

WANG

III.D.1M-3

CUSTOMER ENGINEERING

PRODUCT MAINTENANCE MANUAL

**2336DW INTEGRATED
TERMINAL**

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APRIL 1982

**REORDER NUMBER
741-1087**

WARNING

*
* DO NOT OPEN THE SWITCHING POWER SUPPLY UNDER ANY *
* CIRCUMSTANCE. EXTREMELY DANGEROUS VOLTAGE AND *
* CURRENT LEVELS (IN EXCESS OF 300 VOLTS DC AND UN- *
* LIMITED CURRENT) ARE PRESENT WITHIN THE POWER SUPPLY. *
*
* DO NOT ATTEMPT TO REPAIR THE SWITCHING POWER *
* SUPPLY; IT IS FIELD REPLACEABLE ONLY. *
*
* AFTER POWERING THE UNIT DOWN AND DISCONNECTING THE AC *
* POWER PLUG FROM THE WALL OUTLET, ALLOW ONE MINUTE *
* BEFORE REMOVING THE POWER SUPPLY TO PROVIDE ADEQUATE *
* TIME FOR ANY RESIDUAL VOLTAGE TO DRAIN THROUGH THE *
* BLEEDER RESISTORS. *
*

TABLE OF CONTENTS

<u>Section</u>		<u>Page</u>
1	INTRODUCTION	
	1.1 Scope	1-1
	1.2 Purpose	1-1
	1.3 Options	1-1
	1.4 Related Documentation	1-1
	1.4.1 Diagnostics	1-1
	1.4.2 Revision Levels	1-2
	1.4.3 Other	1-2
	1.5 Description	1-2
	1.5.1 CRT Display	1-5
	1.5.2 Keyboards	1-5
	1.5.3 CPU Interface	1-6
	1.6 Specifications	1-6
2	RECEIVING AND INSPECTION	
	2.1 Incoming Inspection	2-1
	2.2 Packing and Unpacking	2-1
	2.3 Terminal Inspection	2-2
3	INSTALLATION	
	3.1 Physical Assembly and Checks	3-1
4	OPERATION	
	4.1 Indicators and Controls	4-1
	4.1.1 CRT Module	4-1
	4.1.2 Keyboards	4-1
	4.2 Operating Features	4-7
	4.2.1 Screen Dump	4-7
	4.2.2 Display Variations	4-8
5	THEORY OF OPERATION	
	5.1 Terminal Control PCB	5-1
	5.1.1 Z-80 CPU	5-1
	5.1.2 CTC	5-3
	5.1.3 Memory	5-3

<u>Section</u>		<u>Page</u>
5.1.4	CRT Control	5-4
5.1.5	Communications	5-7
5.1.6	Keyboards	5-7
5.1.7	Status	5-8
5.1.8	I/O Control	5-9
5.1.9	Printer	5-10
5.1.10	Control Register	5-10
5.2	Terminal Controllers	5-10
5.2.1	Controller Switch Settings	5-11

6 PREVENTIVE MAINTENANCE AND ADJUSTMENTS

6.1	Preventive Maintenance	6-1
6.1.1	General	6-1
6.2	Adjustments	6-2
6.2.1	Power Supply Voltage Checks	6-2
6.2.2	PCB 7456 CRT Display Voltage Checks	6-3
6.2.3	PCB 7456 CRT Display Alignment Checks	6-3

7 DIAGNOSTICS AND TROUBLESHOOTING

7.1	Troubleshooting	7-1
7.1.1	General	7-1
7.2	Power-up and Burn-in Diagnostics	7-5
7.2.1	Description	7-5
7.2.2	Load Procedure	7-6
7.2.3	Operating Procedure	7-6
7.2.4	Error Code Definitions	7-7
7.2.5	Loopback Connector	7-7
7.2.6	Keyboard Hex Codes	7-8

8 REMOVAL AND REPLACEMENT

8.1	General	8-1
8.2	Sub-assembly Removal and Replacement	8-1
8.2.1	CRT Discharge Procedure	8-1
8.2.2	7743 PCB	8-2
8.2.3	Power Supply	8-2
8.2.4	CRT Chassis	8-3
8.2.5	CRT Rear Panel	8-3
8.2.6	7456 PCB	8-4

