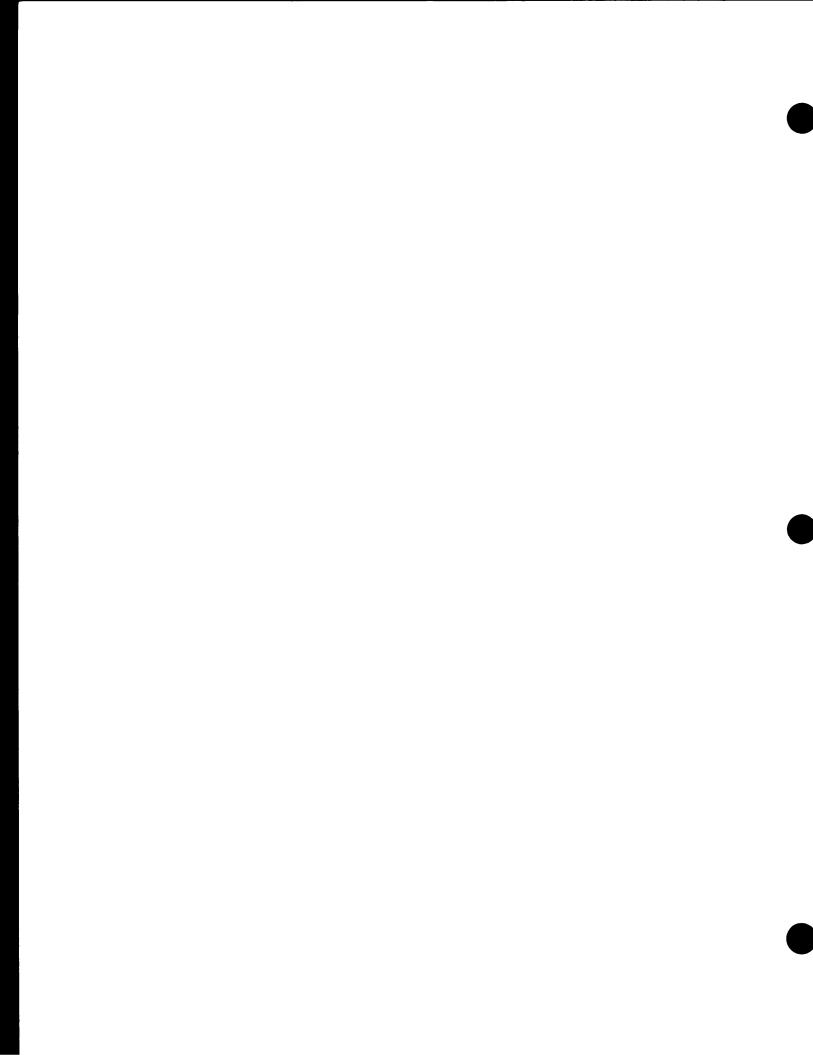


**CUSTOMER ENGINEERING TRAINING CENTER** 

# PROFESSIONAL COMPUTER VIDEO WORKBOOK

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#### **PREFACE**

This Workbook is published as part of a video training program on the Professional Computer System. The Workbook contains support information for the videotape as well as reference material.

This document is intended to be used for TRAINING PURPOSES only. It is not intended to supplement or replace the use of Wang documentation normally used during the servicing of this product.

The material contained in this document, while accurate during the development of this training course, is more generic in nature and may not reflect the latest hardware and software enhancements incorporated into the system you will be servicing.

If any questions arise pertaining to the contents of this workbook and video program, please direct them to:

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EFFECTIVE DATE - June 1983

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#### PROFESSIONAL COMPUTER COURSE INFORMATION

#### SCOPE

This course is designed to provide training pertaining to the Installation, Operation, Troubleshooting, and Repair of the Wang Professional Computer System. The Videotape shows these operations being performed, while the Workbook contains quizzes and Lab. Exercises to reinforce the material presented on the Videotape. To gain the maximum benefit from this course the student must complete the Workbook quizzes and Lab. Exercises after viewing each Section of the Videotape.

#### PREREQUISITES

1. The Trainee must have a knowledge of Basic Electronics and Digital Logic obtained either through a credited Technical School, or through the equivalent work experience.

#### CURRICULUM LEVEL

This module is written to the Wang Customer Engineering, Associate Field Engineering Technician (AFET) level.

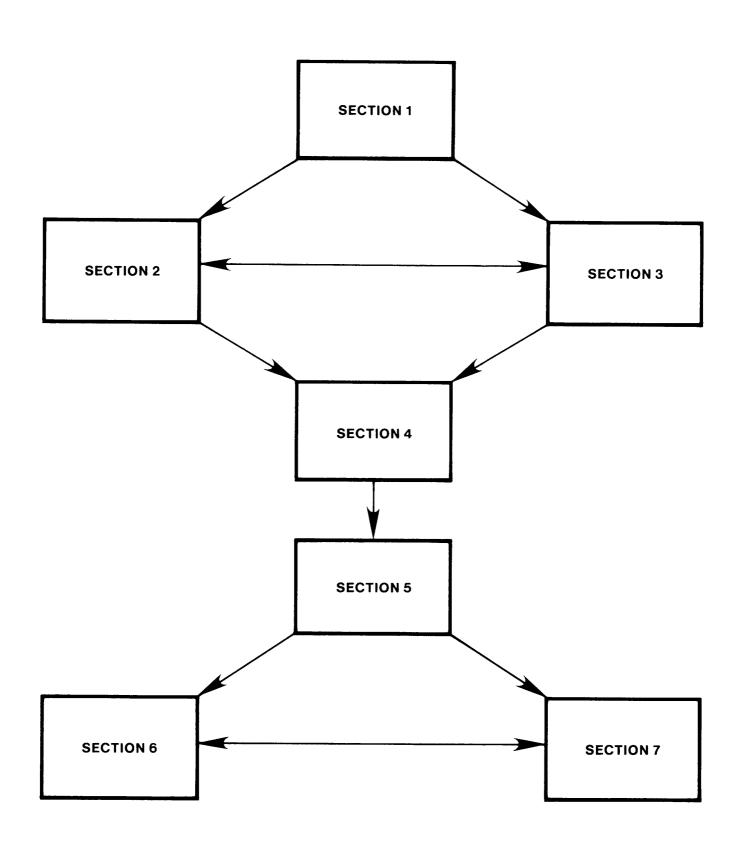
#### APPROXIMATE COMPLETION TIME

Video Tape (run time) - 2 hours 15 mins.

Course Completion Time - 12 hours

#### COURSE STRUCTURE

This course is made up of a VIDEOTAPE and INTERACTIVE WORKBOOK. The WORKBOOK contains two parts. Part I includes the interactive instructions, quizzes, and Lab. Exercises for seven sections of instruction. A Professional Computer System must be available for the students to perform the Lab. Exercises. Part II includes most of the material presented in the video as well as more detailed text, parts lists, diagrams, and tables. Part II of the Workbook is to be used as a reference while reviewing the course material and while working on the Quizzes and Lab. Exercises.



COURSE MAP

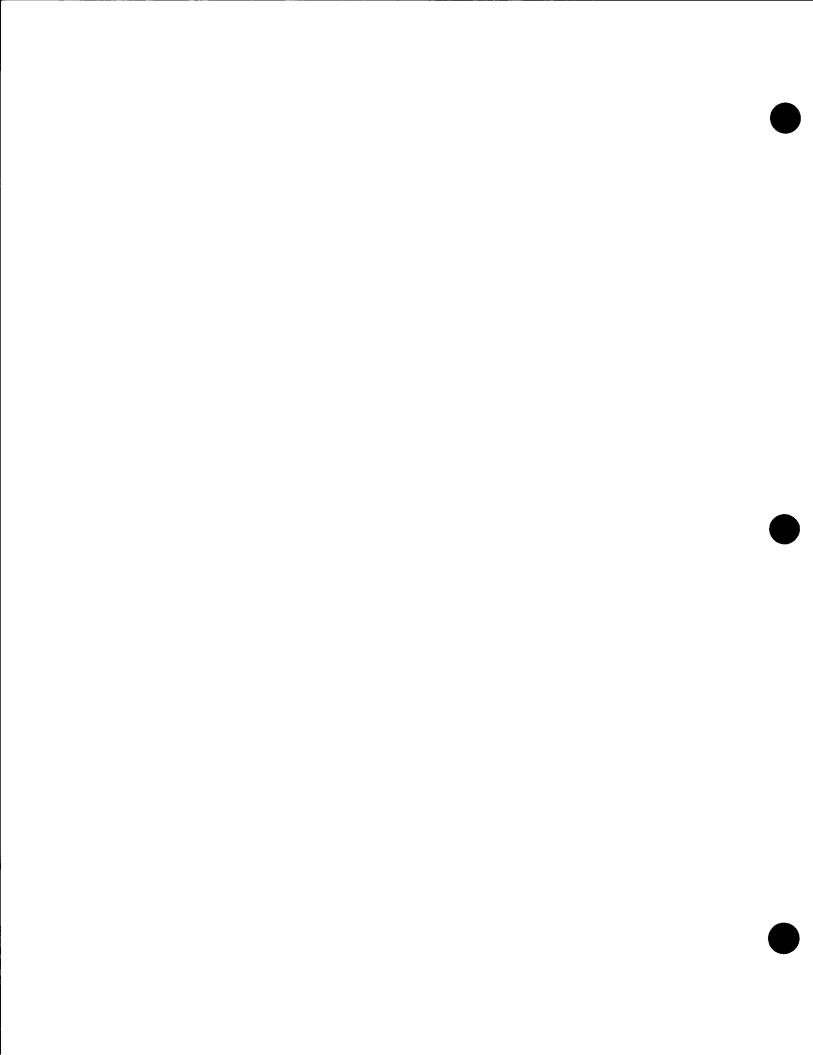
#### COURSE OBJECTIVES

Upon completion of this video training program YOU will be able to:

- 1. Describe how the PC System is physically constructed, list the Options that are offered, and explain how they interface with the system.
- 2. Install the Professional Computer System, including the Options, and verify that the system is operational.
- 3. Operate the PC System to a level adequate for verification that the system is operational and will run all the Customer's software furnished by Wang.
- 4. Remove and replace any Field Replaceable Unit (FRU) in the PC System.
- 5. Be able to perform all the necessary alignments and adjustments on the PC System in a professional manner.
- 6. Be able to troubleshoot and repair the PC System to the FRU level, using and interpreting the system diagnostics and standard troubleshooting techniques.
- 7. Explain the theory of operation of the PC System to the block level.

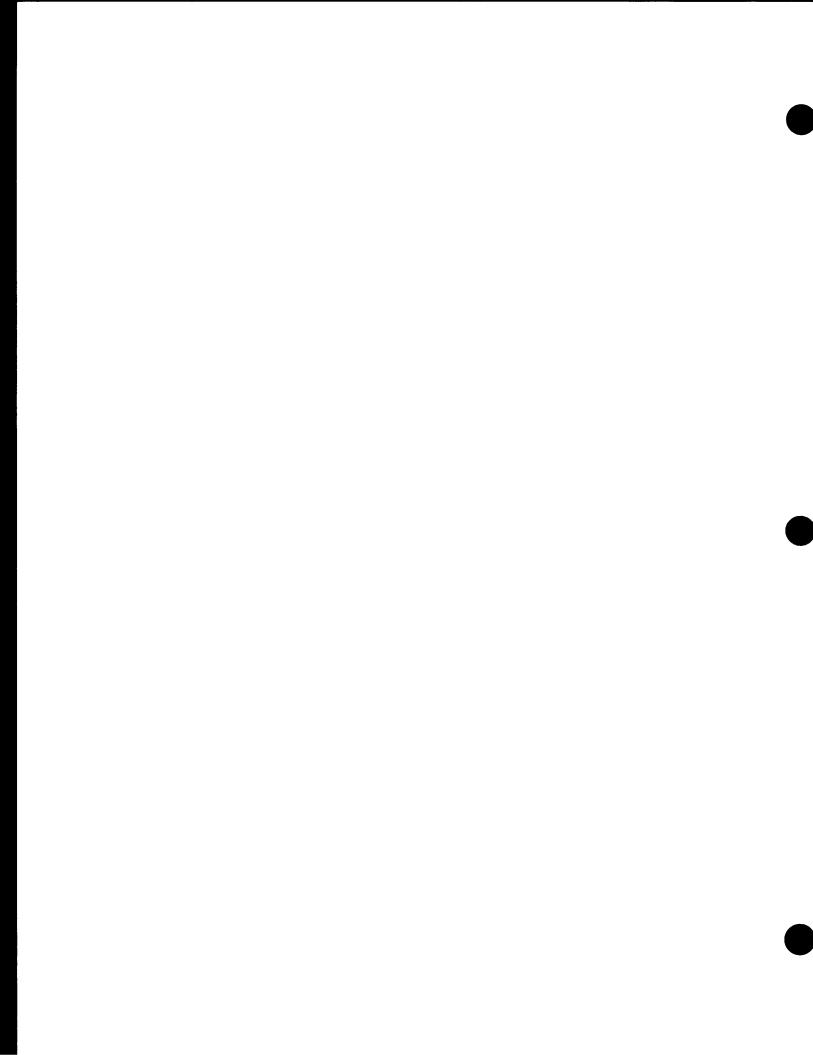
### **PARTI**

# PROFESSIONAL COMPUTER VIDEO WORKBOOK VIDEO SUPPORT MATERIAL



# PART I SECTION 1

# INTRODUCTION TO THE WANG PROFESSIONAL COMPUTER



#### SECTION 1

#### INTRODUCTION TO THE WANG PROFESSIONAL COMPUTER

#### **OBJECTIVES**

Upon completion of this section you will be able to:

- 1. Describe how the Professional Computer System is physically constructed.
- 2. List the various Options available for the PC System.
- 3. Explain how the Options interface with the system.

#### INTERACTIVE INSTRUCTIONS

First read the GLOSSARY OF TERMS for this section then view SECTION 1 of the WANG Professional Computer VIDEO TAPE. After viewing the Video Tape answer the questions in the INTERACTIVE QUIZ for this section. Take your time and if you can't remember the answer to any of the questions refer to PART II, SECTION 1 of this WORKBOOK. All the material contained in the Video Tape is in PART II of this WORKBOOK.

Once you have completed the INTERACTIVE QUIZ check your answers against the correct answers in Appendix B. Remember, these quizzes are designed to help you learn the material presented in the Video. So if you did miss any of the questions, going over them again helps you remember those points later.

This completes SECTION 1 of the Professional Computer Video Training Course. Proceed to Section 2 of this workbook.

#### SECTION 1

#### GLOSSARY OF TERMS

BUS One or more conductors used as a path for

transmitting information from any of several

sources to any of several destinations.

BYTE 8 bits of data operated on as a unit.

CP/M-80 An 8 bit Control Program for Microprocessors

marketed by Digital Research Inc. This is the control program that runs on the TRS-80 and many other Personal Computers controlling a large

variety of popular 8-bit applications programs.

CPU Central processing unit - The heart of all

computers.

CRT Cathode ray tube. Used for the WORKSTATION

display tube in WANG equipment.

DAISY PRINTER A letter quality printer with the characters

arranged in a circle on the ends of spokes, or

'petals' that extend from a central hub.

DMA Direct memory access.

EU Wang Professional Computer Electronics Unit.

E-PROM Erasable-Programmable Read Only Memory chip.

These chips can be used over, and over again as

compared to the older ROM chips that could only be

used once.

K Kilobyte

#### GLOSSARY - (CONTINUED)

Kilobyte

One thousand bytes, also abbreviated as K and KB.

LED

Light emitting diode.

Megabyte

One million bytes, also abbreviated as Meg and MB.

Microprocessor

An 8, or 16-bit CPU, housed in a single chip. The Z80, 8080, and 8086 are common examples that require external memory and are packaged in a 40-pin chip. Other examples are the 8049 and 8031 which contain a small internal memory and are used for special applications, such as keyboards and printers.

Modem

Also called Data Set. A device that performs the modulation/demodulation and control functions necessary to provide compatibility between Computer Systems and Communications facilities.

OIS

Wang Office Information Systems such as the OIS-125 and the OIS-140 systems.

Pixel

Picture element, or dot, that is the smallest displayable unit that can be addressed by computer software. Each character displayed on a computer driven CRT is made up of many dots that are clearly visible when the CRT brightness control is turned down slightly.

**PROM** 

Programmable read only memory.

RAM

Random access memory.

#### GLOSSARY - (CONTINUED)

RF

Radio Frequency.

RF Modulator

A low cost Television Modulator used with the Low Resolution Video Controller to modulate the Composite Video Signal onto a television channel frequency so it can be received and displayed by a normal commercial television set.

RS-232

The document number of the Electronics Industries Association (EIA) document that details engineering standards for use by the Computer and Communications Industry in the United States of America for the interface between Data Terminal Equipment (DTE) and Data Communication Equipment (DCE) employing serial binary data interchange. This number is used as an acronym for the interface, as is EIA to a lesser degree.

RTC

Remote Telecommunications Controller.

TV

Television.

VS

Wang Virtual Storage Computers Systems such as the VS-25, VS-80 and VS-100.

X.21

The European equivalent of RS-232.

#### INTERACTIVE QUIZ 1-1

This is a multiple choice quiz. Circle the letter of your choice for the  $\underline{most}$  correct answer then check your answers with the correct answers in Appendix B.

- 1. Which board controls the whole P/C System?
  - a) The Master CPU Board.
  - b) The Motherboard.
  - c) The Medium Resolution Character Generator.
  - d) The Power Supply.
- 2. What is the maximum capacity of a PC Floppy Diskette?
  - a) 300 Kilobytes.
  - b) 5 Megabytes.
  - c) 360 Kilobytes.
  - d) 10 Megabytes.
- 3. How does the MS-DOS System Program get into the Main Memory?
  - a) It is loaded by the PROM resident BOOT STRAP LOADER program from the Disk Drive during the Power-Up sequence.
  - b) It is permanently resident.
  - c) It is loaded at Power-Up time by the B.I.T.
  - d) It is transferred from the Power-Up PROM at Power-Up.
- 4. The RS-232 Asynchronous Interface can be used to:
  - a) Drive a Parallel Printer.
  - b) Allow the PC to emulate a 2236DW Terminal.
  - c) Run the PC on a remote Wangnet.
  - d) Run 2780/3780 communications software.

5.	The Tandon Floppy Disk Drive is a DSDD Drive. What does DSDD mean and what is the size of the Diskettes?			
	a)	DUAL SIDED, DOUBLE DENSITY, 8 inches in diameter.		
	b)	Drop-sided, diamond dipped, 6 inches in diameter.		
	c)	Diamond-studded, double-dipped 6.5 inches in		
	• >	diameter.		
	d)	Dual-sided, double density, 5.25 inches in		
		diameter.		
6.	The	Motherboard has Option slots.		
	a)	8		
	b)	4		
	c)	5		
	d)	6		
7.	What	is the maximum amount of Main Memory possible in the PC?		
	a)	512 Kbytes.		
	b)	640 Kbytes.		
	c)	1 megabyte.		
	d)	128 Kbytes.		
8.	Whicl	n program executes first on Power-Up?		
	a)	The B.I.T. (Built-In-Test).		
	b)	The Power-Up sequencer.		
	c)	MS-DOS.		
	d)	The BOOT STRAP LOADER.		

9.	The	Winchester Controller Board must be installed
	in	?
	a)	The Winchester Drive.
	b)	EU slot 5.
	c)	Any EU slot.
	d)	EU slot 1.
10.	The	Medium Resolution Graphics Board
	a)	Has 12 Kilobytes of static RAM.
	b)	Drives a graphic display.
	c)	
	d)	Connects to the Medium Res. Character Board.
11.	The	LED on the Memory Expansion Board
	a)	Indicates when the board is being accessed by the
	aj	software.
	<b>5</b> )	Is programmable.
	b)	. •
	c)	
	d)	Indicates a write protect error.
12.	The	RTC Board
	a)	Has its own IEEE-488 industry standard interface.
	ь)	Is the system Real Time Clock.
	c)	Comes in two versions, RS-232 and X.21.
	۵۱	Communicates with the Main CPU in ASCII code.

13.	The	Medium Res. Character Generator character matrix
	a)	8 x 9 pixels.
	b)	10 x 12 pixels.
	c)	5 x 7 pixels.
	d)	Programmable.
14.	The	Low Res. Video Controller
	a)	can be used to drive a television.
	b)	can be used to drive a color, or black and white
	·	television.
	c)	can be used to drive a color, or B & W television or;
		color, or B & W video monitor.
	d)	generates a screen display of 25 eighty character
		lines.
15.	Tho	Iow Pos Widos Controllor concretes
13.	THE	Low Res. Video Controller generates
	a)	16 program-selectable colors in the Video Monitor mode.
	b)	16 program-selectable colors in the TV mode.
	c)	4 program-selectable colors in the TV mode.
	d)	Two bits per pixel in the TV mode.
16.		Option that allows the PC to operate as a VS workstation
	is c	alled the
	a)	CP/M-80 Option.
	b)	Z80 Option.
	c)	Local Comm. Option.
	d)	Data Link Option.

17.	Two	boards make up the
	a)	CP/M-80 Option.
	b)	Data Link Option.
	-	Expansion Memory Option.
	d)	-
18.	The	CP/M-80 Option allows the PC to
	a)	Emulate a CP/M-80 terminal.
	b)	Run CP/M-80 based 8-bit programs.
	c)	Run IBM programs.
	d)	Run Multiplan.
19.	A11	the PC Option boards are
	a)	Multilayered
	b)	Translucent
	c)	8 x 12 inches in size.
	d)	Heat treated.
20.	CP/N	1-80 Operating System software runs onbased
	comp	outer systems.
	a)	8086
	b)	Z80
	c)	8087
	d)	68000

21.		of RAM memory is located on the PC CPU Board.
	a)	128 Kbytes
	b)	256 Kbytes
	c)	512 Kbytes
	d)	1024 Kbytes
22.		of RAM Memory is located on the RTC Option
	Boar	d.
	a)	64 Kbytes
	b)	128 Kbytes
	c)	64 Kwords
	d)	256 bytes
23.	32 K	ilobytes of dynamic RAM Memory is located on
	a)	Local Comm Option Data Link Board.
	b)	CP/M-80 Option Board.
	c)	Medium Res. Graphics Board.
	d)	Low Res. Video Controller Board.
o./.	m1	T D
24.		Low Res. Video Controller generates characters per
	line	in the TV Mode.
	a)	80
	b)	40
	c)	66
	d)	132

- 25. Which of the following is interpreted by the CPU as a Fatal Error \_\_\_\_\_\_.
  - a) A Monitor failure.
  - b) An Option board failure.
  - c) A Memory Parity Error.
  - d) An Open Floppy Door.

# PART I SECTION 2

# INSTALLATION OF THE PROFESSIONAL COMPUTER

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#### SECTION 2

#### INSTALLATION OF THE PROFESSIONAL COMPUTER

#### **OBJECTIVES**

Upon completion of this section you will be able to:

- 1. Install the Professional Computer System.
- 2. Install PC Option boards.
- 3. Determine that the PC System is operating properly.

#### INTERACTIVE INSTRUCTIONS

First read the GLOSSARY OF TERMS for this section then view SECTION 2 of the WANG Professional Computer VIDEO TAPE. After viewing the Video Tape answer the questions in the INTERACTIVE QUIZ for this section. Take your time and if you can't remember the answer to any of the questions refer to PART II, SECTION 2 of this WORKBOOK. All the material contained in the Video Tape is in PART II of this WORKBOOK.

Once you have completed the INTERACTIVE QUIZ check your answers against the correct answers in Appendix B. Remember, these quizzes are designed to help you learn the material presented in the Video. So if you did miss any of the questions, going over them again helps you remember those points later.

After you have completed the Interactive Quiz perform Lab. Exercise # 2-1. The Lab. Exercises are a vital part of this Training Course because they give you the hands-on experience necessary to perform professionally at the Customer's Site. You have seen the Installation of the system on the Video Tape, now you should take this opportunity to do it. If you encounter problems with the Lab. go back and view that portion of the video tape over. Remember, this is a Self-Paced course. Your responsibility is to completely learn the course material, even if it takes longer than you anticipated.

When you have completed the Lab. Exercise proceed to Section 2 of this workbook.

### SECTION 2

### GLOSSARY OF TERMS

Attribute A software selectable video enhancement such

highlight, reverse video, underscore, blink, etc.

Baud Rate The speed, or rate, in Bits-per-Second, of serial

data transmission.

CPU Central processing unit - The heart of all

computers.

CRT Cathode ray tube. Used in the Wang PC Monitor to

display the Video.

DAISY PRINTER A letter quality printer with the characters

arranged in a circle on the ends of spokes, or

'petals' that extend from a central hub.

EU Wang Professional Computer Electronics Unit.

LED Light emitting diode.

Modem Also called Data Set. A device that performs the

modulation/demodulation and control functions necessary to provide compatibility between

Computer Systems and Communications facilities.

Monitor Refers to the Wang Professional Computer Video

Display device.

MPI The acronym for Micro Peripherals Inc., a company

that markets floppy disk drives and other computer

products.

### GLOSSARY - (Continued)

Multiplan

A "Spreadsheet" applications program that is

similar to "VisiCalc".

MX-80FT

A small, light weight Dot Matrix printer capable

of printing at the rate of 80 characters per

second.

Winchester

An acronym for small, high speed disk drives

utilizing "Winchester" technology. The ten

megabyte Winchester Drive offered as a PC Option

fits in the same slot as the optional 360 Kilobyte

Floppy Disk Drive, giving the PC System

approximately 28 times more data storage/ access

capacity than the Floppy Drive.

### INTERACTIVE QUIZ 2-1

- 1. Who does the Presite Planning prior to a PC System installation?
  - a) A Wang Customer Engineer.
  - b) The Customer is responsible for their own Presite planning.
  - c) It is a joint responsibility between Wang and the Customer.
  - d) No presite planning is necessary.
- 2. How many Shipping Containers make up a Standard PC System?
  - a) Three
  - b) Five
  - c) Four
  - d) Two
- 3. What should the Customer do with the Shipping Containers after unpacking the system?
  - a) Throw them away.
  - b) Use them as a table to install the PC System on.
  - c) Read the installation instructions printed on the box.
  - d) Save them for possible return of the equipment.
- 4. Which Shipping Container should be opened first?
  - a) Auto-Enclosure
  - b) blue
  - c) white
  - d) EU

5. is used to protect the Floppy Disk Drive during shipment. a) A head retaining clip b) A locking bar c) A thin piece of cardboard d) A carriage clamp 6. The is packed with the EU. a) AC power cord b) Six rubber feet c) Documentation Guide d) Introductory Guide 7. The Standard PC installation requires the use of a screwdriver. Why? a) To connect the Monitor to its pedestal. b) To mount the rubber feet on the EU. To secure the AC power cord to the EU. c) d) To install the Option boards. 8. The keyboard LEDs all come on then sequence out in about 30 seconds. WHY? a) To indicate to the User that the B.I.T. is running properly. b) To indicate proper Power-Up delay while the system stabilizes. c) To indicate to the User that the LEDs are operational. d) To assure the User that the system is running.

9. What should be done first in the PC check-out process ? a) Load the System Software. Load, and run the PC Diagnostic Package. b) Test the power supply voltages. c) d) Run the Command Processor. When a tab covers the notch on the edge of a diskette, it 10. a) NOT Write-Protected. b) Released software. c) Preliminary software. d) Write-Protected. 11. If the PC system you are installing is to be powered by a 230 volt circuit what must be done? Replace the 115 volt power supply with a 230 volt one. a) Cut the 115 volt plug off the power cord and replace it b) with a 230 volt plug. Remove the EU cover and change the power supply switch c) from 115 volt operation to 230 volt operation. Adjust the power supply Over-voltage-protect d) potentiometer for 230 volt operation. 12. What configuration of the baud rate selector switch causes the PC to loop on the B.I.T.? All switches ON. a) All switches OFF. b) c) 0001 1000 d)

13.	When	installing an Option Board	?
	a)	It must be cleaned.	
	b)	The back panel must be attached.	
	c)	The blank rear panel must be removed from the EU slot	
		it is to be installed in.	
	d)	The EU power supply must be removed.	
14.	Whon	installing the second floory drive Drive A must be	
14.		installing the second floppy drive, Drive A must be ved to	
	гещо	ved to	
	a)	Change the terminators.	
	b)	Run the cables for Drive B.	
	c)	Free the power cable and connector for drive B.	
	d)	Get the bottom plate for Drive B.	
15.	The l	MPI address platform plug is jumpered for a hex	
	a)	21	
	ъ)	20	
	c)	01	
	d)	02	
16.	The V	Winchester Controller board must be	<u>.</u>
	a)	Addressed for a hex 03.	
	b)	Installed in Option slot 5.	
	c)	Secured to the cable clip.	
	d)	Addressed for a hex 02.	

7.	Self by	-test is run on the MX-80F/T, Type III printer
	<i></i>	
	a)	Applying printer power with the LINE FEED button held down.
	b)	Applying printer power with the READY button held down
	c)	Applying printer power with the ON LINE button held down.
	d)	Applying printer power with both the ON LINE and LINE FEED buttons held down.
8.	·	is the correct configuration for the
	MX-8	OF/T, Type III configuration switch banks.
	a)	Hex 01 for switch bank 1 and hex 5 for switch bank 2.
	ъ)	Hex 50 for switch bank 1 and hex 1 for switch bank 2.
	c)	Hex 05 for switch bank 1 and hex 1 for switch bank 2.
	d)	Hex 03 for switch bank 1 and hex 4 for switch bank 2.
).	The	Monitor Swivel Arm is preset for a
	a)	360 degree swing.
	ъ)	180 degree swing.
	c)	90 degree left arc.
	d)	90 degree right arc.
).	For	a 90 degree right arc, the Monitor Swivel
	Arm	·
	a)	Must be clamped to the right side of the desk.
	b)	Set screw must be in the BOTTOM hole of the swivel arm
	c)	Set screw must be in the CENTER hole of the swivel arm
	d)	Set screw must be in the TOP hole of the swivel arm.

## PROFESSIONAL COMPUTER TRAINING

# LABORATORY EXERCISE # 2-1

# INSTALLATION

NAME		
	Start Time	End Time
	:	:

### PROFESSIONAL COMPUTER INSTALLATION

DIRECTIONS: It is important to perform the steps of this Lab.

Exercise in the order given to achieve the maximum

benefit from this procedure.

OBJECTIVES: Upon completion of this exercise you will be able to

install the PC System and all of the Options offered

with it, including system check-out to assure its

operational integrity.

### MATERIAL REQUIRED:

- 1. A PC System, Configuration PC-004
- 2. Phillips screwdriver
- 3. Flat blade screwdriver with a long shaft
- 4. Flat surface table or workbench
- 5. 3/32 Hex (Allen) wrench.
- 6. Monitor Swivel Arm
- 7. Electronic Unit Desk Clamp
- 8. PC MS-DOS Diskette
- 9. PC Diagnostic Diskette

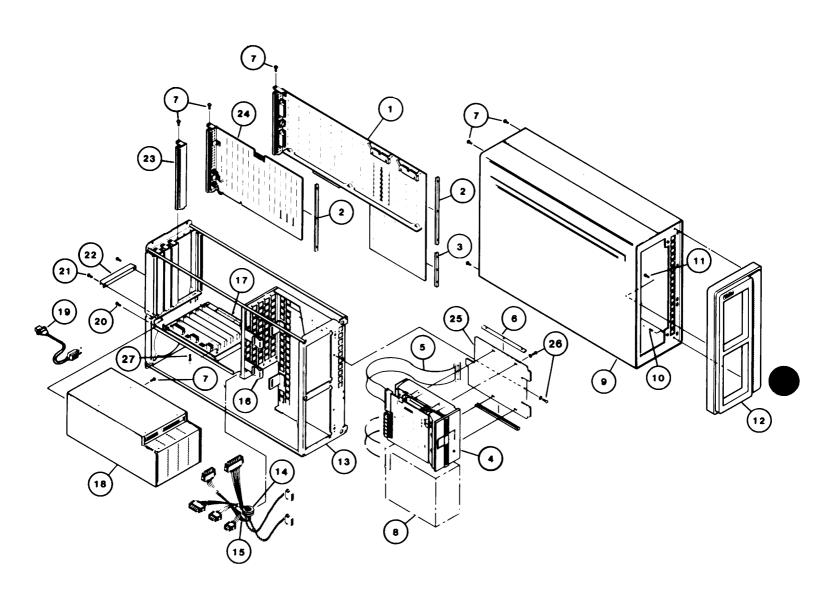


FIGURE I-2-1 ELECTRONICS UNIT ILLUSTRATED PARTS BREAKDOWN

# CONNECTING YOUR SYSTEM Align the Keyboard cable connector key with the keyway in 1. its socket at the rear of the Electronics Unit and plug the connector into its socket. 2. Turn the Monitor upside down, align the 8 pin cable connector of the Monitor cable with its socket and plug it Then, align the other, 5 pin cable connector with its Monitor socket and plug it in. Return the Monitor to its upright position. 3. Connect the other end of the Monitor cable to the two sockets at the rear of the Electronics Unit the same way as the Monitor was connected. 4. Connect the power cord to the 3 pronged socket at the rear of the Electronics Unit and secure it by screwing the two captive screws into the posts on either side of the power cord connector. 5. Set the power switch next to the power cord connector to the OFF position. When the ZERO is flush with the back panel, the switch is in the OFF position. 6. Plug the free end of the power cord into a convenient AC power outlet.

7. Remove the cardboard shipping protectors from the floppy disk drive(s) before you turn on the system power. Just open the Floppy Drive door and pull the protector straight out and leave the floppy drives door(s) open.

#### **CPU ELECTRONICS ENCLOSURE**

ITEM	PART NO.	DESCRIPTION	ITEM	PART NO.	DESCRIPTION
1	210-8221-A**	PCA, CPU/MEMORY BOARD	20	651-0070	SCREW, #8 SELF TAP X 5/8 IN.
2	465-1243	CARD GUIDE, NYLON WHITE 8 IN.		653-4000	#8 FLAT WASHER
3	452-4042	CARD GUIDE, NYLON WHITE 4 IN.			
4	278-4026**	DISKETTE DRIVE, DSDD 48TPI	21	650-2120	SCREW, 4-40X 3/8 IN. (1200 UNITS AND BELOW
5	220-3239**	CABLE, SYSTEM DRIVE (USE WITH ITEM 4)		652-0032	#6 LOCKNUT
6	465-1242	CARD GUIDE, NYLON WHITE 6 IN.		650-3132	SCREW, 6-32 X 3/8 IN. (1200 UNITS AND ABOVE)
7	650-3080	SCREW, 6-32 X 1/4 PAN HD. PHIL		653-3000	FLAT WASHER
8	450-0153	BEZEL, BLANK OR		653-3001	LOCK WASHER
	278-4026**	DISKETTE DRIVE DSDD 48TPI (USE CABLE		000 0001	EGGIC WAGILEN
		220-3240**) OR	22	445-9106	HANDLE, CHASSIS PULL
	278-4030**	WINCHESTER DRIVE 10MB (USE "A" CABLE	23	452-3009	RF SHIELD, BLANK
		220-3240**) (USE "B" CABLE 220-3238**)	25	452-0284	PLATE, MOUNTING
9	458-3026	ENCLOSURE, CPU		102 0204	TEXTE, MODITING
10	478-0822	PIN GUIDE	26	650-3120	SCREW, 6-32 X 3/8
11	651-0006	SCREW, #6 SELF TAP 1/2 IN, LONG		653-3000	#6 FLAT WASHER
12	449-0622	BEZEL, CPU		000 0000	*OTERT WASHEN
13	458-3200	CHASSIS, CPU	27	650-3120	SCREW, 6-32 X 3/8 (300 UNITS AND BELOW)
14	654-1205	GROMMET		653-3000	#6 FLAT WASHER
15	270-3279**	HARNESS ASSY. (INCLUDES ITEM 14)		653-3007	#6 NYLON WASHER
16	449-0671	CABLE CLAMP		650-3080	SCREW 6-32 X 1/4 PAN HD. (300 UNITS AND ABOVE)
17	210-8237**	PCA. MOTHERBOARD		653-3000	#6 FLAT WASHER
18	270-0792**	POWER SUPPLY, SWITCHING SPS 200		033-3000	"OFLAT WASHER
19	420-2019	POWER CORD			

### 24" LISTED BELOW ARE OPTIONS BOARDS

210-8222-A**	COLOR AND GRAPHICS BOARD	210-8248-A**	CP/M-80 EMULATOR BOARD
210-8225-A**	WINCHESTER CONTROLLER BOARD	210-8242**	EXPANDED MEMORY BOARD 128K
210-8233**	GRAPHICS DISPLAY ADAPTER	210-8242-1**	EXPANDED MEMORY BOARD 256K
210-8243/8343-A** 210-8245-A** 210-8246-A** 220-3281**	CHARACTER DISPLAY ADAPTER LOCAL COMMUNICATIONS BOARD (DATA LINK) LOCAL COMMUNICATIONS BOARD (CPU) CABLE ASSY FOR LOCAL COMMUNICATION BOARDS	210-8242-2** 210-8232-A** 210-8252 A**	EXPANDED MEMORY BOARD 512K REMOTE COMMUNICATIONS BOARD X.21 REMOTE COMMUNICATION BOARD

<sup>&</sup>quot;DENOTES RSL ITEMS

Table I-2-1 ELECTRONICS UNIT PARTS LIST

8. Move the power switch to the ON position while watching the 6 keyboard LEDs. They should flash on and off, then in about 2 seconds they will all come on solid, and start to sequence off from left to right. In about 30 seconds the last LED will go out and the following message will be displayed on the Monitor:

WANG PROFESSIONAL COMPUTER. REV 1.00

\*\*\* 40 NO AUTO-START DEVICE

This message indicates that you tried to start the System with the Floppy Drive door open.

9. Close the Floppy Drive(s) door and depress the "R" key on the keyboard. The following message will be displayed on the Monitor screen:

:R

01 WILL START FROM DRIVE A

02 STARTING FROM DRIVE A

\*\*\*41 START FAILED
72 DRIVE A NOT READY

\_\_\_\_ 10. Open the Floppy Drive doors and insert the Diagnostic

Diskette in Drive A and a Scratch Diskette in Drive B.

Depress the "R" key on the keyboard to load the Diagnostics.

11.	When the Diagnostic comes up type in "YES" to access the Customer Menu, then depress the "EXECUTE" key to start the Diagnostics.
12.	When the prompt comes up asking for the drive to be tested type in"B", and depress "EXECUTE" to select Drive B and start the test.
13.	After approximately 2 minutes the Floppy Drive test will complete and the Video Controller/Monitor Test will start, then prompt you to depress the "MERGE" key with the Attributes displayed on the screen. Depress the "MERGE" key and the Diagnostics will complete with a message displayed on the Monitor Screen for the Customer.
14.	Remove the Diagnostic Diskette from the Drive and replace it with the MS-DOS System Diskette. Depress the "CANCEL" key.
15.	When the WANG LOGO comes up on the Monitor screen depress the "EXECUTE" key on the Keyboard to display the Main Menu. Depress "EXECUTE" again to access the Applications Menu, and depress "EXECUTE" one more time to access the Multiplan Program.
16.	Since the Multiplan Software is not on the System Diskette you must replace the System Diskette with the Multiplan Diskette. Then depress the "EXECUTE" key to load the program.

17.	First the WANG LOGO will come up on the screen then, a blank Multiplan "spreadsheet" will come up. At this point the intent of this Lab. is to check out the system, not to teach you how to run Multiplan. So depress the "Q" key, which represents QUIT, and then depress the "Y" key for yes to exit Multiplan.
18.	Replace the Multiplan Diskette with the MS-DOS System Diskette and depress the "EXECUTE" key. When the Application Menu Comes up depress the "CANCEL" key to return to the Main Menu.
19.	Depress the "SPACE BAR" to step the selection block to the DOS Command Processor and depress "EXECUTE" to access it. The letter A followed by a colon indicates the Command Processor is up and Floppy Drive A is prime. Type in "VOL' and depress "RETURN" to display the volume number of the System Diskette.
20.	Remove the System Diskette from the drive and compare the volume numbers, they should match. If not, or if the number is not printed on the diskette, print it on the label using a felt tip pen. Also check the "Write-Protect" hole on the side of the diskette. It should be covered with a TAB, otherwise known as a Band-Aid. If not, put one on and replace the System Diskette in the floppy drive.
21.	Type the word "EXIT" and depress "RETURN" to return to the Main Menu. This completes the installation and check-out of a <a href="Standard PC System">Standard PC System</a> .

