassis (TM 990/601 Only)

Power supply requirements for the TM 990/601 kit are shown in Table 2-1. Typical current values are calculated using typical loads for each discrete component; maximum current values are calculated using maximum values for each discrete component. In addition, the following are actual measured values for the three boards in the chassis:

<u>Voltage</u>	<u>Current</u>
+ 5 V	4.5 A
+12 V	0.284 A
-12 V	0.08 A
Total Power	26.87 W

A Texas Instruments TM 990/518 power supply will provide sufficient power in a typical application, or the user can use a power supply from another vendor.

TABLE 2-1. POWER REQUIREMENTS FOR KIT BOARDS

Board	Typical Current, Power				Maximum Current, Power			
	+5 V	+12 V	-12 V	Total Watts	+5 V	+12 V	-12 V	Total Watts
TM 990/303A	2.1 A	0.1 A	0.04 A	12.15 W	3.0 A	0.2 A	0.2 A	19.8 W
TM 990/203-23	1.9 A	0.09A	0.01 A	10.7 W	3.0 A	1.2 A	0.02A	29.64 W
TM 990/101MA-3	<u>1.8 A</u>	<u>0.3 A</u>	<u>0.03 A</u>	<u>15.6 W</u>	<u>2.6 A</u>	<u>0.5 A</u>	<u>0.4 A</u>	<u>23.8 W</u>
Totals	5.8 A	0.49A	0.08 A	38.48 W	8.6 A	1.9 A	0.62A	73.24 W

To attach a power supply to the TM 990/510 chassis, do the following:

- 1) Remove the two shipping brackets from the front of the TM 990/510 chassis. Store the removed hardware.
- 2) Remove the three TM 990 modules from the chassis. First remove the CPU module in slot 3; then remove the memory module in slot 2 and then the disk controller module in slot 1. Stack these latter two atop the CPU module from slot 3 so that the modules are in the order they appear in the chassis,
- 3) MAKE SURE THE AC POWER TO THE POWER SUPPLY IS DISCONNECTED.
- 4) Connect the voltages to the connector terminal at the back of the chassis as shown in Figure 2-1. Check to see that +12 V and -12 V are not reversed.

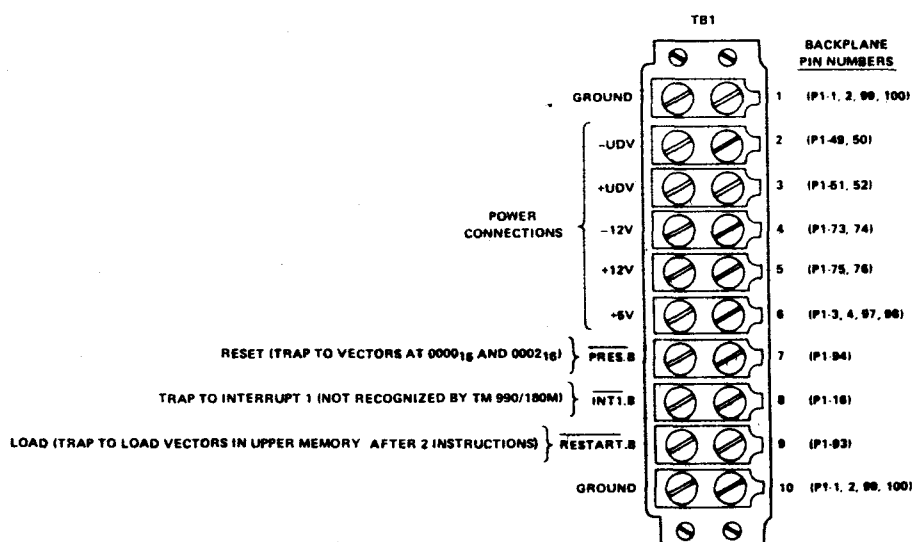


FIGURE 2-1. TERMINAL STRIP ON CARD CAGE BACKPLANE

- 5) Turn on the power supply (the boards are still removed). Measure the voltages on the backplane with a voltmeter. If the voltages and their polarity are correct, then proceed to step 6. If incorrect readings are found, turn off power and check the hookup to the chassis terminal block. If the connections are correct, other possible causes could be the power supply fuse or the ac power source.
- 6) Before reinserting the boards, wipe the edge connectors with alcohol to clean them. (This insures a good electrical connection.) With the power supply connected correctly and the power turned off, reinsert the three TM 990 modules into the chassis verifying that they are in the correct slot as shown in Figure 1-1 (TM 990/303A in slot 1; TM 990/203 in slot 2; TM 990/101MA in slot 3). The boards should snap into the backplane connectors.
- 7) Turn on the power. The LED on the left side of the TM 990/101MA board (slot 3) should be on, and at least one LED on the TM 990/303A board (slot 1) should be on. If possible, measure the currents and compare these to Table 2-1.
- 8) Turn off the power and proceed to set up the disk drives as explained in section 2.3.3. If desired, reattach the shipping brackets.

#### 2.3.2 PRES.B Hookup to a Push Button Switch (Optional, TM 990/601 only)

This section is optional in that the user can reset the system by cycling power on the system. The purpose of this switch is to allow the user to reset the system without cycling the power. The hook up procedure for this switch is listed below.

**WARNING**

#### TURN OFF THE POWER TO THE CHASSIS BEFORE BEGINNING

- 1) Set the chassis so that the front of it faces you.
- 2) Insert a small single pole single throw (SPST) push button switch in the top hole of the left flange slightly above the top card slot. Secure this with a washer and lock nut.
- 3) Cut two pieces of wire about 13 inches long. Strip  $\frac{1}{2}$  inch of insulation off both ends of the two pieces of wire. Attach one piece of wire to each lug of the switch. Solder both connections.
- 4) Run one wire around to the back of the chassis and pull it across the 'GND' screws in the #1 position (top) of the terminal strip. Refer to Figure 2-1 in section 2. Attach it to the 'GND' terminal with the screw provided.
- 5) Run the remaining wire around to the back of the chassis and pull it across the 'PRES.B' bar screws in the #7 position of the terminal strip. Refer to Figure 2-1 in section 2. Attach it to the 'PRES.B' terminal with the screw provided.
- 6) Check the wires to insure that they are connected to the terminal screws at positions 1 and 7. Also verify that none of the exposed wire is touching adjacent terminal positions.

### 2.3.3 Set Up and Connect the Disk Drive(s) to Floppy Disk Controller

A TM 990/527 ribbon cable is supplied to connect the TM 990/303A floppy disk controller board (slot 1) to one or two eight-inch disk drives. This must be installed by the user for both the TM 990/601 and TM 990/602.

The disk controller is set up to operate with the following eight-inch disk drives:

- CDC 9404B            Single sided
- Shugart SA800        Single sided
- Qume DT-8            Double sided

#### NOTES

1. In a single-drive system, the drive must be designated as drive DS1 during installation (this is a jumper setting on the drive; see the drive installation instructions) in order to perform a bootload at a hardware reset or at a powerup. The second drive should be jumpered as drive DS2.
2. The disk controller board must reside in slot 1. A trace at this slot has been modified as explained in Appendix B.

#### 2.3.3.1 Disk Drive Jumper Settings

Follow the manufacturer's instructions for setting jumpers on the respective disk drive controller board. Suggested disk drive jumper settings are listed in Table 2-2 for the Shugart Model 800 (see Figure 2-4), Table 2-3 for the CDC 9404B (see Figure 2-5), and Table 2-4 for the Qume DT-8 (see Figure 2-6).

For each drive, the user must select a unique drive number (DS1 or DS2). This designation is shown in the jumper tables. One drive must be designated DS1; this drive will contain the bootload-formatted diskette. (Various areas of the diskette must be initialized for the bootload to execute; further information on this is in the TM 990/303A manual.) The last drive (or only drive) on the interconnecting TM 990/527 cable must have terminator jumpers installed (T1, T2, T3, T4, T5, and T6 on Shugart 800; 1TM and 2TM on Qume DT-8; or resistor pack R220/330 on the CDC 9404B).