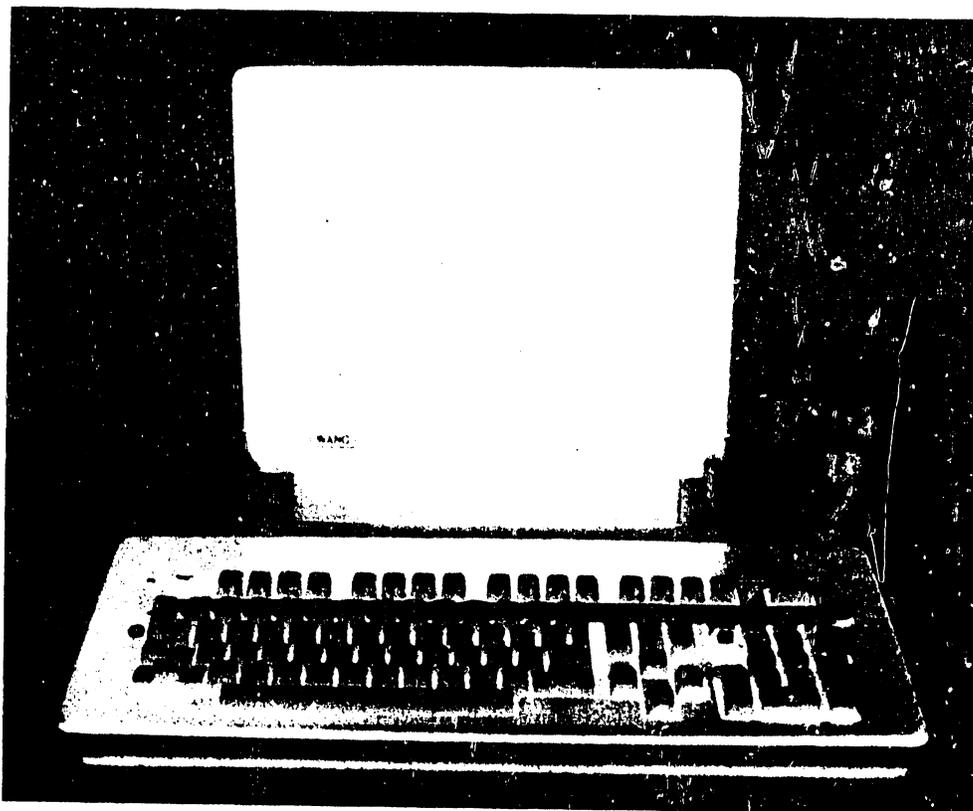
9 ILLUSTRATED PARTS BREAKDOWN 9-1

APPENDICES

A	Recommended Spares List	A-1
B	Direct and Modem Cable Part Numbers	B-1
C	Schematic Diagrams	C-1

LIST OF FIGURES

<u>Number</u>	<u>Title</u>	<u>Page</u>
1-1	2336DW Terminal	1-4
3-1	Terminal Cable Connections	3-3
3-2	Terminal Rear Panels	3-4
3-3	115/230 Switch Location	3-5
3-4	Baud Rate Switch Settings	3-6
4-1	Brightness and Contrast Controls	4-4
4-2	Standard Keyboard	4-5
4-3	Expanded Keyboard	4-6
4-4	Normal Character Set	4-13
4-5	Alternate Character Set	4-14
4-6	Character Set Division	4-15
4-7	Box Graphics Line Placement/Character Position	4-19
4-8	Box Graphics Line Placement/Graphic Character Set	4-19
5-1	2336 Block Diagram	5-2
6-1	Power Supply Voltage Adjustments	6-4
6-2	7456 PCB Adjustments	6-5
7-1	2336DW Troubleshooting Flowchart	7-2



**2336DW INTEGRATED
TERMINAL**

SECTION

1

INTRO-

DUCTION

SECTION 1

INTRODUCTION

1.1 SCOPE

This Product Maintenance Manual describes the 2336DW Integrated Terminal. It is intended for use by qualified Customer Engineering personnel. Familiarity with Wang 2200 product line equipment is an essential prerequisite to proper use of this document.

1.2 PURPOSE

This manual provides the information necessary to:

- a. Unpack and install each terminal
- b. Perform alignment, adjustment, and diagnostic tests
- c. Perform basic operation
- d. Perform preventive maintenance
- e. Perform troubleshooting and fault diagnosis
- f. Perform Removal/Replacement procedures of major sub-assemblies

1.3 OPTIONS

Each 2336DW is available with either the standard or the expanded (international) keyboard. The two configurations are as follows:

<u>MODEL</u>	<u>PART NO.</u>	<u>KEYBOARD NO.</u>	<u>DESCRIPTION</u>
2336DW	177-2336	725-2637 STD	2336DW Integrated Terminal with standard keyboard
2326DW	177-2326	725-2652 EXP	2336DW Integrated Terminal with expanded keyboard.

1.4 RELATED DOCUMENTATION1.4.1 DIAGNOSTICS

There are two types of diagnostics employed by the 2336DW terminal. Power-up and burn in diagnostics (documentation release 9230) are PROM based and installed on the control board. System diagnostics for the 2200 are also available to those who are familiar with loading and operational procedures.