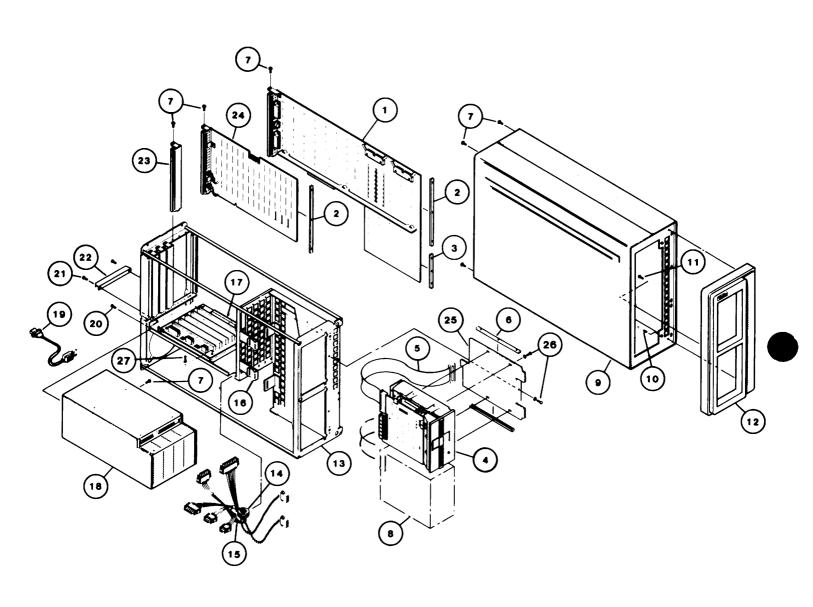


FIGURE 1-2-1 ELECTRONICS UNIT ILLUSTRATED PARTS BREAKDOWN

4.	Observe that the monitor displays the MS-DOS title after the program loads and requests the date and current time be entered.
5.	Enter the date and time from the keyboard and the MAIN MENU should be displayed. This is confirmation that you have reassembled the system correctly.
MONITOR	SWIVEL ARM INSTALLATION
1.	With the Monitor disconnected from the Electronic Unit turn the monitor upside-down so the pedestal base is facing up and remove the four screws holding the base to the Monitor with a Phillips # 1 screw driver. Save the 4 screws.
2.	Gently lift the base off the Monitor and remove the rubber bellows by pinching it and pulling. Then unsnap the restrictor band that prevents the the Monitor from rotating while it is on the base and replace the rubber bellows.
3.	Using a small flat-blade screwdriver, snap out the swivel arm protective cover, flip the arm over so the arm ring is over the Monitor, line up the screw holes, and using the four screws you removed in step 1, secure the Monitor to the swivel arm.
4.	Snap the protective cover back into the swivel arm ring and snap out the cable guide from the arm with a flat-blade screwdriver. Place the Monitor cable in the arm and snap the cable guide back in place.

5.	The Monitor Swivel Arm elevates the Monitor up to 14 inches above your desktop and is set to rotate through 180 degree arc. You can change this arc to 90 degrees or a full 360 degrees. To change the arc to 90 degrees you'll have to move the stop screw to either the center or innermost arc setting. Remove the set screw using the 3/32 inch Allen wrench supplied with the Swivel Arm from the 180 degree hole and screw it into left or right 90 degree hole desired.
6.	Open the clamp so the opening is wide enough to fit over your desk lip, then lift the whole assembly being careful not to trip over the cable, put it in the position desired, and clamp it to the desk.
ELECTRONI	C UNIT DESK CLAMP INSTALLATION
1.	Open the 2 clamps so the clamp openings will fit over the lip of your desk and position the clamp. The Electronics Unit extends 3 inches beyond the front and rear of the clamp so take this into consideration when positioning the clamp.
2.	Tighten the clamps until the jaws are flush with the bottom of the desk, then tighten them at least two more turns, or until you can't turn them anymore.
3.	Carefully pick up the Electronics Unit with the Wang LOGO up for the right-hand desk side installation, and slip the

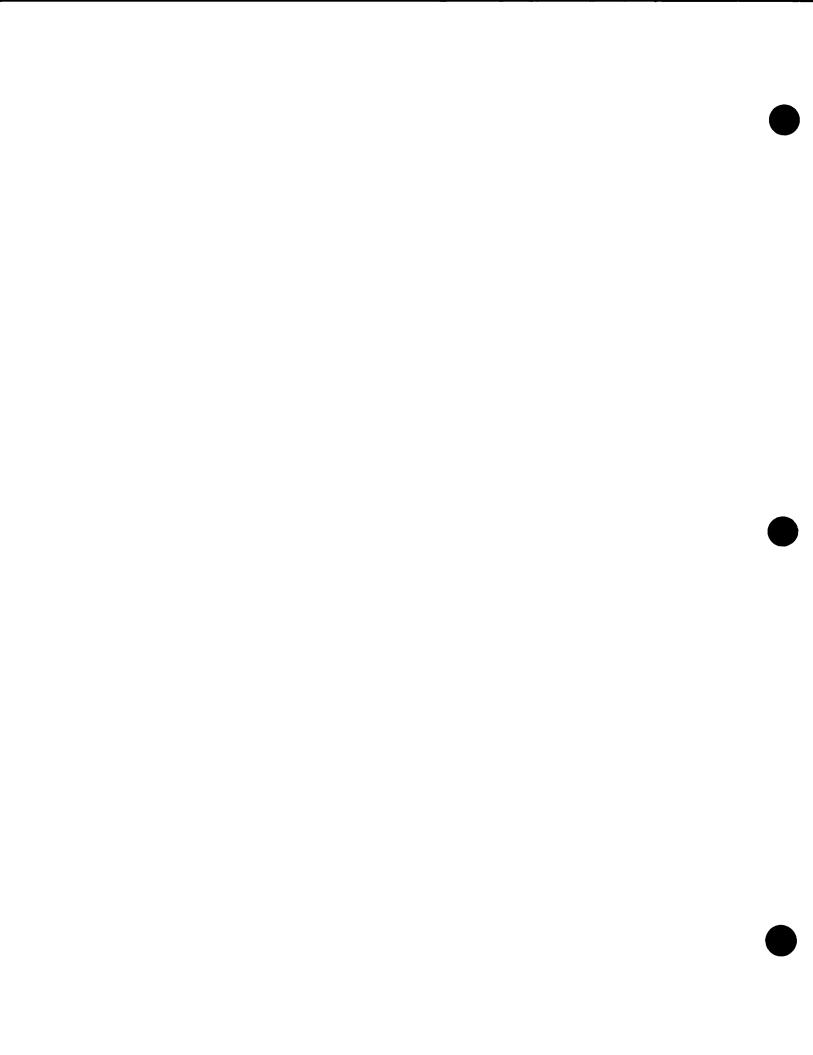
pages I-2-24 and I-2-25.

cutouts on the Unit into the tabs on the desk clamp.

Check out your PC System by repeating steps 1 through 5 on

# PART I SECTION 3

# OPERATION OF THE PROFESSIONAL COMPUTER



### SECTION 3

### OPERATION OF THE PROFESSIONAL COMPUTER

### **OBJECTIVES**

Upon completion of this section you will be able to:

- 1. Operate the Professional Computer System.
- 2. Determine that the PC System is operating properly.
- Identify nonfatal errors occurring on Power-Up and correct them.
- 4. Load and run the PC System Diagnostics.

### INTERACTIVE INSTRUCTIONS

First read the GLOSSARY OF TERMS for this section then view SECTION 3 of the WANG Professional Computer VIDEO TAPE. After viewing the Video Tape answer the questions in the INTERACTIVE QUIZ for this section. Take your time and if you can't remember the answer to any of the questions refer to PART II, SECTION 3 of this WORKBOOK. All the material contained in the Video Tape is in PART II of this WORKBOOK.

Once you have completed the INTERACTIVE QUIZ check your answers against the correct answers in Appendix B. Remember, these quizzes are designed to help you learn the material presented in the Video. So if you did miss any of the questions, going over them again helps you remember those points later.

After you have completed the Interactive Quiz do Lab. Exercise # 3-1 in this section. The Lab. Exercises are a vital part of this Training Course because they give you the hands-on experience necessary to perform professionally at the Customer's Site. You have seen it done on the Video Tape, now you do it. If you encounter problems with the Lab. go back and view that portion of the video tape over. Remember, this is a self-paced course. Your responsibility is to completely learn the course material, even if it takes longer than you anticipated.

When you complete the Lab. Exercise proceed to Section 4 of this workbook.

### SECTION 3

### GLOSSARY OF TERMS

BIT or B.I.T.

The Professional Computer PROM resident Built-In-Test, or Power-Up Diagnostic.

Boot Strap

The Boot Strap LOADER program is PROM resident and is initiated by successful completion of the B.I.T. It initiates the default floppy drive and transfers the MS-DOS system software from the diskette to Main Memory. Program control is passed to MS-DOS as soon as the transfer is complete.

CP/M-80

An 8 bit Control Program for Microprocessors marketed by Digital Research Inc. This is the control program that runs on the TRS-80 and many other Personal Computers controlling a large variety of popular 8-bit applications programs.

DOS

Disk Operating System software. A system control program that uses a disk drive, hard or floppy, as an extension of Main Memory. All permanent data files and programs entered by the user are written to the disk. The Control program used by the PC is MS-DOS.

**PCSYS** 

Professional Computer System. Used as part of the 11 character volume number assigned to diskettes, such as PCSYS080483, where 08-04-83 represents the date the diskette was recorded.

### GLOSSARY - (CONTINUED)

**PRACGLOS** 

Practice Glossary. A demo glossary programmed onto the PC Word Processing diskette for use by the user in learning how to use the Glossary Function.

PROM

Programmable read only memory.

RTC

Remote Telecommunications Controller.

Spreadsheet

Computer terminology for programs that display a basic form of columns and rows that can be filled in and altered by the user, with simple commands to build a financial balance sheet, manufacturing schedule, engineering plan, etc. VisiCalc, SuperCalc and Multiplan are Off-The-Shelf examples.

VOL

Volume number. An alphanumeric of 11 characters maximum used to label the PC diskettes.

Warm Start

The PC System is reset and the System software is loaded without running the B.I.T. Rerunning the B.I.T. and then "Booting" the system is termed a "Cold Start".

### INTERACTIVE QUIZ 3-1

1.	What	indicates that the B.I.T. is running?
	a)	The keyboard LEDs flash all on, then sequence off.
	b)	The keyboard speaker "BEEPS".
	c)	The keyboard LEDs keep flashing.
	d)	The Monitor Screen displays a message.
2.	The MENU	Database program is listed on the?
	a)	System Utilities
	ъ)	Applications
	c)	Communications
	d)	DOS Command Processor
3.	The "	Debugger" is listed on the Menu ?
	a)	Applications
	b)	System Utilities
	c)	Program Development
	d)	Word Processing
4.	"A:"	means
	۵١	You are in Basic and Floppy Drive A is prime.

- a)
- You are in the Debugger and Floppy Drive A is "bugged". b)
- You are in the Utilities and floppy drive A is prime. c)
- You are in the DOS Command Processor and Floppy Drive A d) is prime.

- 5. When the notch on the edge of the diskette is covered with a TAB the  $\,$ 
  - a) Diskette is NOT Write-Protected.
  - b) Diskette is Write-Protected.
  - c) Programs on the diskette are enabled for ODD parity.
  - d) Programs on the diskette are enabled for EVEN parity.
- 6. How do you list all the files on a diskette?
  - a) Select the DOS Command Processor, type in "DIRECTORY", then depress the "RETURN" key.
  - b) Load "BASIC", type in "LIST" and depress the "RETURN" key.
  - c) Access the DOS Command Processor, type in "DIR -P" and depress the "RETURN" key.
  - d) Access the System Utilities, select "DIRECTORY PATH" and depress "EXECUTE".
- 7. What communication program emulates IBM protocol ?
  - a) 2780/3780 Batch Communications.
  - b) Asynchronous Communications.
  - c) Business Graphics.
  - d) Multiplan.
- 8. What program allows the User to develop a financial "Spreadsheet"?
  - a) Business Graphics
  - b) Word Processing
  - c) Database
  - d) Multiplan

9.	How many Compiler programs are available for the PC !
	a) 2 - Basic and Debugger
	b) 3 - Basic, Debugger and Protocol
	c) 4 - Basic, FORTRAN, COBOL and PASCAL
	d) 5 - Basic, FORTRAN, COBOL, PASCAL and PLATO
10.	What Option has to be installed in the PC before it can be
	used as a Wang VS System Terminal (Workstation)?
	a) Wang 2200 Terminal Emulation
	b) Remote Wangnet
	c) The RTC Option
	d) The Local Comm Option
11.	To return to the Main Menu from the DOS Command Processor
	type and depress "RETURN".
	a) "QUIT"
	b) "SYSTEM"
	c) "EXIT"
	d) "GO TO"
12.	To access the Disk Alignment Program type in
	within 5 seconds from the time the B.I.T. completes.
	a) ''M''
	b) "DISK"
	c) "R" for REDIRECT
	d) "G" for GO TO Disk Alignment Program

13. Depressing the "Q" key		cessing the "Q" key
	a)	Allows "Booting" from the optional disk drive.
	b)	
	c)	
	d)	Reruns the B.I.T.
14.	Befo	ore a diskette can be used it has to be
	a)	Write-Protected.
	b)	Formatted.
	c)	"Masked".
	d)	"Debugged".
15.	A Di	skette Volume number can contain up to characters.
	a)	10
	b)	8
	c)	12
	d)	11
16.	''COM	'' is a three character
	a)	"File Extender" that labels the file as a Command file.
	b)	"File Modifier" that means the file contains Common
		Data.
	c)	"File Extender" that labels the file as Common Data.
	d)	"File Extender" that extends the memory space of the
	*	File.

17.	To exit the Multiplan program type					
	a)	"EXIT" and depress the "RETURN" key.				
	b)	"SYSTEM" and depress the "RETURN" key.				
	c)	"Q" for quit and depress the "RETURN" key.				
	d)	"QUIT" and depress the "EXECUTE" key.				
18.	. "PRACGLOS" in the Word Processing program					
	a)	Stands for Practical Glossiness.				
	b) Is a Demo Glossary.					
c) Is a Document number.						
d) Is a dictionary of WP acronyms.						
19.	. In the WP Print Format pitch is standard.					
19. In the willing format pitch is standard.						
	a)	10				
	b)	12				
	c)	15				
	d)	8				
0.0	1					
20.	The _	Option is necessary to run the PC on a				
	Remot	te Wangnet.				
	a)	Local Comm				
	b)	CP/M-80				
	c)	RTC				
	d)	Async Comm				

## PROFESSIONAL COMPUTER TRAINING

## LABORATORY EXERCISE # 3-1

## SYSTEM OPERATION

NAME				
	Start	Time	End	Time
		:		•
		•		:

### PROFESSIONAL COMPUTER SYSTEM OPERATION

DIRECTIONS:

It is important to perform the steps of this Lab. Exercise in the order given to achieve the maximum benefit from this procedure. When completed return this exercise to the Instructor for grading.

**OBJECTIVES:** 

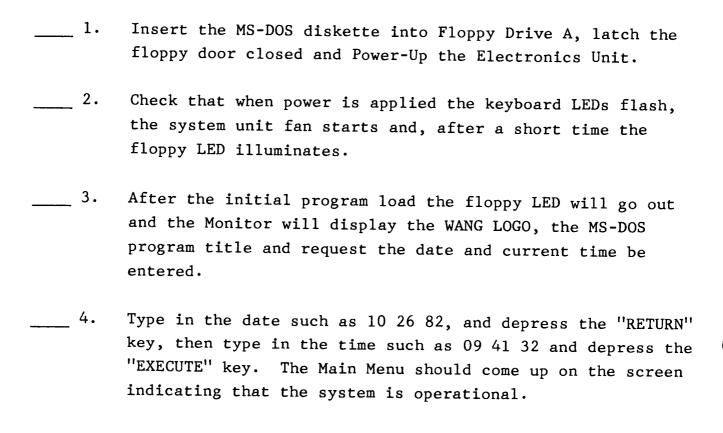
Upon completion of this exercise you will be able to:

- 1. Operate the PC System.
- Determine that the PC System is operating properly.
- Identify nonfatal errors that can occur on system Power-Up.
- 4. Load and run the PC System Exerciser and Monitor Diagnostic programs.

# MATERIAL REQUIRED:

- 1. PC System, Configuration PC-004
- 2. PC MS-DOS Operating System diskette
- 3. PC System Monitor Diagnostic Diskette
- 4. PC Word Processing Diskette
- 5. PC Multiplan Diskette
- 6. Scratch Diskette

### SYSTEM INITIALIZATION



### NOTICE

All keyboard entries are enclosed in quotation marks, "TYPE-IN", to offset them from the rest of the text.  $\underline{DO}$  NOT TYPE IN THE QUOTATION MARKS

\_\_\_\_\_5. Step the selection block to DOS Command Processor (highlighted) with the "SPACE BAR" and depress the "EXECUTE" key. The Command Processor will display a prompt to type "EXIT" to return to the Main Menu, COMMAND V.X.XX and "A:".

6.	Type "DIR -P" (for directory and page) next to the "A".  The "-P" will keep the program from scrolling the top items off the screen when the disk has more than a page of files on it. Depress "RETURN" and the command menu will be displayed. This is a list of all the programs (files) on the MS-DOS System Diskette.
7.	Type "FORMAT" after the "A:" and the Command Processor will ask you to exchange the System Diskette for the diskette to be formatted.
8.	Remove the System Diskette from Drive A and replace it with the Scratch diskette and hit any key and the Command Processor will format your scratch diskette. When it completes the program will ask for an 11 bit System name. Type in SYSTEMXXXXX, for System Disk with the five X's equal to the current date. Depress "RETURN" and "N' for no to complete the FORMAT SYSTEM operation.
9.	When the format operation completes remove the Scratch Diskette from Drive A, put it in Drive B, put the System Diskette back in Drive A and type "COPY A:*.* B:*.*" next to the A: and depress the RETURN key. The Command Processor will now copy all the files from the System Diskette to the Scratch Diskette.
10.	When the COPY routine completes type "B:" and depress the RETURN key to switch from Drive A to Drive B. Type "CHKDSK B:" and depress the "RETURN" key. The Command Processor will check the disk in drive B and display a report of what is on the disk plus any errors found.

- 11. Type in "A:" and hit RETURN to return to the Drive A. Type in "EXIT" and hit RETURN to display the Main Menu, then depress the "SPACE BAR" to step to SYSTEM UTILITIES and depress the EXECUTE key to display the Utilities Menu.
  - \_\_\_\_12. Using the "SPACE BAR" step the block to "CHECK DISK" and depress the "EXECUTE" key. This is the same program you ran by typing in "CHKDSK" under the Command Processor with a few enhancements added under Utilities. Default drive A is specified and no entry is required at present. Depress "EXECUTE" to run the operation and the diskette in drive A will be checked. At present the File ID type-in, Error fix-up and Trace does not work. Future program up dates will correct this problem. At present use the Command Processor for individual file Checksums and attempted error corrections, as well as the Trace Table.
- DISK FORMAT. This is similar to FORMAT you ran under the Command Processor with a few enhancements. The Volume ID is asked for and if its not written on the disk Label you can find out what it is by typing "VOL" in the Command Processor. The Drive which is listed first is "A" because that is the default drive. Depress EXECUTE to start the program and you will be asked to insert the diskette to be FORMATTED in drive A. Remove the System Diskette from A and put in the Scratch, just as you did before and depress any key on the keyboard.
- \_\_\_\_\_14. When FORMAT completes remove the Scratch disk and place the System diskette back in drive A and put the Scratch diskette in Drive B.

- Depress "CANCEL" to return to the Utility Menu and select 15. This is similar to Copy that you ran under the Command Processor with a few enhancements. First, type in the Volume ID just as in step 13. You are asked for the input Drive which is listed as "A" because that is the default drive. You can change it to B if you desire but remember INPUT means the diskette you will copy the files Type in \*.\* beside File ID to copy all the files. If you only wanted to copy a file you would type in the name of the file with the file extender, such as DEBUG.COM (COM is the file extender). Depress EXECUTE and the OUTPUT information will be requested. If your PC has two Floppy Drives type in B if you assigned A for the the INPUT drive, and you must insert a FORMATTED diskette into drive B. your system has a single drive you must designate A for both INPUT and OUTPUT and the COPY program will copy all the data to main memory and then ask you to remove the INPUT diskette and replace it with the formatted diskette you want to copy the files to. Using your scratch diskette copy the DEBUG file from the System Diskette by typing in DEBUG.COM next to FILE ID: and depress EXECUTE.
- 16. When the copy is complete type in "CANCEL" twice to return to the Main Menu and select the DOS Command Processor, depress EXECUTE to go to it, and type B: and RETURN to swap drives.

17.	Type in DIR and press RETURN and the DEBUG file should be listed. Type in A: and RETURN to go back to drive A and type EXIT and RETURN to display the Main Menu and select System Utility again. Now select DELETE and press EXECUTE.A field similar to the Utilities you just ran will be displayed. Replace Drive A by typing in "B" in place of "A", skip Volume ID: by hitting RETURN and type DEBUG.COM next to File ID: and depress EXECUTE.
18.	When the DELETE completes go back to the Main Menu and switch drives by repeating step 16.
19.	Type in DIR to display the files on the Scratch diskette in drive B and DEBUG should no longer be there, proving you deleted it with the DELETE Utility.
20.	Return to drive A and type in EXIT and RETURN to go back to the Main Menu and select Program Development. Depress EXECUTE and select BASIC. Depress EXECUTE to access the Basic program.
21.	Using the RETURN key to complete a line and the BACKSPACE key to correct any typing errors, type in the following program and be sure to depress the RETURN key at the end of each line:  10 PRINT "HOHO"; 20 GOTO 10 RUN
22.	When you depress RETURN after typing "RUN" the program will execute filling the screen with "HO" characters. Depress "CANCEL" to stop the program and return to Basic. You have just written your first program on the PC.

\_\_\_\_ 23. To control the lines displayed type in the following program:

10 FOR X = 1 to 5

20 PRINT "The WANG Professional Computer is powerful."

30 NEXT X

40 STOP

RUN (Depress "RETURN" to start)

#### NOTE:

If you have an MX-80 printer attached to your PC substitute LPRINT for PRINT to access the printer.

24. To make music type in the following program:

10 X = INT(RND(1)\*4000+1)

20 SOUND X,2

30 GOTO 10

RUN (Depress "RETURN" to start, and )
 ("CANCEL" to stop the test. )

25. Type in "SYSTEM", then hit "RETURN" to return to the Main System. Select Program Development, then select DEBUGGER and depress EXECUTE to access it. This program allows you to display and modify memory. For example type "D FFFO" and RETURN. A block of memory will be displayed starting at memory address FFFO. If you want to print the data out on a line printer depress "CONTROL/P" after you type in the address, and before depressing RETURN. To turn off printer access type 'CONTROL/N".

- 26. Type Q for quit to go back to the Program Development Menu then "CANCEL" to go to the Main Menu and select APPLICATIONS. Depress EXECUTE and select WORD PROCESSING on the Applications Menu and depress EXECUTE to access it. The program will ask you to replace the System diskette with the WP diskette. Do it.
- 27. This WP program is very similar to all WANG Word Processing programs. First you must create a document. Use a four digit number such as 0001 for the document number and create a page of data by typing in anything then end the page and cancel out. Now select EDIT OLD DOCUMENT and type in the number of the document you created. Edit it, cancel out and then print it out (if you have a printer). Return to the Main Menu by depressing "CANCEL" and take the WP diskette out of the drive and replace it with the Multiplan Diskette.

#### NOTE:

At present System Software does not permit this. You will have to Load the System Diskette after removing the WP Diskette and select APPLICATIONS on the Main Menu, then remove the System Diskette and replace it with the Multiplan Diskette when you select Multiplan. When Multiplan comes up proceed as follows:

28. Locate the CELL POINTER to row 3, column 1 with the left, right, up, or down ARROW KEYS. This is indicated in the lower left hand corner of your screen as R3C1. This cell is where you are going to enter your first heading on your work sheet. Press "A" for Alpha and type "SALES". Then depress RETURN and "SALES" will be entered on your screen at R3C1.

Press the down arrow key twice to locate the cell pointer 29. to R5Cl and press A for Alpha, then type in COSTS. press the down arrow key and "COSTS" will be automatically entered. Now move the pointer to R8C1 with the down arrow key and 30. you will notice you are still in the Alpha entry mode for Type in "GROSS PROFITS" and press RETURN to text only. enter it. This time we want to go out of the Alpha mode so we depressed RETURN instead of an arrow key. As you can see our column width was not wide enough to accept all the characters in "GROSS PROFITS" so we will have to make the column wider. Press "F" for format and the FORMAT message line will be 31. displayed. Type "W" for width and a new message will be Type in 15, replacing the "d" for default and displayed. hit RETURN. You have just widened column 1 from 10 to 15 and GROSS PROFITS is now displayed. Move the pointer to R3C2 opposite "SALES" and type in 32. 20000, the average monthly sales of Spencer Chemicals and press the down arrow key to enter the data. Press the down arrow key again to move the pointer opposite 33. COSTS at R5C2 and type 15000, the average monthly costs of Spencer Chemicals, and press RETURN to enter this figure.

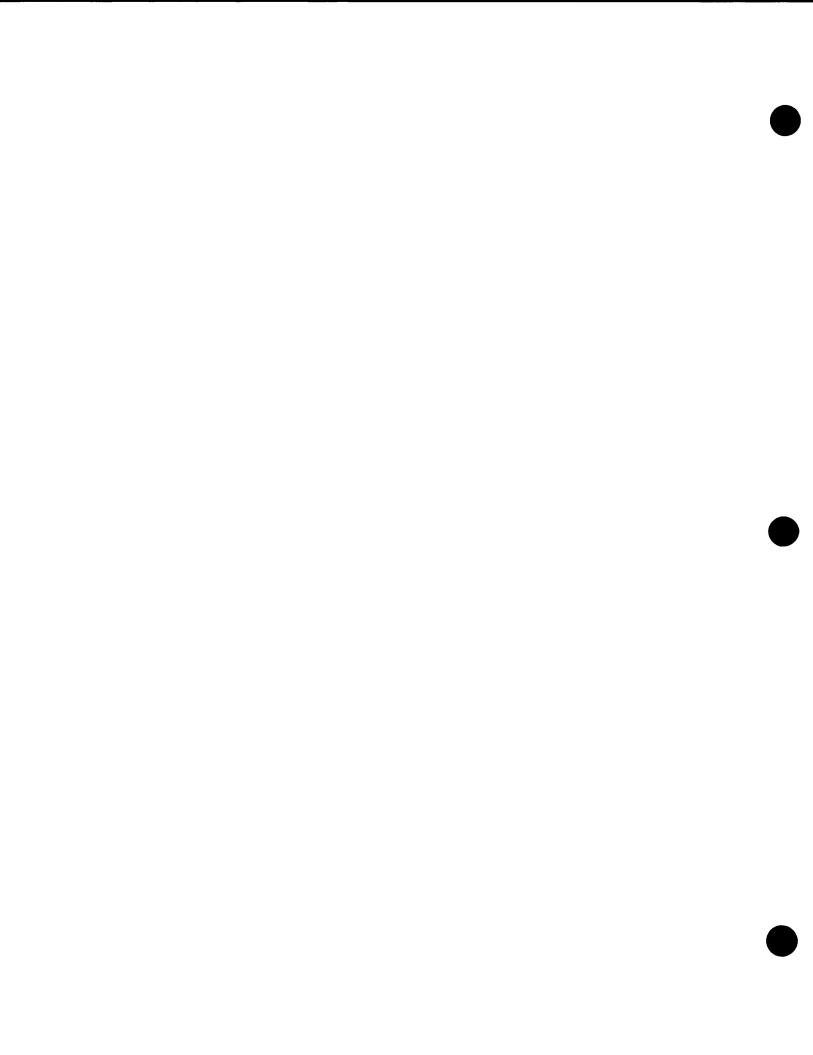
- 34. Now we need a symbol to represent our figures. Press "F" for format and then "D" for default and the Format message will be displayed. Press "C" for cells and a new message will be appear. Press TAB to enter GEN and move the cursor to the next field and type "\$" to select the dollar sign and return to execute your inputs. The figures you entered now have dollar signs and decimal points.
- 35. We must breakdown the costs to make our info more meaningful. Move the pointer to R6C2 and press "I" for insert since we need more rows to enter our cost info. Press "R" for row and type 7 to replace the 1 at the cursor location. Press TAB to move to the "before row: 6" and leave this as is because we want to insert new rows starting at row 6. Press RETURN and Gross Profits will drop down to row 15, indicating that 7 rows were inserted.
- 36. Press the left arrow key once to move the cell pointer to R6Cl and press A for Alpha so you can enter text. Type MATERIAL, press down arrow once, type LABOR, press down arrow once, type OVERHEAD, press down arrow twice to move the pointer to row 10 and type TOTAL COSTS. Finally press down arrow one more time to enter your last entry.
- \_\_\_\_ 37. Move the cell pointer to R6C2, type 4000, press the down arrow, type 7000, press down arrow, type 4000 and press RETURN.

	38.	Now we must align our headings under COSTS to the right side of the column so they will be recognized as subcategories. Move the pointer to R6C1, press F for format and "C" for cells. Press: (colon) and move the pointer to R1OC1. Press the TAB key to move to the next field, press "R" for right alignment and press RETURN Now our cost breakdown makes some sense but the total, \$15000.00 is in the wrong place.
	39.	Move the pointer to R5C2, over the \$15000.00 and type "B" for blank and press RETURN. Now move the pointer to R9C2, press "A" for text and type 10 dashes () to make a line for our addition and press RETURN to enter it.
-	40.	Now to make our figures relate to time move the pointer to R1C2, type A for text and type July press the right arrow key to move to R1C3, type August, press right arrow, type September, press right arrow, type October, press right arrow, type November, press right arrow, type SUM and press RETURN. Press "HOME" to go back to R1C1.
	41.	Now center the months in the column by pressing F for format C for cells and R1C1 will be under the cursor. Depress the "CMD" key. Press BACKSPACE twice to delete C1 then TAB, then C for center and RETURN. The months should now be aligned.
	42.	To continue this worksheet go to page 2-32 in your Multiplan Training Guide and continue. When you have finished sign off with QUIT.

----- E N D -----

### PART I SECTION 4

# PROFESSIONAL COMPUTER REMOVAL AND REPLACEMENT PROCEDURES



#### SECTION 4

#### PROFESSIONAL COMPUTER REMOVAL AND REPLACEMENT PROCEDURES

#### **OBJECTIVES**

Upon completion of this section you will be able to:

- 1. Disassemble the PC System to the Field Replaceable Unit (FRU) level.
- 2. Identify the FRUs that make up the Wang PC System.
- 3. Reassemble the PC System in a professional manner.

#### INTERACTIVE INSTRUCTIONS

First read the GLOSSARY OF TERMS for this section then view SECTION 4 of the WANG Professional Computer VIDEO TAPE. After viewing the Video Tape answer the questions in the INTERACTIVE QUIZ for this section. Take your time and if you can't remember the answer to any of the questions refer to PART II, SECTION 4 of this WORKBOOK. All the material contained in the Video Tape is in PART II of this WORKBOOK.

Once you have completed the INTERACTIVE QUIZ check your answers against the correct answers in Appendix B. Remember, these quizzes are designed to help you learn the material presented in the Video. So if you did miss any of the questions, going over them again helps you remember those points later.

After you have completed the Interactive Quiz do Lab. Exercise # 4-1 in this section. The Lab. Exercises are a vital part of this Training Course because they give you the hands-on experience necessary to perform professionally at the Customer's Site. You have seen it done on the Video Tape, now you do it. If you encounter problems with the Lab. go back and view that portion of the video tape over. Remember, this is a self-paced course. Your responsibility is to completely learn the course material, even if it takes longer than you anticipated.

When you complete the Lab. Exercise proceed to Section 5 of this workbook.

#### SECTION 4

#### GLOSSARY OF TERMS

CPU Central Processing Unit, the "Heart" of the

computer.

CRT Cathode Ray Tube.

EU The Professional Computer "Electronics Unit".

Motherboard The Printed Circuit Board in the PC Electronics

Unit that all the other boards plug into. It interfaces the power supply voltages, the CPU buses, and control signals to all the boards

installed in the EU.

PCA Printed Circuit Assembly. Also called PCB for

Printed Circuit Board.

## INTERACTIVE QUIZ 4-1

1.	To 1	remove the CPU Board first,	
-	a)	Remove the floppy drive(s)	
	b)	Unplug the floppy drive r	bbon cable connector(s).
	c)	Remove the retaining scre	<b>7.</b>
	d)	Pop the board out of its	connector.
2.	The	e Winchester Controller Board	l must be installed in Option
	slot	ot	
	a)	One	
	b)	Two	
	c)	Five	
	d)	Three or Four	
3.		power supply cables con	ect to the Motherboard.
	a)	Three	
	b)	Two	
	c)	Four	
	d)	Five	
4.	The	e power supply connects direc	tly to the
. •		to the	<del></del>
	una		<del></del> `
	a)	CPU Board, Wang Monito	or.
	b)	keyboard, Wang Monito	or.
	· c)	Motherboard, Floppy Disk	Drive(s).
	d)	Motherboard, Wang Monito	or.

5.	The Floppy Drive(s) are held in the EU by
	<ul><li>a) two retaining screws.</li><li>b) one retaining screw.</li></ul>
	c) a locking lever.
	d) its Motherboard connector.
6.	One of the CAUTIONS when disassembling the Wang Monitor is
	to
	a) NOT twist the screwdriver when pushing down the 2 retaining tabs.
	b) SHORT-OUT the high voltage before removing the High Voltage connector from the CRT.
	c) NOT drop it.
	d) All the above.
7.	The easiest way to disconnect the High Voltage connector from the CRT is to
	a) Pull it straight out.
	b) Unscrew it.
	c) Pinch the spring clip together with a pair of pliers.
	d) Pry it out with a screwdriver.
8.	Its easier to replace the Monitor Board retaining screw if
	you
	a) Replace the board first.
	b) Set the Monitor on its CRT face plate.
	c) Use a Phillips screwdriver.
	d) Use a pair of long-nose pliers.

- 9. When assembling the Monitor its important to \_\_\_\_\_\_.
  - a) Make sure the retaining tabs are locked in place before replacing the two retaining screws.
  - b) Hold it together while turning it over.
  - c) Connect the cables before replacing the pedestal.
  - d) Make sure the Locking Ring is properly installed before replacing the bellows.
- 10. If your not careful disassembling the keyboard \_\_\_\_\_\_.
  - a) The keys will all fall out.
  - b) You can break the PCA.
  - c) You can break the speaker wires.
  - d) You can damage the speaker.

## PROFESSIONAL COMPUTER TRAINING LABORATORY EXERCISE # 4-1 MODULE REMOVAL AND REPLACEMENT

NAME		
	Start Time	End Time
	•	:
	:	•

#### PROFESSIONAL COMPUTER MODULE REMOVAL AND REPLACEMENT

**DIRECTIONS:** 

It is important to perform the steps of this Lab. Exercise in the order given to achieve the maximum benefit from this procedure. When completed return this exercise to the Instructor for grading.

**OBJECTIVES:** 

Upon completion of this exercise you will be able to:

- 1. Disassemble the PC System to the Field Replaceable Unit (FRU) level.
- 2. Identify the FRUs that make up the Wang Professional Computer System.
- 3. Reassemble and Install the System.

#### MATERIAL REQUIRED:

- 1. PC System, Configuration PC-004
- 2. Phillips screwdriver
- 3. Flat blade screwdriver w/long shaft
- 4. Flat surface table or workbench
- 5. PC MS-DOS Diskette
- 6. PC Introductory Guide P/N 700-7590

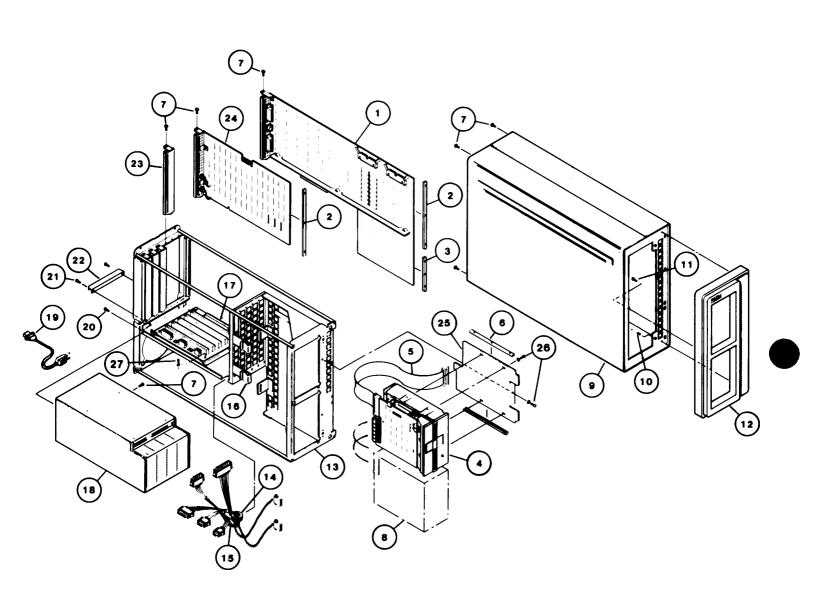


Figure I-4-1 ELECTRONICS UNIT ILLUSTRATED PARTS BREAKDOWN

#### SYSTEM UNIT DISASSEMBLY

1.	Disconnect the AC power cable, the keyboard cable, and the Monitor cable from the rear of the PC System Unit.
2.	Remove the 4 Phillips screws from the rear, 4 corners of the System Unit with the unit setting flat on a table or work bench with the air vents downward. Then, grasping the vertical angle bracket at the rear of the unit pull the unit straight out of the cover by holding the cover with the other hand. Set the cover aside.
3.	Set the System Unit on its side, power supply down and carefully remove the floppy drive ribbon cable connectors from the 2 top, left connectors on the 8221 System Board. Pull enough ribbon cable slack to get the connector out of the way (just over the side of the floppy drive).
4.	At the top right end (rear of unit) of the system board remove the Phillips screw from the RF shield (attached to system board) tab that holds the system board in place and remove it by pulling on one side, then the other to free it from its mother board connector, then carefully pull it straight up; until it clears the the guides while holding the floppy drive ribbon cables out of the way.
5.	At the top right end (rear of unit) of the first Option board remove the Phillips screw from the RF shield (attached to the board) tab that holds the Option board in place and remove it the same way as the system board was removed.
6.	Repeat step 5 for any other Option boards installed.

#### CPU ELECTRONICS ENCLOSURE

ITEM	PART NO.	DESCRIPTION	ITEM	PART NO.	DESCRIPTION
1	210-8221-A**	PCA, CPU/MEMORY BOARD	20	651-0070	SCREW, #8 SELF TAP X 5/8 IN.
2	465-1243	CARD GUIDE, NYLON WHITE 8 IN.		653-4000	#8 FLAT WASHER
3	452-4042	CARD GUIDE, NYLON WHITE 4 IN.			
4	278-4026**	DISKETTE DRIVE, DSDD 48TPI	21	650-2120	SCREW, 4-40X 3/8 IN. (1200 UNITS AND BELOW
5	220-3239**	CABLE, SYSTEM DRIVE (USE WITH ITEM 4)		652-0032	#6LOCKNUT
6	465-1242	CARD GUIDE, NYLON WHITE 6 IN.		650-3132	SCREW, 6-32 X 3/8 IN. (1200 UNITS AND ABOVE)
7	650-3080	SCREW, 6-32 X 1/4 PAN HD. PHIL		653-3000	FLAT WASHER
8	450-0153	BEZEL, BLANK OR		653-3001	LOCK WASHER
	278-4026**	DISKETTE DRIVE DSDD 48TPI (USE CABLE			
		220-3240**) OR	22	445-9106	HANDLE, CHASSIS PULL
	278-4030**	WINCHESTER DRIVE 10MB (USE "A" CABLE	23	452-3009	RF SHIELD, BLANK
		220-3240**) (USE "B" CABLE 220-3238**)	25	452-0284	PLATE, MOUNTING
9	458-3026	ENCLOSURE, CPU			
10	478-0822	PIN GUIDE	26	650-3120	SCREW, 6-32 X 3/8
11	651-0006	SCREW, #6 SELF TAP 1/2 IN. LONG		653-3000	#6 FLAT WASHER
12	449-0622	BEZEL, CPU			
13	458-3200	CHASSIS, CPU	27	650-3120	SCREW, 6-32 X 3/8 (300 UNITS AND BELOW)
14	654-1205	GROMMET		653-3000	#6 FLAT WASHER
15	270-3279**	HARNESS ASSY. (INCLUDES ITEM 14)		653-3007	#6 NYLON WASHER
16	449-0671	CABLE CLAMP		650-3080	SCREW 6-32 X 1/4 PAN HD. (300 UNITS AND ABOVE)
17	210-8237**	PCA, MOTHERBOARD		653-3000	#6 FLAT WASHER
18	270-0792**	POWER SUPPLY, SWITCHING SPS 200			
19	420-2019	POWER CORD			

#### 24\* LISTED BELOW ARE OPTIONS BOARDS

210-8222-A**	COLOR AND GRAPHICS BOARD	210-8248-A**	CP/M-80 EMULATOR BOARD
210-8225-A**	WINCHESTER CONTROLLER BOARD	210-8242**	EXPANDED MEMORY BOARD 128K
210-8233**	GRAPHICS DISPLAY ADAPTER	210-8242-1**	EXPANDED MEMORY BOARD 256K
210-8243/8343-A**	CHARACTER DISPLAY ADAPTER	210-8242-2**	EXPANDED MEMORY BOARD 512K
210-8245-A**	LOCAL COMMUNICATIONS BOARD (DATA LINK)	210-8232-A**	REMOTE COMMUNICATIONS BOARD
210-8246-A**	LOCAL COMMUNICATIONS BOARD (CPU)	210-8252 A**	X.21 REMOTE COMMUNICATION BOARD
220-3281**	CABLE ASSY FOR LOCAL COMMUNICATION BOARDS		

<sup>&</sup>quot; DENOTES RSL ITEMS

Table I-4-1 Electronics Unit Parts List

- 7. With the system unit setting on its side, power supply down, remove the 2 screws at the rear of the unit that hold the power supply to the system unit rear panel, and the screw on the side. Then slide the power supply out to the right (facing rear of unit) until the 2 cable connectors can be removed. Remove the cables, then slide the supply the rest of the way out.
- 8. With the system unit setting on its bottom, remove the floppy drive (or drives) by removing the one screw at the front, center of the unit then disconnect the ribbon cable and power cable at the rear of the drive and slide the drive straight out.
- 9. Reverse steps 1 through 8, above to reassemble the system unit and assure each board is properly mated in its mother board connector before replacing the hold-down screws in the RF shield tabs.