#### 2.3.3.2 TM 990/527 Cable Installation

The TM 990/527 cable connects the TM 990/303A floppy controller (slot 1) to the eight-inch disk drive as shown in Figures 2-2 and 2-3.

The following are cable installation steps:

- 1) Turn off power to the chassis and the disk drives.
- 2) If this is for a TM 990/602 kit, unscrew the two top screws from the enclosure and remove the top panel.

- 3) The TM 990/527 cable has three connectors on it; one for the TM 990/303A edge connector, and two connectors for two disk drives. The end with the two connectors closest together connects to the disk drive(s). Connect the other end to connector P4 on the disk controller board as shown in Figure 2-2. The colored stripe and pin 2 go to the left of connector P4 when properly installed. (The colored stripe runs along the wire to pin 1.) Also, the cable must point downward from the board edge connector when installed.

**CAUTION**

Make sure that the TM 990/527 ribbon cable connector is attached to the edge connector on the TM 990/303A board in slot 1. DO NOT attach it to the TM 990/101MA board in slot 3.

- 4) If being used with a TM 990/602 enclosure, run the cable up and over the card cage and out the large slot at the top of the back panel. Reattach the top panel.
- 5) Connect either one or both of the disk drive cable connectors to the disk drive(s). Consult the manufacturer's installation instructions for proper orientation of pin 1 on the disk drive connector. Pin 1 on the TM 990/527 cable is designated by an arrow engraved into the connector close to the side near the colored stripe. See Figure 2-3 for orientation. If pin 1 at the disk drive is on top of the edge connector, the arrow on the connector must also be on top, oriented with that pin.
- 6) To attach an EIA connector, proceed to section 2.3.4.

#### 2.3.4 Connect System Terminal

A suitable cable must be connected from the system terminal to a 25-pin EIA connector located:

- On TM 990/601: Connector P2 (left side viewed from front) of the TM 990/101MA CPU board (slot 3)
- On TM 990/602: 25-pin EIA outlet on the back of the enclosure. This port is connected to the CPU board via a TM 990/538 cable inside the enclosure.

TM 990 cables available include:

- TM 990/502: For RS-232 devices except as noted below
- TM 990/503A: For Texas Instruments 743 or 745 terminal
- TM 990/504A: For Model 33 ASR teletype
- TM 990/505: For Texas Instruments 733 ASR terminal

Table 2-5 lists the pinouts of connector P2 on the TM 990/101MA board.