- a. Burn-in and Power-up diagnostics are described in section 7.
- b. 2200 system diagnostics are described in the Diagnostic Handbook (P/N not available at this time)

1.4.1.1 Hardware and Software Revision Levels

This manual contains valid information for systems with the 7743 board at revision level 3, the 7456 board at revision level 12 and 2200 software at a level of 2.3 for MVP/LVP models and 2.5 for SVP/VP models.

1.4.2 HARDWARE MANUALS

2200 Maintenance Manual - 03-0071-1

1.4.3 OTHER

Corporate Publications Literature Catalog - P/N 700-5294C

1.5 SYSTEM DESCRIPTION

The 2336DW is a two-piece terminal consisting of a CRT display/electronics module and a detachable keyboard, see figure 1-1. The key ergonomic features of the 2336DW design are a tilting CRT assembly and a detached keyboard. This terminal is Z80-based and consists of a 12-inch diagonally measured CRT, a capacitive-type keyboard, a 12-inch monitor sweep PCB (P/N 210-7456), a switching power supply (P/N 270-0734), and a control PCB (P/N 210-7743-A).

The 2336DW is an enhancement of the 2236DW. It offers the same features of the 2236 plus the added flexibility of a detachable keyboard. The terminal features include:

- . Word Processing style cursor control and function keys which support the integrated word processing and data processing functions
- . Repeating keys and underlined characters
- . Character display attributes including bright, blinking, and underlined characters plus reversed video
- . Graphics character set
- . Box graphics
- . Interface to local printer independent of the CPU
- . Self-test diagnostics

The 2336DW terminal can be attached locally to the 2200MVP or LVP CPU at distances up to 2000 feet (606.1 meters), or remotely via modems and telephone lines. Terminals connected to a 2200SVP or VP CPU can be attached locally at a maximum distance of 50 feet (15.2 meters) and 2000 feet (606.1 meters) respectively. Communication between the terminal and the CPU is asynchronous and full-duplex, with selectable line speeds ranging from 300 to 19,200 bits per second (bps). To accelerate communications between the terminals and the CPU, the system performs automatic data compression on information transmitted to each terminal.

Each terminal can support its own terminal printer which can be used for program output. Additionally, hard copy of CRT displays can be created at each terminal site. A dump of the display screen to the terminal printer may be initiated from the keyboard, resulting in the printing of all standard characters present on the screen. The screen dump feature requires no special software and can be performed at any time.

The 2336DW and its controller employ microprocessors to optimize data throughput. For example, strings of four or more identical characters are compressed for transmission into 3-byte blocks. A ready/busy protocol controls information flow between the terminals and the terminal processor. Thus, it is unnecessary for the attached printer to keep up with the serial communication line data rate. These features are automatic and are completely transparent to the 2200 CPU software .

As an added feature, the 2336DW performs self-test diagnostics every time it is turned on. These diagnostics ensure optimum terminal conditions before use. If the unit fails one of the tests, a continuous alarm sounds, alerting the user to the failure. The tests allow a Wang customer service representative to quickly identify the problem and minimize downtime.

Any standard Wang printer or plotter with a 36-pin cable connection may be plugged into the printer connector on the terminal. A Wang supplied direct-connection cable or an optional modem cable plugs into an RS-232-C compatible connector on the terminal.