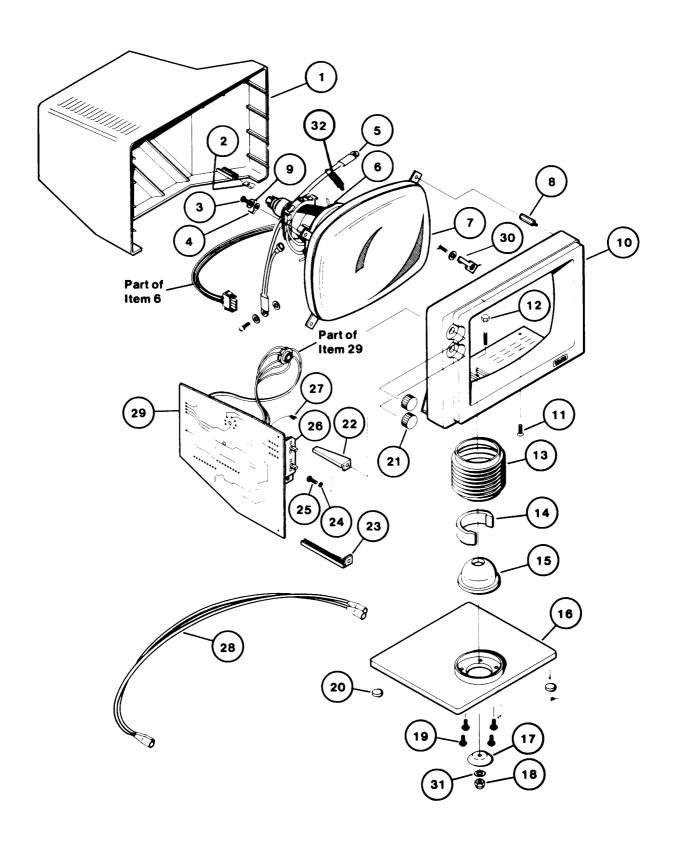


Figure I-4-2 TTL Monitor Illustrated Parts Breakdown

#### WANG MONITOR DISASSEMBLY

- 1. With the monitor cable disconnected from the system unit and the Monitor, remove the 2 thumb wheel knobs from the front of the monitor panel by pulling them straight out.
- 2. Turn the Monitor upside down and set it on the top of its cover and remove the two screws that hold the cover to the face plate.
- Joing a small flat blade screwdriver, push the right (from rear of monitor), top retaining spring tab holding the cover to the face plate down through its slot to free the cover (on the right side).

#### IMPORTANT

Do not twist the screw driver as this will damage the plastic.

Then holding the right side of the cover free so the tab does not spring back into the slot, push the left side spring tab down through its slot to free the cover and remove it by pulling it straight back to clear the neck of the CRT.

4. Unplug the CRT cable connector from Jl at the rear of the monitor board and disconnect the "Faston" clip from the top, right (facing the rear of the monitor) CRT holding screw ground lug.

## TTL MONITOR ASSEMBLY 279-0541\*\*

ITEM NO.	PART NO.	DESCRIPTION
1	449-0630	COVER, MONITOR
2	651-0268	FASTENER, #8-32 U-TYPE
3	650-6160	SCREW, 10-32 X 1/2 TRUSS HD PHIL
4	654-0125	TERMINAL LUG, 0.200 HOLE X 1/4 IN. SPADE
5	220-1964	GROUNDING CABLE ASSEMBLY
J	220 1004	(REQUIRES ITEM 30 FOR INSTALLATION)
		(11201120112011011101110111)
6	270-3289	YOKE ASSY (LESS MAGNETS)
•	320-0126	MAGNET, 11 GAUSS
	320-0127	MAGNET, 20 GAUSS
	320-0128	MAGNET, 12 GAUSS
	0.00	
7	340-0111	TUBE, C/R 12 IN. (LESS YOKE ASSY)
8	462-0610	STANDOFF, 3/8 HEX X 1-5/8 IN. LONG
9	653-6000	WASHER
10	449-0631	BEZEL, MONITOR
		<b></b> ,
11	650-4121	SCREW, 8-32 X 3/8 PHIL HD FLT (WHITE)
12	650-9077	SCREW, 1/4-28 X 1-3/4 HEX
13	449-0635	BELLOW, SLEEVE
14	449-0626	COLLAR, BALL JOINT
15	478-0805	BALL JOINT
.0	.,,,	
16	449-0627	BASE, MONITOR
17	449-0625	CAP SPRING
18	652-0064	STOP NUT, 1/4-28
19	650-3160	SCREW, 6-32 X 1/2 PAN HD PHIL
20	655-0286	FOOT, 5/8 X 1/8 SELF-ADHESIVE
	000 000	, , , , , , , , , , , , , , , , , , , ,
21	449-0596	KNOB
22	449-0629	HOLDER, PCB UPPER
23	449-0628	HOLDER, PCB LOWER
24	653-4001	WASHER
25	651-0052	SCREW, 8 X 1/2 SELF TAP PAN HD PHIL
26	451-4985	BRACKET (INCLUDED WITH ITEM 29)
27	220-1263	WIRE AND LUB ASSY (INCLUDED WITH ITEM 29)
28	421-0001**	CABLE ASSY, I/O
29	210-8244**	PCA, MONITOR
•	210-8344**	PCA, MONITOR
30	452-2737	CLIP, SPRING
31	653-6006	WASHER
32	465-1637	SPRING (INCLUDED WITH ITEM 5)

#### \*\* DENOTES RSL ITEM

Table I-4-2 TTL Monitor Parts List

\_\_\_ 5. Disconnect the CRT neck socket connector from the CRT socket.

#### CAUTION

Discharge any possible High Voltage that may be present on the CRT by shorting the High Voltage connector to ground before proceeding.

- pinching the wire clip together with a pair of long nose pliers. This can be done by pinching the outside of the plastic cover just above the plastic washer that lies flat on the CRT. Unscrew the monitor board holding screw in the angle bracket that holds the board to the faceplate, with the long shafted, flat blade screwdriver to release the board. Since this screw is spring loaded to release, and retained in its angle bracket, it is easier to remove and replace by laying the monitor face down on the table.
- \_\_\_\_ 7. Reverse steps 1 through 6 to reassemble the monitor.

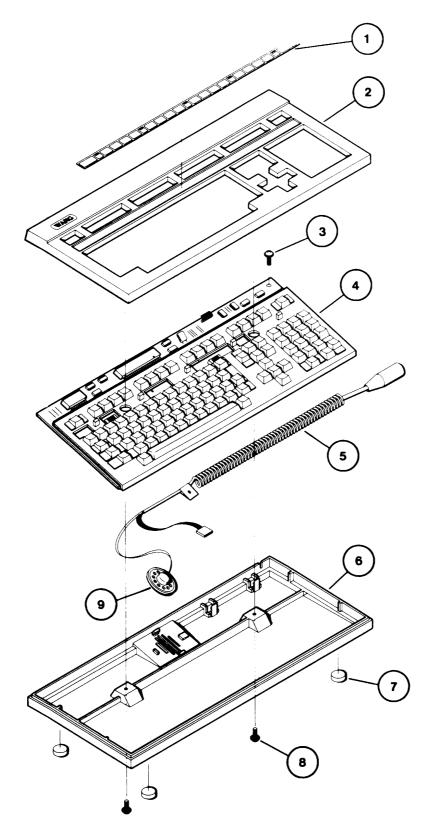


Figure I-4-3 Low Profile Keyboard IPB

#### KEYBOARD DISASSEMBLY

- 1. Disconnect the keyboard cable from the system unit.
- 2. Turn the keyboard over, set it on a flat surface and remove the two screws from the bottom of the unit that hold the assembly together.
- 3. While holding the assembly together, turn it back over and set it down on the flat surface in its normal position.

## CAUTION

If the assembly is not held together while turning it over the three parts will separate and one, or both of the two speaker wires will break off, either at the speaker solder joints or at the Jl connector on the PC board.

- 4. Remove the top cover and disconnect Jl from the top center of the PC board, being careful not break the speaker wires.
- 5. Remove the Cable Clamp screw from the top, right corner of the PCA to release the cable from the PCA.
- 6. Remove the PC Board/Key assembly from the bottom cover, being careful to leave the J1 plug and cable assembly in the bottom cover.
- 7. Reverse steps 1 through 5 to reassemble the keyboard.

#### LOW PROFILE KEYBOARD ASSEMBLY

ITEM NO.	PART NO.	DESCRIPTION
	279-2042-US**	UNI/KBD-US (UNITED STATES)
	279-2042-UK**	UNI/KBD-UK (UNITED KINGDOM)
	279-2042-SL**	UNI/KBD-SL (SPANISH-LATIN AMERICAN)
	279-2042-AZ**	UNI/KBD-AZ (AZERTY)
	279-2042-GE**	UNI/KBD-GE (GERMAN EXPANDED)
1	615-2059	STRIP, FUNCTION
2	449-0608	COVER, TOP (NON-EXPANDED)
	449-0611	COVER, TOP (EXPANDED)
3	650-4120	SCREW, 8-32 X 3/8 PAN HD PHIL
_	652-0029	LOCKNUT (USE WITH ITEM 3)
4	725-2738-US	KEYBOARD, UNIVERSAL KTC LOW PROFILE (US)
	725-2738-UK	KEYBOARD, UNIVERSAL KTC LOW PROFILE (UK)
	725-2738-SL	KEYBOARD, UNIVERSAL KTC LOW PROFILE (SL)
	725-2738-AZ	KEYBOARD, UNIVERSAL KTC LOW PROFILE (AZ)
	725-2739-GE	KEYBOARD, UNIVERSAL EXP. KTC LOW PROFILE (GE)
5	220-0305	CABLE ASSEMBLY
6	449-0607	BASE, KEYBOARD
7	655-0286	FOOT, 5/8 DIA X 1/8 THICK SELF ADHESIVE
	655-0291	FOOT, 5/8 DIA X 1/16 THICK SELF ADHESIVE
8	650-4160	SCREW, 8-32 X1/2 PAN HD PHIL
9	320-0306	SPEAKER, ROUND 2 IN. 8 OHM LOW PROFILE

<sup>\*\*</sup> DENOTES RSL ITEM

Table I-4-3 Low Profile Keyboard Parts List

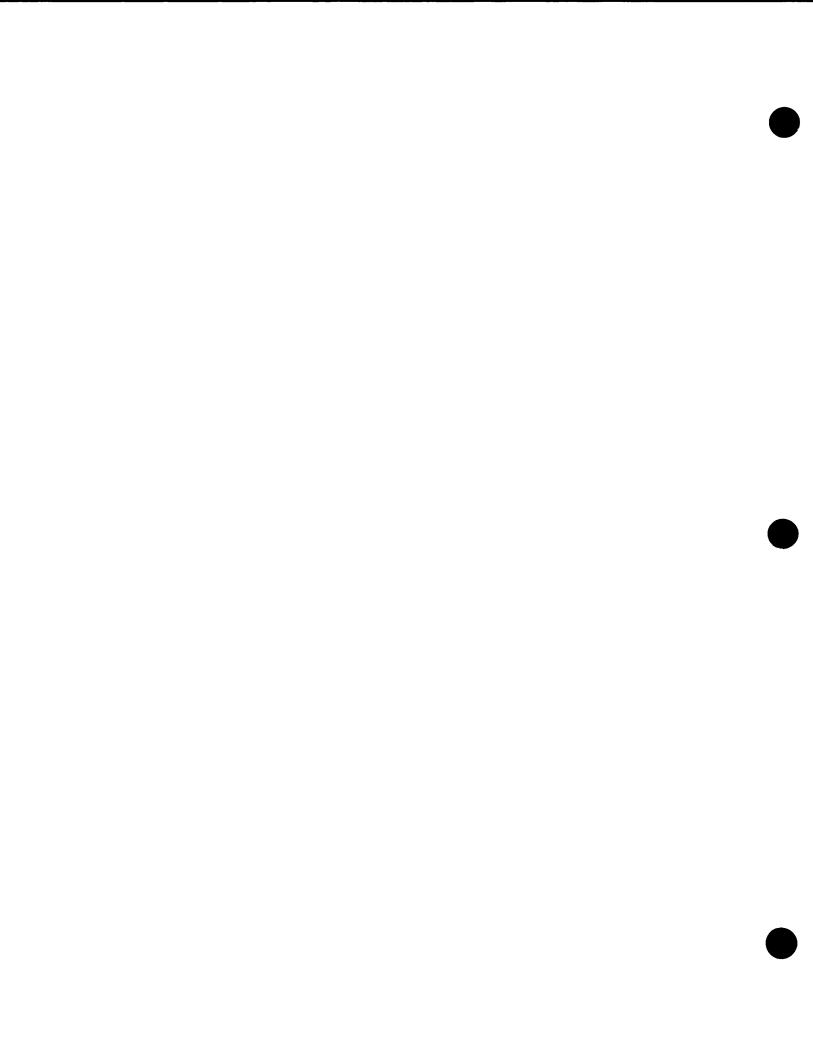
#### REASSEMBLY CHECK OUT PROCEDURE

	1.	Connect the monitor cable and the keyboard cable to the System Unit and connect the AC power cord to the System Unit.
·····	2.	Insert the MS-DOS System Program Diskette into floppy drive A, latch the drive door and turn on the system unit power.
	3.	Check that the power supply fan at the rear of system unit is turning, and that the floppy drive LED illuminates after a few seconds.
	4.	Observe that the monitor displays the MS-DOS title after the program loads and requests the date and current time be entered.
	5.	Enter the date and time from the keyboard and the MAIN MENU should be displayed. This is confirmation that you have reassembled the system correctly.

---- END ----

# PART I SECTION 5

# PROFESSIONAL COMPUTER ADJUSTMENTS AND ALIGNMENTS



#### SECTION 5

#### PROFESSIONAL COMPUTER ADJUSTMENTS AND ALIGNMENTS

#### **OBJECTIVES**

Upon completion of this section you will be able to:

- 1. Properly adjust the motor speed on the Tandon and MPI Floppy Drives for disk rotation of 300 RPM.
- 2. Perform the Radial-Track alignment on the Tandon and MPI Floppy Disk Drives.
- 3. Perform the Index-To-Data alignment on the Tandon and MPI Floppy Disk Drives.
- 4. Properly adjust the Track Zero end-stop on the MPI Floppy Drive.
- 5. Completely align the Wang Monitor for the display of both characters and graphics.

#### INTERACTIVE INSTRUCTIONS

First read the GLOSSARY OF TERMS for this section then view SECTION 5 of the WANG Professional Computer VIDEO TAPE. After viewing the Video Tape answer the questions in the INTERACTIVE QUIZ for this section. Take your time and if you can't remember the answer to any of the questions refer to PART II, SECTION 5 of this WORKBOOK. All the material contained in the Video Tape is in PART II of this WORKBOOK.

Once you have completed the INTERACTIVE QUIZ check your answers against the correct answers in Appendix B. Remember, these quizzes are designed to help you learn the material presented in the Video. So if you did miss any of the questions, going over them again helps you remember those points later.

After you have completed the Interactive Quiz do Lab. Exercise # 5-1 starting on page I-5-11. The Lab. Exercises are the most important part of this Training Course because they give you the hands-on experience necessary to perform professionally at the Customer's Site. You have seen it done on the Video Tape, now you do it. If you encounter problems with the Lab. go back and view that portion of the video tape over. Remember, this is a self-paced course. Your responsibility is to completely learn the course material, even if it takes longer than you anticipated.

When you complete the Lab. Exercise proceed to Section 6 of this workbook.

#### SECTION 5

#### GLOSSARY OF TERMS

AC Alternating Current.

Barreling The lines displayed on a CRT are not straight as

they should be, but rounded out (curve) away from

the center of the screen.

Cat's-Eye-Pattern Two adjacent diamond shaped patterns displayed on

the oscilloscope used for the Radial-Track

alignment.

DC Direct current.

Index-To-Data The delay time between the Disk Index pulse and

the start of the data read from, or written to the

disk. This delay is necessary to compensate for

variations in motor speed and the diskettes

themselves, since the Index pulse is generated by

a hole in the diskette.

Microsecond One millionth of a second  $(1 \times 10)$  to the minus 6

seconds).

Millisecond One thousandth of a second (1  $\times$  10 to the minus 3

seconds).

Millivolt One thousandth of a volt  $(1 \times 10)$  to the minus 3

volts).

MPI Micro Peripherals Incorporated. The name of a

Company that manufactures disk drives.

## GLOSSARY - (CONTINUED)

Pincushioning

The lines displayed on a CRT are not straight as they should be, but sucked in towards the center of the screen.

Radial-Track Alignment

The carriage of a disk drive is mechanically positioned so that the Read/Write Heads mounted on the carriage are precisely over track 16 (used for alignment) on a standard precision alignment diskette.

Tandon

The name of a Company that manufactures disk drives.

TP

Test point.

# INTERACTIVE QUIZ 5-1

1.	The	tolerance o	of the DC voltages in the PC is			
	a)	5%				
	b)	10%				
	c)	15%				
	d)	20%				
2.	The DC voltages provided by the PC power supply are,					
	a)	Plus and m	ninus 5 volts, and plus and minus 20 volts.			
	b)		ninus 5 volts, and plus and minus 12 volts.			
			ninus 12 volts, and plus and minus 20 volts.			
	d)		ninus 5 volts, plus and minus 12 volts, and			
			ninus 20 volts.			
3.		A 12 volt supply voltage below, or above is out of tolerance.				
	15 0					
	a)	11.5,	12.5			
	b)	-	13			
	c)	11.4,	12.6			
	d)	10,	14			
4.	The	SPS-200 pow	er supply used in the PC EU is			
	a)	Field repa	irable.			
	b)	A linear power supply.				
	c)	Self destructive.				
	d)	A FRU.				

٥.	rne	rioppy Drive motor speed is
	a)	300 RPM.
	b)	360 RPM.
	c)	Variable.
	d)	3600 RPM.
6.	A F1	oppy Drive in a system connected to 115 volts has
	corr	ect motor speed when the
	a)	Inner timing marks on the spindle pulley are stationary.
	b)	Outer timing marks on the spindle pulley are stationary.
	c)	Disk drive diagnostic passes.
	d)	Spindle pulley belt is running smoothly.
7.		must be used for the Motor speed adjustment
	to w	ork properly.
	a)	Incandescent light
	b)	A strobe light
	c)	Fluorescent light
	d)	An arc lamp
8.	When	making the Radial-Track Alignment the O'scope TIME BASE
	must	be set for
	a)	20 milliseconds.
	b)	20 microseconds.
	c)	50 millivolts.
	d)	50 microvolts.

9.	The disk alignment program is			
	a) b) c) d)	On the Diagnostic Diskette.  Accessed by typing "M" in the floppy diagnostic.  Accessed by typing "D" as soon as the B.I.T. completes.  In the B.I.T.		
10.		special equipment used in addition to a O'scope to orm the Radial-Track alignment		
	a) b) c) d)	An "offset" screwdriver. An insulated alignment tool. An Alignment Diskette, W.L.I. Part No. 726-8068. A small magnet.		
11.		performing the Radial-Track alignment on the Tandon e the Cat's Eyes must		
	a) b) c) d)	Be within 80 % amplitude of each other.  Be within 75 % amplitude of each other.  Both be equal in amplitude.  Be within 80 % width of each other.		
12.	Track is used for the Index-To-Data adjustment.			
	a) b) c) d)	Zero One Two Forty		
	-,	,		

The \_\_\_\_\_ must be depressed on the keyboard 13. to drive the heads to Track One. Zero key a) b) One key c) Two key d) Three key What is moved to accomplish the Index-To-Data adjustment? The Index Photo Cell a) b) The Index LED c) The Index switch d) The Index Hole 15. What does the Track 00 End Stop actually do? It stops the carriage at Track Zero. a) b) It seeks to Track Zero. It prevents a "Head Crash". c) It protects the mechanism in the event the electronics d) fails. What must be displayed on the Monitor Screen while adjusting the Monitor on a PC System without the Graphics Option. The Monitor Attributes. a) The "HO" test pattern. ъ) c) The Wang LOGO. d) The Monitor Alignment Screen.

17.	Moni	tor Board <sub>l</sub>	potentiometer	R45 allows	what to be	adjusted?
	a)	Vertical l	hold.			
	b)	Horizonta	l hold.			
	c)	Horizonta	l width.			
	d)	Horizonta	l linearity.			
18.	The Graphics Monitor Alignment program is					
	call	ed	, an	d it runs u	ınder	•
	a)	MONALIGN,		BASIC.		
	ъ)	BUSINESS (	GRAPHICS,	Application	ons.	
	c)	WANG GRAPI	HICS,	BASIC.		
	d)	GRAPHO,		BASIC.		
19.			or is properl			
	a)	squares	Grid Patter	n	1 inch by	l inch.
	b)	circles	Measurement	Pattern	perfectly i	cound.
	c)	size	Grid patter	n	6 by 8 inch	nes.
	d)	circles	Measurement	Pattern	2 inches in	diameter.
20.	The	two tab rin	ngs around th	e CRT neck	are used to	
	a) Adjust the deflection coils.					
	b) Eliminate blooming.					
	c)	c) Ground static electricity.				
	d)	Center the	e display pat	tern in the	screen.	

# TANDON FLOPPY DRIVE ALIGNMENTS AND ADJUSTMENTS

NAME		<del></del>
	Start Time	End Time
	<u> </u>	:
	:	:

#### TANDON FLOPPY DRIVE ALIGNMENTS AND ADJUSTMENTS

<u>DIRECTIONS</u>: It is important to perform the steps of this Lab

Exercise in the order given to achieve the maximum benefit from this procedure. When completed return

this exercise to the Instructor for grading.

OBJECTIVES: Upon completion of this exercise you will be able to

properly align the Tandon Floppy Disk Drive and verify

that it is in alignment.

#### MATERIAL REQUIRED:

1. PC System, Configuration PC-004

- 2. PC MS-DOS Operating System diskette
- 3. Alignment Diskette
- 4. Wang CE Tool Kit
- 5. Fluke Multimeter (Volt/Ohmeter)
- 6. Dual channel Oscilloscope (Tektronix 465 or equivalent)
- 7. A flat-blade, nonmetallic, alignment screwdriver

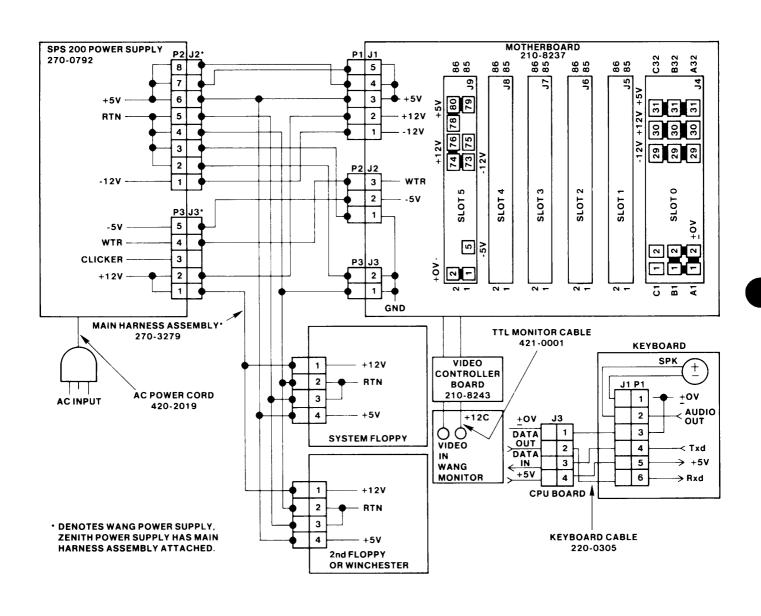


Figure I-5-1 Power Distribution and Interconnection Diagram.

#### TANDON FLOPPY DISK DRIVE ALIGNMENT

- 1. Remove System Unit cover per steps 1, 2 and 3 of Lab
  Exercise # 2-1 on page I-2-21 and set the system unit on
  its side, power supply down.
- 2. Reconnect the AC power cord and the keyboard cable to the system unit and turn on the power.
- 3. When the B.I.T. completes depress the "M" key to access the Disk Alignment Program. Verify that the program is working by depressing the "4" key to drive the heads to track 40, then depress the "1" key to drive the heads back to track zero. Insert the Alignment Diskette into Floppy Drive A and close the drive door.
- 4. Using your multimeter supplied, check the voltages at the Jl connector pins on the motherboard as follows:

Pin 3, + 5 Volts 
$$\pm$$
 5% (4.75 to 5.25 VDC)

If either voltage is out of tolerance report it to your Supervisor.

5. Remove the front plate holding screw from floppy drive A, slide it out as far as its cables will allow and view the spindle pulley through the slot in the bottom cover plate of the drive. With fluorescent lighting shining through the slot, the outer timing marks on the spindle pulley should appear stationary when the drive motor is running at the correct speed.

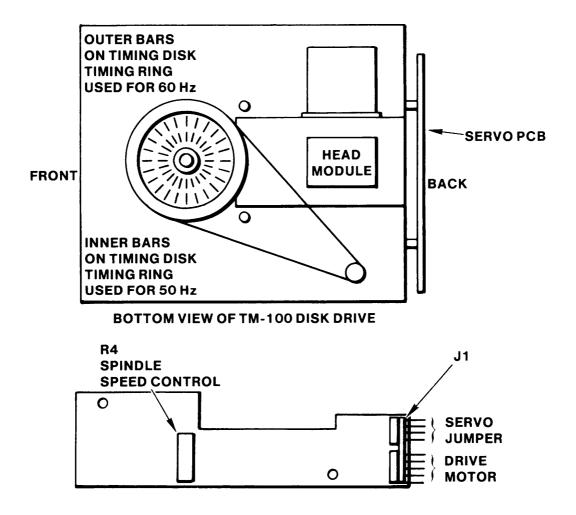


Figure I-5-2 Tandon Motor Speed Adjustment

## TANDON DRIVE MOTOR SPEED ADJUSTMENT

6. With an insulated screwdriver, rotate R4 on the servo board at the rear of the floppy drive while viewing the timing marks. They will start to turn as you turn R4. Readjust R4 to its proper setting with the marks stationary.

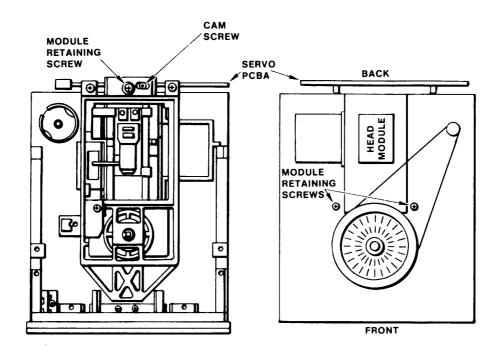


Figure I-5-3 Tandon Head Module Retaining Screw Locations.

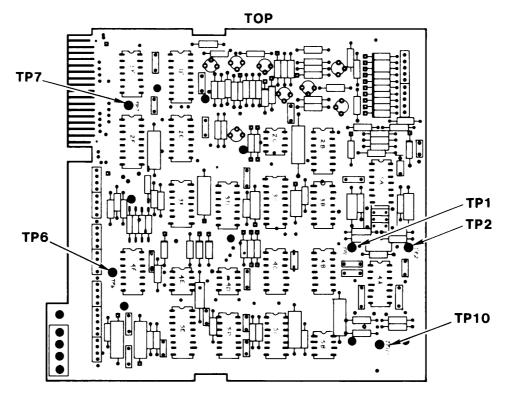


Figure I-5-4 Tandon PCB Test Point Locations

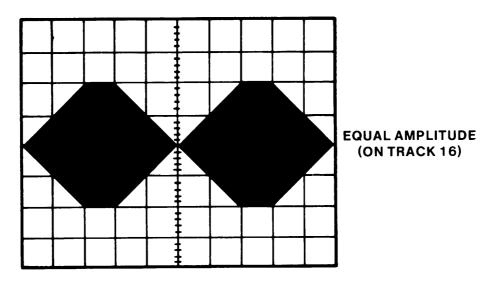
#### TANDON DRIVE RADIAL-TRACK ALIGNMENT

4.

to track 0.

1. Set the System Unit on its side, power supply down, and pull floppy drive A out as far as its cables will allow and loosen the two module retaining screws - accessible through the 2 holes in the bottom plate - 1/2 turn counterclockwise. 2. Set the System Unit back in its normal desk-top position and loosen the top module retaining screw 1/2 turn counterclockwise and leave the System Unit in this position with the floppy drive loose in its slot. 3. Turn power back on and wait for the B.I.T. to complete. This is indicated by the display message "System will Start From DEVICE A". Within 5 seconds type in "M" and the following message will be displayed on the screen. 1 - RECAL 2 - CYL 1 3 - CYL 16 4 - CYL 40 5 - RS232 LOOP 6 - RERUN BIT

Depress the number "1" key on the keyboard to step the head



TIME SCALE = 20 ms/Div

Figure I-5-5 Cats Eye Pattern

\_\_\_\_ 5. Set up the Scope as follows:

Scope Channel A to TPl on the drive PCB Scope Channel B to TP2 on the drive PCB Ground the Scope probes to TP10

Read Differentially: A plus B, B inverted Time Base: 20 milliseconds per division

Amplitude: 50 Millivolts per division

Coupling: AC

External Trigger: TP7 with probe ground to TP6

- \_\_\_\_ 6. Depress the number "3" key to drive the head to track 16 and adjust the scope to display the "CATS EYE" pattern.
- 7. Verify that both CAT EYES are within 80 % amplitude of each other and record the exact amplitude of each EYE.

8. Drive the heads to track 0 by depressing the number "1" key, then back to track 16 with the number "3" key and repeat step 7. 9. Drive the heads to track 40 by depressing the number "4" key, then back to track 16 with the "3" key and repeat step 7. 10. With the heads at track 16, turn the adjusting cam screw clockwise with a flat blade screwdriver while watching the CATS EYE pattern on the scope. You are now missadjusting the RADIAL-TRACK alignment and one of the "EYES" will decrease while the other one increases. Keep turning the cam until the process reverse and the the small "EYE" starts increasing. 11. Now adjust the cam for equal amplitude of both eyes, then readjust slightly so your EYES are equal in amplitude to your recorded values for track 16 for both heads. 12. Tighten the 3 module retaining screws and repeat steps 7 through 9 to verify your alignment. If any of the tracks/heads do not agree with your original readings loosen the 3 retaining screws and readjust the cam, then be sure to tighten the screws.

#### IMPORTANT

If you are unable to meet the tolerance called out in step 7 of this procedure the Tandon Floppy Drive must be REPLACED.

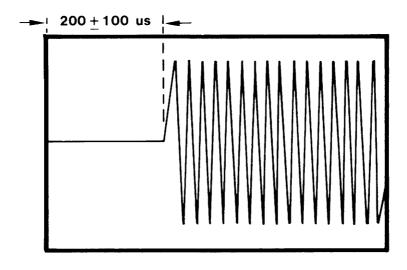


Figure I-5-6 Index-To-Data Burst Alignment Pattern

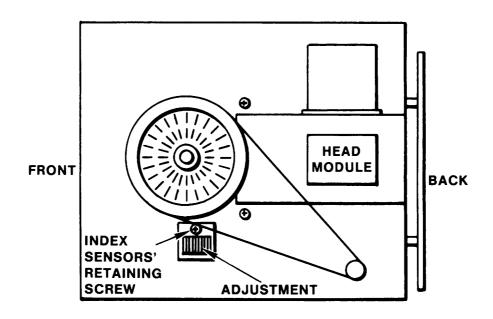


Figure I-5-7 Tandon Index Sensor Adjustment

TANDON IN	DEX-TO-DATA ALIGNMENT
1.	Use the same scope set-up except change the time base to 50 microseconds per division.
2.	With power ON and the alignment diskette in the drive select track 1 with key "2" on the keyboard. The data pattern on the scope should start 200, plus or minus 100 microseconds from the start of the sweep.
3.	Loosen the Index to Data sensor retaining screw through the slot in the bottom cover 1/4 of a turn with a Phillips screwdriver.
4.	Slide the sensor back and forth while watching the scope pattern. The start-of-trace to data gap should increase as the sensor is moved in one direction and decrease in the other direction.
5.	Return the sensor to its original position for a gap of 200, plus or minus 100 microseconds and tighten the retaining screw.
TANDON WR	ITE PROTECT SWITCH ADJUSTMENT
1.	To check the Write-Protect Switch refer to Figure I-5-5 on page I-5-18 connect the scope as follows:  Channel A scope probe to TP9.  The channel A probe ground clip to TP6.  Set the time base to 50 milliseconds.  The vertical amplitude to 2 volts.  Set the trigger mode to automatic.
	Set the trigger source to internal.

 2.	Switch the channel A voltage input switch to ground and adjust the trace to the center line. Now switch the voltage input switch to DC and the trace should move up approximately two divisions, or plus four volts DC.
 3.	Remove the Alignment diskette from the drive and the scope trace should drop down to zero volts.
 4.	Insert a diskette into the drive that does not have a write protect tab on it, and close the door. The trace should move back to plus 4 volts as the diskette is being inserted, then drop back down to zero volts when it is fully inserted.
 5.	Power down the system, remove the floppy drive, loosen the two write protect switch mounting screws, and adjust the switch position while sliding the diskette in, and partially out while listening to the switch clicks. When the diskette hits the stops the switch should click closed, and as it starts out the switch should click open.
 6.	Tighten the screws, reinstall the drive and check it out under power.

----- E N D -----

# MPI FLOPPY DRIVE ALIGNMENTS AND ADJUSTMENTS

NAME		
	Start Time	End Time
	:	:

#### MPI FLOPPY DRIVE ALIGNMENTS AND ADJUSTMENTS

DIRECTIONS: It is important to perform the steps of this Lab

Exercise in the order given to achieve the maximum benefit from this procedure. When completed return

this exercise to the Instructor for grading.

OBJECTIVES: Upon completion of this exercise you will be able to

properly align the MPI Floppy Disk Drive and verify

that it is in alignment.

#### MATERIAL REQUIRED:

- 1. PC System, Configuration PC-004
- 2. PC MS-DOS Operating System diskette
- 3. Alignment Diskette
- 4. Wang CE Tool Kit
- 5. Fluke Multimeter (Volt/Ohmeter)
- 6. Dual channel Oscilloscope (Tektronix 465 or equivalent)
- 7. A flat-blade, nonmetallic, alignment screwdriver

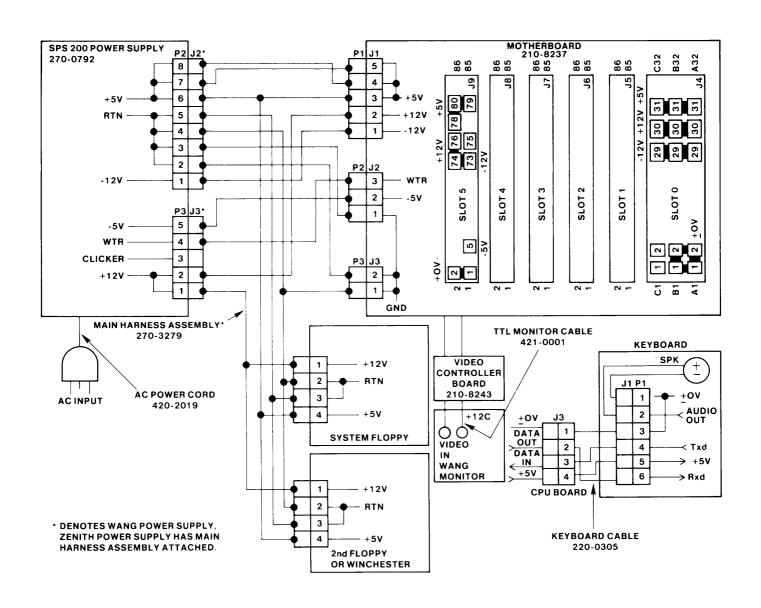


Figure I-5-8 Power Distribution and Interconnection Diagram.

#### MPI FLOPPY DISK DRIVE ALIGNMENT

- 1. Remove System Unit cover per steps 1, 2 and 3 of Lab Exercise # 2-1 on page I-2-21 and set the system unit on its side, power supply down.
- 2. Reconnect the AC power cord and the keyboard cable to the system unit and turn on the power.
- 3. When the B.I.T. completes depress the "M" key to access the Disk Alignment Program. Verify that the program is working by depressing the "4" key to drive the heads to track 40, then depress the "1" key to drive the heads back to track zero. Insert the Alignment Diskette into Floppy Drive A and close the drive door.
- 4. Using your multimeter supplied, check the voltages at the J1 connector pins on the motherboard as follows:

Pin 2, +12 Volts 
$$\pm$$
 5% (11.4 to 12.6 VDC)

Pin 3, + 5 Volts 
$$\pm$$
 5% (4.75 to 5.25 VDC)

If either voltage is out of tolerance report it to your Supervisor.

5. Remove the front plate holding screw from floppy drive A, slide it out as far as its cables will allow and view the spindle pulley through the slot in the bottom cover plate of the drive. With fluorescent lighting shining through the slot, the outer timing marks on the spindle pulley should appear stationary when the drive motor is running at the correct speed.

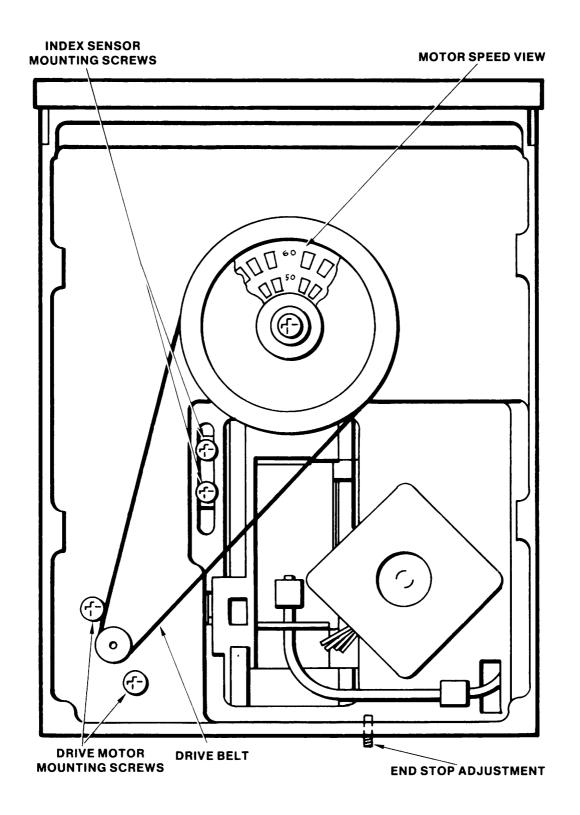


Figure I-5-9 MPI Floppy Drive Bottom View

# MPI DRIVE MOTOR SPEED ADJUSTMENT

\_\_\_\_ 6. Rotate R38 on the MPI PC Board while viewing the timing marks. They will start to turn as you turn R38. Readjust R38 to its proper setting with the marks stationary.

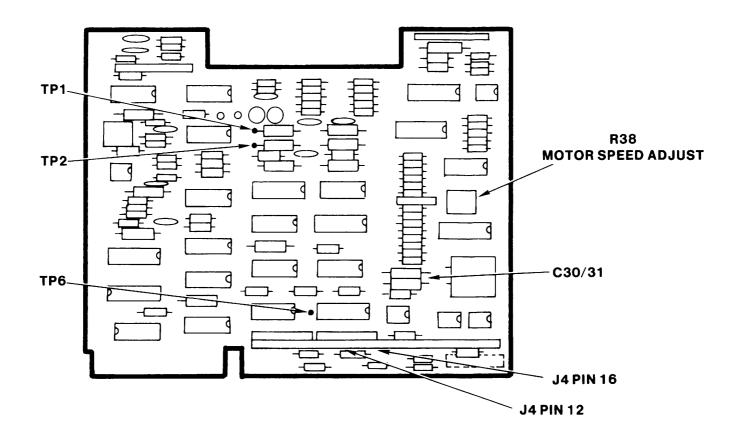


Figure I-5-10 MPI PCB Test Point Locations

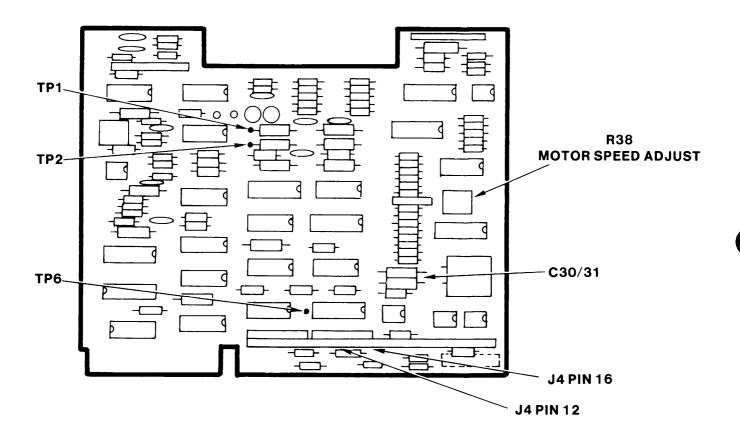


Figure I-5-11 MPI PCB Test Point Locations

# MPI FLOPPY DRIVE RADIAL-TRACK ALIGNMENT

1.	Insert the alignment diskette into the drive. Remove the drive retaining screw and slide the drive part way out of the EU.
2.	Power-Up the system, and when the power-up diagnostic completes, depress the M key to access the disk drive alignment program.
3.	Refer to Figure I-5-11, on the opposite page and Connect the scope as follows:
	Connect Channel A to TP1 Connect Channel B to TP2 Connect the probe ground clips to the ground leads of capacitors C30 and C31. Connect the external trigger to TP6. Set Channel A, and B voltage input for 50 millivolts AC. Select A plus B input, with channel B inverted. Set time base to 20 milliseconds. Set trigger to External trigger. Set coupling to AC, normal trigger mode, and a positive trigger level.
4.	Depress the number three key on the keyboard to drive the heads to track sixteen on the alignment diskette. Adjust the trigger level knob on the scope to display the Cat's-Eye pattern on the scope.
5.	Verify that both CAT'S EYES are within 80 % amplitude of each other and record the exact amplitude of each EYE.