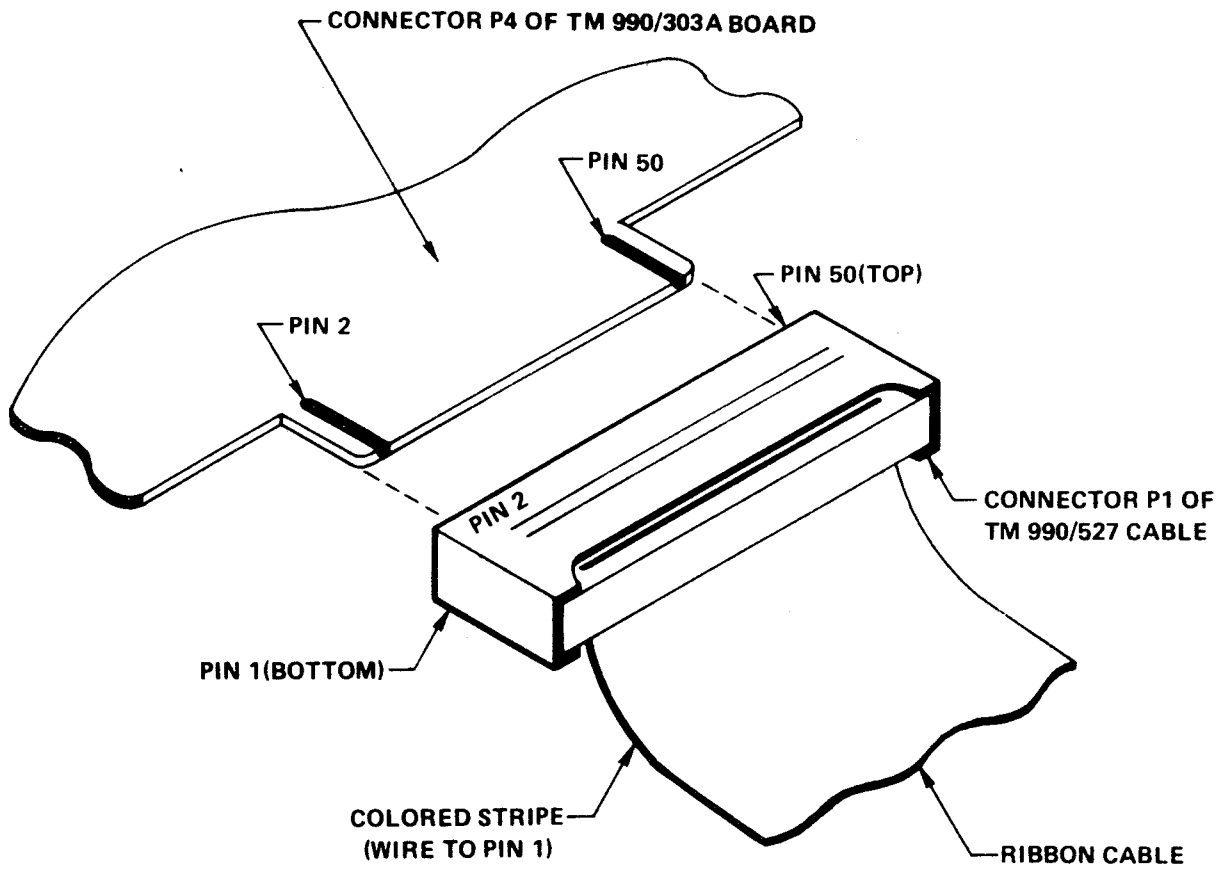


FIGURE 2-2. CONNECTING TM 990/527 DISK DRIVE CABLE TO P4 OF TM 990/303A

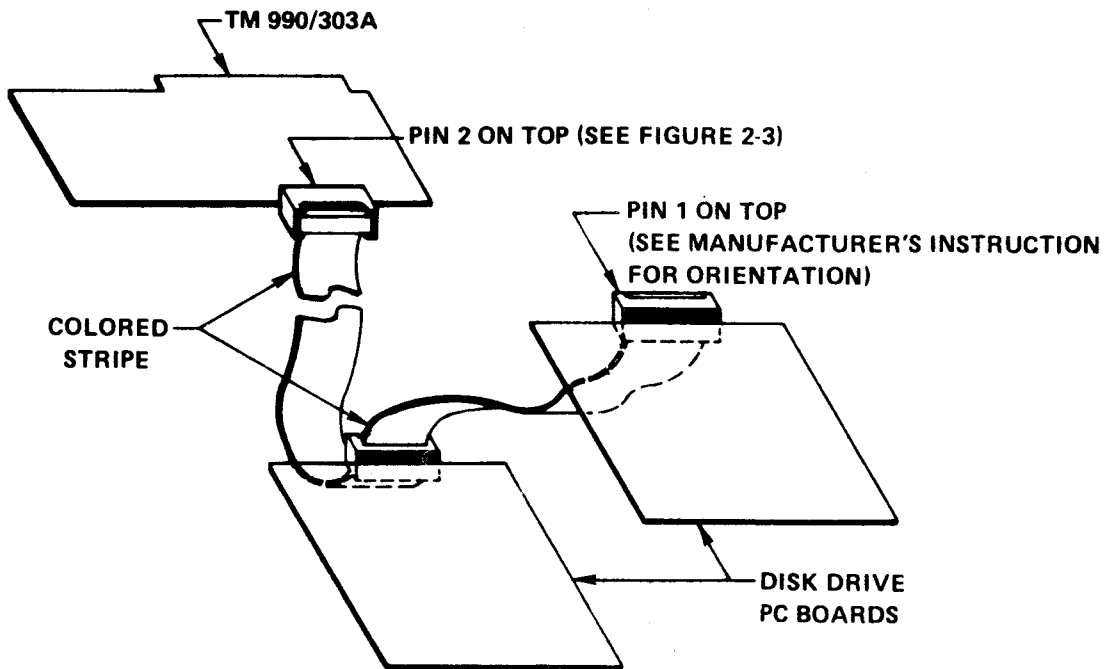


FIGURE 2-3. TM 990/527 CABLING BETWEEN CONTROLLER AND DISK DRIVES



TABLE 2-2. SUGGESTED SHUGART SA 800 DISK DRIVE JUMPER SETTINGS

Jumper Name	Board Position	Termination Board Jumper In or Out	Intermediate Board Jumper In or Out
A	A	In	In
B	A	In	In
C (P18)	B	In	In
D	B	Out	Out
DC	B	In	In
DDS	C	Out	Out
DS	D	In	In
DS1	E	See Note	See Note
DS2	E	See Note	See Note
DS3	E	See Note	See Note
DS4	E	See Note	See Note
HL	D	Out	Out
T1	C	In	Out
T2	C	In	Out
T3	E	In	Out
T4	E	In	Out
T5	E	In	Out
T6	E	In	Out
X	F	Out	Out
Y	G	Out	Out
Z	G	In	In
800	H	In	In
801	H	Out	Out

NOTE

Only one of the DS1 to DS4 jumpers (Drive Select 1 to 4) is jumpered to select a disk drive. Use DS1 for the drive containing the bootload formatted diskette; use DS2 for the second disk drive.



TABLE 2-3. SUGGESTED CDC 9404B DISK DRIVE JUMPER SETTINGS

Jumper Name	Board Position	Termination Board Jumper In or Out	Intermediate Board Jumper In or Out
W1/W5	A	See Note 1	See Note 1
W2/W5	A	See Note 1	See Note 1
W3/W5	A	See Note 1	See Note 1
W4/W5	A	See Note 1	See Note 1
Terminator Pack Beckman R220/330	B	In	Out

## NOTE 1

Drive designators W1 to W4 correspond to drive select numbers 1 to 4. One of these is jumpered to W5 to designate the disk drive number which corresponds to the disk drive select number in the two LSBs of Command Word 2. As shipped from the factory, W1 is jumpered to W5 to designate the drive as drive 1. Jumper as disk drive 1 the disk drive that contains the bootload formatted diskette; jumper as disk drive 2 the second disk drive.

<u>Disk Drive Select Number</u>	<u>Install Jumper</u>
1	W1/W5
2	W2/W5
3	W3/W5
4	W4/W5

To select drive 2, 3, or 4, the user must first remove the soldered jumper installed at the factory between W1 and W5 (to select drive 1). It is recommended that the user substitute a four-switch standard DIP package (AMP 435166-2 or 435626-1, 7000 series) between W5 and W1 to W4. This allows the user to easily designate the drive number by setting one of the four switches to ON.

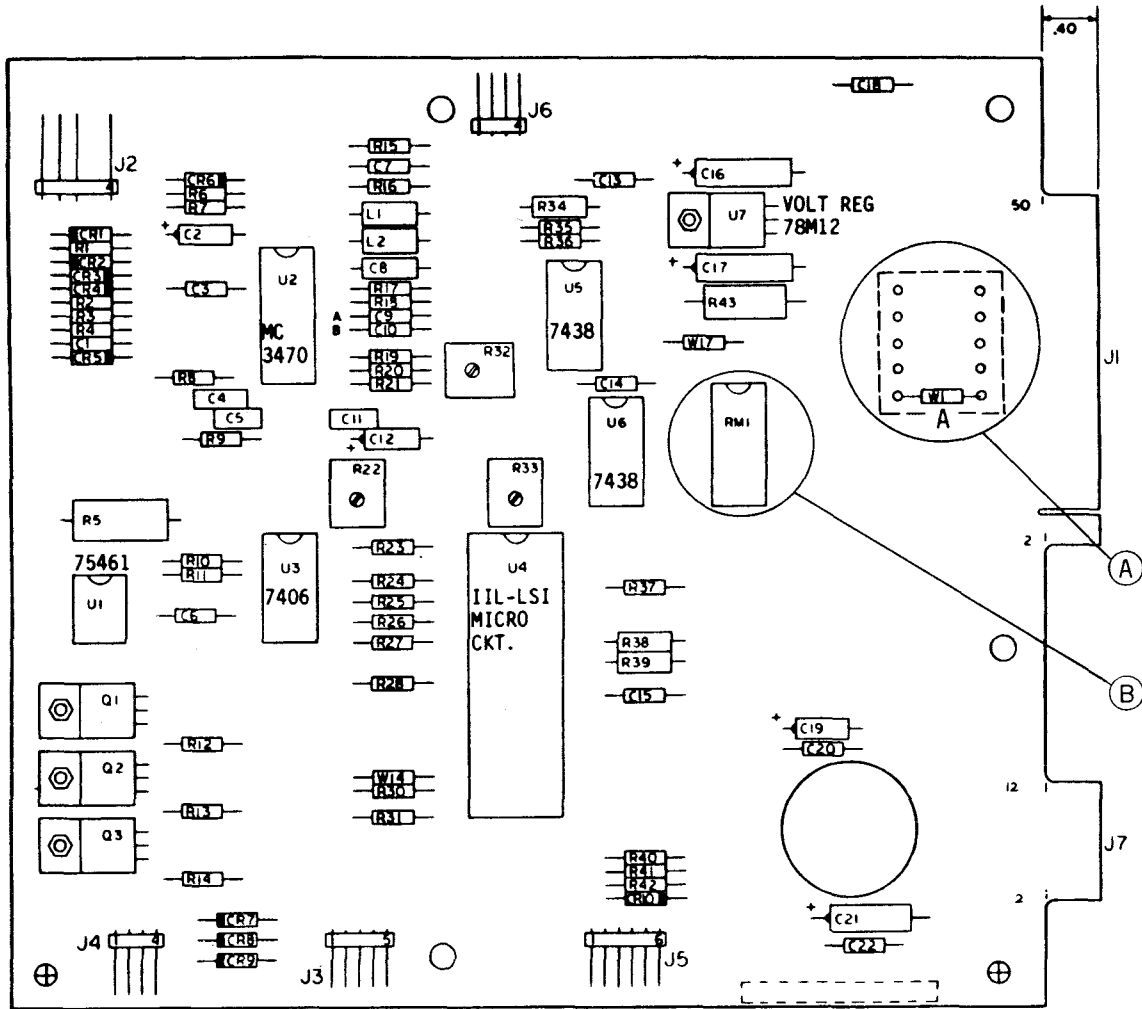


FIGURE 2-5. JUMPER LOCATIONS ON THE CDC 9404B DISK DRIVE

TABLE 2-4. SUGGESTED QUME DT-8 DISK DRIVE JUMPER SETTINGS

Jumper Name	Board Position	Termination Board Jumper In or Out	Intermediate Board Jumper In or Out
A	H	In	In
B	H	In	In
B1	D	Out	Out
B2	D	Out	Out
B3	D	Out	Out
B4	D	Out	Out
C (Pin 18)	B	Cut to Pin 18	Cut to Pin 18
D	B	Out	Out
DC	B	In	In
DDS	F	Out	Out
DL	G	Out	Out
DS	G	Out	Out
DS1	D	See Note	See Note
DS2	D	See Note	See Note
DS3	D	See Note	See Note
DS4	D	See Note	See Note
GND	G	Out	Out
GND	G	Out	Out
HA	G	Out	Out
HL	H	Out	Out
I	H	In	In
R	H	In	In
S1	C	Out	Out
S2	C	In	In
S3	C	Out	Out
X	H	In	In
Y	G	Out	Out
Z	H	In	In
2S	B	In	In
1TM	A	In	Out
2TM	A	In	Out

## NOTE

Only one of the DS1 to DS4 jumpers (Drive Select 1 to 4) is jumpered to designate a disk drive number; this number (DS1 to DS4) corresponds to the disk drive select number. Jumper as DS1 the drive that contains the bootload-formatted diskette; jumper as DS2 the drive that contains the second diskette.