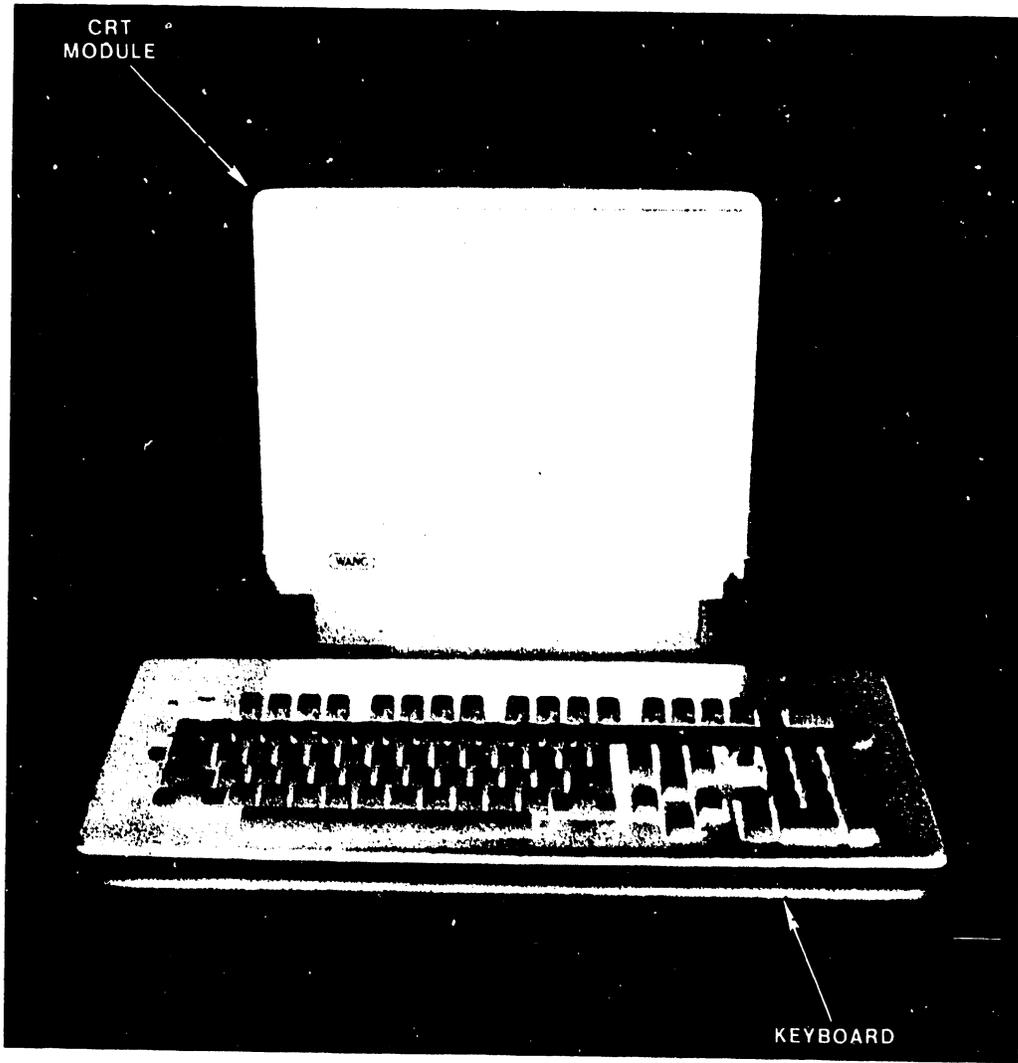


FIGURE 1-1 2336 TERMINAL

1.5.1 CRT DISPLAY

The 2336DW terminal contains a 12-inch (30.5 centimeter) diagonally measured cathode ray tube (CRT) screen display. The CRT displays a full 128-character set, including uppercase and lowercase keyboard characters, some foreign language characters, special symbols, and underlining. The CRT also displays an alternate set of graphic characters and box graphics. All characters may be displayed using one or more of several character display attributes.

The CRT has a 24-line, 80 characters/line capacity (1,920 character positions) for full-screen operator prompting and verification of keyed characters. Brightness and contrast controls provide a sharp clear image on the screen. Display speed is approximately 2,000 characters/second at a 19,200 baud. A cursor, resembling an underscore, indicates the location on the display where the next character will appear. In addition to controlling cursor movement and positioning from the keyboard, a number of codes can be used to manipulate the cursor under program control for specially formatted displays.

1.5.2 KEYBOARDS

1.5.2.1 General

The typewriter keyboard which can generate 88 different ASCII characters, including uppercase and lowercase letters, numbers, and symbols. It also includes a numeric keypad, several program control keys, and 18 program-definable special function keys: 16 numbered keys along the top of the keyboard, and the TAB and GL keys located in the alphanumeric keyboard zone. Each special function key can be used with the SHIFT key for a total of 36 special function keys. The keyboard also contains editing keys (INSERT and DELETE), location keys (NEXT SCRNL and PREV SCRNL), and cursor control keys (controls movement of cursor in indicated direction -- up, down, right, and left).

1.5.2.2 Standard Keyboard

The 2336DW terminal is equipped with a new combination keyboard which features the conventional typewriter format plus a numeric keypad as well as cursor control, editing and special function keys normally associated with Wang Word Processing systems.

1.5.2.3 Expanded Keyboard. The expanded (international) keyboard has the same features as the standard keyboard plus an additional four keys needed to meet international requirements.

1.5.3 CPU INTERFACE

The 2236MXD and 22C32 TC controller PCBs are part of the 2200 system main frame and interface between the 2200 CPU and the 2336DW terminals. The 2236MXD can support 4 terminals. The 22C32 Triple Controller supports a single terminal. The 2336DW plugs directly into the terminal controller PCB. No additional controllers are necessary.