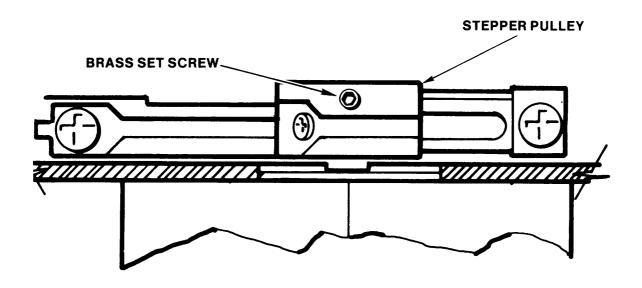


Figure I-5-12 MPI Stepper Motor Pulley and Band Assembly

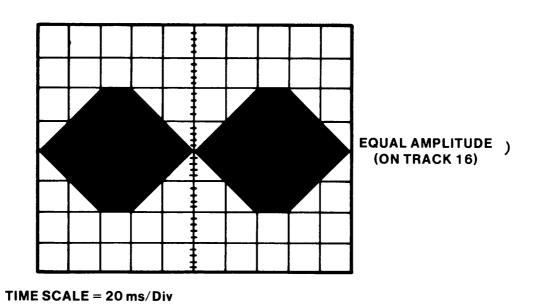


Figure I-5-13 Cats Eye Pattern

6. With the heads at track sixteen loosen the set screw in the stepper motor pulley with a 0.5 hex screw driver. 7. Carefully position the pulley until the Cat's-Eyes are equal in amplitude. This adjustment requires a little patience. When the Cat's-Eyes are equal gently tighten the set screw 8. for two inch-pounds of torque, while watching the scope. Caution here, too much torque will score the shaft, making future adjustment very difficult. If the Cat's-Eyes slip out of tolerance while tightening the set screw, do the adjustment over and compensate for the direction of slippage. 9. To verify the adjustment depress the number one key on the keyboard to drive the heads to track zero, then depress the number three key to drive the heads back to track 16. Cat's-Eye pattern should be the same. Now move the heads to track 40 by depression the number 10. four key, then back to 16 with the number three key. again the Cat's-Eye should be the same. If not, the alignment will have to be done over.

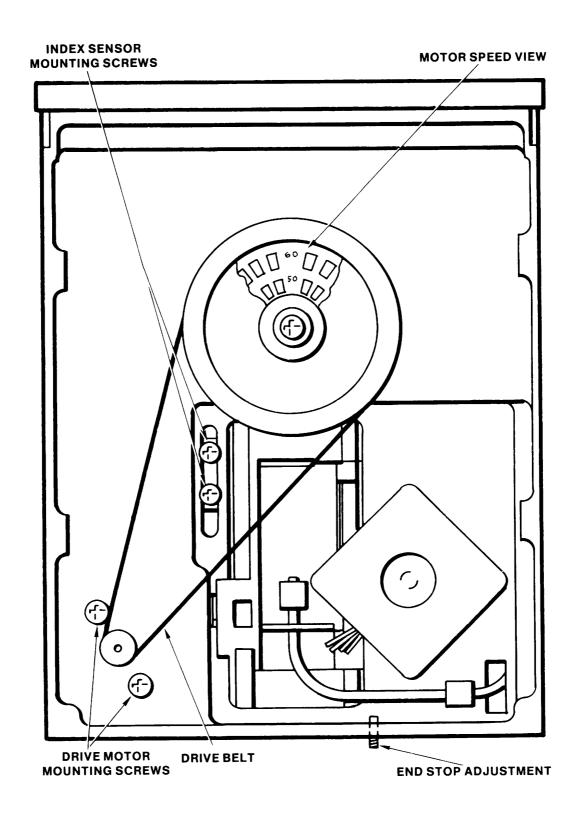


Figure I-5-14 MPI Floppy Drive Bottom View

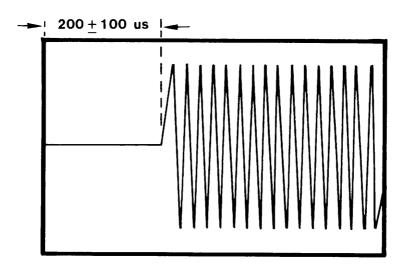


Figure I-5-15 Index-To-Data Alignment Pattern

#### MPI FLOPPY DRIVE INDEX-TO-DATA ADJUSTMENT

- 1. To check the Index-To-Data alignment, change the scope time base to 50 microseconds, the channel A and B voltage range to 0.1volt, and the trigger coupling to DC. Leave all the other scope settings and connections as is.
- 2. Depress the number 2 key to drive the heads to track one, and adjust the trigger level knob on the scope to display the data burst. The start of the data burst should be 200 microseconds from the start of the sweep, plus or minus 100 microseconds.
- 3. To adjust the Index-To-Data sensor loosen the two sensor retaining screws through the access hole in the bottom plate about one quarter of a turn.

- 4. Using the tip of the screwdriver in the slotted screw holes, slide the sensor assembly back and forth while watching the scope. Adjust the start of the data burst approximately four division marks to the right of the left side of the screen.
- \_\_\_\_ 5. Then carefully tighten the retaining screws while watching the scope.

## CAUTION:

Do not over tighten these screws as you might crack the sensor mounting block.

#### MPI TRACK ZERO END STOP ADJUSTMENT

- 1. Whenever the Radial-Track adjustment is made the Track Zero end stop must be checked.
- 2. With power applied and the disk alignment program accessed depress the four key, then the one key for a maximum track seek. The carriage should stop within 10 thousandths of an inch from the End Stop set screw.
- \_\_\_\_ 3. If this is not the case adjust the set screw to meet the ten thousandths tolerance.

#### MPI WRITE-PROTECT SENSOR CHECK

1. To check the Write Protect sensor refer to Figure I-5-11 on page I-5-32 and connect the scope as follows:

Connect Channel A probe to J4 pin 16 Connect the probe ground clip to C31 Set the time base to 50 milliseconds Set Channel A amplitude for 2 volts/cm Set Trigger mode to automatic Set the Trigger Source to internal

- 2. Switch the channel A input to ground and adjust the scope trace to the horizontal center line. Then switch it to DC and the trace should move up approximately two divisions.
- 3. Remove the Alignment diskette and the trace should drop to zero. Insert a diskette without a write protect tab and the trace should go to 4 volts while the diskette is being slid in, then drop to zero when it is fully inserted. Do this twice to make sure the sensor is working properly. If the sensor is faulty the drive will have to be replaced.

----- E N D -----

LABORATORY	EXERCISE	#	5-	. 3
------------	----------	---	----	-----

## WANG MONITOR ALIGNMENT FOR CHARACTER DISPLAY ONLY

NAME		
	Start Time	End Time
	:	<u> </u>
	:	:

#### WANG MONITOR ALIGNMENT FOR CHARACTER DISPLAY ONLY

<u>DIRECTIONS</u>: It is important to perform the steps of this Lab

Exercise in the order given to achieve the maximum benefit from this procedure. When completed return

this exercise to the Instructor for grading.

OBJECTIVES: Upon completion of this exercise you will be able to

properly align the Wang Monitor for character display

only, and verify that it is in alignment.

#### MATERIAL REQUIRED:

1. PC System, Configuration PC-004

- 2. PC Diagnostic Diskette
- 3. Wang CE Tool Kit
- 4. A flat-blade, nonmetallic, alignment screwdriver
- 5. A long, flat-blade, nonmetallic alignment tool
- 6. A six inch plastic scale
- 7. An eight inch plastic scale

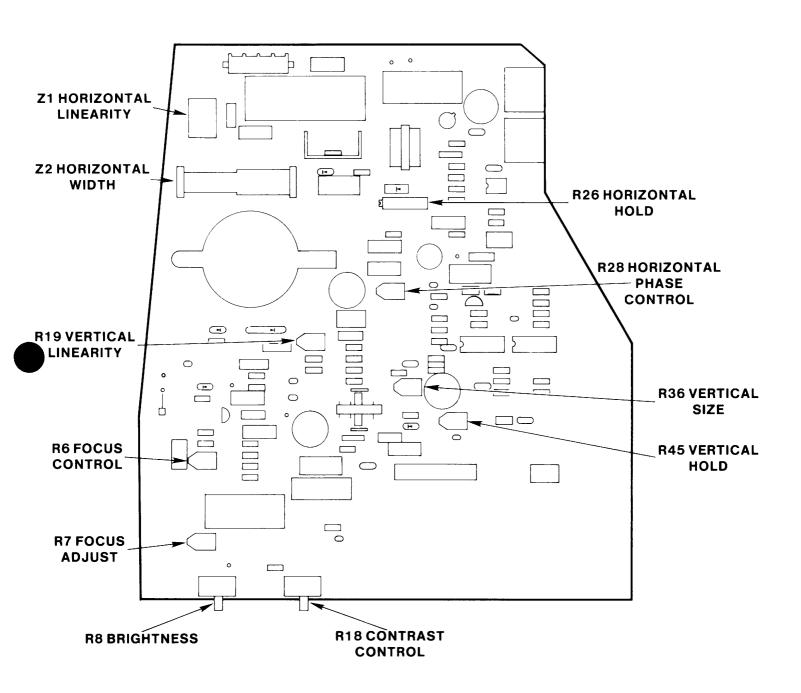


Figure I-5-16 8244 Monitor Board Test Point Locations

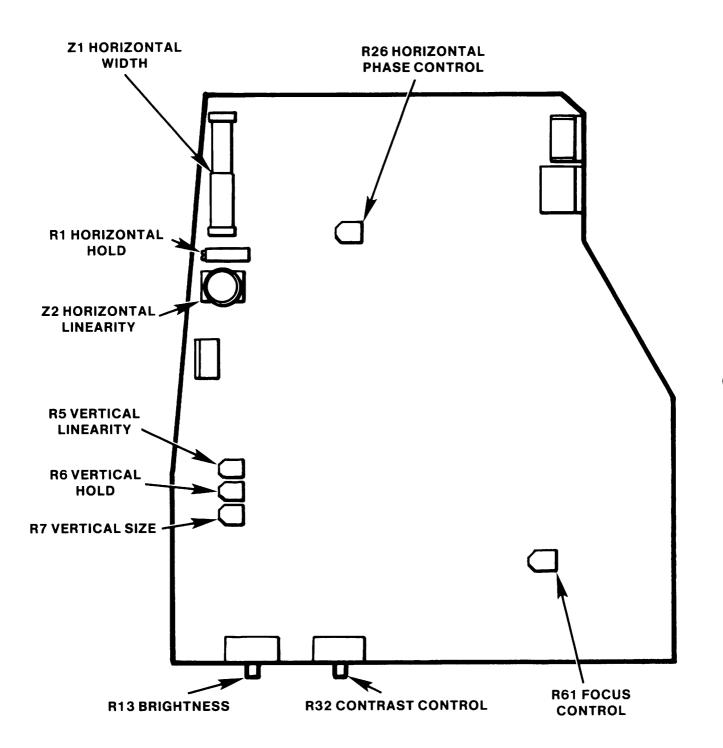


Figure I-5-17 8344 Monitor Board Test Point Locations

## WANG MONITOR ALIGNMENT FOR CHARACTERS ONLY

1.	First remove the Monitor cover, reconnect the cable, insert the Diagnostic Diskette into the A drive, and power up the system.
2.	When the Customer Disclaimer Screen comes up hold down the "SECOND" key and depress the "D" key, then the "M" key to display the C-E Menu.
3.	Depress RETURN, and the SPACE BAR to select "Select By Manual Entry", then depress EXECUTE to display all the Diagnostic tests. Step down to the "Wang Monitor Attributes with the SPACE BAR and depress INSERT to select it, then depress execute to run the test.
4.	When the test stops with the Attribute Display depress the MOVE key to display the "HO" test pattern. This is the screen pattern we will use to adjust the Monitor.
5.	Adjust the vertical hold to the center of its stable range.
6.	Adjust the vertical size for a display height of 6 inches, or if you have a metric scale, 15.2 centimeters, with a tolerance of plus or minus one eighth inch, or 3 millimeters.
7.	Adjust the vertical linearity for character rows of equal height.
8.	Check the height again, and readjust if necessary. Then check for linearity again, and readjust if necessary.

 9.	Using the long alignment tool adjust the horizontal width coil for a display width of 8 inches, or 20.3 centimeters, plus or minus one eighth inch or 3 millimeters.
 10.	Adjust the horizontal linearity coil thumb wheel for equal character width across the screen.
 11.	Turn up the brightness control to display the raster and adjust the horizontal phase to center the whole character display in the raster.
 12.	Check the top row of characters for distortion, and using your long alignment tool, adjust the horizontal hold to remove the distortion.
 13.	Turn the Brightness back down until the raster disappears, and adjust the focus control for the best overall character display.
 14.	Power down the system and replace the Monitor cover.

----- E N D -----

LABORATORY	EXERCISE	#	5-4

# WANG MONITOR ALIGNMENT FOR CHARACTER AND GRAPHICS DISPLAY

NAME		
	Start Time	End Time
	:	:
	•	:

#### WANG MONITOR ALIGNMENT FOR CHARACTER AND GRAPHICS DISPLAY

<u>DIRECTIONS</u>: It is important to perform the steps of this Lab

Exercise in the order given to achieve the maximum benefit from this procedure. When completed return

this exercise to the Instructor for grading.

OBJECTIVES: Upon completion of this exercise you will be able to

properly align the Wang Monitor for character and

graphics display, and verify that it is in alignment.

#### MATERIAL REQUIRED:

- 1. PC System, Configuration PC-004
- 2. PC MS-DOS System Diskette
- 3. PC Diagnostic Diskette
- 4. Wang CE Tool Kit
- 5. A flat-blade, nonmetallic, alignment screwdriver
- 6. A long, flat-blade, nonmetallic alignment tool
- 7. A six inch plastic scale
- 8. An eight inch plastic scale

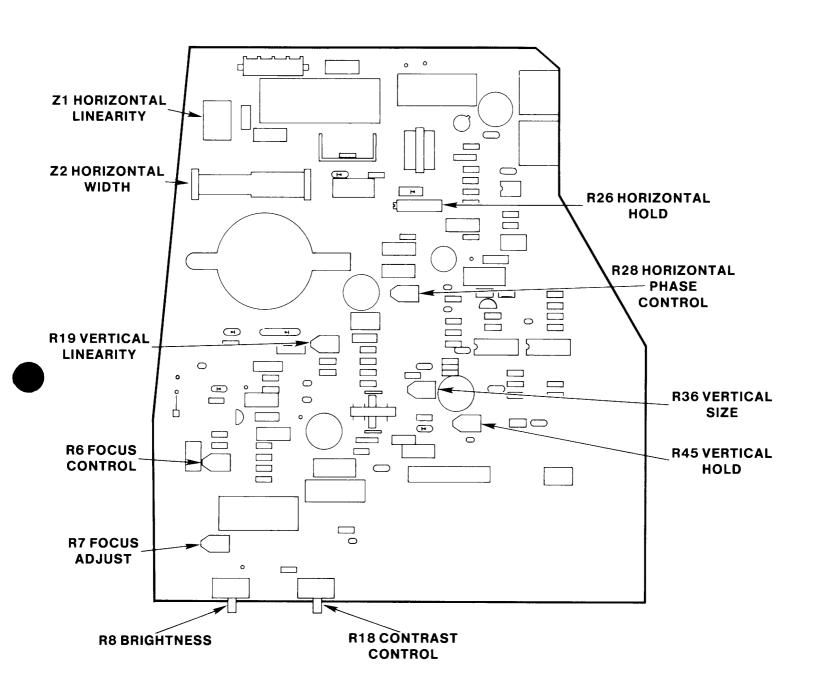


Figure I-5-18 8244 Monitor Board Test Point Locations

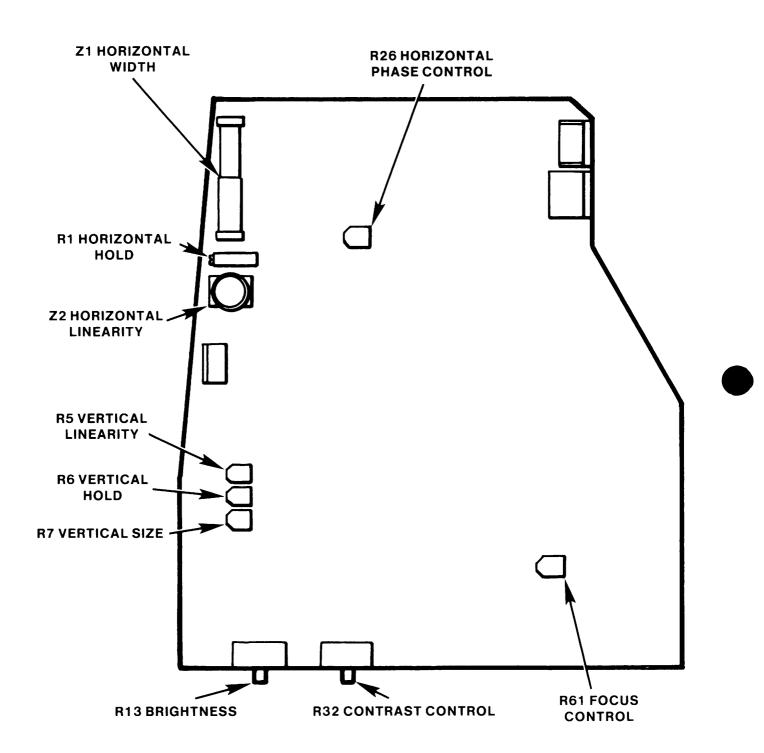
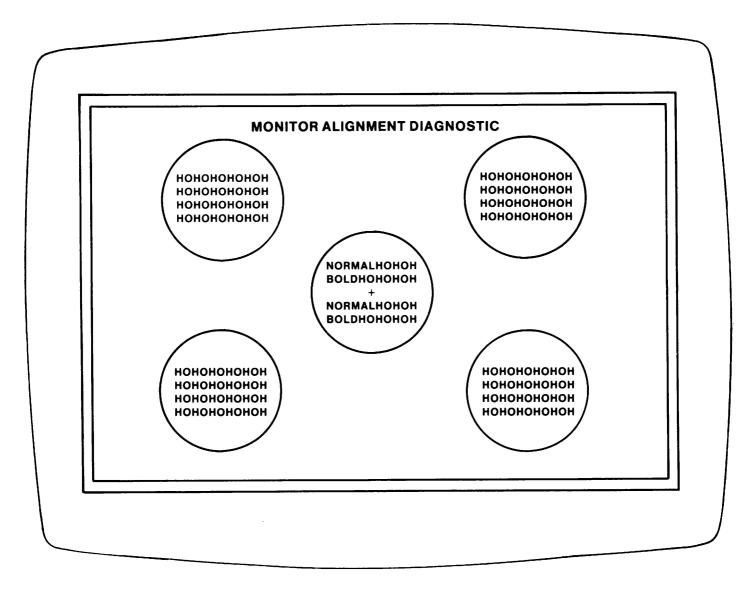
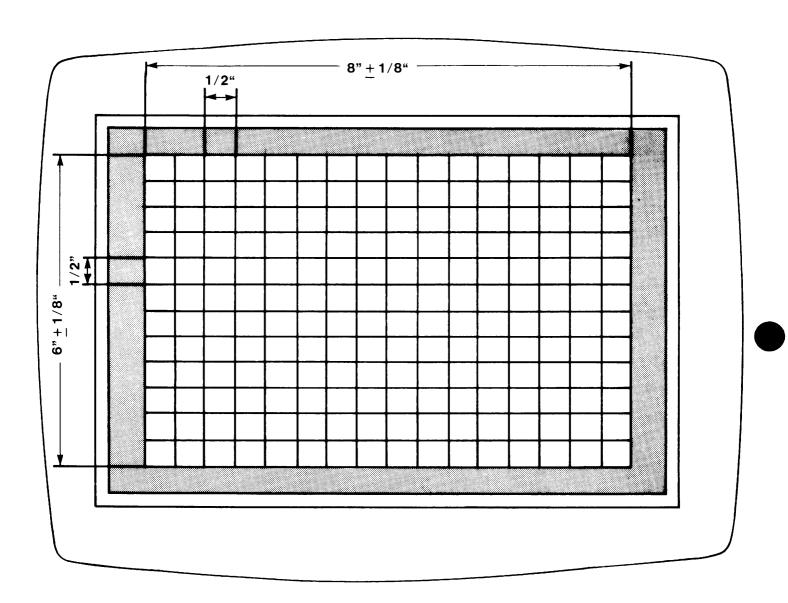


Figure I-5-19 8344 Monitor Board Test Point Locations



NOTE: NOT TO SCALE CIRCLES ARE 2 INCHES IN DIAMETER

Figure I-5-20 Monitor Graphics Alignment Screen



NOTE: NOT TO SCALE
GRID PATTERN HAS 16 VERTICAL X 12 HORIZONTAL SQUARES

Figure I-5-21 Monitor Graphics Alignment Grid Pattern

# WANG MONITOR ALIGNMENT FOR GRAPHICS AND CHARACTERS

1.	If your system has the graphics option insert the MS-DOS System diskette into Drive A and power up the system.
2.	When the System comes up depress EXECUTE to display the Main Menu, depress the SPACE BAR twice to select Program Development and depress EXECUTE to display its Menu.
3.	Depress EXECUTE again to load Basic and replace the System Diskette with the Diagnostic Diskette, after Basic Loads.
4.	Now type in LOAD, depress the SPACE BAR, type "MONALIGN" (Note, MONALIGN must be bracketed by quotation marks), and depress RETURN to load the Monitor Alignment program.
5.	When it comes up type "RUN", and depress RETURN to run the alignment program.
6.	When the program comes up read the directions displayed on the screen, and then depress the SPACE BAR to display the Inverse Video Screen, again for the Monitor Measurement Screen, and again to display the Grid Pattern, which is the pattern we will use for the basic alignment.
7.	First adjust the vertical hold to the center of its stable range.
8.	Adjust the horizontal hold to the center of its stable range. If the display had been out of sync, and rolling or tearing these adjustments will stabilize it.

9.	Adjust the vertical size for a display height of 6 inches, or 15.2 centimeters, plus or minus one eighth inch, or 3 millimeters.
10.	Adjust the horizontal width coil for a display width of 8 inches, or 20.3 centimeters, plus or minus one eighth inch, or 3 millimeters.
11.	Adjust the vertical linearity so the squares at the top of the screen are the same vertical size as the squares along the bottom of the screen. This adjustment affects the vertical height, so measure the display height again, and readjust if necessary.
12.	Turn up the brightness control to display the raster and adjust the horizontal phase to center the display matrix in the raster.
13.	Adjust the horizontal linearity coil so the width of the squares along the left margin are the same width as the ones along the right margin. Then recheck the total display width, and readjust if necessary.
14.	Adjust the two tabs around the CRT neck, one at a time to center the display, and eliminate any barreling, pincushioning, or distortion.
15.	Place your ruler parallel to the top matrix line, it should be straight to within plus or minus 1/16 of an inch, or 1.5 millimeters.
16.	Check the right, and left margins with the straight edge, they should also be straight to within plus or minus 1/16 inch, or 1.5 millimeters.

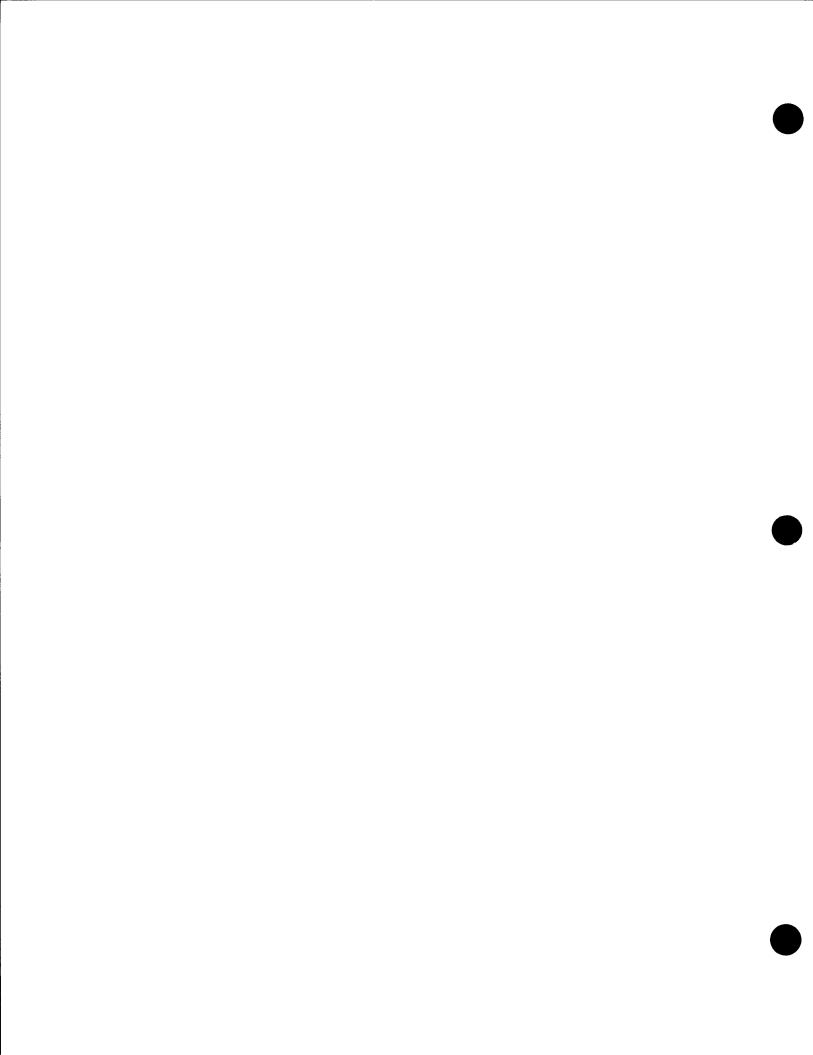
17.	If you cannot bring the display in tolerance with the centering tabs, adjust the pincushion magnets one at a time to remove pincushioning or barreling.
18.	Then check all the squares for $1/2$ inch, or $13$ millimeter sides, plus or minus $1/16$ inch or $1.5$ millimeters.
19.	If the vertical sides are out of tolerance readjust the vertical size and linearity slightly, and be sure to recheck the display height.
20.	If the horizontal sides of the squares are out of tolerance readjust the horizontal width and linearity slightly, and be sure to recheck the display width after adjusting the linearity.
21.	Depress the SPACE BAR twice to display the Measurement Pattern and check that the circles are perfectly round. They should measure 2 inches, or 51 millimeters in diameter. Usually any distortion is horizontal rather than vertical.
22.	Readjust the Horizontal Linearity, and the Horizontal Width. Now recheck the circles. If they are still distorted, adjust the Horizontal Hold potentiometer slightly to remove some of the distortion.
23.	Readjust the Horizontal Linearity and Width. Sometimes you will have to repeat these adjustments several times to make the circles perfectly round. Normally, if the Squares in the Grid Pattern are all in tolerance the circles will be okay.

24.	If you change the Horizontal Hold adjustment, then you must recheck the Horizontal Phase adjustment. Turn up the brightness to display the raster and check to see that the Grid Pattern is centered in the raster. If not readjust the Horizontal Phase.
25.	Finally, adjust the Focus Control for the best overall display pattern using the Circle Pattern.
26.	To adjust the Brightness and Contrast depress the SPACE BAR to display the Inverse Video Pattern. First adjust the Brightness control for normal viewing level.
27.	Next, adjust the Contrast Control for the best overall viewing level between the normal display level and the reverse video. Double-Check this adjustment by displaying the Circle Pattern.
28.	Power down the system, and replace the Monitor cover.

----- E N D -----

## PART I SECTION 6

# PROFESSIONAL COMPUTER SYSTEM TROUBLESHOOTING



#### SECTION 6

#### PROFESSIONAL COMPUTER SYSTEM TROUBLESHOOTING

#### **OBJECTIVES**

Upon completion of this section you will be able to:

- 1. Run and interpret the PC System Diagnostics.
- 2. Troubleshoot and repair the PC System by replacing the failed module (FRU).
- 3. Verify that the PC System is completely operational by running the appropriate tests.

#### INTERACTIVE INSTRUCTIONS

View SECTION 6 of the WANG Professional Computer VIDEO TAPE. After viewing the Video Tape answer the questions in the INTERACTIVE QUIZ for this section. Take your time and if you can't remember the answer to any of the questions refer to PART II, SECTION 6 of this WORKBOOK. All the material contained in the Video Tape is in PART II of this WORKBOOK.

Once you have completed the INTERACTIVE QUIZ check your answers against the correct answers in Appendix B. Remember, these quizzes are designed to help you learn the material presented in the Video so if you did miss any of the questions going over them again helps you remember those points later.

After you have completed the Interactive Quiz do Lab Exercise # 6-1 for this section. The Lab Exercises are a vital part of this Training Course because they give you the hands-on experience necessary to perform professionally at the Customer's Site. You have seen it done on the Video Tape, now you do it. If you encounter problems with the Lab go back and view that portion of the video tape over. Remember, this is a self-paced course. Your responsibility is to completely learn the course material, even if it takes longer than you anticipated.

After you complete the Lab Exercise proceed to Section 7 of this workbook.

# INTERACTIVE QUIZ 6-1

1.	B.I.	T. is an abbreviation for
	a) b) c) d)	Ballistic Interface Test.  Balanced Interface Test.  Big Initialization Test.  Built-In-Test.
2.	-	ower-up the system halts with a keyboard LED indication 0 0 1 1 1. What FRU is indicated as being the problem
	a) b) c) d)	The CPU Board The Keyboard The Medium Resolution Video Character Controller The Monitor
3.		the following message is displayed on the screen at r-Up what is wrong ?
		***40 NO AUTO-START DEVICE
	a) b) c)	The Floppy Drive(s) has/have failed.  Both Floppy Drive doors are open (not latched).  The Floppy Controller has failed.

The Floppy Drive does not have a diskette installed.

d)

4.	how	a bad keyboard or bad keyboard interface is indicated, do you determine whether its the keyboard or the rface on the CPU board?
	a) b) c) d)	Replace the keyboard with the "LOOP-BACK" connector and rerun the B.I.T.  Try another CPU Board.  Try another keyboard.  Run the Keyboard Diagnostic.
5.		do you access the Customer Engineer (C/E) Mode of the py Resident Diagnostics?
	a) b) c) d)	Depress Shift/Cancel.  Type "NO" when the Customer Disclaimer Comes up.  Hold down the "2nd" key and depress "D", then "M".  Type "C-E" and depress "EXECUTE".
6.		entry on the C/E Diagnostic Menu lists all the diagnostics when this entry is cted ?
	a) b) c) d)	Select by Diagnostic Select by Manual Entry Select by Option Card Repair Aids
7.	When	is the "HELP" key active ?
	a)	While a Diagnostic or group of Diagnostic tests are running.

8.	How is a Diagnostic Program Loop activated ?
	a) Depress the "FORMAT" key.
	b) Depress the "PAGE" key.
	c) Depress the "CENTER" key.
	d) Depress the "DEC TAB" key.
9.	If the PC Monitor has a raster that overshoots the top, and
	bottom of the screen and no video, the problem
	is
	a) The Video Controller Board.
	b) The CPU Board.
	c) The Monitor Board.
	d) The CRT.
10.	The whole PC Monitor must be replaced when thefails.
	a) High Voltage b) CRT
	c) Vertical deflection
	d) Horizontal deflection
	dy morraonear defrection
11.	A Keyboard failure is indicated by
	a) The keyboard "LEDs" blinking off and on.
	b) A constant Keyboard "tone".
	c) Intermittent "BEEPS" from the keyboard.
	d) Error message ***43.

12.	One thing to check when disk errors occur is
	a) The drive door.
	b) The power supply voltages.
	c) The power supply fan.
	d) The keyboard cable.
13.	If you have a two drive system and neither drive works
	replace
	a) Them both.
	b) The CPU Board.
	c) The power supply.
	d) The keyboard.
14.	On a two Drive System, if both floppy Drive terminators are
	left installed
	a) The system will run fine.
	b) Disk address problems will result.
	c) Disk write errors will result.
	d) Disk read errors will result.
15	Fatal CPU failure is indicated by
13.	ratar or or rarrier is indicated by
	a) Error 52 on the Monitor screen.
	b) One or more keyboard LEDs staying lit.
	c) All keyboard LEDs staying on and a constant tone.
	d) A flashing Monitor screen.

16.	Α	is necessary to check the Asynchronous
	inte	rface.
	a)	Loop-Back plug
	b)	Modem
	c)	Data Scope
	d)	"Null Modem"
17. To access t		ccess the RS232 Loop Test
	a)	Select the Serial Loop-Back test.
	b)	Depress the "M" key right after the B.I.T. completes.
	c)	Select the Parallel Loop-Back test.
	d)	Load the Diagnostics.
	-/	-oud the Diagnostics.
18. The Diagnostic Tests on the Manual Entry Menu are		Diagnostic Tests on the Manual Entry Menu are selected
		epressing the
	a)	"SPACE BAR".
	b)	"INDENT" key.
	c)	"INSERT" key.
	d)	"TAB" key.
19.		diagnostic test stops on an error you can resume
	test	ing by depressing the
	a)	"TAB" key.
	•	"MERGE" key.
		"CANCEL" key.
		"SEARCH" kev.

- 20. The Diagnostic Error Log is displayed \_\_\_\_\_
  - a) At the end of the current test.
  - b) At the end of all the diagnostic tests you selected.
  - c) By depressing the "COMMAND" key.
  - d) By depressing the "STOP" key.

# PROFESSIONAL COMPUTER CE VIDEO WORKBOOK

# LABORATORY EXERCISE # 6-1

# TROUBLESHOOTING

NAME		
	Start Time	End Time
	:	:

#### LABORATORY EXERCISE # 6-1

#### PROFESSIONAL COMPUTER SYSTEM TROUBLESHOOTING

DIRECTIONS: It is important to perform the steps of this Lab

Exercise in the order given to achieve the maximum benefit from this procedure. When completed return

this exercise to the Instructor for grading.

OBJECTIVES: Upon completion of this exercise you will be able to

troubleshoot the PC System to the FRU level, repair the

PC System by replacing the failed FRU or making the appropriate alignment, and verify proper operation of

the PC System.

#### MATERIAL REQUIRED:

- 1. PC System, Configuration PC-004
- 2. PC MS-DOS Operating System diskette
- 3. PC Diagnostic Diskette -- P/N 732-0022
- 4. Scratch Diskette -- P/N 177-0080-1
- 5. Wang CE Tool Kit -- P/N 727-9401
- 6. RS-232C Loop-Back connector -- P/N 420-1040
- 7. FLUKE Multimeter or equivalent

# LABORATORY EXERCISE # 6-1

# POWER SUPPLY PROBLEMS

1.	Perform steps 1, 2 and 3 of Lab Exercise # 2-1 on page I-2-21 to remove the cover from the Electronics Unit.
2.	Reconnect the AC Power Cord, Keyboard cable and the Monitor cables to the Electronics Unit
3.	Inform your Instructor you are ready for BUG #1. Your Instructor will ask you to leave the room while he "BUGS" the System and return in approximately 5 minutes, long enough for you to get a cup of coffee.
4.	Troubleshoot the System and repair it by removing the "BUG". Then run the System Diagnostic to verify the repair and fill out the STUDENT TROUBLESHOOTING FORM on the next page.
5.	Inform your Instructor you are ready for the next "BUG" and take another 5 minute break.
6.	On return from your 5 minute break repeat steps 4 and 5. Continue this procedure until you have cleared all 10 "BUGS".

-- E N D --

# STUDENT TROUBLESHOOTING FORM

BUG #	DIAGNOSTIC INDICATION	REPAIR ACTION and COMMENTS
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

#### PREFAULTED TROUBLESHOOTING BOARD INFORMATION

#### TROUBLESHOOTING FAULT NUMBER 1

MODEL #	COMPONENT NAME		L.I. PART NO.	SERIAL #
PROFESSIONAL COMPUTER	MOTHERBOARD		10-8237	
FAULTY COMPONENT	T FUNCTION AFFECTED System will not BOOT,		ALTERNATE	LOCATION
Connector Jl, Pin 1	Errors 41 and 70 dis-		Errors 41 and 70 dis- No played on the Monitor.	

REFERENCES: First Customer Ship Manual page 7-7 Illustrated Parts Breakdown (IPB) items 17 and 15.

#### NOTES/CAUTIONS/WARNINGS:

Be very careful not to short any of the connector pins together.

#### SET-UP PROCEDURE OBSERVED INDICATIONS Unplug Pl from Jl on the Mother-board. With a pin removal tool The following message is displayed on the Monitor Screen. remove pin 1 from the connector \*\*\* 41 START FAILED plug barrel. Plug Pl back into Jl, then inset pin l part way back into the plug but not enough to make 70 Drive A Read Error contact. The intent here is to remove the - 12 VDC from the Mother board.

#### FAULT DESCRIPTION

Loss of the - 12 VDC load circuit on the Motherboard causes deterioration of the - 12 volts so the Floppy Disk Drive operation becomes intermittent and the System Software will not "BOOT".

#### PREFAULTED TROUBLESHOOTING BOARD INFORMATION

#### TROUBLESHOOTING FAULT NUMBER # 2

MODEL #	COMPONENT NAME		L.I. PART NO.	SERIAL #
PROFESSIONAL COMPUTER	MOTHERBOARD		10-8237	
FAULTY COMPONENT Connector J1, Pin 2	FUNCTION AFFECTED System will not BOOT, Monitor and Floppy Drive do not function		<u>ALTERNATE</u> Nor	

REFERENCES: First Customer Ship Manual page 7-7 Illustrated Parts Breakdown (IPB) items 17 and 15.

#### NOTES/CAUTIONS/WARNINGS:

Be very careful not to short any of the connector pins together.

#### SET-UP PROCEDURE

#### OBSERVED INDICATIONS

Unplug P1 from J1 on the Mother-board. With a pin removal tool remove pin 2 from the connector plug barrel. Plug P1 back into J1, then inset pin 2 part way back into the plug but not enough to make contact. The intent here is to remove the + 12 VDC from the Mother board.

The Monitor Screen is blank, and a second "BEEP" is generated by the keyboard approximately 10 seconds after the first one that indicates the B.I.T. completed.

#### FAULT DESCRIPTION

Loss of the  $+\ 12\ \text{VDC}$  load circuit on the Motherboard causes deterioration of the  $+\ 12\ \text{volts}$  so the Floppy Disk Drive will not operate, the Monitor will not operate, and the System Software cannot "BOOT".

#### PREFAULTED TROUBLESHOOTING BOARD INFORMATION

#### TROUBLESHOOTING FAULT NUMBER 3

MODEL #	COMPONENT NAME		L.I. PART NO.	SERIAL #
PROFESSIONAL COMPUTER	KEYBOARD		79-2042	
FAULTY COMPONENT	T FUNCTION AFFECTED		ALTERNATE	LOCATION
Connector J3, Pin 2 & 3	System will not "BOO"	г''	Nor	ne

#### **REFERENCES:**

First Customer Ship Manual page 4-47, paragraph 4.13.4

#### NOTES/CAUTIONS/WARNINGS:

Be very careful not to short either of the other 2 pins, or the connector barrel to pins 2 and 3.

#### SET-UP PROCEDURE OBSERVED INDICATIONS Unplug the Keyboard Connector, J3 The Keyboard LEDs do not light from the rear of the Electronics during the B.I.T. and the Monitor Unit. Using a small piece of solid displays: wire short J3 pins 2 and 3 together by wrapping one turn around each 01 WILL START FROM DRIVE A pin, then push the wire to the bottom of the connector barrel and plug it back into its receptacle but does not BOOT. at the rear of the Electronics Unit.

#### FAULT DESCRIPTION

The LOOP causes a timing problem that makes the BOOT Software think a key entry is to be made. If the "M" key is depressed (sometimes twice) the Disk Alignment program will be displayed. If the "G" key is depressed (sometimes twice) the System Software will BOOT but keyboard operation is erratic.

#### PREFAULTED TROUBLESHOOTING BOARD INFORMATION

#### TROUBLESHOOTING FAULT NUMBER

MODEL #	COMPONENT NAME		L.I. PART NO.	SERIAL #
PROFESSIONAL COMPUTER	Floppy Disk Drive		78-4026	
FAULTY COMPONENT	FUNCTION AFFECTED	FUNCTION AFFECTED		LOCATION
Terminator in System will not "BOOT socket 2F		Γ''	Nor	ne

#### **REFERENCES:**

First Customer Ship Manual page 4-27, Figure 4-30.

#### NOTES/CAUTIONS/WARNINGS:

Be very careful not to damage the Terminator pins.

SET-UP PROCEDURE	OBSERVED INDICATIONS
Remove the Terminator from socket 2F on the electronics board in Floppy Disk Drive A.	The Monitor will display the following error message:  *22 DRIVE A DEFECTIVE 57 SYSTEM CARD FAILURE
FAULT DES	SCRIPTION

Loss of the Drive Terminator results in erratic control signals between the Disk Drive and the Floppy Disk Controller on the CPU System Board. This prevents the System Software from Booting and provides bad status to the CPU.

#### PREFAULTED TROUBLESHOOTING BOARD INFORMATION

#### *#* 5 TROUBLESHOOTING FAULT NUMBER

MODEL #	COMPONENT NAME		PART NO.	SERIAL #
PROFESSIONAL COMPUTER	Floppy Disk Drive		78-4026	
FAULTY COMPONENT FUNCTION AFFECTED		ALTERNATE LOCATION		LOCATION
Address Plug in socket lE	lug in System will not "BOOT		Nor	ne 

#### REFERENCES:

First Customer Ship Manual page 4-27, Figure 4-30.