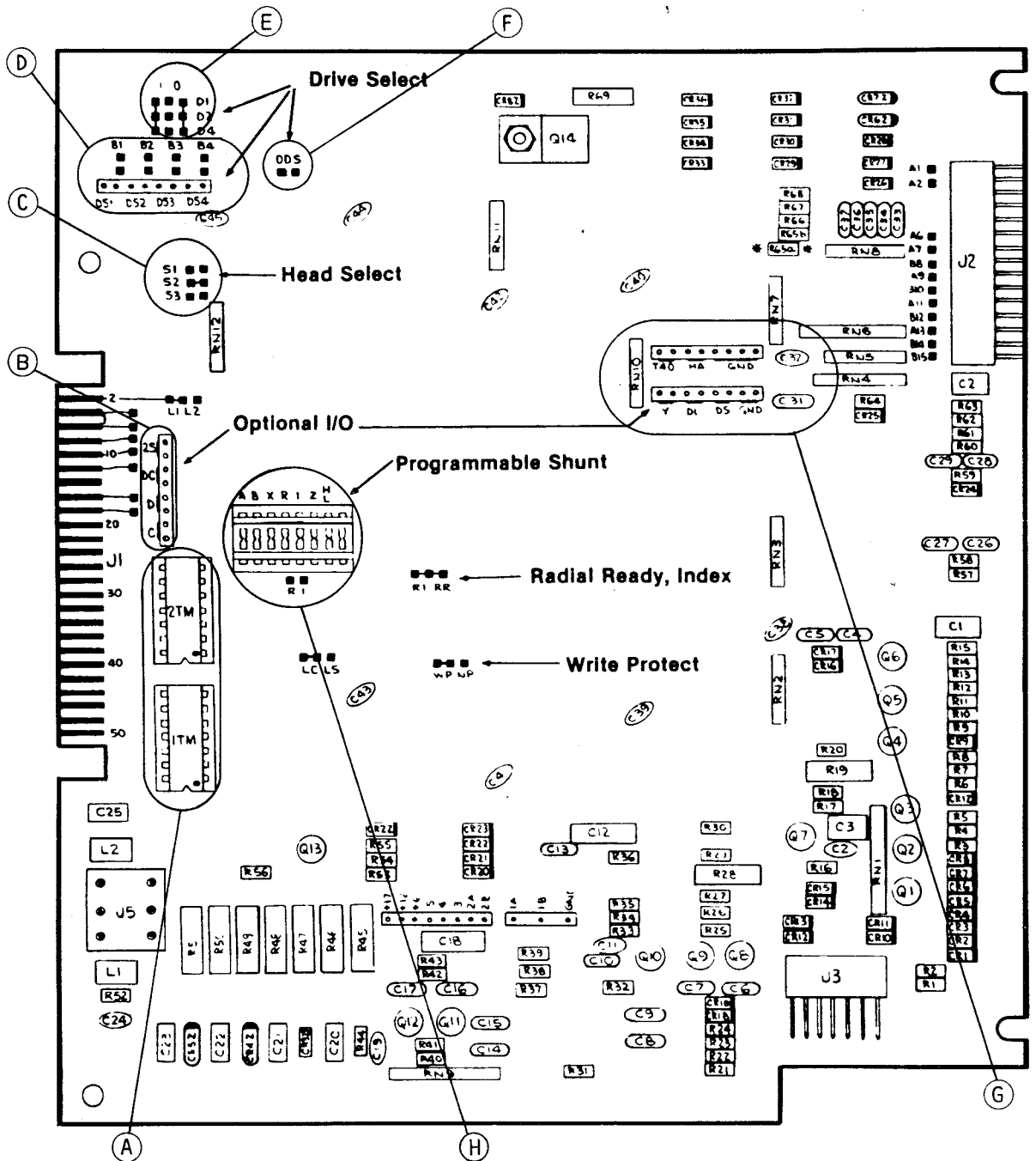


FIGURE 2-6. JUMPER LOCATIONS ON THE QUME DT-8 DISK DRIVE

### 2.3.5 Printer Hookup

A printer can optionally be connected to the system by attaching the printer's EIA cable to the auxiliary 25-pin EIA connector at P3 in the center of the TM 990/101MA board.

For TM 990/602 kits, another TM 990/538 cable (same as attached to P2 and the enclosure back panel) can be attached between connector P3 and one of the

slots in the back of the enclosure. Connect this cable similar to the the connection of the TM 990/538 cable installed for the system terminal (section 2.3.4).

Consult the respective installation guide for the printer used. Table 2-6 lists the pinouts of connector P3.

TABLE 2-5. CPU-BOARD CONNECTOR P2 PIN ASSIGNMENTS

P2 Pin	Pin Assignment
1	Ground
2	Data Received at CPU
3	Data Transmitted from CPU
5	Clear to Send
6	Data Set Ready
7	Ground
8	Data Carrier Detect
12	+12 V (if jumpered E22-E23 on CPU)
13	-12 V (if jumpered E25-E24 on CPU)
14	+5 V (if jumpered E21-E20 on CPU)
16	Restart-
18	Inpull
20	Data Terminal Ready
23	Inpush
24	Outpush
25	Outpull

TABLE 2-6. CPU-BOARD CONNECTOR P3 PIN ASSIGNMENTS

P3 Pin	Pin Assignment
1	Ground
2	Data Received at CPU
3	Data Transmitted from CPU
5	Clear to Send
6	Data Set Ready
7	Ground
8	Data Carrier Detect
15	Synchronous Transmit Clock
16	Modem Clear to Send
17	Synchronous Receive Clock
19	Modem Data Set Ready
20	Terminal Data Terminal Ready
20	Modem Data Carrier Detect
21	Modem Data Terminal Ready
22	Ring Indicator

## APPENDIX A

### BOARD AS-SHIPPED CONFIGURATIONS

#### A.1 GENERAL

This appendix lists the as-shipped jumper and switch configurations of the three boards in these kits:

- TM 990/303A Disk Controller Board                      Slot 1
- TM 990/203-23 Dynamic RAM Board                      Slot 2
- TM 990/101MA-3 CPU Board                              Slot 3

This data will allow the user to check the board configuration to see that it is set up for system use. Further information on jumpers and switches for the boards is available in the manuals supplied for each board.

#### A.2 TM 990/303A DISK CONTROLLER

The disk controller in either kit will be configured such that it will operate with single-sided single-density disk drives, and that it will bootload off a diskette when the disk drive is jumpered as DS1.

Table A-1 is a list of jumper pins on the TM 990/303A and their setting as shipped with the TM 990/601 and TM 990/602 kits. Figure A-1 shows the locations of these jumpers.