1.6 SPECIFICATIONS

Size

Height	15.0 in. (38.1 cm)
Depth	12.8 in. (32.5 cm)
Width	13.5 in. (34.3 cm)

Weight

28.0 lb (12.7 kg)

CRT

Display Size	12 in. diagonal (30.5 cm)
Capacity	24 lines, 80 characters/line
Character Height	0.16 in. (0.41 cm)
Character Width	0.09 in. (0.23 cm)

Character Set

128 characters, including uppercase and lowercase letters; each character is assigned one or more attributes for high- or low-intensity display, reverse video, blinking, or underlining. Additional alternate character set consisting of 64 graphic characters and other special symbols is supplied. Also capable of displaying line-segment (box) graphics, separate from either character set.

Operating Environment

Temperature

50°F to 80°F (10°C to 30°C)

Relative Humidity

35% to 65% noncondensing (recommended)

20% to 80% noncondensing (allowable)

Power Requirements

115 or 230 Vac \pm 10%
50 or 60 Hz \pm 1.0 Hz
50 Watts

Communication Mode

Asynchronous, full-duplex

Transmission Rates

Manually selectable for each terminal at 300, 600, 1200, 2400, 9600, or 19.2K baud

Character Format

When communicating with a 2200MVP, LVP, SVP, or VP system:

1 start bit, 1 stop bit

8 data bits, plus odd parity (11 bits/character)

Other selectable character formats:

8 data bits, no parity

7 data bits, odd parity

7 data bits, even parity (10 bits/character)

EPROM Complement

L5 - 378-5080-2 Character Generator
L9 - 378-6013-2 Terminal Microcode
L10 - 378-6014-2 Terminal Microcode

SECTION

2

RECEIVING &

INSPECTION

SECTION 2

RECEIVING AND INSPECTION

This section contains the information necessary to unpack and inspect the 2336DW Terminal.

2.1 INCOMING INSPECTION

When the equipment arrives, immediately locate the packing slip and note the work order number. Verify the equipment model and serial number as listed on the packing slip.

Before opening the containers, inspect them carefully for signs of damage (crushed edges, puncture holes, tears, etc.). Should damage be noted, promptly file a claim with the carrier and notify the factory:

WLI DISTRIBUTION CENTER
 Department #90
 Quality Assurance Department
 Tewksbury, MA 01876.

State the nature and extent of damage and make arrangements for replacement equipment, if necessary. Be certain to include this information:

WORK ORDER # _____
 CUSTOMER NAME _____ CUSTOMER # _____
 MODEL # _____
 SERIAL # _____

2.2 PACKING AND UNPACKING

2336DW terminals are packaged in two cardboard containers with special packing material for protection during shipping. The CRT and keyboard are packaged separately. Circuit boards and other components are installed at the factory.

2.3 TERMINAL INSPECTION

Remove the terminal cover as follows:

a. Stand at the rear of the unit, remove the Phillips-head screws , one on each side of the rear of the CRT unit. Place both hands on the top of the CRT unit, push the cover back along the side tracks, and lift it from the unit. Set the cover aside. Avoid scratching the surface.

Perform a careful internal inspection of the CRT unit. Look for broken or shifted boards or other components, and wiring, screws, or hardware that might have come loose during shipment. Revision levels of particular PCBs used in the 2336DW should be verified as specified in section 1.

SECTION

3

INSTAL-

LATION

SECTION 3

INSTALLATION

This Section describes terminal installation procedures.

3.1 Physical Assembly and Checks

Follow the instructions given in this section to connect the 2336DW terminal to the 2200 system. Refer to Figure 3-1 for cable connections.

- a. Remove the CRT module cover by removing the the two screws on the rear of the unit. (figure 3-2) Remove packing insert.

WARNING

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*****
*                                                                 *
* DO NOT OPEN THE SWITCHING POWER SUPPLY UNDER ANY           *
* CIRCUMSTANCE.  EXTREMELY DANGEROUS VOLTAGE AND              *
* CURRENT LEVELS (IN EXCESS OF 300 VOLTS DC AND UN-          *
* LIMITED CURRENT) ARE PRESENT WITHIN THE POWER SUPPLY.      *
*                                                                 *
* DO NOT ATTEMPT TO REPAIR THE SWITCHING POWER                 *
* SUPPLY; IT IS FIELD REPLACEABLE ONLY.                       *
*                                                                 *
* AFTER POWERING THE UNIT DOWN AND DISCONNECTING THE AC      *
* POWER PLUG FROM THE WALL OUTLET, ALLOW ONE MINUTE          *
* BEFORE REMOVING THE POWER SUPPLY TO PROVIDE ADEQUATE       *
* TIME FOR ANY RESIDUAL VOLTAGE TO DRAI THROUGH THE          *
* BLEEDER RESISTORS.                                          *
*                                                                 *
*****