#### NOTES/CAUTIONS/WARNINGS:

Be very careful not to damage the the Address Plug

SET-UP PROCEDURE	OBSERVED INDICATIONS
Remove the Address Plug from socket lE on the electronics board in Floppy Disk Drive A.	The Monitor will display the following error message:  *22 DRIVE A DEFECTIVE 50 OR MISSING  ***40 NO AUTO-START DEVICE :
FAILT DES	SCRIPTION

Loss of the Drive Address Plug results in no address being returned to the Boot Software when requested, so a Floppy Drive failure is reported. This prevents the System Software from Booting and provides bad status to the CPU.

#### PREFAULTED TROUBLESHOOTING BOARD INFORMATION

#### TROUBLESHOOTING FAULT NUMBER # 6

MODEL #	COMPONENT NAME W	I.L.I. PART NO.	SERIAL #
PROFESSIONAL COMPUTER	Video Character Control Board	210-8243	
FAULTY COMPONEN	FUNCTION AFFECTED	ALTERNATE LOC	CATION
Video Character Control Board	Monitor Screen "Rolls"	None	

#### **REFERENCES:**

Student Handout/Transparency TP2-9

#### NOTES/CAUTIONS/WARNINGS:

Be very careful not to short 2 pins together (the adjacent pin).

SET-UP PROCEDURE	OBSERVED INDICATIONS		
Jumper pin 40 to pin 1 on the CTR Controller Chip, L62 on the Video Character Resolution Board.	The Monitor screen continuously "ROLLS".		
FAULT DESCRIPTION			

The Vertical Sync output, pin 40 of the CRT Controller chip is grounded causing loss of the vertical sync pulse to the Monitor Board. This causes the Monitor Display Screen to constantly "ROLL".

#### PREFAULTED TROUBLESHOOTING BOARD INFORMATION

#### TROUBLESHOOTING FAULT NUMBER # 7

MODEL #	COMPONENT NAME		L.I. PART NO.	SERIAL #
PROFESSIONAL COMPUTER	Video Character Control Board	21	10-8243	
FAULTY COMPONENT	FUNCTION AFFECTED		ALTERNATE	LOCATION
Video Character Control Board	Monitor Screen Displ	splay None		ne

#### **REFERENCES:**

Student Handout/Transparency TP2-9

#### NOTES/CAUTIONS/WARNINGS:

Be very careful not to short 2 pins together (the adjacent pin).

SET-UP PROCEDURE	OBSERVED INDICATIONS
Jumper pin 14 to pin 1 on the CTR Controller Chip, L62 on the Video Character Resolution Board.	The Monitor Screen Displays portions of the same "Screenload" 3 times at different positions on the screen.
FAULT DES	CRIPTION

# Display Refresh address line MA10, is grounded causing the memory addressing sequence to repeat the same addresses twice, while skipping another group of addresses during each screen refresh operation. This results in a very interesting display.

#### PREFAULTED TROUBLESHOOTING BOARD INFORMATION

#### TROUBLESHOOTING FAULT NUMBER # 8

	MODEL #		COMPONENT NAME		L.I. PART NO.	SERIAL #
	PROFESSIONAL COMPUTER	CI	PU/System Board	2	10-8221	
	FAULTY COMPONENT		FUNCTION AFFECTED		ALTERNATE LOCATION	
L	CPU/System Board		No Keyboard Input		Nor	ne

#### REFERENCES:

Student Handout/Transparency TP2-7

#### NOTES/CAUTIONS/WARNINGS:

Be very careful not to short 2 pins together (the adjacent pin).

SET-UP PROCEDURE	OBSERVED INDICATIONS
Jumper pin 20 to pin 16 on the 6402 UART Chip, L52 on the CPU/System Board.	The Monitor Screen Displays the following error message at the end of the B.I.T. sequence:  *22 KEYBOARD DEFECTIVE 50 OR MISSING
FAULT DES	CRIPTION

The Keyboard serial data output to the 6402 UART is grounded so the keyboard status is invalid and no data can be transferred from the keyboard to the CPU. Thus, the B.I.T. reports the keyboard as failed even though the System Software will be Booted.

#### PREFAULTED TROUBLESHOOTING BOARD INFORMATION

#### TROUBLESHOOTING FAULT NUMBER # 9

MODEL #	COMPONENT NAME		L.I. PART NO.	SERIAL #
PROFESSIONAL COMPUTER	CPU/System Board		10-8221	
FAULTY COMPONENT	FUNCTION AFFECTED	<u>ALTERNATE LOCATION</u>		LOCATION
CPU/System Board	System will not "BOO"	None None		ne 

#### REFERENCES:

Student Handout/Transparency TP2-7

#### NOTES/CAUTIONS/WARNINGS:

Be very careful not to short 2 pins together (the adjacent pin).

SET-UP PROCEDURE	OBSERVED INDICATIONS
Jumper pin 10 to pin 12 on the 8253 CTC Chip, L79 on the CPU/System Board.	The B.I.T. sequence stops with the 3 right hand keyboard LEDs lit. No Monitor display.
FAULT DES	CRIPTION

Since CTC channel 0 output is grounded the System Clock is held inactive, and B.I.T. test 4 will not pass because no RTC Interrupt can occur.

#### PREFAULTED TROUBLESHOOTING BOARD INFORMATION

#### TROUBLESHOOTING FAULT NUMBER # 10

MODEL # PROFESSIONAL	CF	COMPONENT NAME CPU/System Board		L.I. PART NO.	SERIAL #
COMPUTER					
FAULTY COMPONENT		FUNCTION AFFECTED ALTERNATE LOCATI		LOCATION	
CPU/System Board		B.I.T. will not run.	. will not run. None		ne

#### REFERENCES:

Student Handout/Transparency TP2-7

#### NOTES/CAUTIONS/WARNINGS:

Be very careful not to short 2 pins together (the adjacent pin).

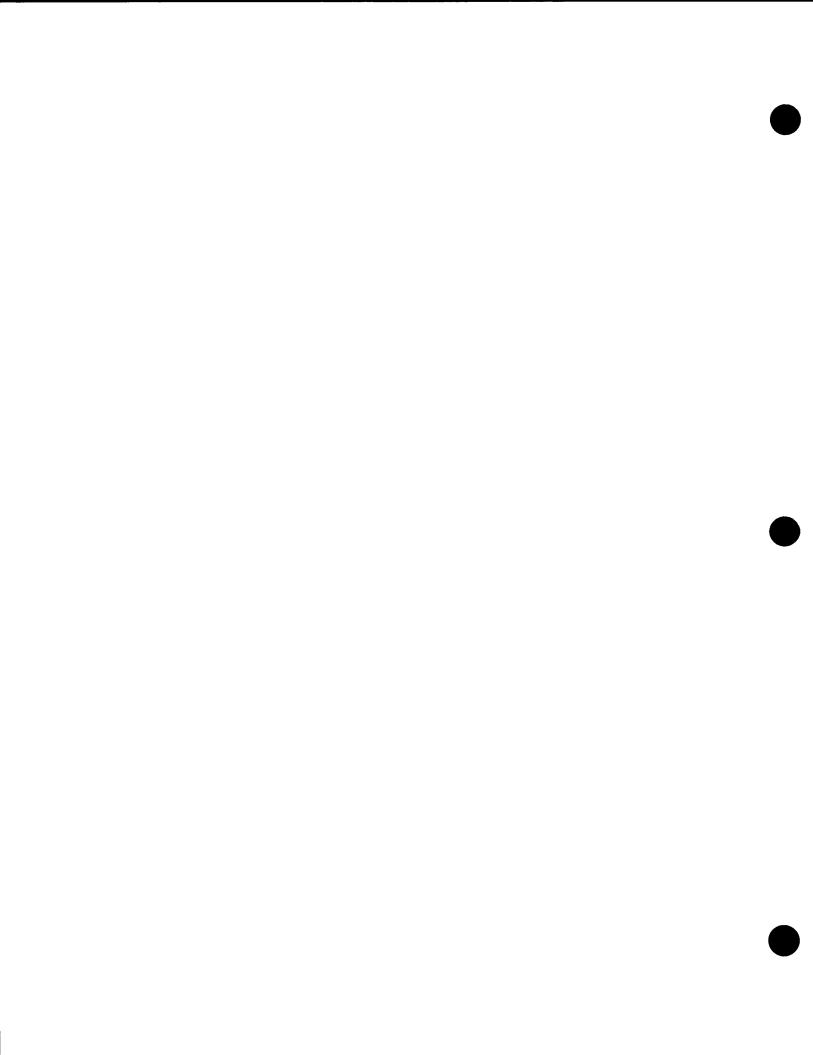
SET-UP PROCEDURE	OBSERVED INDICATIONS		
Jumper pin 1 to pin 12 on the 2732A EPROM, L97 on the CPU/System Board.	The B.I.T. sequence stops with the 5 top keyboard LEDs lit. No Monitor display.		

#### FAULT DESCRIPTION

Buffered Address line BA8 is grounded resulting in loss of B.I.T. program operation after the all keyboard LEDs were turned on and LED 6, the "LOCK KEY" was sequenced off.

# PART I SECTION 7

# PROFESSIONAL COMPUTER THEORY OF OPERATION



#### SECTION 7

#### PROFESSIONAL COMPUTER SYSTEM THEORY OF OPERATION

#### **OBJECTIVES**

Upon completion of this section the student will know:

- 1. The PC System theory of operation to the block level.
- 2. The PC System startup sequence.
- 3. How the Direct Memory Access (DMA) operation works.
- 4. How the Counter-Timer (CTC) and Priority Interrupt Controller (PIC) logic works.
- 5. How the printer and the asynchronous communication interfaces work.

#### INTERACTIVE INSTRUCTIONS

View SECTION 7 of the WANG Professional Computer VIDEO TAPE. After viewing the Video Tape answer the questions in the INTERACTIVE QUIZ on page I-7-3. Take your time and if you can't remember the answer to any of the questions refer to PART II, SECTION 7 of this WORKBOOK. All the material contained in the Video Tape is in PART II of this WORKBOOK.

Once you have completed the INTERACTIVE QUIZ check your answers against the correct answers in Appendix B. Remember, these quizzes are designed to help you learn the material presented in the Video so if you did miss any of the questions going over them again helps you remember those points later.

After you have completed the Interactive Quiz complete the Final Exam starting on page I-7-9. The Final Exam reinforces the more important points of the course. Remember, this is a self-paced course. Your responsibility is to completely learn the course material, even if it takes longer than you anticipated. After you finish the Final Exam make a note of any of the questions you were not 100 percent sure of and look them up in Section II of the Workbook, then review that portion of the Video Tape.

#### GOOD LUCK

# INTERACTIVE QUIZ 7-1

1.	The	8086 operates at
	a)	4 Megahertz.
	ъ)	16 Megahertz.
	c)	8 Megahertz.
	d)	24 Megahertz.
2.	The	8086 addresses of memory.
	a)	Two Megabytes
	ъ)	One Megaword
	c)	One Megabyte
	d)	16 kilobytes
3.	The of E	Standard PC System comes with
	a)	640 Kilobytes
	b)	128 Kilobytes
	c)	256 Kilobytes
	d)	512 Kilobytes
4.	The	B.I.T. and BOOT-STRAP LOADER programs are
		ited
	a)	In RAM.
	ъ)	On the MS-DOS Diskette.
	c)	In 2 E-PROMs.
	d)	In the 8086 internal memory.

5.	When	the B.I.T. completes it
	a)	Waits for an operator input.
	b)	Waits 5 seconds for an operator input.
	c)	Waits 5 seconds for a possible operator input, and if there is none the BOOT-STRAP LOADER program attempts to load the MS-DOS system software.
	d)	Waits 5 seconds for an operator input, and if there is none it loops on the B.I.T.
6.		the BOOT-STRAP LOADER finishes loading the MS-DOS
	Syst	em Program it
	a)	Loads the Command Processor.
	b)	Loads the Utilities.
	c)	Passes control to MS-DOS.
	d)	Keeps "BEEPING" the speaker to notify the Operator the System is up.
7.	The	CRT Controller Board memory
	a)	Contains the data that is displayed on the Monitor screen.
	b)	Is "Dynamic" memory.
	c)	Is constantly "Refreshed".
	d)	Is Read-Only (ROM) Memory.
8.	The	CRT Screen is constantly
	a)	Refreshed at a l Kilohertz rate.
	b)	Refreshed at a 60 Hertz rate.
	c)	Blanked at a l Kilohertz rate.
	<i>a</i> )	Rlanked at a 250 Kilohertz rate.

9.	Reverse Video is
	a) Used to test the Monitor Circuitry.
	b) Used to "Highlight" hard to read text.
	c) An "Attribute".
	d) "Back-up" for normal video.
10.	The Attribute Memory
	a) Shadows the Font Memory.
	b) Shadows the Character Memory.
	c) Mixes the video.
	d) Controls the video.
11	The CO21 ship is
11.	The 8031 chip is
	a) An analog to digital converter (ADC).
	b) A digital to analog converter (DAC).
	c) A serial to parallel converter.
	d) A Microprocessor used in the PC Keyboard.
12.	A "UART" is
12.	n one is
	a) A Universal Analog Receiver/Transmitter.
	b) A Graphic Generator Chip that provides "Universal Art".
	c) A Universal Asynchronous Receiver/Transmitter.
	d) An acronym for Telecommunications.
13.	The 6402 chip
	a) Is a "UART".
	b) Is a Microprocessor.
	c) Is a 64 Kilobit X 1 ROM.
	d) In a "CMOS"

14.	The Grant signal is used to
	a) Put the CPU in a "Wait State".
	b) Acknowledge an "Interrupt".
	c) Grant a "DMA" request to the DMA Controller Chip.
	d) Grant a "DMA" request to the Floppy Controller Chip.
15.	The PC CPU Board has DMA Channels.
	a) Four
	b) Three
	c) Two
	d) Eight
16.	DMA channel one is used for
	a) The Real-Time-Clock (RTC).
	b) Priority interrupt control.
	c) The Floppy Disk Controller.
	d) Main Memory Refresh.
17.	Eight levels of interrupts are controlled by the
	a) Software.
	b) "PIC".
	c) "Interrupt Controller".
	d) RTC (Real-Time-Clock).
18.	Interrupt Level zero is used for
	a) An optional printer.
	b) The DMA Controller Chip.
	c) The Real-Time-Clock (RTC).
	d) The PIO Chip.

- 19. The PPI Chip is connected to an external connector wired for a standard \_\_\_\_\_\_\_.

  a) "Centronics" printer interface.
  b) "RS-232" interface.
  c) Parallel Input/Output interface.
  d) Telecommunications interface.
  - a) To emulate a VS, OIS or Alliance Terminal.
  - b) For 2780/3780 Batch Communications.
  - c) To emulate a 2200 Terminal.
  - d) Electronic "Note Taking".

# P C COURSE FINAL EXAM

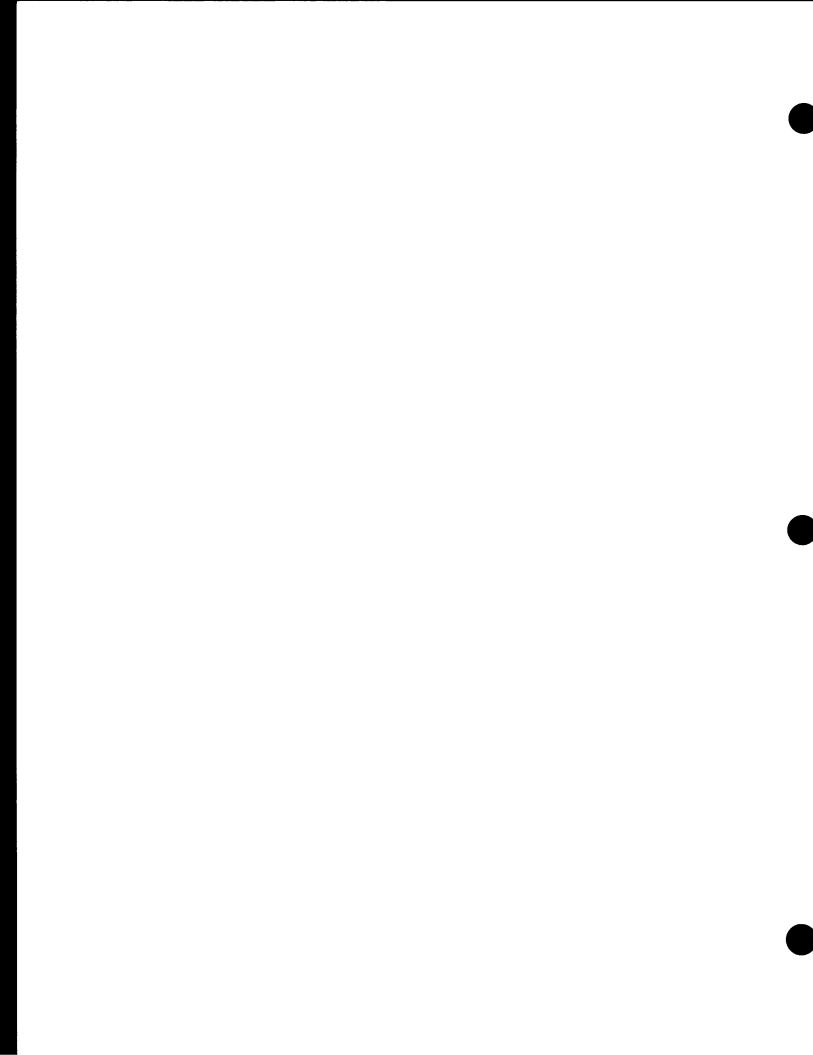
NAME:	DATE:
Check the most cor	rect answer to the following questions:
1. A keyboar	d LED display of 0 0 0 1 1 indicates that the :
a.	Keyboard has failed.
	CPU board has failed.
	System Disk Drive has no diskette installed.
d.	System Disk Drive has failed.
2. When the	keyboard LEDs display 0 0 1 1 1 the:
a.	CPU board must be replaced.
	Display Monitor must be replaced.
c.	Video Controller board must be replace.
d.	Printer must be replace.
3. PC System	configuration PC-004 includes a:
a.	Memory Expansion board with 128K of memory.
b.	Winchester Disk Drive.
c.	DW-20 Wang Daisy Printer.
d.	Graphics Display Adapter.

4.	must purchase the	Customer wants Color Video <u>only</u> , he	
	b. PC-002 confi	guration with a PC-PM003 adapter uni	
	c. PC-PM003 ada d. PC-004 confi	guration with a PC-ACOO1.	
5.	. The PC Electronics Uni	weighs	
	a. 15 pounds.		
	b. 25 pounds.		
	c. 35 pounds.		
	d. 45 pounds.		
6.	a. 210-8233 b. 210-8243 c. 210-8222	Medium Resolution Character Board is	s:
7.	d. 210-8232 . When the 2 eyes of the	"CAT'S-EYE" scope pattern are equal	
	in amplitude on track l	6 of the alignment disk:	
	a. A RADIAL-TRAC	K Alignment is indicated.	
	b. The RADIAL-TF	ACK Alignment is correct.	
	c. The + 12 volt	s is low.	
	d. The INDEX-TO-	DATA alignment is correct.	

8.	The + 12	voits can be measured most easily at:	
	b.	P1, pin 2 on the Mother Board. P4, pin 1 on Floppy Drive A. P5, pin 1 on Floppy Drive B. P7, pin 2 on the SPS-200 Power Supply.	
9.	The Flopp	y Disk Sector size is and tota	1
		city is	
	a.	256 bytes 320 Kilobytes.	
	b.	1024 bytes 320 Kilobytes.	
	c.	512 bytes 360 Kilobytes.	
	d.	256 bytes 320 Kilobytes.	
LO.	The ID co	de for the Low Resolution Video Board is:	
	a.	14 hex.	
	b.	1C hex.	
	c.	12 hex.	
	d.	10 hex.	

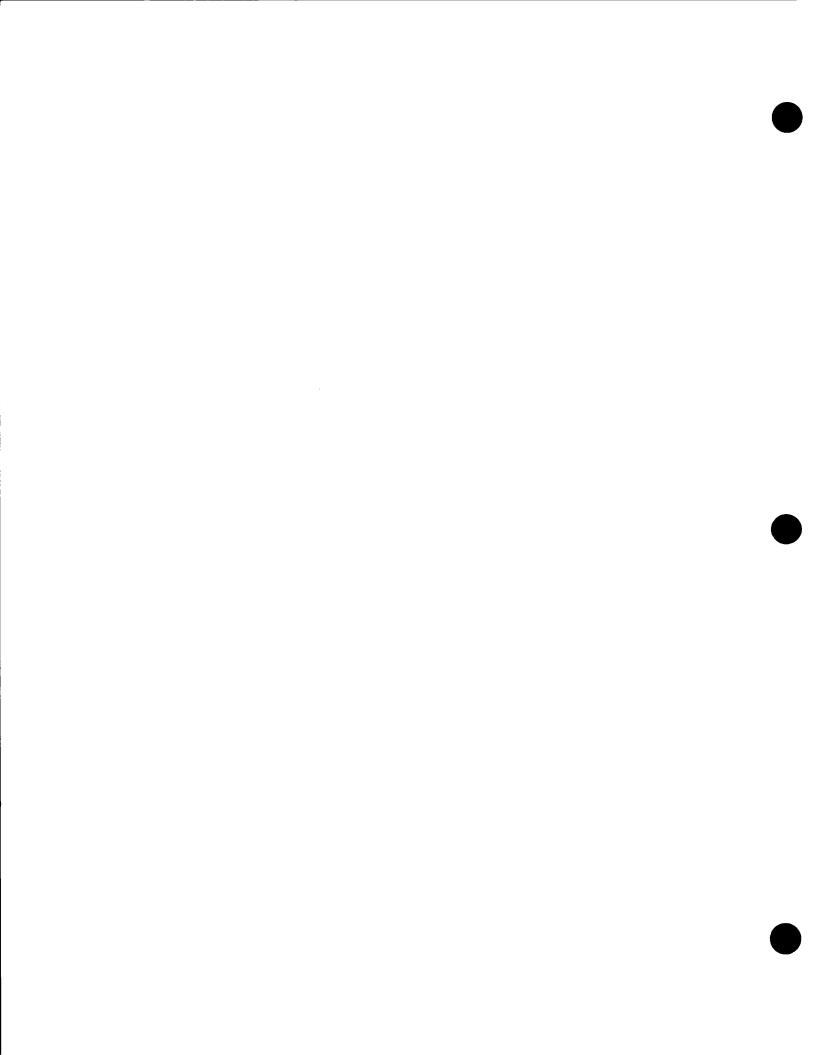
# VIDEO REFERENCE MATERIAL

# **PART II**



# PART II SECTION 1

# INTRODUCTION TO THE PROFESSIONAL COMPUTER



#### LABORATORY EXERCISE # 2-1

#### INSTALLATION OF THE PC OPTIONS

switch.

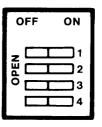
Turn the PC power OFF, unplug the power cord from the 1. outlet, disconnect the keyboard from the EU, and disconnect the Monitor Cable from the rear of the EU. Set the keyboard and the Monitor to one side so you have 2. plenty of room on your table or desk to remove the EU cover from the chassis. Remove the 4 Phillips screws from the rear, 4 corners of 3. the Electronics Unit with the unit setting flat on a table or work bench with the air vents downward. Then, grasping the EU chassis handle at the rear of the unit, pull the unit straight out of the cover by holding the cover with the other hand. Set the cover aside. Set the System Unit on its side, power supply down with the floppy drive(s) on your left, and the rear of the EU chassis on your right. Located on the side of the power supply is the two position, AC line voltage selector switch. The EU is shipped with the switch in the 115 volt position. For 230 volt operation slide the switch to the

#### CAUTION

Do not change this switch unless your actual line voltage is 220 to 240 volts. Since the 240 volt plugs and sockets are physically different than the 115 volt outlets you can not plug the PC into a 240 volt outlet without first changing the plug on the power cord.

right with a screwdriver to expose the number "230V" on the

sw	ITCH S	BAUD RATE		
1	2	3	4	
0	0	0	0	**
0	0	0	1	75
0	0	1	0	110
0	0	1	1	134.5
0	1	0	0	150
0	1	0	1	300
0	1	1	0	600
0	1	1	1	1200
1	0	0	0	1800
1	0	0	1	2000
1	0	1	0	2400
1	0	1	1	3600
1	1	0	0	4800
1	1	0	1	7200
1	1	1	0	9600
1	1	1	1	19200



SW1

- \*\* Denotes loop on power-up diagnostics. Refer to paragraph 4.13.
- 0 Denotes ON (CLOSED)
- 1 Denotes OFF (OPEN)

TABLE I-2-2 BAUD RATE SELECTION TABLE

# LABORATORY EXERCISE # 2-1

To gain access to the baud rate selector switch on the CPU 5. Board we must remove the Medium Resolution Video Controller Board and any other Option boards installed in the EU. First, rotate the EU chassis so the floppy drive(s) are on your right and the rear of the EU is on your left. At the top left end (rear of EU) of the first Option board 6. remove the retaining screw that holds the Option board in place and remove the board by pulling it straight up, and out of the slot. You might have to rock it a little at first to break it loose from the Motherboard connector. The 4 switch Baud Rate Selector switch bank is located at 7. the bottom, left of the CPU board between the Motherboard connector and J2, the printer connector. See Table I-2-2 on page I-2-22 for baud rate selection. When all 4 switches are placed in the ON position the PC will loop on the Power-Up diagnostics (B.I.T.). So assure the switches are not left in this configuration. Replace the Medium Resolution Video Controller board into 8. its slot being careful to guide the back panel tab into its slot as the board edge connector is pushed into the Motherboard connector. If the tab at the bottom of the board back panel misses its slot it will bend causing poor seating of the board connector. Replace the board retaining screw. 9. Step 8 is the same way any Option board would be installed in the system with additional instructions for the Winchester Controller and the Medium Resolution Graphics

Controller.

# LABORATORY EXERCISE # 2-1

a.	The Winchester Controller must be installed in
	slot 5 and the 2 ribbon cables must be run to the
	Winchester Drive through the slots provided in
	the chassis frame.

- b. The Medium Resolution Graphics Board must be installed next to the Medium Resolution Character Board and the short ribbon cable on the Graphics Board connected to the character board.
- \_\_\_\_ 10. Other than the above two restrictions any Option board can be installed in any of the 5 EU Option slots.
- 11. Slide the EU Chassis back into its cover with cover vents and the front chassis vents, below the Floppy Drive(s) both in the down position. The chassis pins below the Floppy Drive(s) must be aligned with the holes in the cover bracket so slide the chassis into the cover as straight as possible. Replace the four retaining screws at the rear of the EU.

# REASSEMBLY & CHECK OUT PROCEDURE

- \_\_\_\_ 1. Connect the monitor cable and the keyboard cable to the System Unit and connect the AC power cord to the System Unit.
- 2. Insert the MS-DOS System Program Diskette into the right-hand floppy drive, latch the drive door and turn on the system unit power.
- 3. Check that the power supply fan at the rear of system unit is turning, and that the floppy drive LED illuminates after a few seconds.

# SECTION 1

#### INTRODUCTION

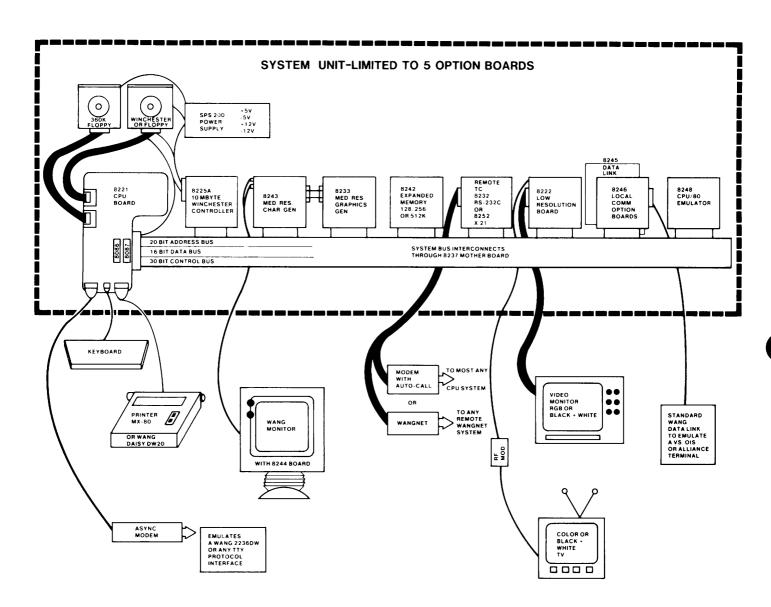
#### **GENERAL**

Included on pages II-1-8 and 9 of this Section of the Workbook is a list of all Field Replaceable Units (FRUs) you will need to service the PC SYSTEM. Included are the part numbers for the Software and Software Operation Manuals, the FRUs, and the Diagnostic and Alignment Diskettes. All PC System components plug into the rear of the ELECTRONICS UNIT, which is referred to as the "EU". The Keyboard, the Monitor, the Printer, the standard RS-232 interface connector, and finally, the AC power cord. Below the AC power cord, is the POWER ON - OFF Switch. Size and weight information for these Units may be found in the Maintenance Manual.

Although this EU has two Floppy Disk Drives, the Standard PC System will be sold with only one drive installed in the Top Slot. These five and one quarter inch drives are Dual Sided, Double Density with 48 Transitions Per Inch, allowing a total of 360 kilobytes of data to be stored on a diskette. In addition, an optional 10 megabyte Winchester Disk Drive may be installed in the bottom slot, in place of the optional Floppy Drive.

#### SYSTEM DESCRIPTION

For the following discussion refer to Figure II-1-1 on the next page. The dotted line encloses the EU which houses a Model SPS 200 switching power supply that supplies all the necessary voltages to run the System. Next, the heart of the system, the CPU Board, with its 8086 Microprocessor. It handles all normal data and communications processing, while its co-processor, the 8087 numeric data processor handles floating point, algebraic, and logarithmic functions.



PC SYSTEM FUNCTIONAL BLOCK DIAGRAM

Figure II-1-1 PC SYSTEM BLOCK DIAGRAM

Two ribbon cable connectors on the CPU Board facilitate connection to the primary Floppy Disk Drive and an optional Floppy Drive. The three connectors at the rear of the CPU Board allow for connection of the Keyboard, an optional Epson Dot Matrix Printer that operates at 80 characters per second, or an optional DW20 Wang Daisy Printer for letter quality print, and the asynchronous RS-232 connector for an optional modem, or direct connection to a Wang 2200 System for emulation of a 2236DW Terminal.

The CPU Board plugs into a Motherboard, that extends its Address Bus, Data Bus, and Control Bus to five Option slot connectors on the Motherboard. The 20 bit address Bus from the 8086 Microprocessor permits addressing of up to one megabyte of memory. 128 kilobytes of Dynamic RAM Main Memory is included on the Board, along with two E-PROMs that contain the Power-Up diagnostics and the BOOT STRAP LOADER program. In addition, an optional Expansion Memory board is offered, extending the main memory. This board is available in three memory configurations, 128 K, 256 K or 512 K.

#### OPTIONS AVAILABLE

The options shown can not all be installed in the EU at the same time. Only five option boards can be installed in the Electronics Unit. Size limitations of the EU only permit five option board connectors on the Motherboard.

The Winchester Controller Board has its own Z-80A microprocessor that performs all disk surface operations under command of the 8086 Main CPU. The 10 megabyte Winchester Drive is connected to the Controller Board by two ribbon cables. Length of these cables make it necessary to install the Controller Board in Option Slot five. This is the only option board that must be installed in a specific slot.

The Medium Resolution Character Generator Board is the Video Controller for the Wang Monitor. Two, multiwire cables with two, barrel connectors at both ends connect the Character Generator Board in the Electronics Unit to the Monitor. One cable carries the twelve volts and ground to power the Monitor while the other cable carries the Video, Horizontal and Vertical Sync, and Intensity signals. The Character Generator Board uses approximately 12 kilobytes of Static Memory to form the characters displayed on the Monitor screen.

The Medium Resolution Video Graphics Board connects to the Character Generator Board. Therefore, it is not a stand-alone board. When graphics are desired both boards must be installed. The character board will stand by itself, however. Thirty two kilobytes of dynamic RAM memory on the Graphics Board contain the programmable Graphic Pattern that is displayed on the Monitor Screen. Since the Graphics Board and the Character Board are connected by a short cable, they must be installed in adjacent slots.

We have already discussed the Expanded Memory Boards as to the three memory sizes offered. Use of one of these boards will be limited to Customers with the larger systems including a Winchester Drive and programs that require a large amount of memory space. A LED on the Memory Expansion Board is used to indicate a memory parity error. The system software treats memory parity errors as fatal errors. The LED on the Expansion Board will indicate that the error was in Expansion Memory if it's on, or in the CPU Board Memory if it's off.

Two Remote Telecommunications Controller Option Boards are offered. The RS 232-version has a standard RS-232 interface connector and an Auto Call connector for use in the United States and parts of Canada. The second board uses the same basic logic, but has an X.21 interface for international use. The RTC includes a Z80A microprocessor and 64 K of Dynamic RAM memory. Software is offered for the RTC to run 2780 or 3780 Batch Communications processing, or to connect to a Remote Wangnet.

The Low Resolution Video Controller Board provides both characters and graphics in color. It will provide black and white as well as color, and has two program selectable modes of operation. Television Mode or Video Monitor Mode. The Customer must provide his own TV or Video Monitor and, if he selects TV, he must also provide his own RF Modulator. Output connectors are provided on the board for both TV and Video Monitor. The Video Monitor Mode of operation as shown in Figure II-1-2 on the next page provides higher resolution with a screen size of 80 characters per line, times 25 lines, while the TV mode only has 40 characters per line, times 25 lines.

Character size of 8 times 9 pixels is the same for both modes, but less dense than the 10 by 12 pixel matrix of the Medium Resolution Controller discussed earlier. The Medium Resolution Controller Board that drives the WANG Monitor will be discussed in detail in Section 7. PIXEL is an acronym for picture element, or the Dots that make up the characters displayed on the video screen. 64 Kilobytes of dynamic RAM memory on the Controller Board provide 4 bits per Pixel in the TV mode of operation, for 16 color selections. Two bits per pixel in the Video Monitor Mode provide 4 different colors. Color selection is programmable.

The Local Communications Option is made up of 2 boards. The CPU board has a Z80A microprocessor, the Z80 interrupt circuitry, and the 8086 interface buffers. The Data Link Board has all the necessary logic to emulate the standard Data Link interface portion of a Wang OIS or VS Workstation and connects to a VS CPU, an OIS Master Unit, or an Alliance Master Unit, allowing the PC to operate as an OIS, VS, or Alliance Workstation. The Data Link Board also includes 64 kilobytes of main memory and 16 kilobytes of CRT memory.

The CP/M-80 Emulator Option Board is Z80A based with 64 Kilobyte of Dynamic RAM Memory and interface circuitry to the 8086 System Bus. It will allow the Professional Computer to run 8 bit programs, which covers most of the popular CP/M-80 programs currently in use.

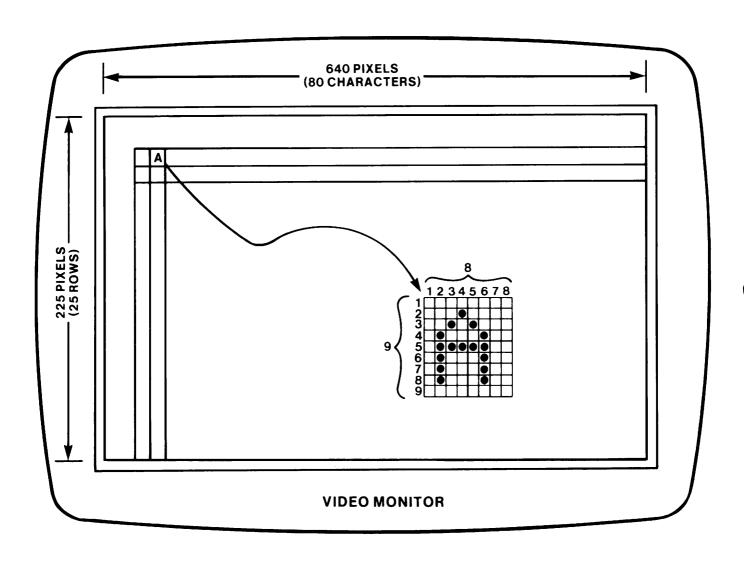


Figure II-1-2 PIXEL CHARACTER LAYOUT

All the option boards that can be plugged into the EU Motherboard are all 8 by 12 inches in size, but remember, there are only five option slots available. The Customer selects which options he wants in his system when he purchases a Professional Computer System. The list of options also includes a choice of Matrix or Daisy Printer, which plugs directly into the EU CPU System Board and an asynchronous RS-232 connector that may be connected to a Wang 2200 system or to an asynchronous modem.

To run the Hardware Options we have discussed is a list of Programs to match the options desired. Refer to page II-1-9 for the list of Programs currently available for the Professional Computer System. This concludes Section One of the Professional Computer Video Training Course.

# TABLE II-1-1 RECOMMENDED SPARES LIST

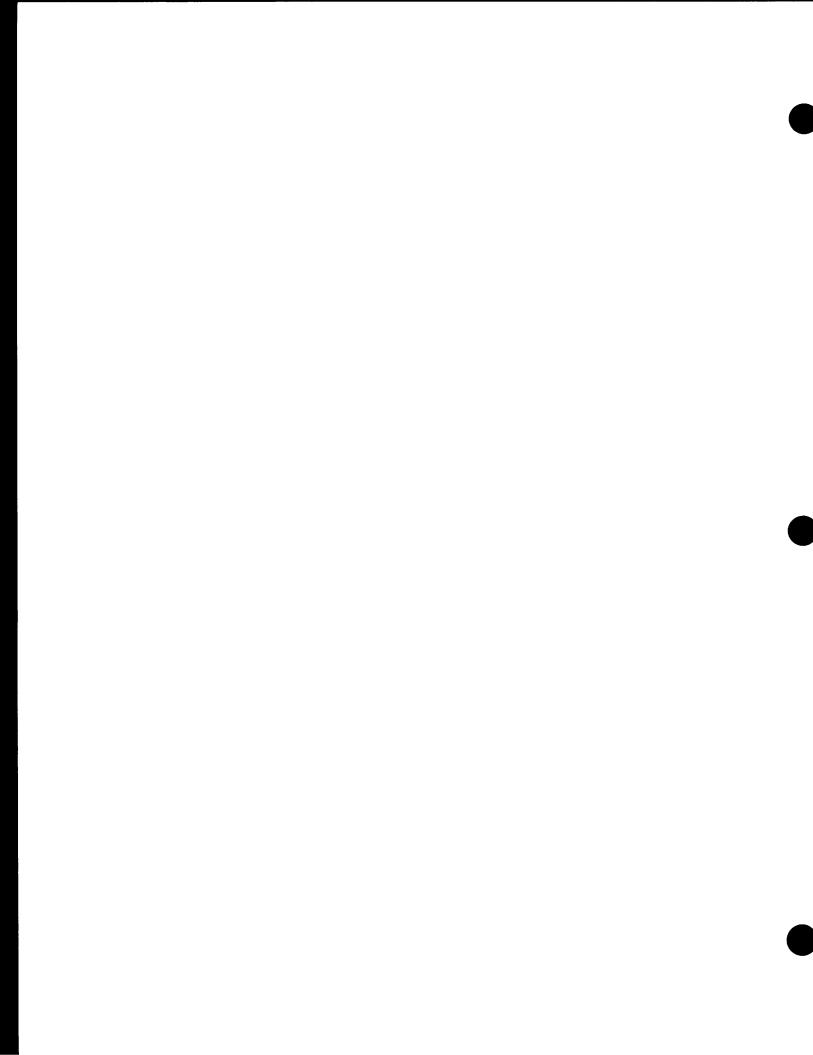
Part Number	Name			
	BOARDS			
210-8221-A 210-8222-A 210-8225-A 210-8232-A 210-8233 210-8237 210-8243-A	CPU Board Color/Graphics Board Winchester Controller Board PC Remote Communications Board Graphics Display Board Motherboard Character Display Board			
210-8244	Monitor Board			
SUBASSEMBLIES AND OPTIONAL EQUIPMENT				
270-0792 278-4026 278-4030 279-0541 279-2042 279-2044 725-0129 725-0129-1	SPS-200 Switching Power Supply 360 KB Floppy Diskette Drive 10 MB Winchester Disk Drive Wang Monitor Assy. Universal Keyboard (US) Universal Keyboard (INT) MX-80 F/T Epson Printer (US) MX-80 F/T Epson Printer (INT)  CABLES			
220-3238 220-3239 220-3240 270-3279 420-2019 421-0001	Winchester B Cable System Floppy Cable 2nd Optional Floppy Cable and Winchester A Cable Main Wiring Harness Assy. AC Power Cord Wang Monitor I/O Cable			

# TABLE II-1-2 PC SOFTWARE

195-2326-9 195-2327-9 195-2328-9 195-2328-9 195-2329-9 195-2330-9 195-2331-9 195-2331-9 195-2332-9 195-2332-9 195-2332-9 195-2333-9 195-2333-9 195-2333-9 195-2334-9 195-2335-9 195-2335-9 195-2336-9 195-2336-9 195-2337-9 195-2337-9 195-2338-9 195-2338-9 195-2338-9 195-2338-9 195-2338-9 195-2338-9 195-2338-9 195-2339-9	PART NUMBER	NAME		
195-2327-9 MS Basic Compiler 195-2328-9 MS PASCAL Compiler 195-2330-9 MS COBOL Compiler 195-2331-9 Async Communications 195-2332-9 Remote Wangnet for VS (leased line only)  195-2333-9 VS 2246S Local Communications Terminal Emulator 195-2334-9 VS 2256C Local Communications Terminal Emulator 195-2335-9 OIS 5536-4 Local Communications Terminal Emulator 195-2336-9 Alliance 5536-4 Local Comm. Terminal Emulator 195-2337-9 195-2338-9 PC Multiplan 195-2339-9 PC Word Processing  PC Word Processing  PC MANUALS  The Wang PC Communications Guide 700-7588 The Wang PC Word Processing Manuals 700-7590 The Wang PC Introductory Guide 700-7592 The Wang PC BASIC Language Guide	195-2326-9	MS-DOS Operating System		
195-2328-9 195-2329-9 195-2330-9 195-2331-9 195-2331-9 195-2332-9 195-2332-9 195-2332-9 195-2332-9 195-2332-9 195-2333-9 195-2334-9 195-2335-9 195-2335-9 195-2336-9 195-2336-9 195-2337-9 195-2337-9 195-2337-9 195-2339-9 195-2338-9 195-2338-9 195-2338-9 195-2339-9	-			
195-2329-9 MS FORTRAN Compiler 195-2330-9 MS COBOL Compiler 195-2331-9 Async Communications 195-2332-9 Remote Wangnet for VS (leased line only)  195-2333-9 VS 2246S Local Communications Terminal Emulator 195-2334-9 VS 2256C Local Communications Terminal Emulator 195-2335-9 OIS 5536-4 Local Communications Terminal Emulator 195-2336-9 Alliance 5536-4 Local Comm. Terminal Emulator 195-2337-9 2780/3780 Communications Support 195-2338-9 PC Multiplan 195-2339-9 PC Word Processing  PC MANUALS  700-7558 The Wang PC Communications Guide 700-7589 The Wang PC Documentation Guide 700-7590 The Wang PC Introductory Guide 700-7592 The Wang PC BASIC Language Guide		-		
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700-7592 The Wang PC BASIC Language Guide	700 <b>-</b> 7589	The Wang PC Documentation Guide		
o o	700-7590	The Wang PC Introductory Guide		
700 7502 The Mana DC Program Development Cuide	700-7592	The Wang PC BASIC Language Guide		
700-7595 The wang FC Frogram Development Guide	700-7593	The Wang PC Program Development Guide		
700-7594 The Wang PC Compiled BASIC Reference Manual	700-7594	The Wang PC Compiled BASIC Reference Manual		
700-7600 The Wang PC Multiplan Manuals	700-7600	The Wang PC Multiplan Manuals		

# PART II SECTION 2

# INSTALLATION OF THE PROFESSIONAL COMPUTER



#### SECTION 2

#### INSTALLATION

The Professional Computer System is designed and packaged for Customer Installation. Not all our Customers will want to install their own systems, however. For this reason Wang Customer Engineering is offering installation. No presite planning is included. You install the PC System where the Customer wants it, but the Customer is responsible for providing the AC power recepticles and furniture.