TABLE A-1. TM 990/303A DISK CONTROLLER JUMPER SETTINGS

Jumper	Function	Stake Pins	Kit Stake Pin Position	Location in Figure A-1
J1	Boot Load	E1,E2,E3	E1-E2	A
J2	Boot Load	E4,E5,E6	E4-E5	B
J3	Interrupt Level	E7 thru E11 E53 thru E61	Not installed	C
J8	Disk Format on Boot	E23,E24	E23-E24	D
J9	Disk Size on Boot	E21,E22	E21-E22	D
J10	Disk Size	E18,E19,E20	E18-E19	E
J11	Disk Size	E15,E16,E17	E16-E17	F



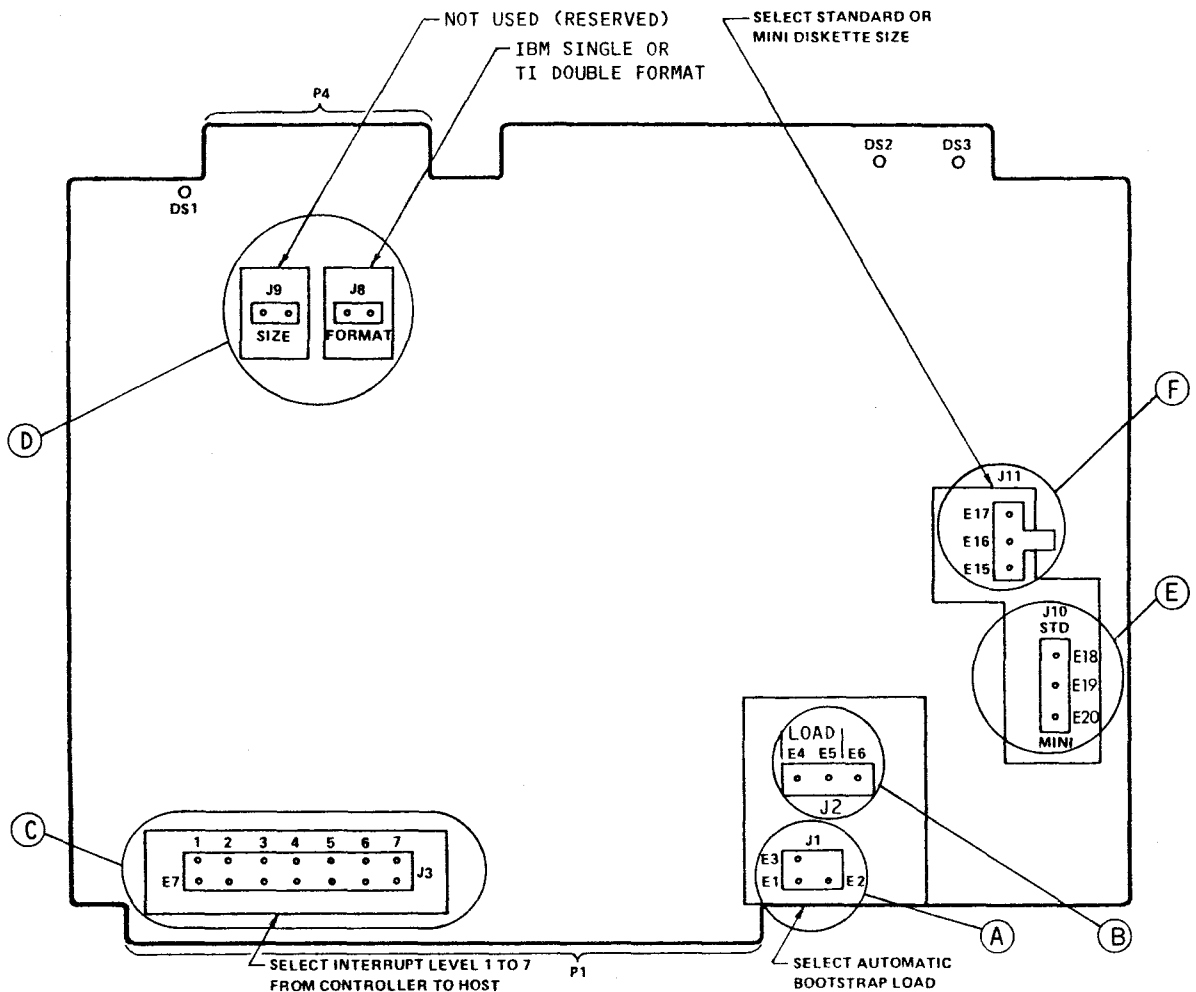


FIGURE A-1. JUMPER LOCATIONS ON TM 990/303A BOARD

A.3 TM 990/101MA-3 MICROCOMPUTER BOARD

The TM 990/100MA-3 microcomputer board is configured so that the system terminal is assigned connector P2 (left side of board facing) and the printer peripheral is connected to connector P3 (center of board). The interval timer will run off the TM 9902 asynchronous controller assigned to connector P3, and the interval timer and system terminal will operate in the interrupt mode.

This board comes populated with eight TMS 4045 static RAMs which are located in the system memory from F000<sub>16</sub> to FFFF<sub>16</sub>.

NOTE

The microcomputer board contains four unpopulated sockets for TMS 2708 or TMS 2716 EPROMS; these are not used in either the TM 990/601 or TM 990/602 kits.

Table A-2 is a list of jumper pins on the TM 990/101MA and their setting as shipped with the TM 990/601 and TM 990/602 kits. Figure A-2 shows the locations of these jumpers.

TABLE A-2. TM 990/101MA MICROCOMPUTER JUMPER SETTINGS

Function	Stake Pins	Kit Stake Pin Position	Location in Figure A-2
Interrupt 4 Source	E1,E2,E3	E2-E3	A
Interrupt 5 Source	E4,E5,E6	E4-E5	A
Slow EPROM	E7,E8,E53	E8-E53	B
TMS 2708/2716 EPROM	E9,E10,E11	E9-E10	C
EPROM Enable	E12,E13,E14	E12-E13	C
Hi/Low Memory Map	E15,E16,E17	E16-E17	C
EIA Connector Ground	E18,E19	E18-E19 installed	D
Microterminal +5 V	E20,E21	E20-E21 installed	E
Microterminal +12 V	E22,E23	E22-E23 installed	F
Microterminal -12 V	E24,E25	E24-E25 installed	F
Main EPROM Type	E26 thru E30	E26-E27, E28-E29	G
Expansion EPROM type	E31 thru E35	E31-E32,E33-E34	H
Teletype	E36,E37	Removed	I
EIA/MD receive select	E38,E39,E40	E39-E40	I
Multidrop Termination	E41 thru E52	No stake pins	J
P3 Port Terminal/Modem	E54,E55,E56	E54-E55	K

## NOTE

DIP switch S2 is not used in the P-System.

## A.4 TM 990/203-23 DYNAMIC RAM BOARD

The TM 990/203-23 in either the TM 990/601 or TM 990/602 kit is configured so that it contains memory enabled from address  $0000_{16}$  to  $FFFF_{16}$  and operates in the cycle steal mode. Its parity interrupt is at level one.

DIP switches S1, S2, S3, and S4 are used to select the correct memory address area for the onboard RAM ( $0000_{16}$  to  $FFFF_{16}$ ). To select the low address bound of  $0000_{16}$ , set the four switches at S1 to all ON and set the four switches at S2 to all ON. To select the high address bound, set all eight switches at S3 and S4 to the OFF position with the exception of switch 4 of S4 which should be in the ON position. Figure A-3 shows these switch settings.

Table A-3 lists the TM 990/203-23 jumper pin settings as shipped in the TM 990/601/602 kits. Figure A-4 shows the locations of these jumpers.