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- b. Remove the label from the ac input connector and verify that it corresponds to the actual voltage (115/230v) selection on the switching power supply (figure 3-3).
- c. Connect and secure the keyboard assembly.
- d. Locate the POWER switch on the rear panel of the CRT module and insure that the switch is in the OFF (0) position.
- e. Insert the terminal ac power cord into the appropriate connector on the rear panel of the CRT module.
- f. Insert the terminal ac power cord into an appropriate outlet. DO NOT USE AN EXTENSION CORD. Turn the POWER switch ON (1).
- g. Refer to section 6 and perform the indicated power supply voltage checks (6.2.1) and CRT display voltage checks (6.2.2).

- h. Turn the terminal AC power switch OFF (0).

NOTE

Burn-in diagnostics can be run at this time if desired. Refer to section 7.2.1 for instructions.

- i. Connect the RS-232 cable (P/N 120-2236-25) between the RS-232 connector on the terminal and the RS-232 connector on the 2200 communications port.
- j. Set the baud rate switches for 19.2K in accordance with figure 3-4.
- k. Each 2336DW terminal is connected to either a 2236MXD Terminal Processor or a 22C32 Triple Controller when configured with a 2200 Central Processing Unit. Existing controllers must be revised to current standards to support the 2336DW terminal as follows:

- 1. Change the two PROMs on PCB 210-7516-A

FROM	TO
378-4092	378-4092-R1
378-4093	378-4093-R1

- 2. Change the two PROMs on PCB 210-7789-A

FROM	TO
378-4092	378-4092-R1
378-4093	378-4093-R1

- 3. Change the four PROMS on PCB 210-7591-A

FROM	TO
378-2140-R06	378-2140-R07
378-2141-R06	378-2141-R07
378-2142-R06	378-2142-R07
378-2143-R06	378-2143-R07

- 4. Change the four PROMs on PCB 210-7816-A

FROM	TO
378-2591	378-2591-R1
378-2449	378-2449-R1
378-2450	378-2450-R1
378-2451	378-2451-R1

NOTE: The above changes do not affect other CPU peripheral devices; ie., all previously supported devices remain compatible after the changes.