# **PACKAGING**

The Standard Professional Computer System is packaged for shipment in 4 boxes. The three white boxes contain the Electronics Unit, the Monitor, and the Keyboard. A graphic representation of each one of these units is on the outside of its box. The brown box contains the Auto Enclosures and is labeled "OPEN FIRST". When the customer does his own installation it is advantageous for him to do this because the detailed installation instructions are in the Introductory Guide in this box.

# The Auto-Enclosure Box Contains:

- 1. The Wang Professional Computer Introductory Guide
- 2. The Wang Professional Computer BASIC LANGUAGE Guide
- 3. The Wang Professional Computer Documentation Guide
- 4. The Wang Supplies Catalog
- 5. Six rubber feet for the Electronics Unit
- 6. A System Software Diskette
- 7. A System Diagnostic Diskette
- 8. A blank diskette
- 9. Optional applications software and manuals purchased by the Customer.

Open each one of the PC Equipment boxes very carefully as the Customer must save them for reuse if the System fails during the 90 day warranty period or, if a Mail-in Service Contract was purchased. Remind the Customer of this as the Equipment can be severely damaged in shipment if it is packed improperly.

Open the Wang Monitor box next and remove the Monitor carefully. If possible have a clean table to set the equipment on after unpacking it. If a table is not available unpack the Equipment in a clear floor area away from traffic flow. The dual Monitor cable is included in the Monitor package at present, but will be packaged with the Medium Resolution Video Controller in the future.

Unpack the Electronics Unit last. Be sure to remove the power cord from the packing and be careful with the box. If the Customer wants the Electronics Unit to sit on a table or desk be sure to inform him of the six rubber feet included in the Auto-Enclosure. Installation of these feet will prevent the E-U from scratching the desk top. Simply peel the adhesive backing off the rear of each foot and position it at the desired location.

A thin piece of cardboard has been inserted in each disk drive during manufacture to protect the drive from damage during shipment. Open the drive door and remove the piece of cardboard. Save these cardboard pieces by placing them in the EU container along with the packing material.

Be sure to return the shipping boxes to the customer before leaving his office, and once again, inform the Customer that the easiest way to repackage a failed piece of equipment for shipment back to the Wang Field Service Center is in the original shipping container.

#### CONNECTING THE PC SYSTEM

The Wang Professional Computer System is easy to set up. If you have a standard system with no additional option boards the only tool you need is a one-fourth inch flat blade screwdriver. If you have to install options, then a number one Philips screwdriver is also needed. To determine whether you have a standard or basic EU, look at its back panel. The one shown in Figure II-2-1 below, with the Video Controller Board in expansion slot 2, is a standard PC System. The one shown in Figure II-2-2, with the five blank panels covering the expansion slots is a Basic EU.

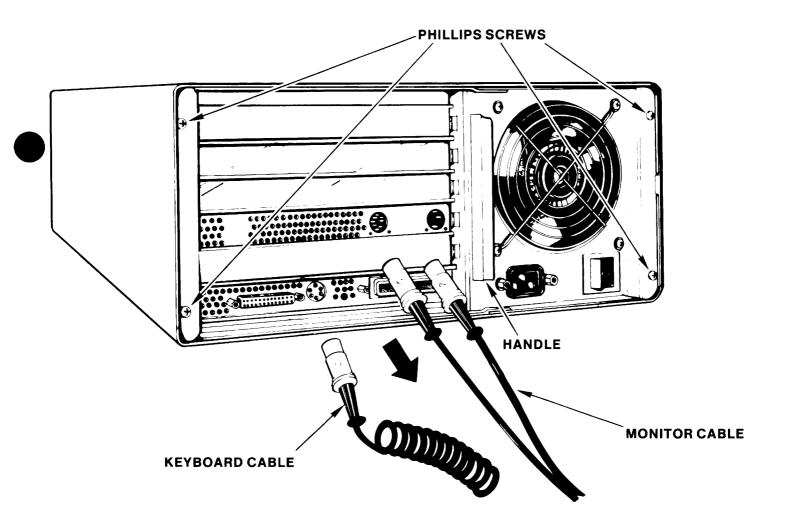


Figure II-2-1 Standard Electronics Unit

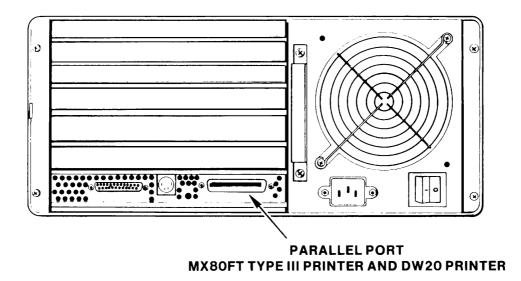


Figure II-2-2 Basic Electronics Unit

First, we will set up a standard system by connecting the keyboard cable plug to the keyboard connector. The plug is keyed, so be sure to align it, with the slotted screw head in the plug facing straight up before inserting the plug into the connector.

To connect the Monitor it is easier to first turn it upside down, so the two recepticles are clearly visible. The connector plugs are the same on both ends of the cable, so plug the five pin power plug and the eight pin video plug into their recepticles, being careful to align the keys. Turn the Monitor right-side up and connect the other end of the cable to the two Video Controller recepticles at the rear of the Electronics Unit.

Connect the power cord and secure it to the rear of the Electronics Unit with the captive screws. Make sure the power ON/OFF switch is in the OFF position, by checking that the side of the switch labeled ZERO is flush with the back panel. If the switch is ON, the side of the switch labeled ONE will be flush with the back panel. Plug the power cord into an 115 volt AC outlet. If the voltage in your area is 220 volts you will have to remove the EU cover and switch the power supply from 115 to 230 Volts. More information on this is coming up later when we remove the EU cover.

Before powering up the PC make sure the cardboard shipping protectors are removed from the floppy disk drives. Once again, save them by placing them in the EU shipping container. If the Customer has already stored the containers give him the cardboard protectors. Leave the Floppy Drive Doors OPEN.

#### SYSTEM CHECK-OUT

Move the power switch to the ON position while watching the six Keyboard Light-Emitting-Diodes. They should flash on and off, then after approximately two seconds they should all come on solid, and start to sequence off from left to right. Depending on the number of options the system has, after 30 seconds maximum the right hand L-E-D will go out, and the Monitor will display this message to indicate that the Power-Up diagnostic have passed but the System Software cannot be loaded because the Floppy Drive Door is open.

Close the Floppy Drive Doors and depress the R key on the keyboard to "Retry". "Boot Strap" program will try to reload the System Software, but cannot because the diskette is not in the Drive. This results in a descriptive message being displayed on the Monitor Screen. An Index of all the ERROR MESSAGES is included in Appendix B of your Maintenance Manual.

To thoroughly check out the System run the Customer Diagnostics by inserting the System Diagnostic Diskette in Drive A and a Scratch Diskette in Drive B. Depress the "R" key to start the Diagnostic.

When the Diagnostic comes up type in "YES" to access the Customer Menu, then depress the "EXECUTE" key to start the diagnostics. The Main Memory test runs first, then you are prompted to select the Drives to be tested. Type in "C" and depress "EXECUTE" to select Drives A and B. Then replace the Diagnostic diskette with a Scratch diskette. Type Zero-Zero and depress "EXECUTE" to start the test. When the Floppy Drive tests complete replace the scratch diskette in drive A with the Diagnostic Diskette as prompted, and type Zero-Zero to continue.

When the screen comes up with the Monitor Test Attributes, depress the "MERGE" key to continue. Then, you will be prompted that the Diagnostics have successfully completed. Replace the Diagnostic Diskette with the System Diskette in Drive A and then depress "CANCELL" to restart the System. When the System comes up with the WANG LOGO enter the date, and the time, and depress EXECUTE to access the Main Menu.

Depress "EXECUTE" to select Applications, then when the Applications Menu comes up depress EXECUTE again to select Multiplan. Since the Multiplan Program is not on the System diskette you must replace the System Diskette with the Multiplan diskette and depress RETURN to load the program. First, the WANG LOGO will be displayed, then a blank Multiplan Spreadsheet will come up. To exit Multiplan depress the Q key, which represents QUIT, then depress Y to confirm your request. Then, replace the Multiplan diskette with the System diskette and depress RETURN to return to Applications.

Depress the CANCEL key to go back to the Main Menu and use the SPACE BAR to select the DOS Command Processor. Depress the EXECUTE key. When the Command Processor comes up, the letter A with a Colon will be displayed. This indicates that the A Floppy Drive is prime. Type "VOL" for Volume Name and depress RETURN. The Volume Number of your System Disk will be displayed.

Remove the System Diskette from the A Drive and compare the Volume number on the Diskette Label with the Volume number displayed. They should agree. If not, correct the Label, or if the number is not on the Diskette Label write it on the label with a FELT TIP PEN. Also check the write protect hole on the side of diskette. It should be covered with a TAB to write-protect it. If not, place a tab over the hole. Replace the Diskette in the Drive.

Type the word EXIT and depress RETURN to return to the Main Menu. This completes the installation and check-out of a Standard PC System.

#### MONITOR SWIVEL ARM AND EU DESK CLAMP

An option that you may have to install is the Monitor Swivel Arm and EU Desk Clamp. These two items allow the PC System to be installed on an office desk, utilizing as little as possible of the desk top space. Only the keyboard needs desk top space while in use.

First, unpack the Monitor Swivel Arm, and the E-U Desk Clamp. Minimum safety specifications for the desk are included in the Appendix of your Maintenance Manual. Make sure the desk is suitable for this installation. Failure to observe this WARNING may result in a dangerous installation causing personal injury or severe damage to the equipment.

With the Monitor cables disconnected, turn it over, and set it down with the pedestal base facing up. Snap the protective cover out of the base ring, remove the 4 base mounting screws and save them, and remove the base. Pinch the rubber bellows so you can free it from the Monitor, remove it and save it. Unsnap the movement restrictor band and replace the bellows.

While holding the Swivel Arm with one hand, align it with the screw holes in the Monitor mounting ring, drop 2 screws in place and tighten them. This is a little difficult to accomplish because of the weight of the swivel arm, but by only dropping in 2 screws you can use the other two empty holes for realignment. Install the other two screws and snap the protective cover back into place.

Snap the cable cover out of the arm and connect the Monitor cable to Monitor. Then thread the cable over the far end of the arm and into the cable channel. Leave some slack in the cable and snap the cable cover back into place.

This can be changed to a left or right 90 degree arc, or a full 360 degrees of swing. To change the swing remove the set screw from the top hole with the 3/32 Allen wrench provided, and leave it out for a full 360 degree swing. Replace the set screw in the center hole for a 90 degree left-hand arc or, in the bottom hole for a 90 degree right-hand arc with the Swivel Arm clamped to the rear of the desk.

Before clamping the Monitor Swivel Arm to the desk be sure the clamp is opened wide enough to fit over the lip of the desk. Have someone help you by holding the Monitor while you locate, and tighten the clamp. If no one is available to help you place a couple of books under the Monitor while you install the clamp. Be sure it is good and tight by turning the tightening bar at least two more turns after the jaw of the clamp contacts the bottom of desk top.

To install the EU Desk Clamp first, make sure the desk you are going to install it on meets the safety specifications found in the Appendix of your Maintenance Manual. Failure to observe this WARNING may result in a potentially dangerous installation.

Open the two jaws of the clamp wide enough to fit over the lip of the desk top and position the clamp so the front of the EU does not extend past the side of the desk. Tighten the bolts until the jaws contact the bottom of the desk top, then tighten the bolts at least two more turns. Pick up the EU with Floppy Drive A up and fit the cutouts on the side of the EU over the prongs on the side of the clamp. Make sure the top of the EU is flush with the desk top before you let go of it.

#### INSTALLING THE OPTIONS

If your PC System is a Basic System with the Television or Video Monitor option, or a Standard System with additional options you will have to remove the cover from the EU to install the options. First, turn the EU power OFF. Unplug the power cord from the AC outlet. Unplug the Keyboard from the EU and set it aside.

Unplug the two Monitor Cables from the EU, and set the Monitor aside. Set the EU flat on the table with the front air vents downward, and remove the four retaining screws from the rear corners. Then grasp the EU chassis handle with one hand and the cover with the other, and pull the chassis free of the cover. Set the cover aside, and set the EU chassis on its side, power supply down.

Located on the side of the power supply is the line voltage selector switch. If your line voltage is 230 volts, this switch must be changed to the 230 volt position. If the system is powered up with the switch in the 115 volt position when connected to 230 volts your system can be seriously damaged.

To access the baud rate selector switch on the CPU Board, first remove the Medium Resolution Video Controller Board by removing the retaining screw, then slide the controller straight up, and out of the slot. The baud rate selector switch may be set up for the particular baud rate your system is going to operate at or, as the switch is default, the software can override it. In any event do not leave all four switches in the OFF, or open condition as this causes the system to loop on the power up diagnostic and is only to be used for maintenance. Refer to the Installation Section of your Maintenance Manual for the table of switch selectable baud rates.

After checking the baud rate switch slide the Controller board back into its slot, being careful to guide the back panel tab into its slot while setting the board in its connector. If the tab misses its slot while forcing the board into its connector the tab will be bent, causing a weak, or bad connection. The lip on top of the back panel should fit flush against the top of the chassis ledge, indicating that the board is properly seated. Replace the retaining screw to complete the installation.

# EU OPTION BOARDS

Before installing an option board we must first remove the Blank Panel occupying the slot we want to install the Board in. If it's a Winchester Controller it must be installed in slot 5. Any other option board may be installed in any slot except for the Graphics Board, which must be adjacent to the component side of the Character Generator board because of the cable connection between these two boards. Remove the screw holding the blank panel in place, then remove the panel and save it to give to the Customer. Slide the option board into the slot while fitting its back panel into the interlocking back panels on either side of it. Firmly press the board edge connector into the motherboard connector while fitting the tab on the end of its back panel into the slot in the chassis.

This is very important because if the tab misses its slot it will be bent, preventing good connector contact. The lip on top of the back panel should fit flush against the top of the chassis ledge, and the screw holes should aligned. Replace the retaining screw to secure the board.

# INSTALLING THE OPTIONAL FLOPPY DRIVE

To install the optional, second floppy drive, remove the blank panel retaining screw, then remove the blank panel. Now we must remove drive A so we can run the cables for drive B. Remove the Drive A mounting screw and slide the drive out as far as the cables will permit and unplug the ribbon cable, then the power cable. Remove the floppy drive. Unpack the new floppy drive, save the packing material, and give it to the Customer. Remove the bottom plate from the blank panel and install it on the new floppy drive.

Thread the new ribbon cable through the holes in the chassis with the connector that plugs into the CPU board facing the same as the A Drive ribbon cable connector. Snap open the jaws on the CPU connector and plug in the ribbon board connector, then close the jaws. Pass the other end of the cable under the guide bars between the two drives, fold the cable over and insert the ninety degree fold into the cable clip. Be sure to fold the cable the same way as the A Drive cable to properly orientate the connector.

Before installing the B drive remove the terminator chip, if it has one. Only one terminator is needed, and it goes in the A Drive. Check that the two drives are the same. If not, you have an MPI Drive and a Tandon Drive. The terminator is located here on the Tandon Drive, and here on the MPI Drive. Once again, make sure only the A Drive has a terminator.

The address plug on the Tandon Drive has pin 2 jumpered to pin 13, and the remaining jumpers are open. The 12 pin jumper platform is inserted into the 14 pin socket with pin 1 of the platform aligned with pin 1 of the socket. On the MPI drive pin 1 of the 12 pin platform is aligned with pin 2 of the 14 pin socket. Pin 2 is jumpered to pin 13 and pin 7 is jumpered to pin 8. All the remaining jumpers are open.

Align the bottom plate with the chassis guides and slide the Drive halfway into the chassis. Connect the shorter of the two power cables to the power connector on the drive controller. Then connect the ribbon cable. Slide the drive the rest of the way in, guiding the tab on the bottom plate into the slot in the chassis, and secure it with the mounting screw. Next, reinstall Drive A. Slide it part way in, connect the cables, slide it the rest of the way in, and secure it.

#### INSTALLING THE WINCHESTER DRIVE

The ten Megabyte Winchester Disk Drive option includes the Drive, the Controller Board and the cables. First, install the Controller Board in EU slot five, as previously explained. Next, remove the blank panel from the bottom Disk Drive slot or, remove Floppy Drive B, which ever the case may be. Remove the bottom plate from the blank panel and install it on the Winchester Drive. Then slide the Winchester Drive part way into the slot, and connect the power cable.

Next, connect the narrower ribbon cable to the Controller, fold it under for a 90 degree bend and thread it through the chassis. Then, connect the wider cable to the Controller, fold it under for a 90 degree bend thread it through the same hole in the chassis with the narrow cable. Now fold both cables over for another 90 degree bend and insert them in the two plastic cable clips provided. Then connect the cables to the Drive, slide the Drive all the way in and secure it with the retaining screw.

Connect the keyboard, and the Monitor to the EU. Plug the power cord into a wall outlet. Power up the system and check it out. If the system does not operate properly recheck all cable connections and try it again. Once the system is proven to operate properly, power it off, remove the power cable, keyboard and Monitor cables. Set the EU chassis flat on the table, orient the cover with the air vents down, slide the chassis into the cover, and replace the four holding screws. Reconnect the system cables and recheck the system operation.

#### INSTALLING THE OPTIONAL PRINTER

If you have a printer to install, it will either be a Model MX-80FT, Type III matrix printer or a model DW-20 Wang Daisy printer. First, unpack the printer. If its a MX-80F/T, Type III set it where the Customer wants it installed, connect the cable from the printer to the EU, plug in the printer power cord, load paper into the printer, and run self-test by holding down both the Line Feed and On Line buttons while turning on the printer power. Then release both buttons. If the printer does not work, replace it.

If the printer is a DW-20 install it the same way, except there is no self-test feature. To test it run the following printer Diagnostic. Insert the Diagnostic Diskette into Drive A, power up the System and type yes, when the disclaimer screen comes up. Then, when the Menu comes up deselect the System Card and the WANG Monitor Card with the DELETE key. Select Printer with the INSERT key and depress EXECUTE to start the Printer Test. Watch the Monitor, and do as directed to run the tests. When the column test completes type X to exit the diagnostics.

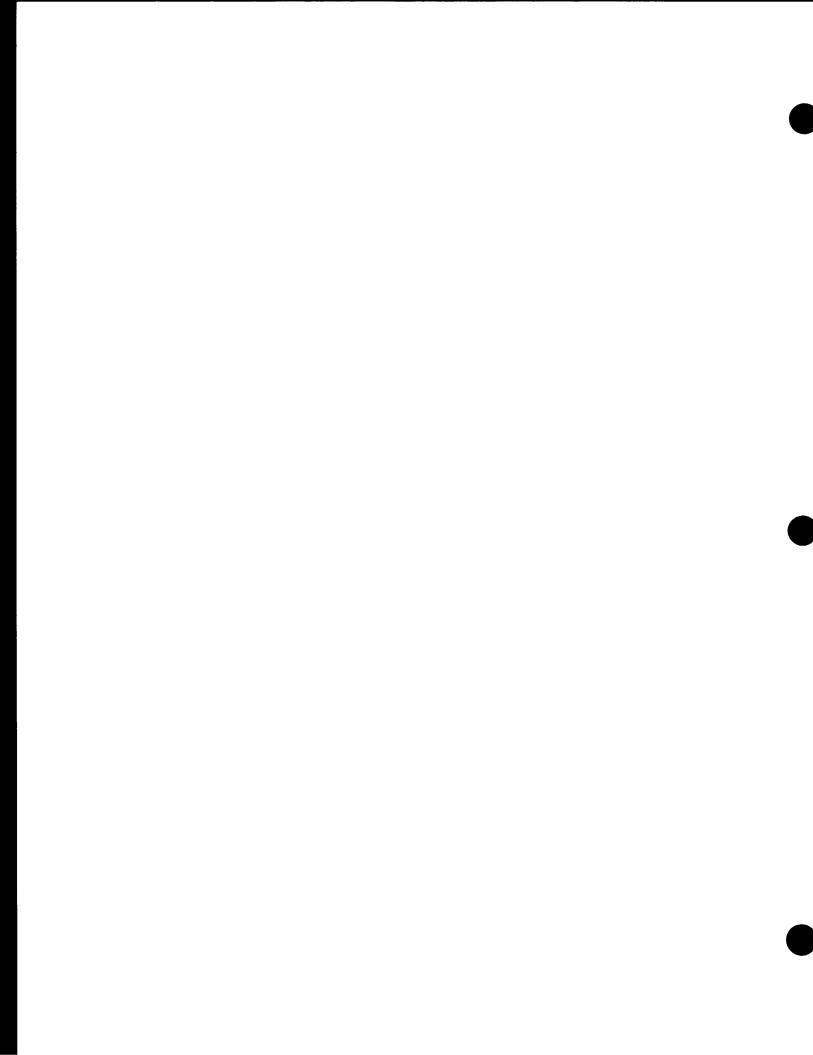
If the MX-80FT, Type III printer does not operate, it is probably not configured properly. To check the switch configuration power the printer down, disconnect the power cord and the interface cable. Turn the printer over and remove the four cover screws. Holding the printer cover to the base, turn it back over carefully so you don't lose the four screws and remove the platen knob. Lift up the cover from the left side, disconnect the control panel connector on the right side to free the cover and set it aside.

Configure switch bank 1 with switches 6 and 8 on, all the rest off. Configure switch bank 2 with switch 4 on and the rest off. Reassemble the printer, reconnect it and rerun the diagnostic tests. If the printer still does not work it will have to be replaced.

Reconnect your PC System and check it out. This concludes Section two on PC Installation.

# PART II SECTION 3

# OPERATION OF THE PROFESSIONAL COMPUTER



#### SECTION 3

#### OPERATION

# INITIALIZING THE SYSTEM

Operation of the PC System starts with turning on the System power which initiates the BUILT-IN-TESTS, otherwise known as the Bit. This is recognized by the six keyboard LEDs all coming on, and then sequencing out, from left to right. These tests take about 30 seconds to complete. As the last LED goes out, the screen will display this prompt. You now have five seconds to select an option, or do nothing, and at the end of five seconds the BOOT-STRAP-LOADER will attempt to load the operational program from Floppy Dive A.

As you may have noticed the diskette is not in the drive, so the program will report this on the screen. The operator options allowed during the five second delay are :

- 1. Depress the P key to rerun the Bit, which takes a while.
- 2. Depress the D key to redirect the System to an optional disk drive. Then type A to select floppy drive A, and depress RETURN to start; or type B to select floppy drive B, then type RETURN to start; or type W plus the slot number of the Winchester Controller Board and RETURN to select the Winchester Drive.
- 3. Depressing G merely bypasses the five second delay.
- 4. Depressing Q executes a WARM START.
- 5. Depressing M loads a special diagnostic menu that permits testing the RS-232 interface and alignment of the floppy drives. Depressing the number six key exits the special diagnostic and reruns the Bit.

Since there isn't any diskette in the drive the BOOT-STRAP program reports this and waits for another entry, allowing you time to load a diskette. Before inserting the System diskette into Drive A check the write protect slot. The slot should be covered, protecting the diskette. Insert the diskette, close the door, and depress the R key to load the system. The R key is for retry, and is similar to the Q key, except the Q key resets the system before trying to re-IPL. The R key does not reset the system.

When the System comes up type in the date, depress RETURN, type in the time, and depress EXECUTE to access the Main Menu. Depress the SPACE BAR 4 times to select DOS Command Processor and depress EXECUTE to access it. Type VOL and depress RETURN to display the volume number of your System Diskette. Write this number down, we need it to create a another System diskette so we can back up our software.

# USING THE SYSTEM UTILITIES

Type EXIT and depress RETURN to display the Main Menu. Select System Utilities with the Space Bar and depress EXECUTE. Depress F to select Format a Disk, depress RETURN as A is the Drive we want and depress Y for yes as we want to transfer the system files. Depress RETURN to select 360 K-B and depress EXECUTE. The software will read the Format Program off the diskette and prompt us to replace the System Diskette with a blank. We will do as prompted. Replacing the System Diskette with a blank, or Scratch diskette and depress any key on the keyboard to start the Format operation.

After approximately 70 seconds the formatting and System transfer will complete, and the program prompts us to type a volume label of eleven characters or less. Type in PCSYS and the date, depress return and the program will ask if we want to format another diskette. Type N for no and the program will prompt us to replace the formatted diskette with the system diskette.

Remove the Formatted diskette from Drive A and put it in Drive B. Replace the System Diskette in Drive A and depress any key to return to the Utility Menu. Select Copy a File with the SPACE BAR and depress EXECUTE. Depress RETURN and type in the Volume number you wrote down, PCSYSXXXXXX (the X's equal the current date), depress RETURN, type asterisk-dot-asterisk, depress return and the input file we just filled in will be duplicated in the output file.

Type B to change the output drive from A to B, depress RETURN, and change volume label to the current date, then depress EXECUTE to start the copy operation. The program will prompt us to mount the source, or object diskette and depress any key to continue. Since we have already loaded the diskettes depress RETURN to continue. Each file copied will be listed. This will continue until all the files are copied and the prompt will list the total number of files copied and ask us to strike any key to return.

Depress RETURN to go back to the copy utility, then depress CANCEL to return to the Utility Menu and select "Change Default Drive" with the Space Bar. Depress EXECUTE, then B, and EXECUTE again to change drives. Select "Directory Display" and depress EXECUTE to display all the files on the B diskette. This proves you really copied all the files from the A drive. Go back to the Utility Menu and select "Delete a File", EXECUTE and type in the Volume ID, PCSYS, the date and Asterisk-dot-DAT, EXECUTE.

When the prompt comes up depress any key to continue and when prompted again depress any key to return to the Delete Utility format. Depress CANCEL to return to the Utilities Menu, select Directory Display and display the files on the B Drive. As you can see, all five data files are gone, and we have a total of 30 files instead of the original 35.

The Asterisk-dot-DAT we typed in told the delete utility to delete all the files with a DAT extender. The three character extenders are separated from the file name by a period which we call a dot. The extender designates what kind of a file it is. For example DAT stands for data file, COM for command file and SYS for system file.

Depress any key to return to the Directory. Display Utility, then depress CANCEL to return to the Utilities Menu. All the Utilities you see here are DOS Command Processor functions that have been programmed for easier use. A few functions, such as List the Volume Label are not included in the Utilities. For more information on the DOS Command Processor read Appendix A of the PC Introductory Guide. For more information on the Utilities read Sections 7 and 9 of the Introductory Guide.

# ACCESSING THE APPLICATIONS PROGRAMS

Depress CANCEL to return to the Main Menu, select Applications, depress EXECUTE, select Multiplan, and depress EXECUTE again.

Replace the System Diskette with the Multiplan Diskette when prompted to do so and stike any key to load the program. We have a Demo in Drive B and will load that so you can see what a filled out Spreadsheet looks like. Depress T for Transfer, L for Load and type B colon, space, WANG, and RETURN.

This "Spreadsheet" demonstrates one of the many uses of Multiplan. Moving the Index Pointer to the right with the right arrow key scrolls the screen to display the rest of the spreadsheet. Changing the dollar amount in the October column on the Sales line, automatically retotals the Sum and other affected figures in the same column. To learn how to create a spreadsheet follow the examples in The PC Multiplan Training Guide. To sign off, depress Q for quit, and when prompted Y for yes. Then, when prompted, replace the Multiplan Diskette with the System Diskette and depress any key to return to the Applications Menu.

Select Word Processing, depress Execute, then replace the System Diskette with the Word Processing diskette and depress any key to load the program. First we will select Document Index with the SPACE BAR, and EXECUTE to display the index. We have four documents and two Glossaries listed. Cancel to go back to the Menu, select Utilities, EXECUTE, type A to change from the default B Drive to the A Drive, and EXECUTE.

Cancel to go back to the Main Menu, select Glossary Functions, and EXECUTE to display the Glossary Menu. Select Attach Glossary, EXECUTE type PRACGLOS, and EXECUTE. PRACGLOS is a Demo glossary and it is now attached to any document listed. To find the letter-designator for this glossary select "Show Valid Entries", EXECUTE and we see that the letter A designates the first page of this glossary, and B the second page. CANCEL twice to get back to the Main Menu, select "Create New Document", EXECUTE, type 3001 for a Document number and EXECUTE. We are now on the first page of our new document. To fill up the first two pages, depress the glossary key, which is labeled GL, and when prompted for which entry, type A. The Demo Memo will now be entered into the document. Cancel and EXECUTE to get back to the Main Menu.

#### USING THE PRINTER

To print our Memo out on the matrix printer select "Print Document", Execute and verify the standard items on the Print Format. Normal is 10 pitch, no right justification, continuous forms, 6 lines per inch, left margin of five and 66 lines per page. The character set info is for a Daisy Printer and does not apply to this matrix printer. To print out the Document check that the printer is on-line, that the Top-Of-Form is adjusted properly and depress EXECUTE. We have just been through most of the word processing functions. For more detailed information on Word Processing, read The PC Word Processing Training Guide.

When the Printout completes depress CANCEL and replace the Word Processing Diskette with the System Diskette when prompted to do so. When the Applications Menu comes up depress CANCEL to return to the Main Menu.

#### OPERATING THE COMMUNICATIONS PROGRAMS

Select Communications and depress EXECUTE to display the Communications Menu. The programs you see listed require additional hardware to operate. The 2780, 3780 Batch Communications and Remote Wangnet both require the RTC option. The Asynchronous Communications program can be used to operate a PC System network with two or more Systems connected over a telecommunications network. For detailed information on how to physically connect your PC communications network and how to operate it, read The PC Asynchronous Communications User Guide.

The Wang 2200 Terminal Emulation program requires a local connection between the PC System and the 2200 system using a Wang Null Modem to connect the two RS-232 interfaces. Operated in this mode, the PC becomes another 2200 terminal.

#### THE PROGRAM DEVELOPMENT PROGRAMS

Depress CANCEL to return to the Main Menu, select "Program Development" and depress EXECUTE to display the Program Development Menu. The Basic Interpreter program allows you to write your own programs. For example type in the following program:

- 10 FOR X = 1 to 5 (RETURN)
- 20 PRINT "The WANG Professional Computer is powerful." (RETURN)
- 30 NEXT X (RETURN)
- 40 STOP (RETURN)
- RUN (RETURN) to run it.

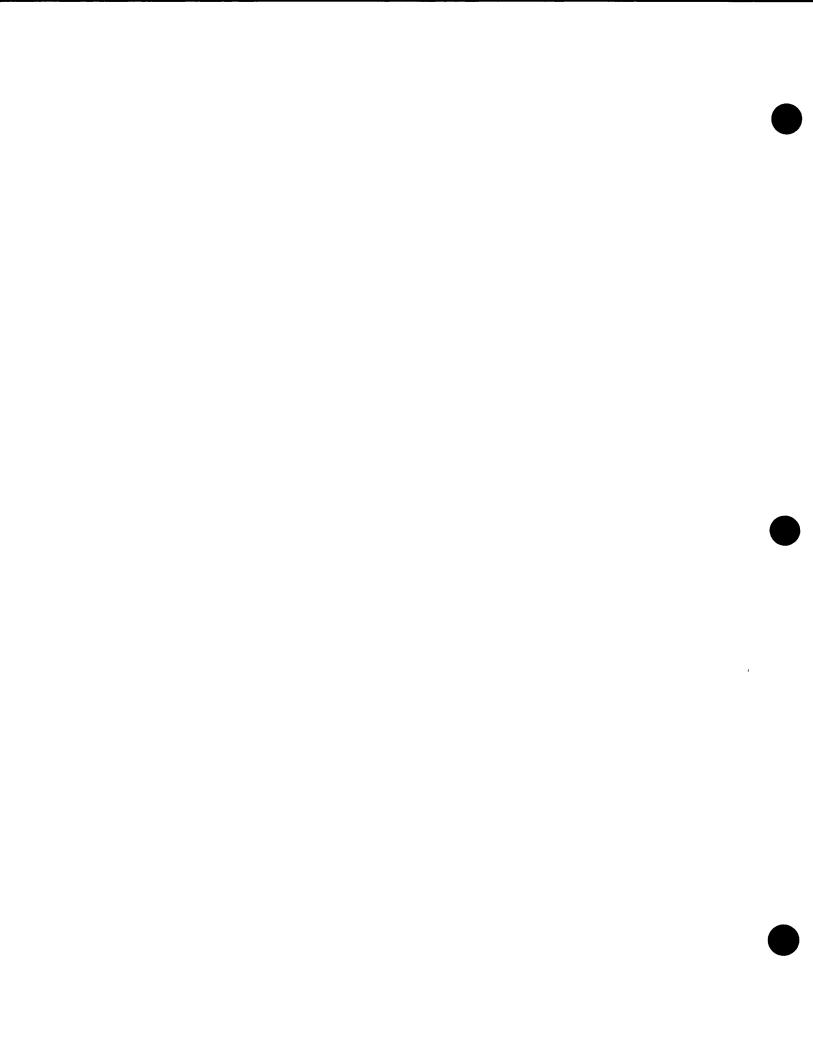
Or, if you want to be noisy, type in this little program:

10 X = INT(RND(1)\*4000+1) (RETURN)
20 SOUND X,2 (RETURN)
30 GOTO 10 (RETURN)
RUN (RETURN) to start it.

Depress CANCEL to stop it. Type in SYSTEM and depress RETURN to return to the Program Development Menu. For detailed instruction on how to develop your own PC programs in Basic read The PC Basic Language Guide and PC Program Development Guide. The other development programs, Debugger, Editor, LINKER and Library Manager are explained in the PC Program Development Guide. This concludes Section three on operation of the Professional Computer.

## PART II SECTION 4

# PROFESSIONAL COMPUTER REMOVAL AND REPLACEMENT PROCEDURES



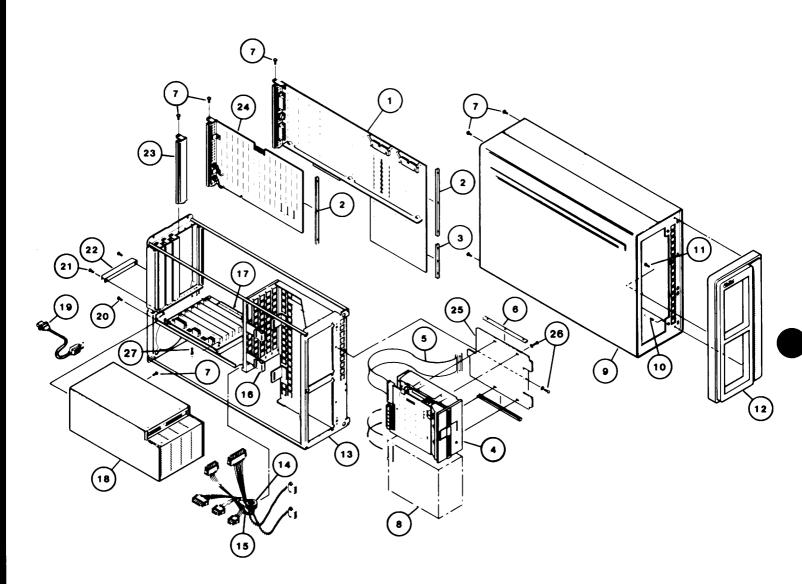


Figure 7-3 CPU Electronics Enclosure

Figure II-4-1 ELECTRONICS UNIT ILLUSTRATED PARTS BREAKDOWN

### SECTION 4

### REMOVAL AND REPLACEMENT PROCEDURES

### **ELECTRONICS UNIT**

To remove the CPU Board, first unplug the two floppy drive ribbon cable connectors from the CPU Board by prying open the connector jaws. Then pull enough slack to get the connectors out of the way. Remove the CPU Board retaining screw and pop the board out of its connector by pushing up on the bottom of the board. Removing the board this way will prevent damage to your fingers. Then, while holding the ribbon cable connectors out of the way, push the board straight up until it clears the guides.

To remove the options boards, first unplug any cables that may be attached. Then, remove the retaining screw, and pull the board straight up until it clears the guides. Repeat this procedure for the other option boards, and remember, if you have a Winchester Controller Board it must be installed in slot five.

To remove the power supply, first unplug the three connectors from the motherboard, and the power supply connector from each of the disk drives. Remove the power supply retaining screw from the side of the chassis frame. Then remove the two screws holding the supply to the rear panel. Slide the power supply and the cable assembly out of the side of the chassis.

To remove the Motherboard, first unplug the three power supply cable connectors. Then, remove the four retaining screws, and remove the board.

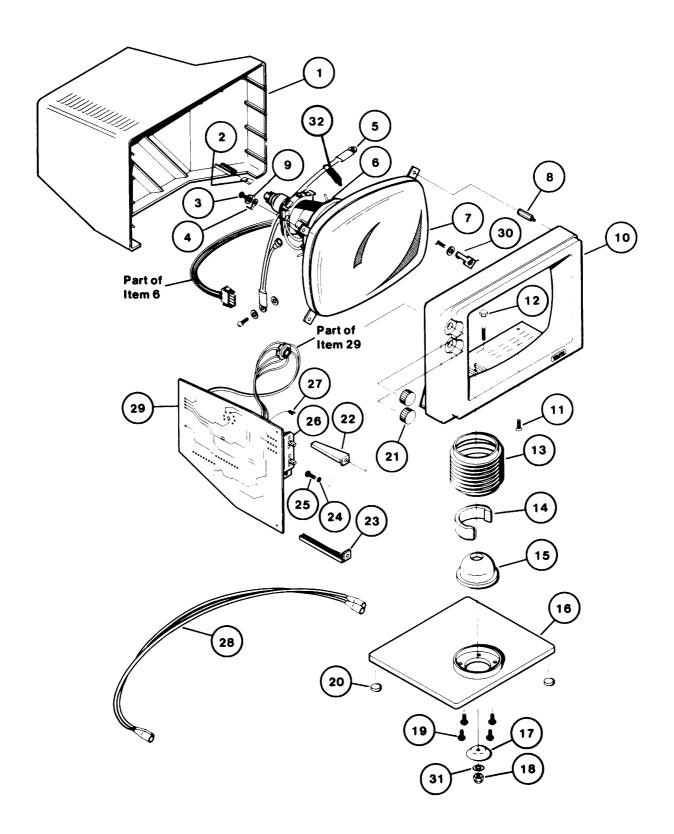


Figure II-4-2 TTL Monitor Illustrated Parts Breakdown

To remove a floppy, or winchester drive, first remove the one retaining screw, slide the drive part way out so you have room to manipulate, then remove the ribbon cable connector, and, the drive.

To reassemble the EU reverse the removal procedure we just went through, with one caution. When inserting the boards into their motherboard connectors, make sure the tab on the back panel of the board fits into the chassis slot.

### MONITOR

To replace the Monitor Board, first disconnect the Monitor Cable and set it aside. Pop the two knobs off their shafts by pulling straight out, and set the Monitor upside down. Remove the two retaining screws, set the Monitor right-side up, and using a small flat-blade screwdriver, push the right retaining tab down, being very careful NOT to twist the screwdriver as the plastic can be damaged. Slide the cover over the tab, just enough so it can't pop back in the slot, then release the left retaining tab, and remove the cover.

Unplug the yoke cable connector from the board, disconnect the CRT neck socket connector from the CRT, and disconnect the fasten clip from its grounding tab. Disconnect the high voltage clip from the CRT by first going around the plastic gasket with your finger to loosen it, then pinch the clip together with pair of pliers and remove it. Unscrew the springloaded board retaining screw using a long shafted, screw driver, and slide the board straight out of its guides.