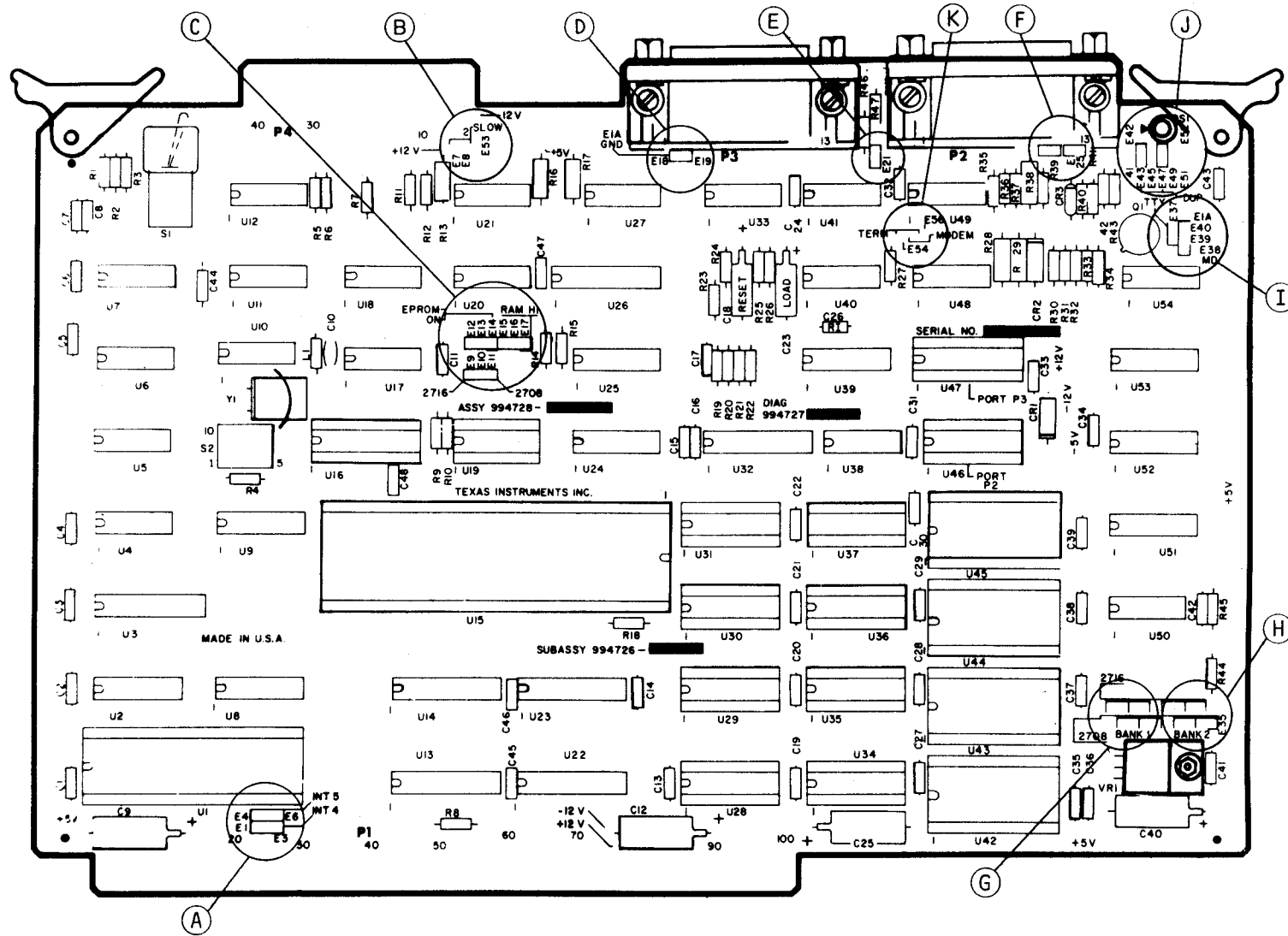


FIGURE A-2. JUMPER LOCATIONS ON TM 990/101MA-3 MICROCOMPUTER BOARD

TABLE A-3. TM 990/203 DYNAMIC RAM BOARD JUMPER SETTINGS

Function	Stake Pins	Kit Stake Pin Position	Location in Figure A-3
Reset Parity Interrupt	E4,E5,E6	E4-E5	A
Enable Parity Interrupt to Backplane	E7,E8,E9	E8-E9	A
Select RAM Size	E10,E11,E13,E14	E13-E14	B
Select RAM Size	E15,E16,E17,E18	E16-E18	C
Select RAM Size	E19,E20,E21,E22	E20-E22	C
Memory Wait States	E23,E24,E25,E26	E23-E24	D
Memory Wait States	E27,E28,E29,E30	E27-E28	E
Number of Refresh Cycles	E31,E32,E34,E35 E59,E60,E61	E31-E34	F
Transport/Cycle Steal Select	E44,E45,E65	E45-E65	G
Size of Memory Device	E46,E47,E48	E47-E48	H
Early/Late MEMCYC-	E73,E74,E75	E73-E74	I
Select Application	E78-E79	Not Installed	J
TMS 4116 Device Used	E82,E83,E87,E88	E82-E83	K
Select Memory Speed	E84,E85	E84-E85	L
Select 16/20 Bit Addr	E89,E90,E91	E90-E91	M
Select 16/20 Bit Addr	E92,E93,E94	E93-E94	M