To reassemble the Monitor, first set it on the CRT face plate, slide the Monitor board into its guides, and tighten the springloaded retaining screw. Snap the high voltage clip into the CRT. Push the fasten clip onto the ground tab. Connect the CRT neck socket to the CRT. And, connect the deflection coil cable to the Monitor Board.

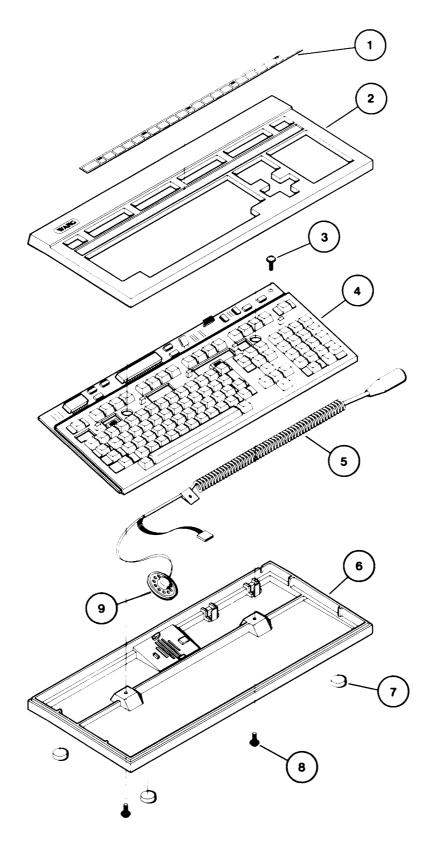


Figure II-4-3 Low Profile Keyboard Illustrated Parts Breakdown

Set the Monitor on its pedestal, slide the cover into place while holding one of the tabs down slightly, until the cover slides over it, the press down the other tab down and slide the cover over it. Make sure both tabs are loaded in their slots, then set the Monitor upside-down and replace the two retaining screws. Press the two knobs onto their shafts, and connect the Monitor cable to the Monitor and to the EU.

### **KEYBOARD**

To disassemble the keyboard Flip it over, and remove the two retaining screws. At this point you have to be careful to hold the keyboard together while you turn it over. The bottom cover, top cover and the PCA are loose, and can separate while turning the assembly over if you fail to hold it together. This can result in the speaker wires breaking off. Remove the top cover. Remove the cable clamp screw from the PCA, then remove the PCA from the bottom cover.

To reassemble the keyboard reverse the procedure we just covered. This concludes Section 4 on removal and replacement.

# PART II SECTION 5

# PROFESSIONAL COMPUTER ALIGNMENTS AND ADJUSTMENTS

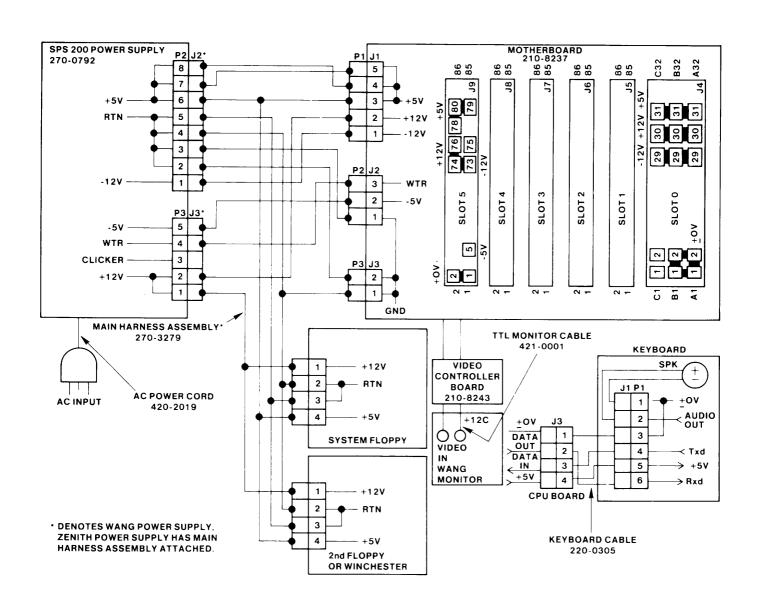


Figure II-5-1 Power Distribution and Interconnection Diagram

### SECTION 5

### ALIGNMENTS AND ADJUSTMENTS

### FLOPPY DRIVE ALIGNMENTS

It is very important that you learn how to align the floppy drives as slight variations in alignment can cause problems in reading all the customers software back into the system after replacement of a floppy drive unit. First, remove the EU cover, and remove the retaining screw from floppy drive A. Then reconnect the system.

Turn on the system power and when the Power-Up diagnostic completes, depress the M key to access the disk alignment program. Verify that the program is working by typing 4 to drive the heads to track 40, then depress 1 to drive the heads back to track zero. Insert the Dysan alignment diskette into floppy drive A and close the drive door.

### VOLTAGE CHECK

Using a Fluke Multimeter measure the plus 12 volts at P-1, pin 2 on the Motherboard. It should be between plus 11.4, and 12.6 volts. Then measure the plus five volts at P-1, pin 3. It should be between plus 4.75, and 5.25 volts. If either of these voltages are out of tolerance replace the power supply.

### TANDON DRIVE ALIGNMENTS

The first group of PC Systems manufactured contained TANDON drives. Future systems will have both Tandon and MPI drives. First, we will go through the Tandon Drive alignments.

### MOTOR SPEED ADJUSTMENT

Our first check on the TANDON Drive is the Motor Speed. With the Drive pulled part way out of the chassis we can observe the timing marks on the spindle pulley through the cutout in the drive bottom plate. The outer ring of marks is for 115 volt operation, and the inner ring is for 230 volt operation. Fluorescent light must be used for this procedure to work properly. When the motor is running at the proper speed the timing marks will appear stationary. If this is not the case adjust potentiometer R4 on the servo board at the rear of the drive to make the timing marks stop rotating.

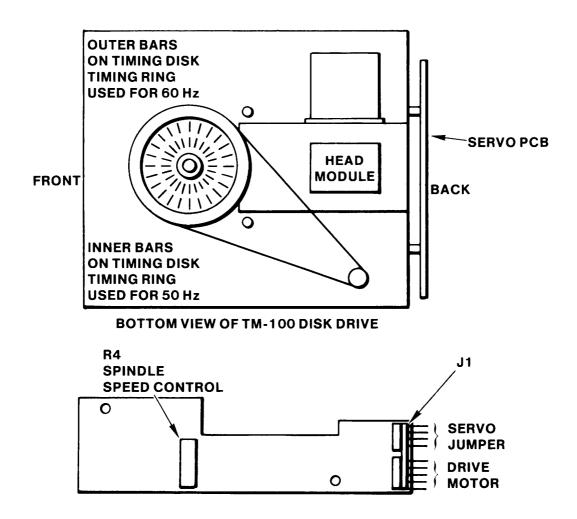


Figure II-5-2 Tandon Motor Speed Adjustment

### TANDON RADIAL-TRACK ALIGNMENT

The Radial Track Alignment Check is next. A dual channel scope with external triggering and a fast sweep speed is needed. Power up the scope and connect it as follows:

Scope Channel A to TP1 on the drive PCB

Scope Channel B to TP2 on the drive PCB

Ground the Scope probes to TP10

Channel A and B (Vertical) Input: A plus B (Add), B inverted

Time Base: 20 milliseconds per division Amplitude: 50 Millivolts per division

Coupling: AC

External Trigger: TP7 with probe ground to TP6.

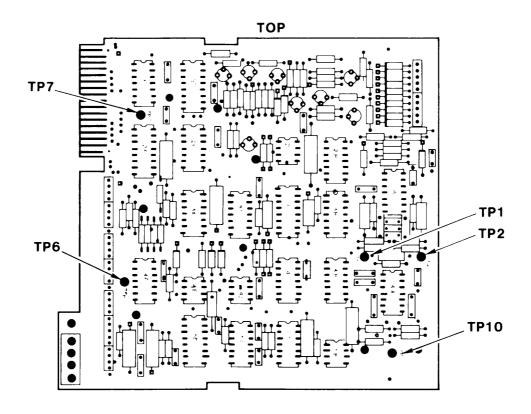
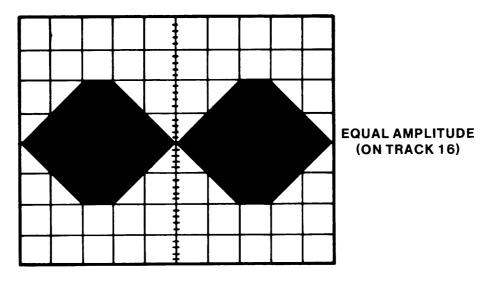


Figure II-5-3 Tandon PCB Test Point Locations



TIME SCALE = 20 ms/Div

Figure II-5-4 Cats Eye Pattern

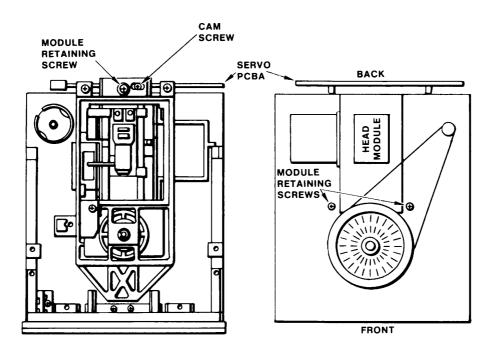


Figure II-5-5 Tandon Head Module Retaining Screw Locations

Depress the number three key to drive the heads to track 16 on the alignment diskette. Adjust the trigger level knob on the scope to display the Cat's-Eye pattern. Both eyes must be within 80 percent of each other in amplitude. If they are not the RADIAL-TRACK alignment must be made.

To make the RADIAL-TRACK alignment, carefully pull the drive out as far as you can and loosen the two screws one half turn counter-clockwise through the two access holes in the bottom plate. Then move the chassis and loosen the top, rear carriage retaining screw one half turn. The alignment cam is next to this screw.

With a flat blade screwdriver, adjust the cam slowly while carefully watching the Cat's-Eye pattern on the scope. When the Cat's-Eyes are equal in amplitude carefully tighten the carriage retaining screws while watching the scope. If the Cat's-Eye pattern moves out of tolerance slightly loosen the retaining screws and readjust the cam to compensate for the movement and then tighten the three retaining screws.

To verify the adjustment, depress the number 1 key on the keyboard to move the heads to track zero, then depress the number 3 key to drive the heads back to the alignment track. The Cat's-Eye pattern should remain the same. Now move the heads to track 40 by depressing the number 4 key, then back to track 16 with the number three key. Once again the Cat's-Eye should remain the same. If not, the alignment will have to be done over.

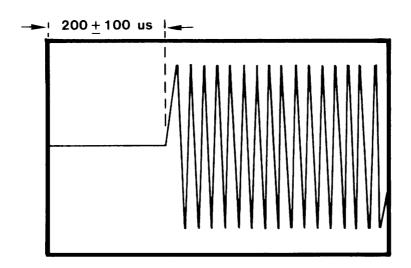


Figure II-5-6 INDEX-TO-DATA Burst Alignment Pattern

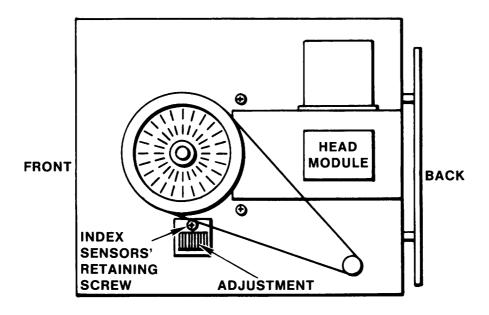


Figure II-5-7 Tandon Index Sensor Adjustment

### TANDON INDEX-TO-DATA ADJUSTMENT

The next alignment check is INDEX-TO-DATA. Leave the scope set up as is, except change the Time Base to 50 microseconds. Depress the number two key on the keyboard to drive the heads to track one. Adjust the trigger level knob on the scope to display the data burst. The start of the data burst should be 200 microseconds from the start of the sweep, plus or minus 100 microseconds.

To adjust the INDEX-TO-DATA sensor loosen the sensor retaining screw through the access hole in the bottom plate one quarter of a turn. With a flat blade screw driver carefully slide the sensor back and forth while watching the scope. Adjust the start of the data burst to approximately 4 division marks to the right of the left side of the screen. Then carefully tighten the sensor retaining screw while watching the scope. If it moves out of tolerance do it over again.

### TANDON WRITE-PROTECT SWITCH ADJUSTMENT

To check the Write-Protect Switch connect the channel A scope probe to TP9, the ground clip to TP6, set the time base to 1 millisecond, the vertical amplitude to 2 volts, set the trigger mode to automatic, set the trigger source to internal, switch the channel A voltage input switch to ground and adjust the trace to the center line Now switch the voltage input switch to DC and the trace should move up approximately two divisions, or plus 4 to 4.5 volts D-C.

Remove the Alignment diskette from the drive and the scope trace should drop down to zero volts. Insert a diskette into the drive that does not have a write protect tab on it, and close the door. The trace should move back to plus four volts as the diskette is being inserted, then drop back down to zero volts when it is fully inserted.

If this is not the case, power down the system, remove the floppy drive, loosen the two write protect switch mounting screws, and adjust the switch position while sliding the diskette in and partially out listening to the switch clicks. When the diskette hits the stops the switch should click closed, and as it starts out the switch should click open. Tighten the screws, reinstall the drive and check it out under power.

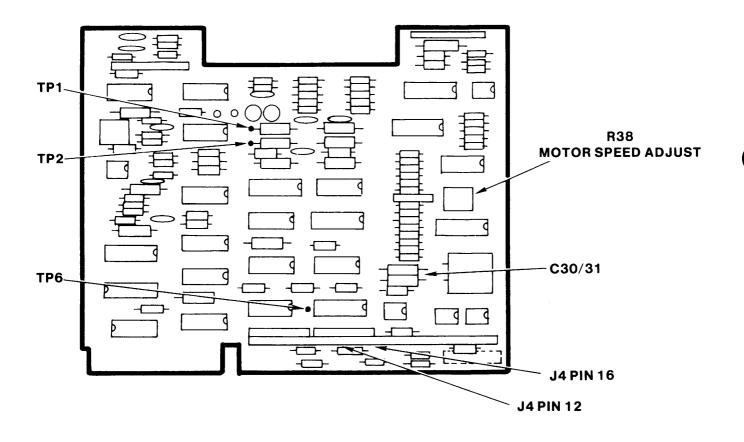


Figure II-5-8 MPI PCB Test Point Locations

### MPI FLOPPY DRIVE MOTOR SPEED ADJUSTMENT

Although the MPI drive is very similar to the Tandon Drive, and the same adjustments must be made, the process of making these adjustments is different. Once again motor speed will be checked first. Insert the Dysan alignment diskette, remove the drive retaining screw and slide the drive part way out of the EU to observe the motor pulley with its timing marks. The outer ring is for 115 volt, 60 hertz operation, and the inner ring for 230 volt, 50 hertz operation.

Power-Up the system, and when the Power-Up diagnostic completes, depress the M key to access the disk drive alignment program. This will cause the drive motor to continuously rotate so the timing marks can be checked and the motor speed can be easily adjusted.

The correct motor speed is indicated by the timing marks appearing stationary under fluorescent lighting. Adjust R38 on the printed circuit board, while watching the timing marks to obtain the correct motor speed.

### MPI RADIAL-TRACK ALIGNMENT

Connect the scope as follows:

Channel A to TP1

Channel B to TP2

Probe ground clips to the ground leads of capacitors C30 and C31 External trigger to TP6

Channel A, and B voltage input for 50 millivolts AC

A plus B input (Add), with channel B inverted

Time base to 20 milliseconds

External trigger

AC coupling

Normal trigger mode, and a positive trigger level.

Depress the number 3 key on the keyboard to drive the heads to track 16 on the alignment diskette. Adjust the trigger level knob on the scope to display the Cat's-Eye pattern on the scope. Both eyes must be within 80 percent of each other. If they are not, then the RADIAL-TRACK Alignment must be made.

With the heads at track 16 loosen the set screw in the stepper motor pulley with a .05 hex screw driver. Carefully position the pulley until the Cat's-Eyes are equal in amplitude. This adjustment requires a little patience, but finally there it is. Now gently tighten the set screw for two inch-pounds of torque, while watching the scope. Caution here, too much torque will score the shaft, making future adjustment very difficult. If the Cat's-Eyes slip out of tolerance while tightening the set screw, do the adjustment over and compensate for the direction of slippage.

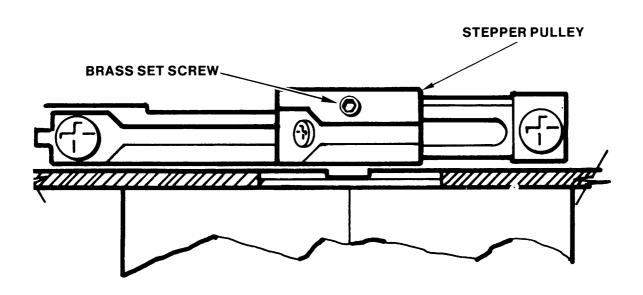


Figure II-5-9 MPI Stepper Motor Pulley and Band Assembly

To verify the adjustment depress the number one key on the keyboard to drive the heads to track zero, then depress the number three key to drive the heads back to track 16. The Cat's-Eye pattern should be the same. Now move the heads to track forty by depressing the number four key, then back to 16 with the number three key. Once again the Cat's-Eye should be the same. If not, the alignment will have to be done over.

### MPI INDEX-TO-DATA ALIGNMENT

To check the INDEX-TO-DATA alignment, change the scope time base to 50 microseconds, the channel A and B voltage range to point one volts, and the trigger coupling to DC. Leave all the other scope settings and connections as is. Depress the number 2 key to drive the heads to track one, and adjust the trigger level knob on the scope to display the data burst. The start of the data burst should be 200 microseconds from the start of the sweep, plus or minus 100 microseconds.

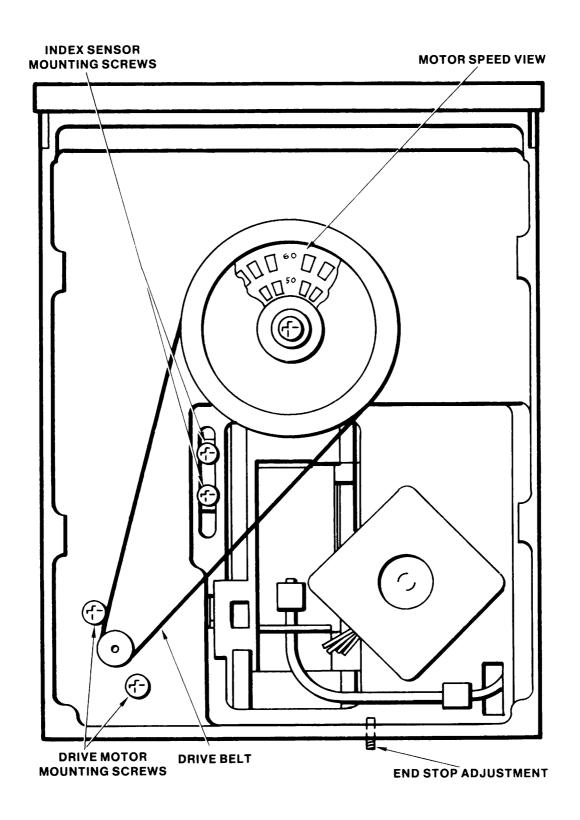


Figure 5-10 MPI Floppy Drive Bottom View

To adjust the INDEX-TO-DATA sensor loosen the two sensor retaining screws through the access hole in the bottom plate about one quarter of a turn. Using the tip of the screwdriver in the slotted screw holes, slide the sensor assembly back and forth while watching the scope. Adjust the start of the data burst approximately four division marks to the right of the left side of the screen, The carefully tighten the retaining screws while watching the scope. Caution do not over tighten these screws as you might crack the sensor mounting block.

### MPI TRACK ZERO END-STOP ADJUSTMENT

Whenever the RADIAL-TRACK adjustment is made the Track Zero end stop must be checked. With power applied and the disk alignment program accessed depress the 4 key, then the one key for a maximum track seek. The carriage should stop within 10 thousandths of an inch from the End Stop set screw. If this is not the case adjust the set screw to meet the ten thousandths tolerance.

### MPI WRITE-PROTECT SENSOR CHECK

To check the Write Protect sensor connect the channel A scope probe to J4, pin 16, connect the probe ground clip to C31, set the time base to 1 millisecond, the channel A amplitude for 2 volts, the trigger mode to automatic, the trigger source to internal, switch the channel A input to ground and adjust the scope trace to the horizontal center line. Then switch it to DC and the trace should move up approximately two divisions.

Remove the Alignment diskette and the trace should drop to zero. Insert a diskette without a write protect tab and the trace should go to four volts while the diskette is being slid in, then drop to zero when it is fully inserted. Do this twice to make sure the sensor is working properly. If the sensor is faulty the drive will have to be replaced.

### VIDEO MONITOR ADJUSTMENTS

Next we will align the Wang Monitor. The tools needed to accomplish this are:

One 6 inch plastic scale
One 8 inch plastic scale
One short, flat-blade, nonmetallic, alignment screwdriver
One long, flat-blade, nonmetallic alignment tool.

Two monitor alignments are possible, the first is for systems with character display only, and the second is for characters and graphics. Monitor alignment is necessary anytime the Monitor board is replaced and aging will also cause the display to drift out of tolerance. First remove the Monitor cover, reconnect the cable, insert the Diagnostic Diskette into the A drive, and power up the system.

### MONITOR ADJUSTMENTS FOR CHARACTER DISPLAY ONLY

When the Customer Disclaimer Screen comes up hold down the "SECOND" key and depress the "D" key, then the "M" key to display the CE Menu. Depress RETURN, and the SPACE BAR to select "Select By Manual Entry", then depress EXECUTE to display all the Diagnostic tests. Step down to the "Wang Monitor Attributes with the SPACE BAR and depress INSERT to select it, then depress execute to run the test. When the test stops with the Attribute Display, depress the MOVE key to display the "HO" test pattern. This is the screen pattern we will use to adjust the Monitor.

Adjust the vertical hold to the center of its stable range. Adjust the vertical size for a display height of 6 inches, or if you have a metric scale 15.2 centimeters, with a tolerance of plus or minus 1/8 inch, or 3 millimeters.

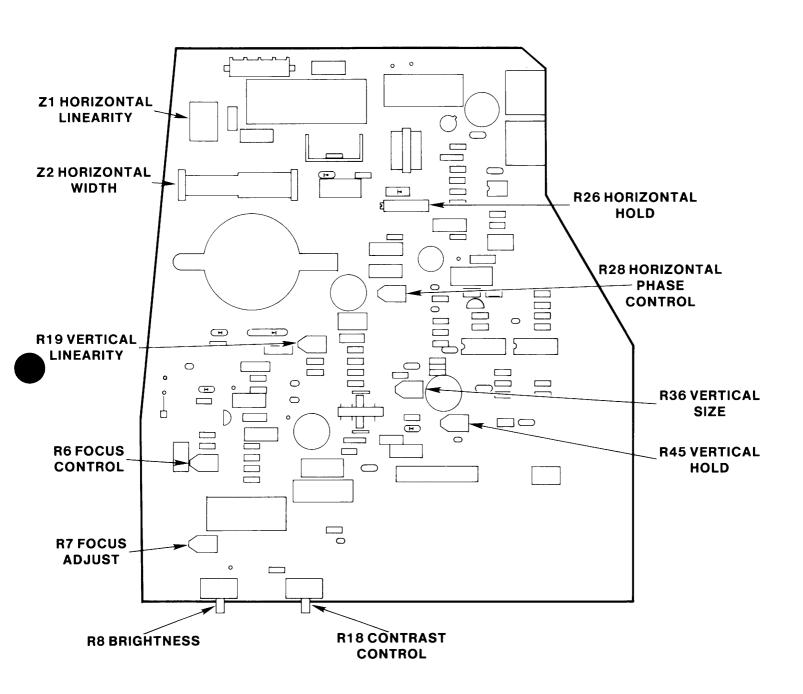


Figure II-5-11 8244 Monitor Board Adjustment Locations

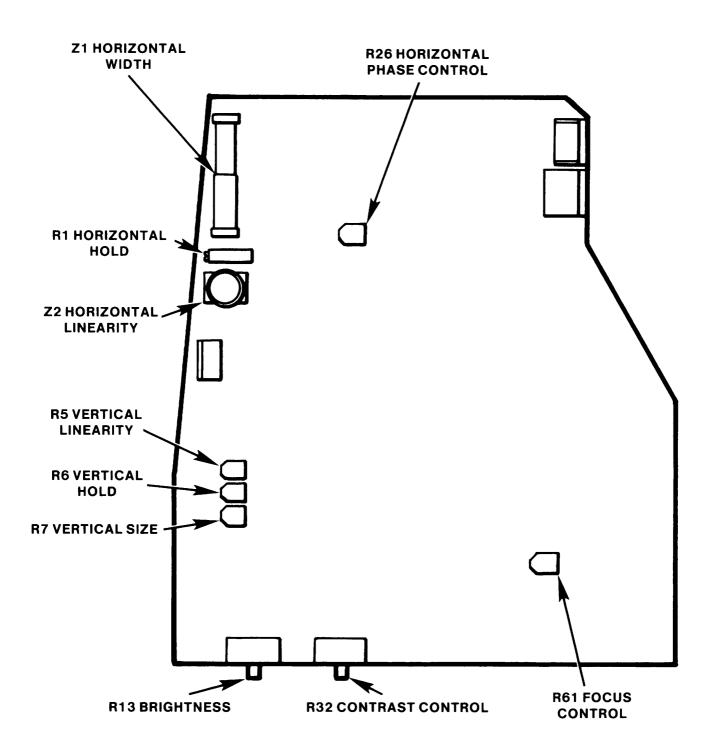


Figure II-5-12 8344 Monitor Board Adjustment Locations

Adjust the vertical linearity for character rows of equal height. Check the height again, and readjust if necessary. Then check for linearity again, and readjust if necessary.

Using the short alignment tool adjust the horizontal width coil for a display width of 8 inches, or 20.3 centimeters, plus or minus 1/8 inch or 3 millimeters. Adjust the horizontal linearity coil thumb wheel for equal character width across the screen.

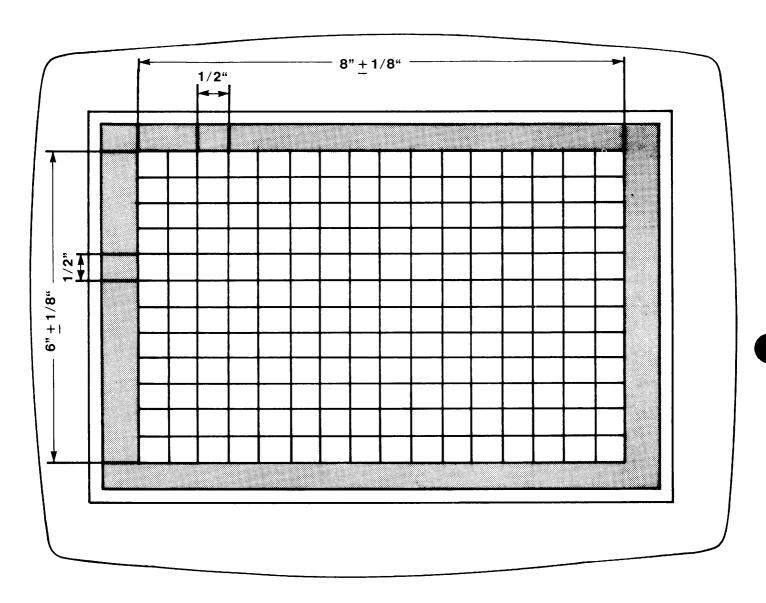
Turn up the brightness control to display the raster and adjust the horizontal phase to center the whole character display in the raster. Check the top row of characters for distortion, and using your long alignment tool adjust the horizontal hold to remove the distortion.

Turn the Brightness back down until the raster disappears and adjust the focus control for the best overall character display. Power down the system and replace the Monitor cover.

### MONITOR ADJUSTMENTS FOR CHARACTER AND GRAPHICS DISPLAY

If your system has the graphics option insert the MS-DOS System diskette into Drive A and power up the system. When the System comes up depress EXECUTE to display the Main Menu, depress the SPACE BAR twice to select Program Development and depress EXECUTE to display its Menu. Depress EXECUTE again to load Basic and replace the System Diskette with the Diagnostic Diskette, after Basic Loads. Now type in LOAD, SPACE BAR, QUOTATION MARK, MONALIGN, QUOTATION MARK and RETURN to load the Monitor Alignment program.

When it comes up type RUN, and depress RETURN to run the alignment program. When the program comes up read the directions displayed on the screen, and then depress the SPACE BAR to display the Inverse Video Screen, again for the Monitor Measurement Screen, and again to display the Grid Pattern, which is the pattern we will use for the basic alignment.



NOTE: NOT TO SCALE
GRID PATTERN HAS 16 VERTICAL X 12 HORIZONTAL SQUARES

Figure II-5-13 Monitor Graphics Alignment Grid Pattern

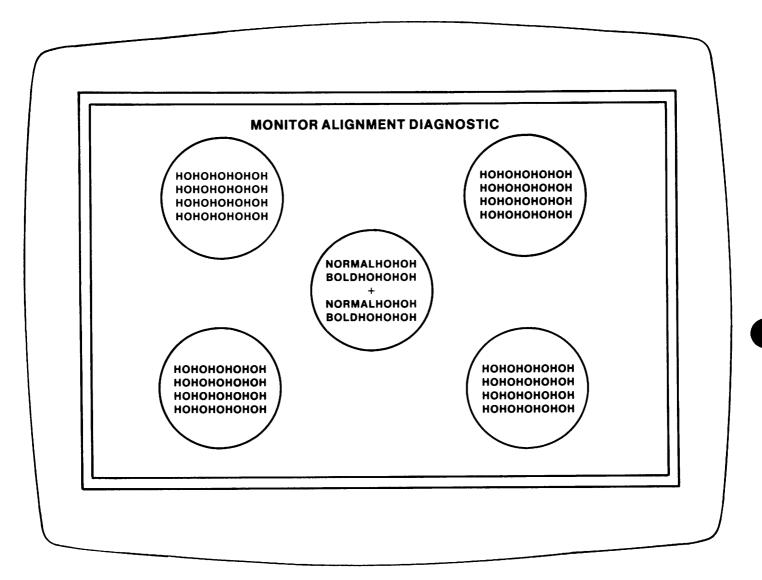
First adjust the vertical hold to the center of its stable range. Then adjust the horizontal hold to the center of its stable range. If the display had been out of sync, and rolling or tearing these adjustments will stabilize it. Adjust the vertical size for a display height of 6 inches, or 15.2 centimeters, plus or minus 1/8 inch, or 3 millimeters.

Adjust the horizontal width coil for a display width of 8 inches, or 20.3 centimeters, plus or minus 1/8 inch, or 3 millimeters.

Adjust the vertical linearity so the squares at the top of the screen are the same vertical size as the squares along the bottom of the screen. This adjustment affects the vertical height, so measure the display height again, and readjust if necessary.

Turn up the brightness control to display the raster and adjust the horizontal phase to center the display matrix in the raster. Adjust the horizontal linearity coil so the width of the squares along the left margin are the same width as the ones along the right margin. Then recheck the total display width, and readjust if necessary.

Adjust the two tabs around the CRT neck, one at a time to center the display, and eliminate any barreling, pincushioning, or distortion. Place your ruler parallel to the top matrix line, it should be straight to within plus or minus 1/16 of an inch, or 1.5 millimeters. Check the right, and left margins with the straight edge, they should also be straight to within plus or minus 1/16 of an inch, or 1.5 millimeters.



NOTE: NOT TO SCALE CIRCLES ARE 2 INCHES IN DIAMETER

Figure II-5-14 Monitor Graphics Alignment Screen

If you cannot bring the display in tolerance with the centering tabs, adjust the pincushion magnets one at a time to remove pincushioning or barreling. Then check all the squares for 1/2 inch, or 13 millimeter sides, plus or minus 1/16 inch or 1.5 millimeters. If vertical sides are out of tolerance readjust the vertical size and linearity slightly, and be sure to recheck the display height.

If the horizontal sides of the squares are out of tolerance readjust the horizontal width and linearity slightly, and be sure to recheck the display width after adjusting the linearity. Depress the SPACE BAR twice to display the Measurement Pattern and check that the circles are perfectly round. They should measure 2 inches, or 5.1 centimeters in diameter. Usually any distortion is horizontal rather than vertical.

Readjust the Horizontal Linearity, and the Horizontal Width. Now recheck the circles. If they are still distorted, adjust the Horizontal Hold potentiometer slightly to remove some of the distortion. Readjust the Horizontal Linearity and Width. Sometimes you will have to repeat these adjustments several times to make the circles perfectly round. Normally, if the Squares in the Grid Pattern are all in tolerance the circles will be okay.

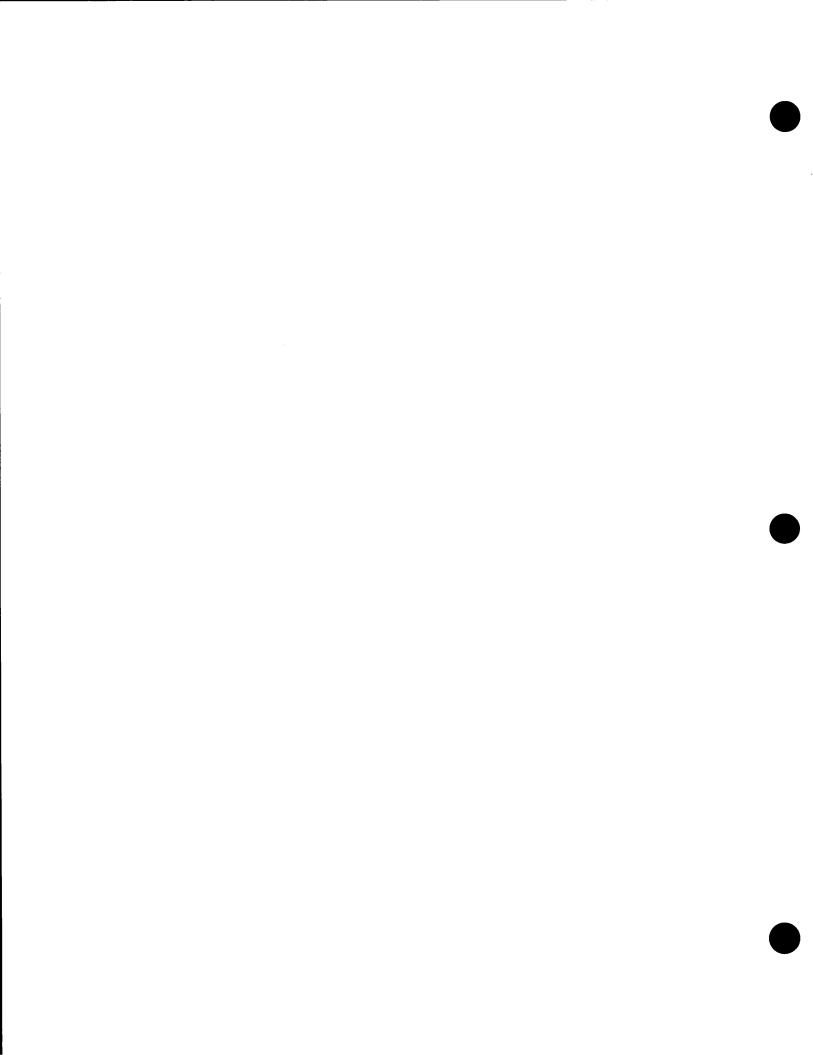
If you change the Horizontal Hold adjustment, then you must recheck the Horizontal Phase adjustment. Turn up the brightness to display the raster and check to see that the Grid Pattern slightly left of center. Or, the left portion of the raster that extends past the display pattern is smaller than the right-hand portion. If not readjust the Horizontal Phase. Finally, adjust the Focus Control for the best overall display pattern using the Circle Pattern.

To adjust the Brightness and Contrast depress the SPACE BAR to display the Inverse Video Pattern. First adjust the Brightness control for normal viewing level. Next, adjust the Contrast Control for the best overall viewing level between the normal display level and the reverse video. Double-check this adjustment by displaying the Circle Pattern.

Power down the system, and replace the Monitor cover. This concludes section five on adjustments and alignments.

# PART II SECTION 6

# PROFESSIONAL COMPUTER SYSTEM TROUBLESHOOTING



### SECTION 6

### TROUBLESHOOTING

### FIELD REPLACEABLE UNITS

Before you start troubleshooting the PC System you must know what Field Replaceable Units, or FRUs, are stocked as spare parts. First, the SPS-200 switching power supply with its cable assembly. Then the Motherboard, the CPU-System Board, the floppy disk drive, the ribbon cable for drive A, and the longer ribbon cable for drive B. The Winchester Disk Drive, its controller board and ribbon cable B. The A ribbon cable for the Winchester is the same cable used for Floppy Drive B. In addition, all the option boards are stocked.

The Wang Monitor is stocked for replacement of Monitors with failed CRTs, and the Monitor Board is stocked separately in case of board failure. The Monitor cable is also stocked. The last item on the list is the keyboard, which is stocked in its entirety. An illustrated parts breakdown is included in Section seven of you Maintenance Manual and a list of all errors reported by the Power-Up diagnostic is in the Appendix.

#### MONITOR FAILURES

Troubleshooting PC failures is easy. If the problem is a nonfatal error it will be reported on the monitor screen, provided the Monitor is working. If the Monitor is not working, watch the keyboard LEDs. They will all sequence off, then the keyboard will BEEP, and the system will load as evidenced by the Floppy drive LED. If your problem is no display, first turn the brightness, then the contrast fully clockwise.

## TABLE II-6-1 RECOMMENDED SPARES LIST

PART NUMBER	ITEM NAME			
	BOARDS			
210-8221-A	CPU Board			
210-8222-A	Color/Graphics Board			
210-8225-A	Winchester Controller Board			
210-8232-A	PC Remote Communications Board			
210-8233	Graphics Display Board			
210-8237	Motherboard			
210-8243-A	Character Display Board			
210-8244	Monitor Board			
	SUBASSEMBLIES AND OPTIONAL EQUIPMENT			
270-0792	SPS-200 Switching Power Supply			
278-4026	360 KB Floppy Diskette Drive			
278-4027	5 MB Winchester Disk Drive			
279-0541	Wang Monitor Assy.			
279-2042	Universal Keyboard (US)			
279-2044	Universal Keyboard (INT)			
725-0129	MX-80 F/T Epson Printer (US)			
725-0129-1	MX-80 F/T Epson Printer (INT)			
	CABLES			
220-3238	Winchester B Cable			
220-3239	System Floppy Cable			
220-3240	2nd Optional Floppy Cable and Winchester A Cable			
270-3279	Main Wiring Harness Assy.			
420-2019	AC Power Cord			
421-0001	Wang Monitor I/O Cable			

# TABLE II-6-2 PC SOFTWARE

PART NUMBER	ITEM NAME				
195-2326-9	MS-DOS Operating System				
195-2327-9	MS Basic Compiler				
195-2328-9	MS PASCAL Compiler				
195-2329-9	MS FORTRAN Compiler				
195-2330-9	MS COBOL Compiler				
195-2331-9	Async Communications				
195-2332-9	Remote Wangnet for VS (leased line only)				
195-2333-9	VS 2246S Local Communications Terminal Emulator				
195-2334-9	VS 2256C Local Communications Terminal Emulator				
195-2335-9	OIS 5536-4 Local Communications Terminal Emulator				
195-2336-9	Alliance 5536-4 Local Comm. Terminal Emulator				
195-2337-9	2780/3780 Communications Support				
195-2338-9	PC Multiplan				
195-2339-9	PC Word Processing				
	PC MANUALS				
700 <b>-</b> 7558	The Wang PC Communications Guide				
700-7588	The Wang PC Word Processing Manuals				
700-7589	The Wang PC Documentation Guide				
700-7590	The Wang PC Introductory Guide				
700-7592	The Wang PC BASIC Language Guide				
700-7593	The Wang PC Program Development Guide				
700-7594	The Wang PC Compiled BASIC Reference Manual				
700-7600	The Wang PC Multiplan Manuals				

If you have a spot in the center of the screen you have lost both vertical and horizontal deflection. If you have a vertical line in the center of the screen you have lost horizontal deflection, and if you have a horizontal line across the center of the screen you have lost the vertical deflection. The most probable cause of any of these three problems is the Monitor board.

If after turning up the brightness and the contrast you have a raster, but no video, the trouble can either be the Monitor Board or the Controller Board in the EU. The most probable cause however, is the controller board. If the raster overshoots the top and bottom of the screen, then the problem is definitely on the Controller Board. Loss of vertical or horizontal sync from the controller board will cause a distorted, out of sync display. A loss of intensity results in no highlighting.

If turning up the brightness and the contrast does not help, inspect the cable for damage. If the cable is okay, check the plus twelve volts at the controller board connector with your multimeter. If the voltage is okay, replace the Monitor Board. Or, if the voltage is bad, the Controller Board, another option board, or the power supply is bad.

To determine which, remove all the option boards and check the voltage at the Motherboard connector. If the voltage is bad replace the power supply. Or, if it is good replace the option boards, one at a time, rechecking the voltage after each board is replaced, until the bad one is found. Other problems that can be caused by the Monitor Board are distortion, ripple, and oscillation that cannot be adjusted out.

A bad CRT is evidenced by weak video, uneven illumination and blank spots. Also inspect the CRT for broken pins or a broken neck. If any of these problems exist the whole Monitor must be replaced.

If you have an intermittent display it could be caused by a faulty cable. Run a pin to pin continuity check on the cable with your multimeter and make sure both connectors at the Monitor end fit tightly in the sockets. If either connector fits loosely in the monitor board socket reverse the cable and try it again. If it fits better power up the system and check it out. Your problem will probably be corrected.

If you replaced the Video Controller Board, or the cable because you had a Raster and no video and still have the same problem, you could have a damaged Motherboard. In any event the Motherboard is the last resort.

### KEYBOARD FAILURES

Keyboard failures are easy to identify. When the system comes up with this message we can verify whether the problem is in the keyboard by unplugging it, and inserting a jumper from pin two to pin three. Turn the power back on.

When the Power-Up completes a colon will be displayed below the Ol message, indicating that the system is waiting for a keyboard input. This indicates that the problem is in the keyboard. If the keyboard error message is displayed again, then the problem is on the CPU Board. If the Keyboard has a hard failure, such as its microprocessor, all the LEDs will stay illuminated (background drone from speaker) and it will put out a constant tone indicating that it must be replaced.

### FLOPPY DRIVE FAILURES

Disk drive errors can be caused by the drive door not being properly latched, by the drive door being latched with out a diskette in the drive, and by having a nonsystem, or unformatted diskette in the drive. Next, try redirecting the system to drive B by typing D for redirect, then B for drive B and RETURN. If the system loads try it again to verify that the problem isn't intermittent, then replace drive A.

If neither floppy drive works on a two drive system check out the voltages on the Motherboard first. Check the minus 12 on connector P1, pin 1, the plus 12 on pin 2, and the plus 5 on pin 4. If the voltages all check good, replace the CPU board as the chances of both drives failing at the same time are remote. Remember, in a two drive system only one terminator is used in Floppy Drive A.

If the voltages all check good replace the drive. But remember, drive A must have a terminator installed while Drive B must not, and the address platforms must match if you are replacing a Tandon with a Tandon, or an MPI with an MPI. If not, pin 2 is jumpered to pin 13 on the Tandon address platform and pins 2 and 13, and pins 7 and 8 are jumpered on the MPI platform. The problem caused by having a terminator in both drives is disk write errors.

If you only have one drive and the errors persist, check the plus and minus 12 volts, and the plus 5 volts on the Motherboard before replacing the floppy drive. Check the minus 12 on connector Pl, pin 1, the plus 12 on pin 2, and the plus 5 on pin 4. Replace the power supply if any of the voltages are out of tolerance. If the voltages check good and you replace the Floppy Drive remember to take the Address Platform out of the bad drive and install it in the new drive. Also assure the new drive has terminator installed.

### CPU BOARD AND OPTION BOARD FAILURES

Fatal errors on the CPU board are indicated by one or more LEDs on the keyboard staying lit. When you encounter this problem be sure to power down the system and remove all the option boards, then rerun the Power-Up diagnostics. A short circuit on an option board can hang the system and appear as a CPU problem. If the problem remains, then replace the CPU board.

If the System Boots up, then you have a bad option board. Power down and replace the option boards, one at a time, and rerun the BIT after each board replaced, until the bad board is found. The Power-Up diagnostic also checks the parallel printer interface chip, and the serial interface chip.

If the Winchester Drive option is installed, it has its own Power-Up diagnostic PROMS that interfaces to the Main CPU Power-Up Diagnostic. Any problems with these devices will be reported on the Monitor. Parallel, or serial interface problems must be corrected by replacing the CPU board. If Winchester problems are experienced the Winchester floppy diskette diagnostic should be run to determine whether the problem is on the controller, or in the drive.

To fully check the RS-232 interface a loop-back plug is necessary. Install the plug then access the disk alignment program by depressing the M key when the Power-Up diagnostic completes. Depress the number 5 key to run the RS-232 loop test. If the test fails the CPU board must be replaced. These are all the tests that can be run from the Power-Up, or BIT.

### USING THE SYSTEM DIAGNOSTICS

The remaining option boards, which include the CP/M-80, Expanded Memory, Remote Telecommunications Controller, OIS/VS Terminal Emulator, and the Standard Monitor Controller must be tested using the Floppy resident, system diagnostics. In addition, the FRUs we have just troubleshot with the B.I.T. must be tested using the system diagnostics as they provide more extensive testing than the BIT.

Select the test you want to run with the INSERT key and depress EXECUTE to start the test. Anytime the WAITING FOR NEXT TEST, or TEST IN PROGRESS screen is displayed you can depress the HELP key to display the help information screen. Depressing any one of these keys will activate the function listed, and depressing the key a second time will cancel that function. Normally, the tests should be run with the STOP ON ERROR function activated.

When an error occurs the program will display the reason for the error, the most probable cause, or causes for the error and remain in this condition, waiting for operator intervention. By depressing the search key you can resume testing and see if any more errors occur. This can help to more positively identify the source of the trouble. Depressing the COMMAND key displays the Error Log, listing all the errors and the most probable causes.

Whenever you replace a board, floppy drive, Winchester Drive, power supply, or Monitor; the system must be thoroughly tested by running the appropriate system diagnostics. If for example, you replaced a floppy drive, then the Mini-Floppy Controller diagnostic must be run. This diagnostic thoroughly tests both the drive, and the controller.

When the Customer Diagnostic Disclaimer comes up hold down the second key and depress the D key, then the M key to access the CE diagnose menu. Depress RETURN, SPACE BAR and EXECUTE to display all the tests. Select the Mini-Floppy Controller test by depressing SPACE BAR and the INSERT key, then EXECUTE to start the test. After the test loads select the drive to be tested and depress EXECUTE, then type zero one to run both read and write tests. Now replace the Diagnostic Diskette with a scratch diskette and type zero zero, then EXECUTE to start the test.

When the test completes replace the Scratch Diskette with the Diagnostic Diskette and type zero zero to reload the floppy diagnostic and, once again you will be prompted to swap diskettes. This is to allow you to run the test again if want. If not, depress the CANCEL key to return to the diagnostic list of tests. If the CPU board is replaced then all the tests should be run. To do this just type in YES when the Customer Disclaimer comes up, and be ready to swap diskettes when the floppy test comes up, if you have a single drive, or use the B drive if you have a dual drive system.

This concludes Section six on troubleshooting.

# PART II SECTION 7

# PROFESSIONAL COMPUTER THEORY OF OPERATION

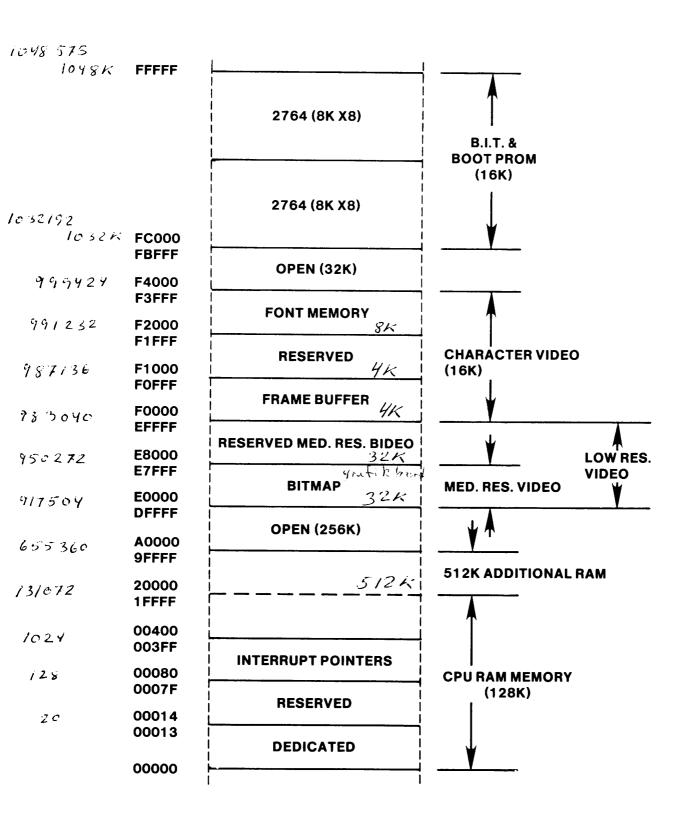


Figure II-7-1 PC Memory Address Map

### SECTION 7

### THEORY OF OPERATION

### SYSTEM START-UP

Operation of the PC starts when the power is turned on. First the eighty 8086 microprocessor and other major system components are reset. After a time delay to allow the power supply to stabilize, the reset is removed and the 8086 starts operation, driven by an 8 megahertz clock.

The first thing the microprocessor does is load its high order address on the system address bus, that is, all the address lines go to logic level "one". It then executes an instruction fetch from this location.

This location is the high order address of the Read Only Memory, located at the very top of the 1 megabyte memory address space. This Read-Only Memory is made up of two E-PROMs containing the Built In Test, or "BIT", and the "boot strap LOADER" program. The first instruction fetched is a jump instruction that changes the 8086 instruction pointer to the Read-Only Memory start address. The next instruction fetched is the start of the "BIT", which tests all the vital functions of the system.

### MEMORY ADDRESSING

One of the diagnostic tests checks the 128 Kilobytes of main memory, which is mapped into the lower 128K of the one megabyte memory map. Above it is 512K of RAM reserved for the optional expansion memory board. Above that is an open 256K reserved for option board memory such as the CPM eighty option.

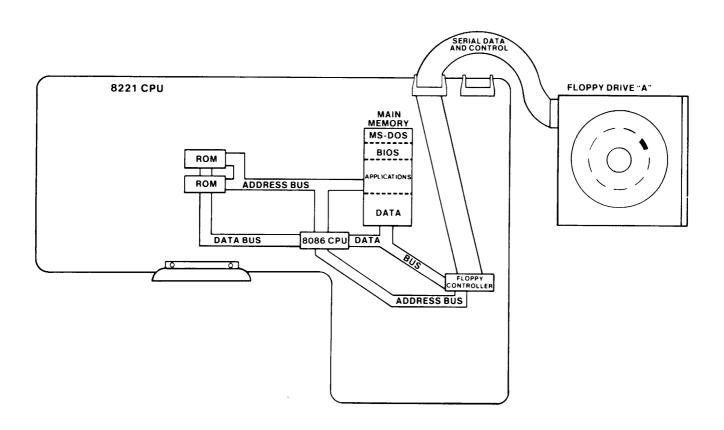


Figure II-7-2 PC Theory Block Diagram #1, Boot Strap Load Sequence

The next 32K block of addresses are used for the Wang Monitor Graphics Controller and the Low Resolution Video Controller. The Low Resolution controller also uses another 32 K block for a total of 64 kilobytes. If both options are installed, no conflict will occur, even though both controllers are sharing the same 32K of memory locations, because the software can enable and disable either controller memory.

The next block of addresses, 16K, is allocated to the Wang Monitor Character Controller. Once again, if more than one of these Controllers were installed in a PC System, no conflict would occur. The software has memory enable-disable control over each controller and will enable a controller memory for a data transfer, then disable it after the transfer is completed.

The next 32K block of the Memory Map is open, and the last 32K is the PROM space discussed earlier.

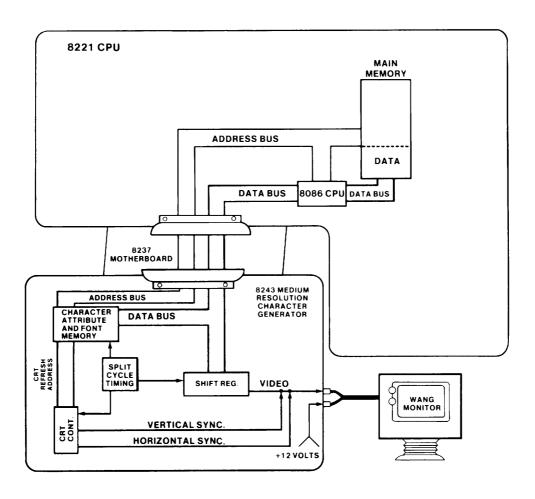
### BUILT-IN-TEST (B.I.T.) AND THE BOOT-STRAP LOADER

Lets return to the Built In Test. After the memory and other vital parts of the system have been checked, the LSI peripheral chips are checked. These include the three port Parallel Peripheral Interface chip, the Programmable Communication Interface chip, the floppy disk controller chip, and the Video Controller. The Winchester Controller and drive are also checked, if they are installed.

When the BIT completes, control is passed to the Boot Strap LOADER Program. This program displays a prompt on the screen, waits five seconds for optional operator input, and, if no input is received, loads the System Software from Floppy Drive A. These operator inputs were discussed earlier, and include rerunning the BIT, changing disk drives, retrying to load the system, and accessing the disk alignment program.

The Boot Strap LOADER program is resident in a PROM. First it reads a predetermined sector from the disk that contains special information it needs to load the system software. Then it reads the MS-DOS system software and the BIOS I-O interface software into main memory. When the System software is in main memory, the Boot Strap program passes system control to the MS-DOS program.

The first thing the software does is read the Wang LOGO screen load from the floppy disk to the area of main memory reserved for data.



CPU Interface to the Medium Resolution Controller and Video Monitor

Figure II-7-3 PC Theory Block Diagram #2

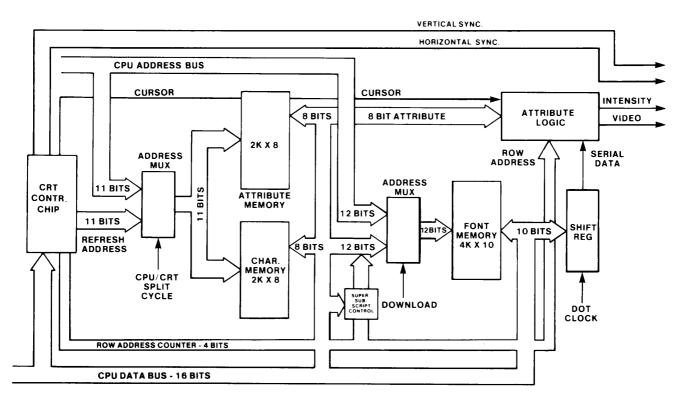
### VIDEO MONITOR CHARACTER CONTROLLER BOARD

Then the program transfers this data, word by word, to the "Video Monitor Character Controller Board" Memory. This board is dual ported, with "split cycle" memory access timing. This means that half of each controller memory cycle is allotted to the CPU, and the other half to the Monitor. The CPU can read or write to the Controller memory during its access time, while the video Monitor is refreshed by the controller board during its access time.

A sequential address counter in the CRT controller chip supplies the memory address during the Monitor screen refresh half of the memory cycle. The data is read out of memory to a shift register that converts the 10 bit parallel word to serial video dots, or Pixels, that are fed to the Monitor along with horizontal and vertical sync from the CRT controller chip.

The address counter in the CRT controller is reset at vertical retrace time, and starts counting again after a short delay. During this delay, the CRT screen is blanked and the deflection circuitry on the monitor board moves the electron beam from the bottom right corner of the screen back up to the top left corner. Then the whole process is repeated.

The characters displayed on the CRT screen appear stationary, but they are actually being refreshed 60 times a second. The inside of the CRT screen is coated with a phosphor which is illuminated by the electron beam. Since this luminescence fades very rapidly, the screen must be constantly refreshed.



BLOCK DIAGRAM #3. MEDIUM RESOLUTION CHARACTER GENERATOR BLOCK DIAGRAM

Medium Resolution Character Controller Block Diagram

Figure II-7-4 PC Theory Block Diagram # 3

The Memory we discussed as one block here, is actually broken down into three memories. The two kilobyte attribute memory shadows, or operates in parallel with, the two kilobyte character memory. When the software has characters to display, it writes the low order byte from the sixteen bit CPU Bus into the character memory. These are the displayable characters. At the same time the high order byte of the sixteen bit data bus is written into the Attribute memory. Therefore, each one of the two thousand possible displayable characters also has an attribute location.

There are a total of 8 possible attributes: Blink, Reverse Video, Blank, High Intensity, Overscore, Underscore, Superscript and Subscript.

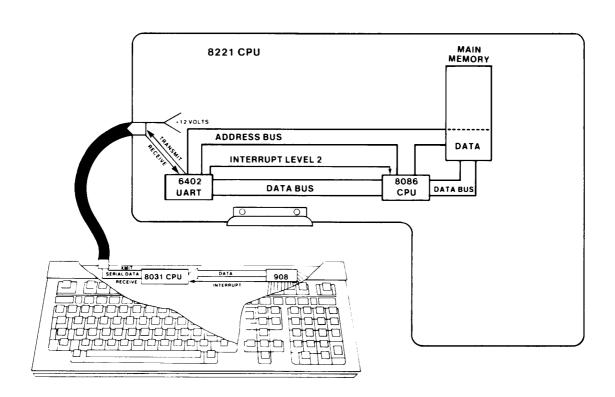
The third memory is the Font Memory. It stores 4,096 (4K) ten bit words which are written into it at program startup time. The "font" resides in the system software and determines the language to be displayed. Since each character location on the screen is a 10 by 12 pixel matrix, and superscript and subscript are used, 16 ten bit words are needed for each one of the 256 characters and symbols permitted.

For a normal display, character rows 2 through 13 make up the 12 pixel rows. For superscript, the displayable row address is scrolled down one, displaying rows 1 through 12. For subscript, it is scrolled up two, displaying rows 4 through 15. Row 16 is not used. The Row counter in the CRT Controller Chip furnishes the four row address bits which are linked to the 8 bit character out of the character memory to form the 12 bit address to the font memory.

During the CRT portion of the split cycle memory access, the CRT Controller 11 bit refresh address is multiplexed to both the Character Memory and the Attribute Memory. Since this is always a memory read cycle, the Character to be displayed is read out of the Character Memory and, with the four bit row address, forms a 12 bit address that is multiplexed to the font memory. A ten bit word is read out of the font memory to a shift register, where it is converted to serial data by the "dot clock" and fed to the Attribute logic. At the same time, the Attribute byte, read out of the attribute memory, is input to the attribute circuitry. The result is a mix of all the inputs to generate the video signal and the high or low "intensity" signal to the video Monitor. The eleven bit refresh address out of the CRT Controller increments 80 times per character row, while the row counter remains at the same count.

At character count 80, the row count increments by one and the character count repeats the same 80 addresses. This continues for all 16 row counts. Then the row count resets to zero and the refresh counter increments to the next set of 80 characters. Every time the refresh counter counts to 80, which is at the end of the character line, horizontal sync is generated by the CRT Controller, and a delay is inserted to allow the electron beam to return to the left margin of the monitor.

At program startup time, the CRT Controller is loaded with the necessary operational information, such as vertical refresh rate, scan mode, character matrix size and cursor control.



### Keyboard Data Input

Figure II-7-5 PC Theory Block Diagram # 4

### KEYBOARD

When a character key is depressed on the Keyboard, it is normally displayed on the Monitor screen. First, the key that is depressed causes a frequency change in the 908 chip's internal oscillator by changing the capacitance of the circuit. The output of this oscillator is internally connected to an analog-to-digital converter that provides the eight bit configuration code for that character. This action within the 908 chip also raises an interrupt to the 8031 microprocessor chip.

The 8031 microprocessor will acknowledge the interrupt and read the key code byte from the 908. This microprocessor contains a UART, or Universal Asynchronous Receiver/ Transmitter interface. It converts the key code to serial data, adds a start bit and two stop bits, and transmits it to the 640% chip on the CPU Board. The 6402 receives the 11 bits, checks for the start and stop bits, and then loads the 8 bit key code into a holding register.

It then sends a level two interrupt to the CPU which the CPU acknowledges as soon as possible. When it does, it reads the key code from the UART and stores it in Main Memory. If more keys have been depressed, this process will be repeated, and the key codes will be stored sequentially in the data portion of the Main Memory.

As soon as time permits, the program will transfer the key code data from Main Memory to the Character Memory on the Video Controller Board and the Characters will be displayed on the Monitor screen as previously explained.

The program can also transmit command bytes to the keyboard to turn on the LEDs, BEEP the speaker, and to read the keyboard Status Byte. The CPU reads this Command byte from memory, and then transfers it to the 6402 UART. There it is converted to serial data and the Start and stop bits are again added. It is then transmitted to the 8031 microprocessor on the keyboard, where it is decoded and executed by the 8031 program.

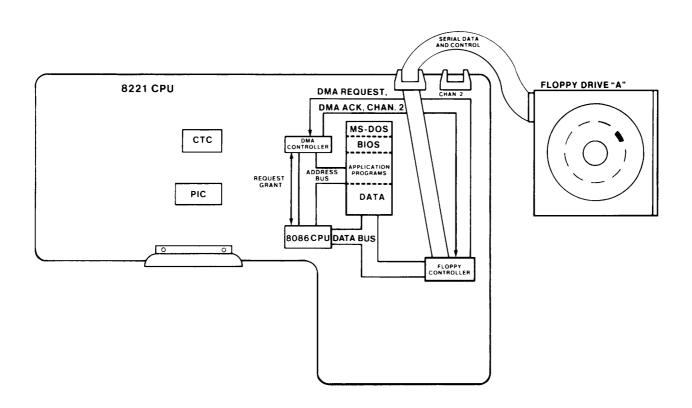


Figure II-7-6 PC Theory Block Diagram #5, DMA Transfer

### DIRECT MEMORY ACCESS (DMA)

A four channel Direct Memory Access, or DMA chip provides fast memory data transfers for selected Devices such as the floppy disk drive and the Optional Winchester Disk Drive. When the Floppy Disk Controller assemble a byte of data it raises a channel two request to the DMA Controller, which, in turn raises a priority one request to the CPU. When the CPU completes its current machine cycle, it will grant the request and put itself in a wait state, turning off all its bus control lines, its data bus buffer and address bus buffers.

When the DMA Controller receives the "Grant" signal from the CPU, it takes control of the system, sends an acknowledge signal to the Floppy Disk Controller, supplies the memory address and control signals to Main Memory, and writes the data byte from the disk into memory. If a disk write operation was in progress, the data byte would be read from memory instead of written to it.

The Floppy Controller will now drop the DMA request, and the DMA Controller will send another request pulse to the CPU. This second request pulse is interpreted by the CPU as "DMA transfer complete." It will take itself out of the wait state and continue normal program operation.

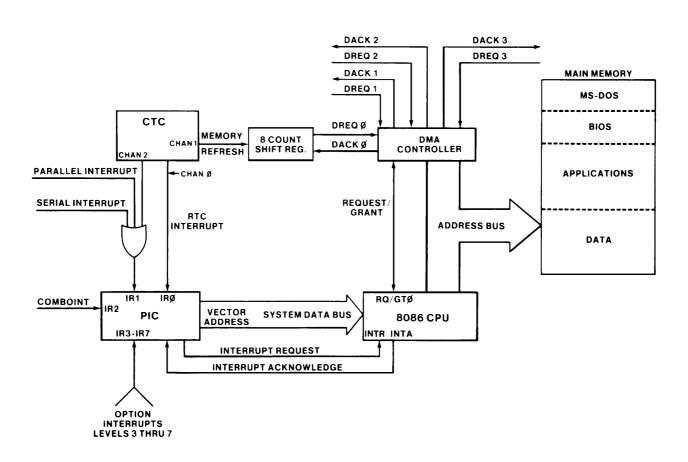


Figure II-7-7 PC Theory Block Diagram # 6, DMA, CTC and PIC Logic

The four DMA channels have a sequential priority scheme, with channel zero having the highest priority, and channel three the lowest. If two or more DMA requests are raised at the same time, the lower channel, higher priority request will be serviced first.

### THE COUNTER TIMER CHIP (CTC)

DMA channel zero is dedicated to Main Memory Refresh, and is operated by channel one of a three channel Counter-Timer, or CTC chip. CTC Channel one is programmed at system startup to raise a DMA channel zero request every 120 microseconds and a 16Kilobyte block of memory is refreshed. This setup allows all of the 128 Kilobyte main Memory to be refreshed within the specified time of 2 milliseconds.

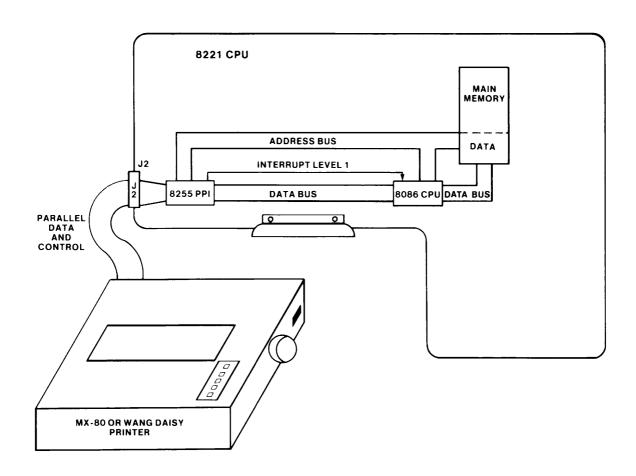
CTC channel zero is used for the Real-Time-Clock, commonly called the RTC. It is connected to the level zero input of an eight level Priority Interrupt Controller Chip, called the PIC. Since this level has the highest priority, the RTC is the highest priority interrupt. It has to be, or the timing would drift. CTC channel zero is programmed to raise a level zero interrupt at periodic intervals. When the CPU acknowledges the interrupt request the PIC gates an eight bit vector address onto the data bus which is read by the CPU.

### PRIORITY INTERRUPT CONTROLLER (PIC)

Since 8 levels of interrupts are controlled by the PIC, it contains eight different vector addresses, programmed at system startup time. The CPU translates the PIC Vector address into a twenty bit memory address located in an area of Main Memory called the Interrupt Vector Table. Located in this table are the start addresses of all the Interrupt subroutine programs, also loaded during system startup time.

The Level Zero Interrupt causes a program jump to the RTC subroutine, which updates the clock and then returns to the main program.

The next two interrupt levels, levels one and two, are used by logic functions on the CPU Board, such as the keyboard interface discussed earlier, the floppy disk controller, the DMA chip, and CTC channel two which used by the software as a general purpose timer. The rest of the interrupts, levels three through seven, are reserved for the option boards.



Parallel Peripheral Interface (PPI)

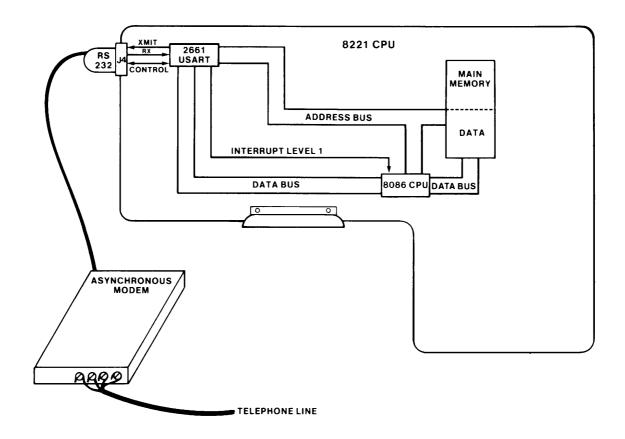
Figure II-7-8 PC Theory Block Diagram # 7

#### PARALLEL PERIPHERAL INTERFACE (PPI)

The Parallel Peripheral Interface chip, called the PPI, is connected to an external standard Centronics Printer interface connector. The data to be printed is transferred a byte at a time from Main Memory through a buffer to the Printer. The PPI provides the input/output control signals from the printer to the CPU, and from the CPU to the Printer. When a user initiates a printout command from the keyboard the print out software routine is accessed by the applications program in use.

An example of this would be the selection of "Print Document" on the Wang Word Processing Menu. After the Print Parameters are typed in and executed, the program reads port A of the PPI chip to determine the status of the printer. It must be powered on, selected, and not busy. Also, the paper empty and fault signals must be off. These signals are all connected to Port A of the PPI chip. The program transfers these signals to memory with an I/O command, and then checks each signal. When the software determines that the printer is ready to print, it transfers the first byte of data to the printer with a data strobe pulse.

The printer will send an acknowledge pulse to the interface, where a level one interrupt is generated to the CPU, causing the software to send another byte of data to the printer. This handshaking type of interface continues until all the data has been transferred to the printer. Since the printer is a relatively slow device, the interrupt interface allows the program to do other tasks between interrupts.



Asynchronous Communications Interface

Figure II-7-9 PC Theory Block Diagram # 8

#### PROGRAMMABLE COMMUNICATIONS INTERFACE (PCI)

The last device on the CPU Board that has an external interface connector is the twenty six sixty one "programmable communication interface" chip, or "PCI", which is a standard RS-232 interface. A modem can be connected to it to run a customer developed program, or it can be connected to a Wang 2200 series processor with a TC interface. The PC will then emulate a 2200 terminal using the the "2200 emulation" software package. Alternatively, two PCs can be connected to each other locally, or, two or more PC's can be connected to each other remotely, using this interface.

The operation of this interface is very similar to the operation of the Keyboard interface. The 2661 Chip is normally in the receive state waiting for input from the remote device. When serial data arrives, the PCI checks that the first bit received is a "one" level bit, indicating a "Start" bit. If this is the case, the PCI assemble the 8 bit byte and checks the parity bit and the stop bit or bits for zero level. If everything checks out, the byte is loaded into a holding register and the PCI raises a "level two" interrupt to the CPU.

When the CPU completes its current instruction cycle, it acknowledges the Interrupt, reads the interrupt vector address from the PIC and initiates a program jump to the "level two" interrupt handler subroutine. The interrupt handler determines what caused the interrupt by reading port B of the PPI chip and then reads the received data byte from the PCI holding register and writes it into memory. This process continues until all the received data has been written into memory.

We mentioned "Stop bit or bits". The decision to have one or two stop bits is made by the communication protocol being used. The same thing holds true for the parity bit, which can be data bit eight. The parity options are odd, even, or no parity. Since the PCI chip is programmable, the communication program will load this information into the PCI chip when it starts up.

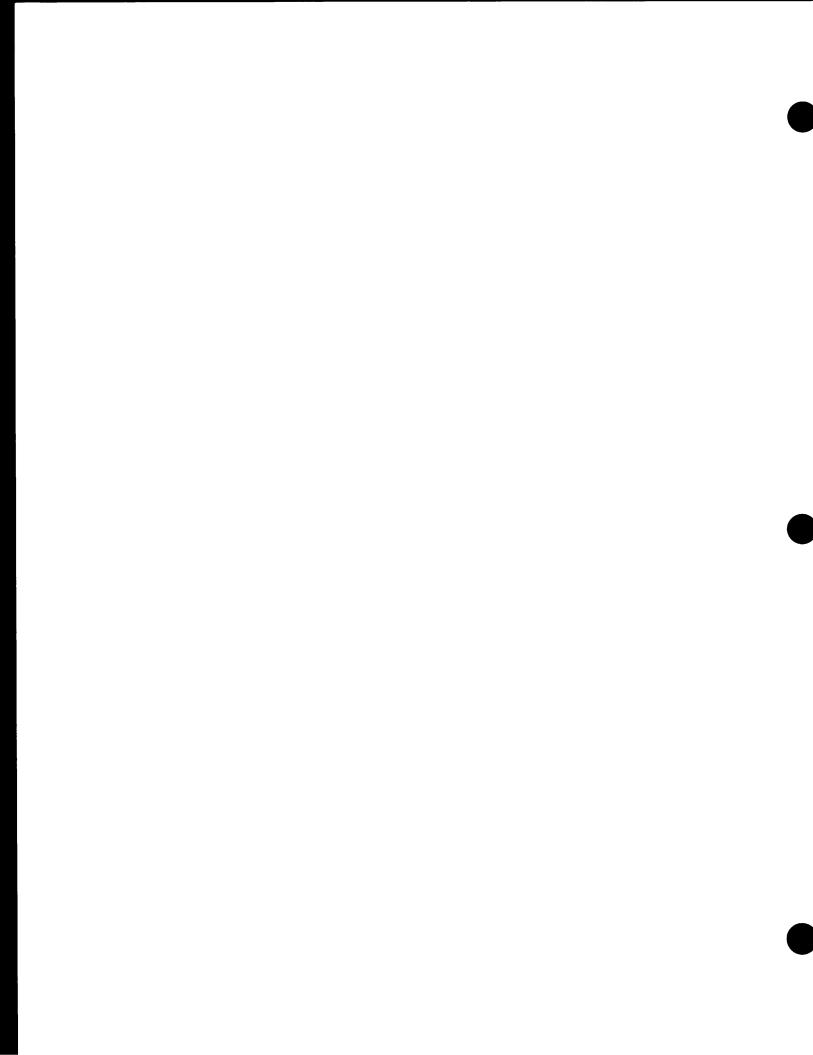
When the Communication program wants to transmit data, it reads the PCI status register to determine if the PCI chip is idle or receiving data. If the PCI is idle, the program will command it to enter the transmit mode. If it is receiving data, the program will periodically recheck status until the receive operation is complete.

As soon as the PCI is in the transmit mode, the Communication program will transfer the first byte of data from memory to the PCI transmit buffer. The PCI transfers the byte to its transmit shift register, and from there, transmits it to the RS-232 port at the baud rate selected by the Communication program.

As soon as the PCI loads the data byte from its input buffer to its shift register, it will raise an interrupt to the CPU. The level two interrupt handler subroutine will then be accessed just as it was when the PCI was receiving data. This time, however, the program will transfer the next data byte to be transmitted from memory to the PCI. This process will continue until all the data has been transmitted.

### **APPENDIX A**

# GLOSSARY OF TERMS SUMMARY



#### GLOSSARY OF TERMS SUMMARY

AC

Alternating Current.

Attribute

A software selective video enhancement such as highlight, reverse video, underscore, blink, etc.

Barreling

The lines displayed on a CRT are not straight as they should be, but rounded out away from the center of the screen.

Baud Rate

The speed, or rate, in Bits-Per-Second, of serial data transmission.

BIT or B.I.T.

The Professional Computer PROM resident Built-In-Test, or Power-Up Diagnostic.

Boot Strap

The Boot Strap Loader program is PROM resident and is initiated by successful completion of the B.I.T. It initiates the default floppy drive and transfers the MS-DOS system software from the diskette to Main Memory. Program control is passed to MS-DOS as soon as the transfer is complete.

BUS

One or more conductors used as a path for transmitting information from any of several sources to any of several destinations.

**BYTE** 

8 bits of data operated on as a unit.

Cat's-Eye-Pattern Two adjacent diamond shaped patterns displayed on

the oscilloscope and used for the Radial-Track

alignment of the Floppy Disk Drives.

CP/M-80 An 8 bit Control Program for Microprocessors

marketed by Digital Research Inc. This is the control program that runs on the TRS-80 and many other Personal Computers controlling a large

variety of popular 8-bit applications programs.

CPU Central processing unit - The heart of all

computers.

CRT Cathode ray tube. Used for the WORKSTATION

display tube in the WANG equipment.

DAISY PRINTER A letter quality printer with the characters

arranged in a circle on the ends of spokes, or

'petals' that extend from a central hub.

DC Direct current.

DMA Direct memory access.

DOS Disk Operating System software. A system control

program that uses a disk drive, hard or floppy, as an extension of Main Memory. All permanent data files and programs entered by the user are written to the disk. The Control program used by the PC

is MS-DOS.

E-PROM

Erasable-Programmable Read Only Memory chip.

These chips can be used over, and over again as compared to the older ROM chips that could only be used once.

EU

Wang Professional Computer Electronics Unit.

Index-To-Data

The delay time between the Disk Index pulse and the start of the data read from, or written to the disk. This delay is necessary to compensate for variations in motor speed and the diskettes themselves, since the Index pulse is generated by a hole in the diskette.

K

Kilobyte

Kilobyte

One thousand bytes, also abbreviated as K and KB.

LED

Light emitting diode.

Megabyte

One million bytes, also abbreviated as Meg and MB.

Microprocessor

An 8, or 16-bit CPU, housed in a single chip. The Z80, 8080, and 8086 are common examples that require external memory and are packaged in a 40-pin chip. Other examples are the 8049 and 8031 which contain a small internal memory and are used for special applications, such as keyboards and printers.

Microsecond

One millionth of a second (1  $\times$  10 to the minus 6 seconds).

Millisecond

One thousandth of a second (1  $\times$  10 to the minus 3

seconds).

Millivolt

One thousandth of a volt  $(1 \times 10)$  to the minus 3

volts).

Modem

Also called Data Set. A device that performs the modulation/demodulation and control functions necessary to provide compatibility between

Computer Systems and Communications facilities.

Monitor

Refers to the Wang Professional Computer Video

Display device.

Motherboard

The Printed Circuit Board in the PC Electronics Unit that all the other boards plug into. It interfaces the power supply voltages, the CPU buses, and control signals to all the boards

installed in the EU.

MPI

The acronym for Micro Peripherals Inc. A company that markets floppy disk drives and other computer

products.

Multiplan

A "Spreadsheet" applications program that is

similar to "VisiCalc".

MX-80FT

A small, light weight Dot Matrix printer capable

of printing at the rate of 80 characters per

second.

OIS

Wang Office Information Systems such as the

OIS-125 and the OIS-140 systems.

**PCA** 

Printed Circuit Assembly. Also called PCB for Printed Circuit Board.

**PCSYS** 

Professional Computer System. Used as part of the 11 character volume number assigned to diskettes, such as PCSYS080483, where 08-04-83 represents the date the diskette was recorded.

Pincushioning

The lines displayed on a CRT are not straight as they should be, but sucked in towards the center of the screen.

Pixel

Picture element, or dot, that is the smallest displayable unit that can be addressed by computer software. Each character displayed on a computer driven CRT is made up of many dots that are clearly visible when the CRT brightness control is turned down slightly.

PRACGLOS

Practice Glossary. A demo glossary programmed onto the PC Word Processing diskette for use by the user in learning how to use the Glossary Function.

**PROM** 

Programmable read only memory.

Radial-Track-Alignment The carriage of a disk drive is mechanically positioned so that the Read/Write Heads mounted on the carriage are precisely over track 16 (used for alignment) on a standard precision alignment diskette.

RAM

Random access memory.

RF

Radio Frequency.

RF Modulator

A low cost Television Modulator used with the Low Resolution Video Controller to modulate the Composite Video Signal onto a television channel frequency so it can be received and displayed by a normal commercial television set.

RS-232

The document number of the Electronics Industries Association (EIA) document that details engineering standards for use by the Computer and Communications Industry in the United States of America for the interface between Data Terminal Equipment (DTE) and Data Communication Equipment (DCE) employing serial binary data interchange. This number is used as an acronym for the interface, as is EIA to a lesser degree.

RTC

Remote Telecommunications Controller.

Spreadsheet

Computer terminology for programs that display a basic form of columns and rows that can be filled in and altered by the user, with simple commands to build a financial balance sheet, manufacturing schedule, engineering plan, etc. VisiCalc, SuperCalc and Multiplan are Off-The-shelf examples.

Tandon

The name of a Company that manufactures disk

drives.

TP

Test point.

TV

Television.

VOL

Volume number. An alphanumeric of 11 characters

maximum used to label the PC diskettes.

VS

Wang Virtual Storage Computers Systems such as the

VS-25, VS-80 and VS-100.

Warm Start

The PC System is reset and the System software is loaded without running the B.I.T. Rerunning the B.I.T. and then "Booting" the system is termed a

"Cold Start".

Winchester

An acronym for small, high speed disk drives utilizing "Winchester" technology. The ten megabyte Winchester Drive offered as a PC option fits in the same slot as the optional 360 Kilobyte Floppy Disk Drive, giving the PC System

approximately 28 times more data storage/access

capacity than the Floppy Drive.

X.21

The European equivalent of RS-232.

# **APPENDIX B**

# INTERACTIVE QUIZ ANSWERS

# ANSWERS TO INTERACTIVE QUIZ 1-1

1. a)

14. c)

2. c)

15. b)

3. a) 16. c)

4. b)

17. d)

5. d)

18. ъ)

6. c)

19. c)

7. b)

20. b)

8. a)

21. a)

9. ь)

22. a)

10. d)

23. c)

11. c)

24. ъ)

12. c)

25. c)

- 13. b)

### ANSWERS TO INTERACTIVE QUIZ 2-1

1. d)

11. c)

2. c)

12. a)

3. d)

13. c)

4. a) or b)

14. b)

5. c)

15. a)

6. a)

16. b)

7. c)

17. d)

8. a)

18. c)

9. b)

19. ъ)

10. d)

20. ъ)

### ANSWERS TO INTERACTIVE QUIZ 3-1

1. a)

11. c)

2. b)

12. a)

3. c)

13. c)

4. d)

14. ъ)

5. b)

15. d)

6. c)

16. a)

7. a)

17. c)

8. d)

18. ъ)

9. c)

19. a)

10. d)

20. c)

### ANSWERS TO INTERACTIVE QUIZ 4-1

- 1. b)
- 2. c)
- 3. a)
- 4. c)
- 5. b)
- 6. a)
- 7. c)
- 8. b)
- 9. a)
- 10. c)

#### ANSWERS TO INTERACTIVE QUIZ 5-1

1. a)

11. a)

2. b)

12. b)

3. c)

13. c)

4. d)

14. a)

5. a)

15. d)

6. b)

16. ъ)

7. c)

17. a)

8. a)

18. a)

9. d)

19. d)

10. c)

20. d)

#### ANSWERS TO INTERACTIVE QUIZ 6-1

1. d)

11. b)

2. a)

12. b)

3. ъ)

13. b)

4. a)

14. c)

5. c)

15. b)

6. b)

16. a)

7. a)

17. b)

8. d)

18. c)

9. a)

19. ъ)

10. b)

20. c)

#### ANSWERS TO INTERACTIVE QUIZ 7-1

1. c)

11. d)

2. c)

12. c)

3. b)

13. a)

4. c)

14. c)

5. c)

15. a)

6. c)

16. c)

7. a)

17. ъ)

8. b)

18. c)

9. c)

19. a)

10. b)

20. c)

### ANSWERS TO THE FINAL EXAM

- 1. b)
- 2. a)
- 3. d)
- 4. a)
- 5. c)
- 6. b)
- 7. b)
- 8. a)
- 9. c)
- 10. d)