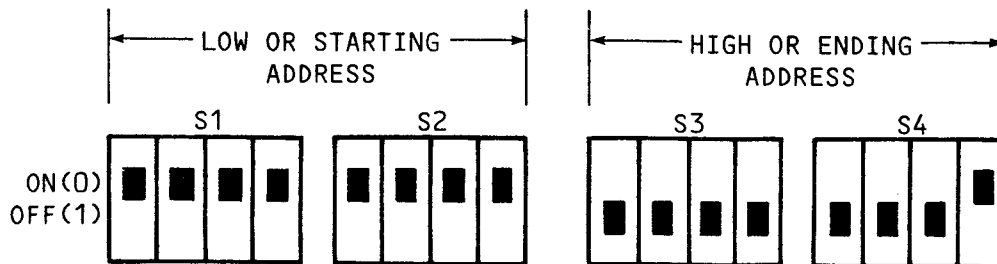


FIGURE A-3. SWITCH S1, S2, S3, AND S4 SETTINGS ON MEMORY BOARD

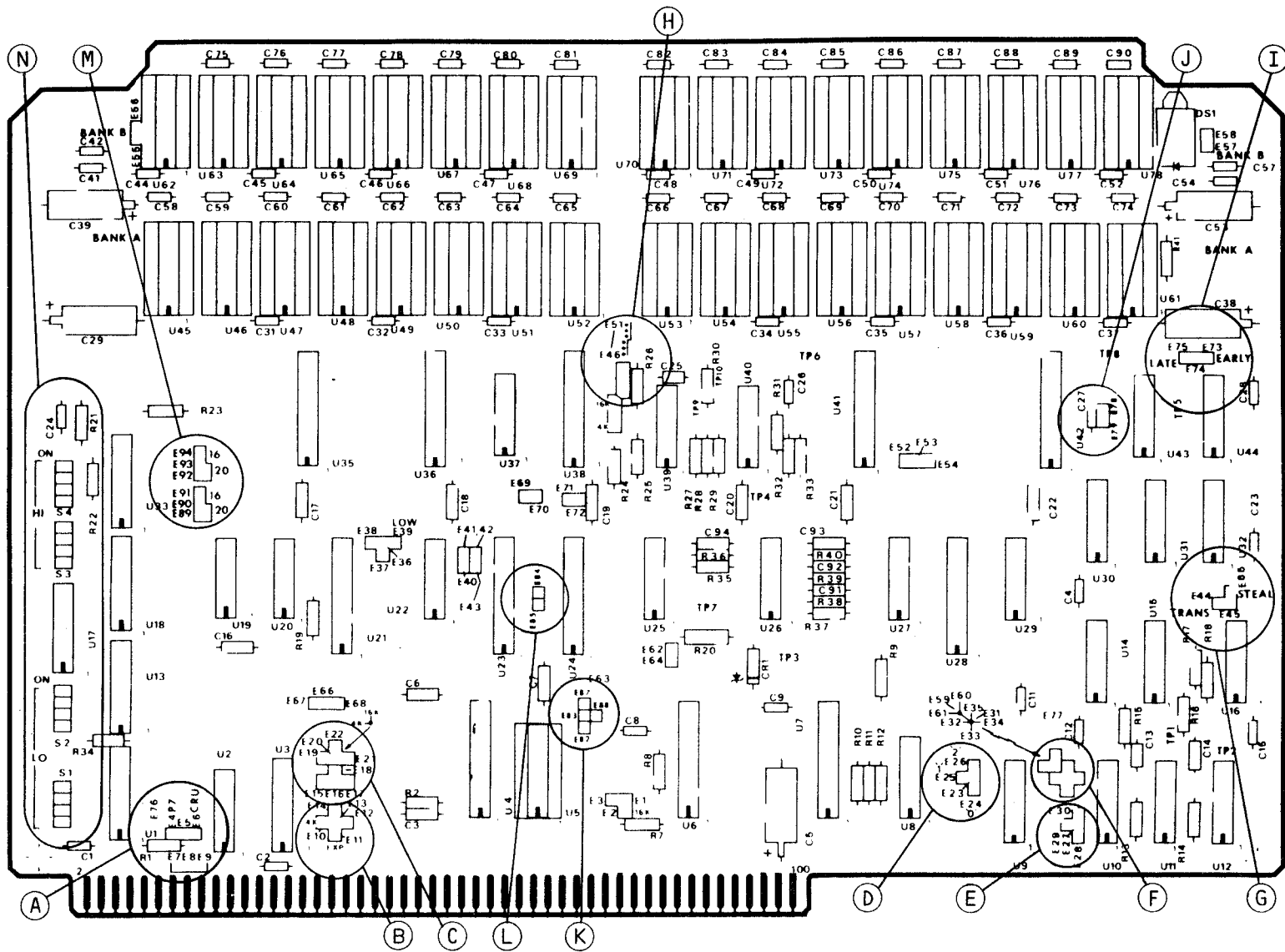


FIGURE A-4. JUMPER LOCATIONS ON TM 990/203-23 MEMORY BOARD

APPENDIX B

CHASSIS AS-SHIPED CONFIGURATION

One special consideration is given to the chassis in configuring it for the TM 990/601 or TM 990/602 kits. The slot containing the TM 990/303A disk controller board (slot 1 as shipped) is set up at the factory as discussed below; slots containing the other boards are not affected.

For kits with the TM 990/510 chassis, a cut in etch is made on the backplane for the disk controller board slot. The etch is cut at the factory on the backplane between lines 95 and 96 as shown in Figure B-1.

On the TM 990/510A chassis, this modification is made by simply removing a stake-pin jumper at the slot. Jumpers marked J5, J6, J7, and J8 correspond to jumpers to set up slots 1 to 4 respectively. These jumpers are located inside the chassis on the backplane adjacent to their respective slot.

The cutting of the trace or removal of the stake pin jumper allows the DMA logic to work correctly by letting the GRANTIN-GRANTOUT lines control DMA priority.

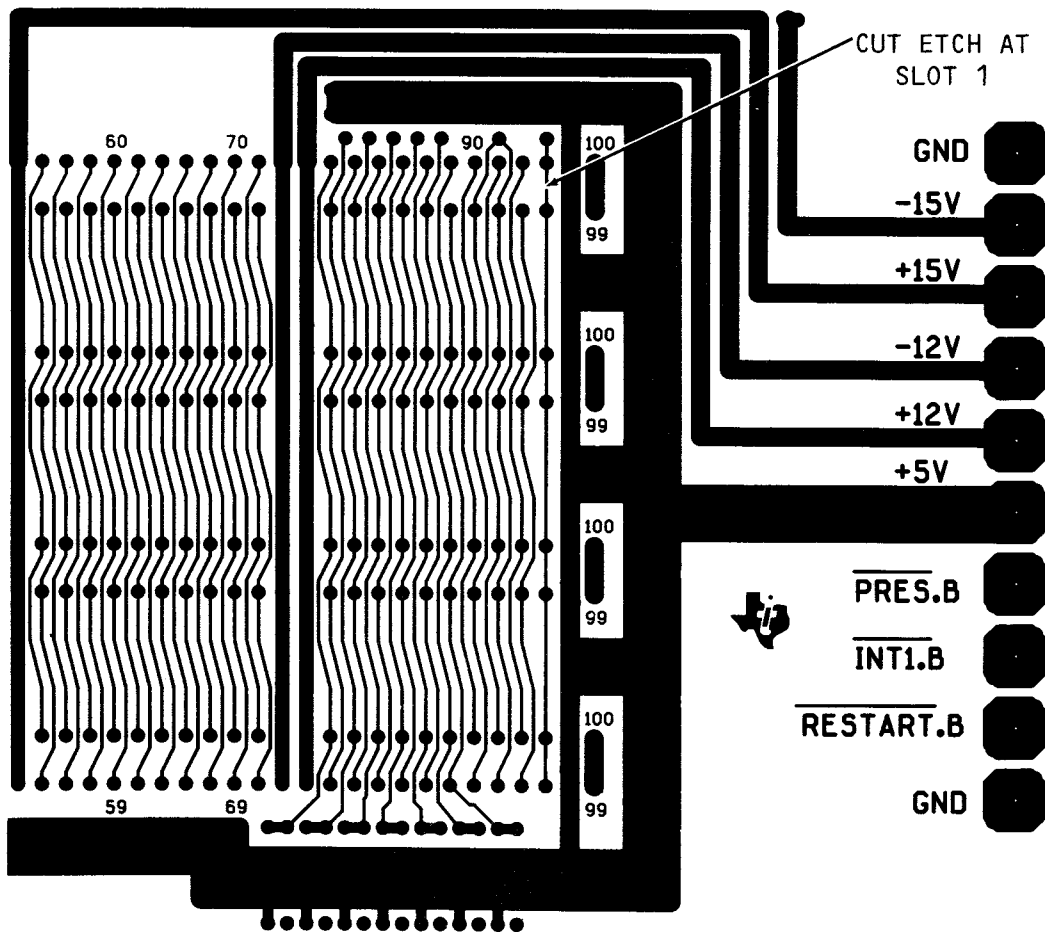


FIGURE B-1. LOCATION OF ETCH TO CUT ON TM 990/510 CHASSIS BACKPLANE

## APPENDIX C

### SYSTEM TROUBLE SHOOTING

This appendix provides the user with some trouble shooting aids in the event the system does not come up correctly. This list is not inclusive but does contain some of the common problems found in working with microcomputer systems.

#### C.1 DISK PROBLEMS

Problem: Disk drives do not spin.

Possible causes:

- 1) The power cord is not plugged into the 110 volt ac outlet.
- 2) One or several of the fuses for the voltages are blown.
- 3) The drives are not hooked up to the power supply.
- 4) The power supply is faulty or inadequate in rating.
- 5) The motor of the disk drive is bad.

Hints:

Assuming the power cord is plugged in and all the fuses are good, the user should be able to measure the voltages at the drive by disconnecting the connector from the drive and measuring at the line side. If these voltages are correct, the drive is probably bad. If the voltages are not correct the power supply is faulty.

If two drives are in the system and only one works, the user should try swapping power connectors to verify the inoperable drive is getting the proper voltages. This may isolate a bad drive or faulty connectors. If the voltages are good in this case, the power supply appears to be good.

## C.2 SYSTEM DOES NOT BOOT

**Problem:** System does not boot when power is turned on.

**Symptoms:** Nothing happens, the disk does not attempt to read.

**Possible causes:**

- 1) The power cord for the floppy disk drives or chassis is not plugged into the 110 volt ac outlet.
- 2) The power supply for the floppy disk drives or chassis is faulty or inadequate in rating.
- 3) There is no floppy disk in floppy disk drive #1.
- 4) The floppy disk in disk drive #1 does not have a boot load program on it.
- 5) The TM 990/527 ribbon cable is not connected between the floppy disk drives and the TM 990/303A floppy disk controller.
- 6) The TM 990/527 ribbon cable is connected between the disk drives and the floppy disk controller but pin 2 of the cable at the drive is not connected to pin 2 at the disk controller. This means the cable is twisted 180 degrees.
- 7) The TM 990/527 ribbon cable is connected to the disk drive correctly but inadvertently connected to the TM 990/101 CPU board in slot 3. The floppy disk controller is in slot 1 of the chassis. If this has happened, the disk drives may have been damaged electrically.
- 8) The boot load jumpers are not set correctly on the TM 990/303A floppy disk controller board. This should not be a problem if this board is in the purchased TM 990/601 kit state.
- 9) The TM 990/303A board or the TM 990/101 board are not seated in card slot 1 and 3 respectively.



### C.3 PARTIAL SYSTEM BOOTS

**Problem:** System partially boots when power to the chassis is turned on.

**Symptoms:** The head on disk drive 1 drops several times and stays up. This may take 10-15 seconds.

**Possible causes:**

- 1) The terminal may not be connected to the CPU card in slot 3 (TM 990/601 kit) or to the EIA connector on the back of the TM 990/522 enclosure (TM 990/602 kit).
- 2) The terminal is connected but the power to it is not turned on.
- 3) The terminal is connected to the wrong EIA connector (P3) on the CPU card in slot 3 (TM 990/601 kit).

**Problem:** System partially boots when power to the chassis is turned on.

**Symptoms:** The head on disk drive 1 drops momentarily and comes back up but nothing happens.

**Possible causes:**

- 1) The diskette in drive 1 does not have a boot load program on it.
- 2) Jumper J8 on the TM 990/303A floppy disk controller is not shorted. This should not be a problem if this board is in the purchased TM 990/601 or TM 990/602 kit state.
- 3) The diskette in drive 1 is in upside down.
- 4) There is a read error when attempting to read the bootload disk.
- 5) There is no memory configured in the lower part of the memory space.
- 6) There is memory configured in the lower part of the memory space but it is overlapped by other memory.

**Problem:** System partially boots.

**Symptom:** The head on disk drive 1 constantly moves back and forth and even after a minute does not stop.

**Possible causes:**

- 1) Memory is not configured correctly or contains parity errors. Re-check memory configuration.
- 2) The boot load jumpers on the TM 990/303A floppy disk controller board not configured correctly.

- 3) Something is repeatedly actuating the PRES.B line on the chassis backplane. A faulty switch or incorrect wiring to this terminal should be suspect.
- 4) An unformatted disk or a disk with another format is in disk drive 1.
- 5) Any unrecoverable error that occurs on the floppy disk controller.

#### C.4 TERMINALS

**Problem:** System boots in approximately 35 seconds but the screen looks funny.

**Symptoms:** Funny looking characters are on the screen or characters are all over the screen.

**Possible causes:**

- 1) Your CRT is not the terminal recommended for your operating system. Refer to the software installation guide for getting your CRT configured into the system. You are not far from being in a running state.
- 2) If no characters are recognizable your CRT may be configured incorrectly e.g. wrong baud rate, wrong parity, etc. These settings for the more popular CRTs can be found in the software configuration guide.

**Problem:** System boots in approximately 35 seconds but the screen is still dark.

**Symptoms:** No characters are on the screen but several bells or beeps came from the terminal during the booting process.

**Possible causes:**

- 1) The brightness may be turned down on the CRT.
- 2) The display tube in the CRT may be bad.

**Problem:** System boots in approximately 35 seconds, but no key strokes are being accepted by the system.

**Symptoms:** Things look good but the system appears dead.

**Possible causes:**

- 1) Interrupts are not enabled on the CPU card in slot 3. Refer to the jumper setup table for the CPU board in Appendix A.
- 2) The wrong cable is being used between the terminal and the CPU board. This means some of the lines in the EIA cable are not pin matched for your terminal.
- 3) The terminal is broken. Verify its operation on another system.

## C.5 PRINTERS

Problem: When data is sent to the printer nothing happens.

Possible causes:

- 1) The printer is not plugged into the 110 volt ac outlet.
- 2) The printer is not turned on.
- 3) The printer is off line.
- 4) The EIA cable from the printer is not connected to the P2 connector the CPU card in slot 3 (TM 990/601 kit) or an EIA connector on the back of the TM 990/522 enclosure (TM 990/602 kit). An additional TM 990/538 cable will be needed between the P2 connector on the CPU card and the back of the TM 990/522 enclosure (TM 990/602 kit).
- 5) The ends of the EIA cable are reversed which cause signal lines to appear in the wrong place.
- 6) The correct printer is not being used. Refer to the system installation manual for the correct printer for your specific system.

Problem: Data is being printed at the printer but it is garbled or wrong.

Possible causes:

- 1) The printer is not configured correctly, e.g. wrong parity, wrong baud rate, etc. This information can be found in the software installation guide.

## C.6 MISCELLANEOUS SYSTEM PROBLEMS

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**Problem:** The system keeps trapping parity errors and prints a message on terminal screen.

**Possible causes:**

- 1) The system is getting hot which is caused by inadequate cooling. This should not occur in the TM 990/602. The boards in the TM 990/601 will run cooler if the chassis is set on its backplane so that heat can rise between the boards. Be sure the chassis is not sitting on a metal table so the power lines will not short out.
- 2) There is a bad memory device on the TM 990/203 memory board. Replace the bad memory device,

**Problem:** The system gets intermittent errors when doing disk I/O.

**Possible causes:**

- 1) The TM 990/303A floppy disk controller is not in a slot in the chassis which has had the etch between lines 95 and 96 on the backplane cut. This is shown in appendix B. If the TM 990/601 or TM 990/602 kit is being used, the floppy disk controller should in slot 1 of the chassis.
- 2) The memory is not configured correctly. Overlapping memory addresses between two different modules in the chassis will cause bus contention problems. Refer to Appendix A for module configuration.

**Problem:** The system boots but crashes after a few commands are entered.

**Possible causes:**

- 1) The memory is marginally adequate in size. Increase available memory.
- 2) A memory failure has occurred. Run memory diagnostics.

**Problem:** The system take a very long time to boot in ( 1-2 minutes).

**Symptoms:** The system appears to be booting but very slowly. The head on the system disk occasionally moves and the terminal occasionally beeps. The messages that come to the screen are correct. This problem can be verified by trying to access the second disk via a disk map command.

**Possible causes;**

- 1) Your disk drives have been modified beyond that of just configuring the stake pin jumpers. A solder trace line may have been severed or two lines shorted on purpose. This could easily happen if the disk drives have been used in a different system previously. An example of this would be a cut trace between the two RR pads on the jumper side of the disk drive printed circuit board. In general, reinspect this board on all drives used for modifications.

Problem: The system fails to execute some programs correctly.

Symptoms: The system boots correctly, runs the assembler, editor, or compiler compiler correctly but fails to execute a user program correctly.

Possible causes:

- 1) Your program has logic errors. Go back through your program and verify its logic.
- 2) You have a bad memory device on either the CPU or the memory board. To isolate this problem,
  - Exchange the memory with a spare memory board. Execute the program that failed. If the program runs, your memory board is bad and should be sent back for Factory Repair. If the program still does not run, restore the original memory board and
  - Exchange the CPU board with a spare CPU board. Execute the program that failed. If the program runs, your CPU board is bad and should be sent back for Factory Repair.