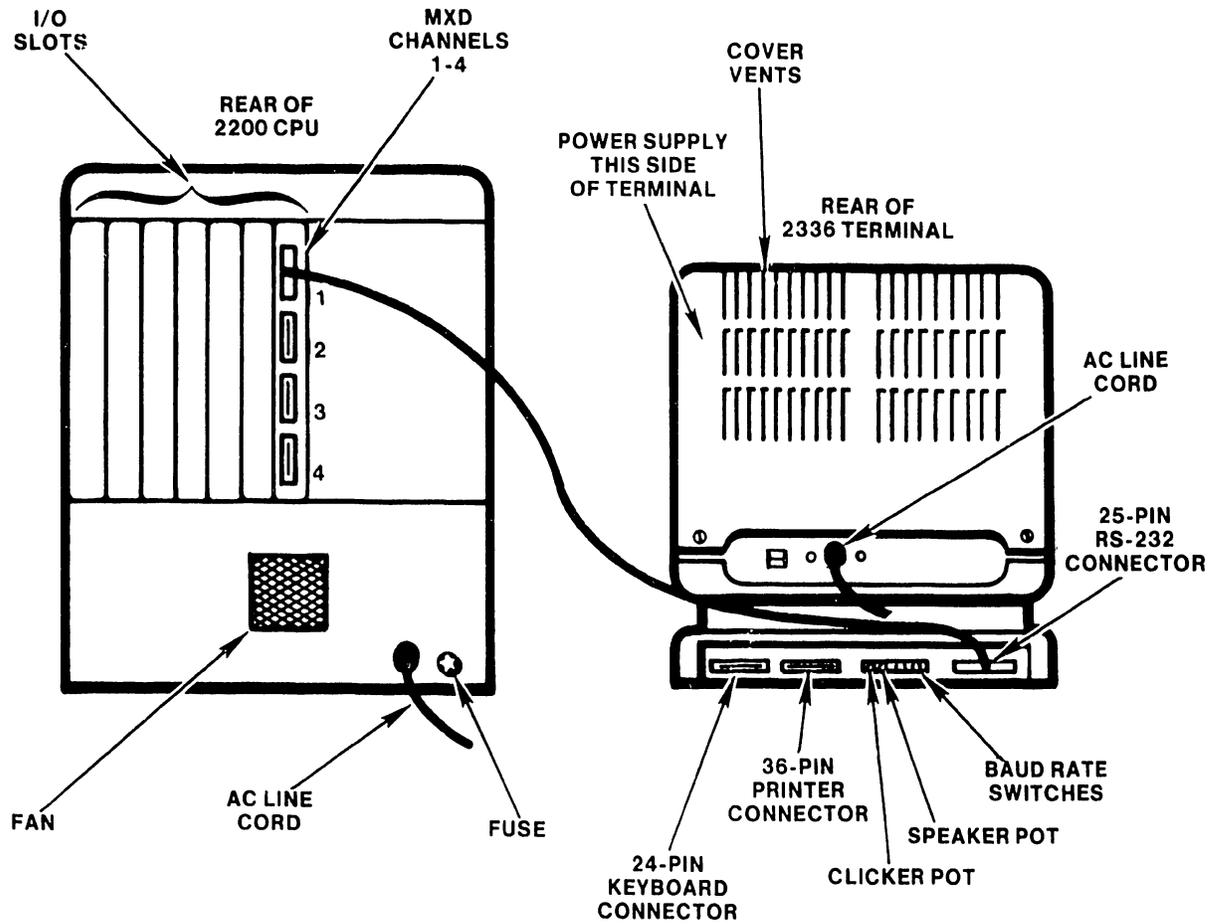


FIGURE 3-1 TERMINAL CABLE CONNECTIONS

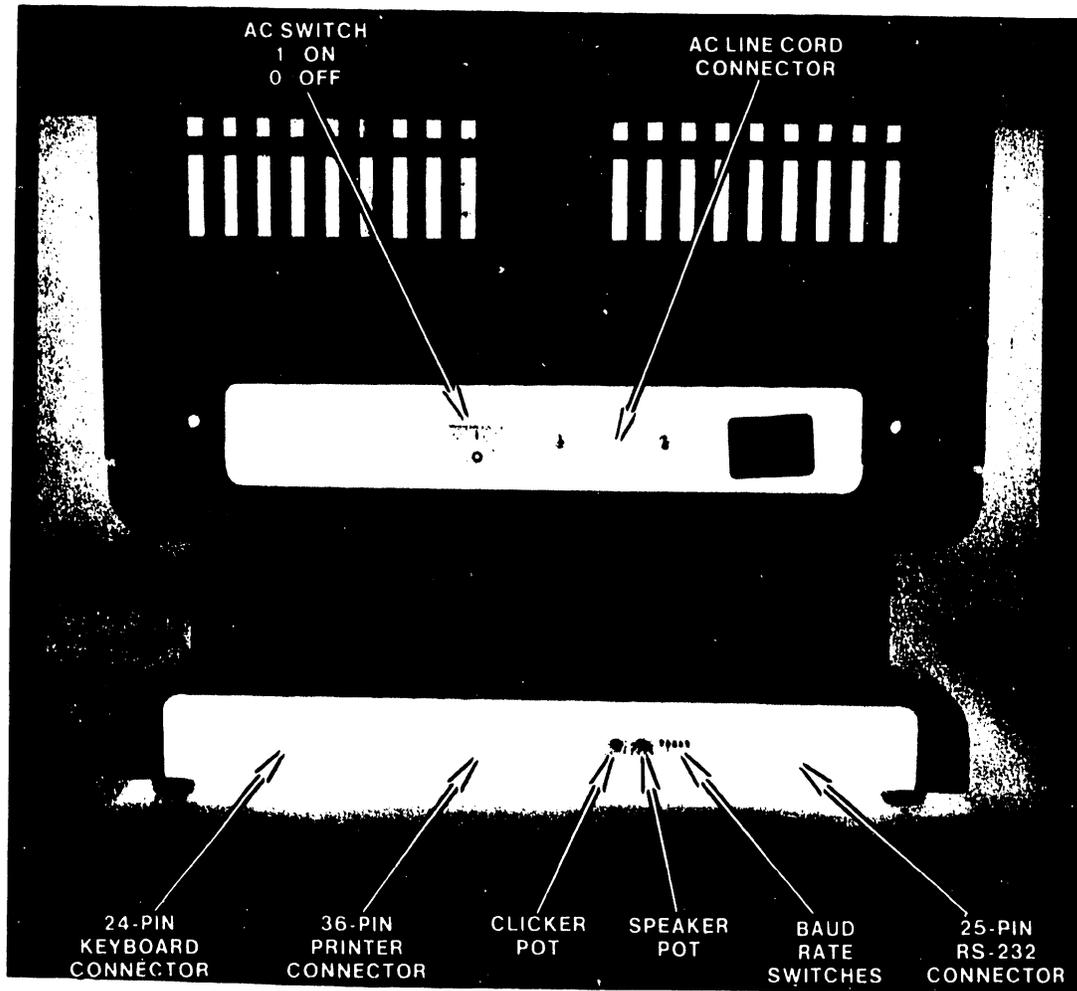


FIGURE 3-2 TERMINAL REAR PANELS



CAUTION

Use a non-metallic wand when making switch selection

FIGURE 3-3 POWER SUPPLY (115/230v) SWITCH LOCATION

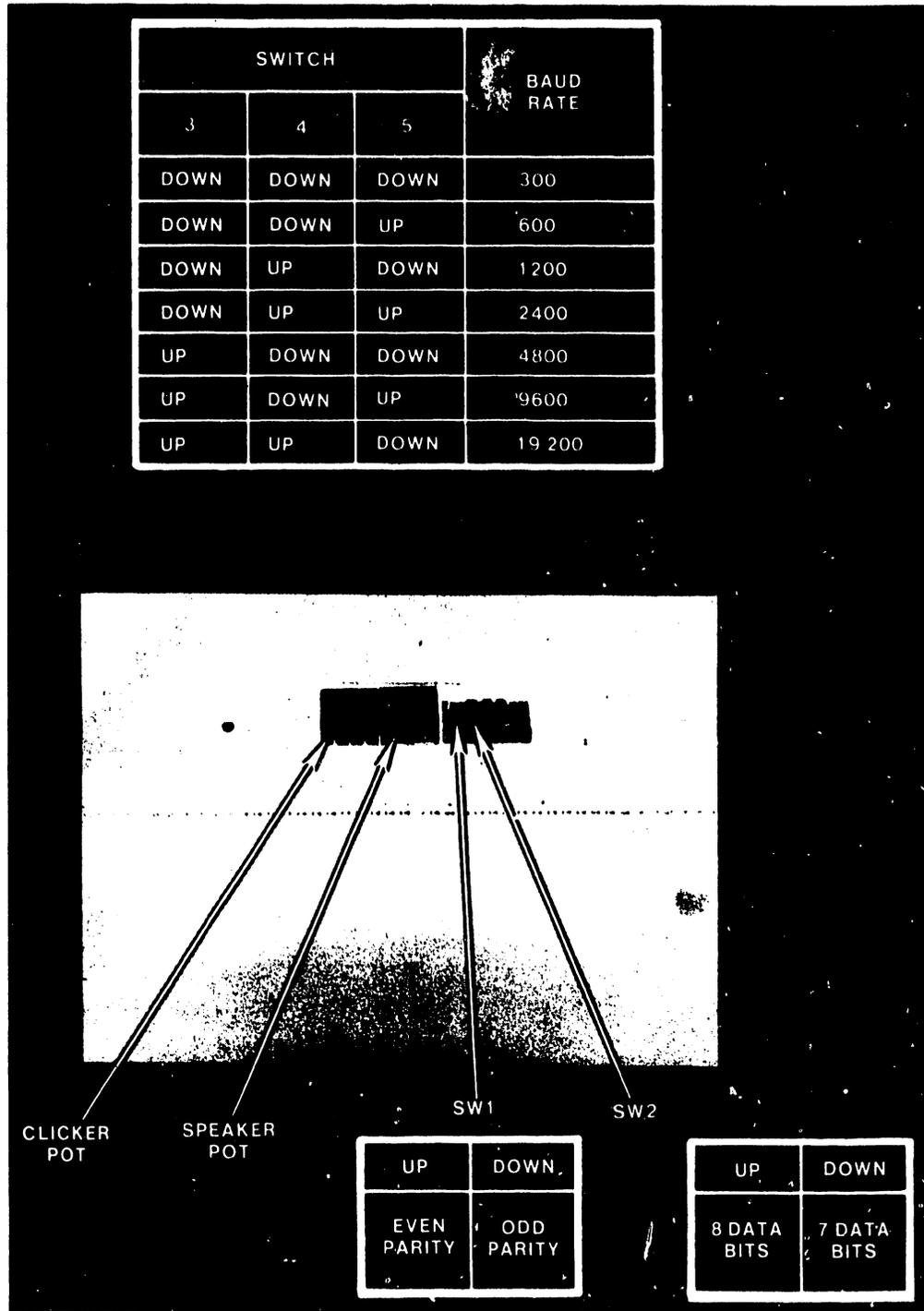


Figure 3-4. Baud Rate Switch Settings

- l. Power ON (1) the 2200 and then the 2336DW. At this time, the power-up diagnostics will be initiated. Ten tests are performed on the terminal. Upon successful completion of the tests, the terminal microcode will display the terminal type, baud rate, and word length state. Refer to section 7.2.1 for power-up diagnostic instructions.

NOTE

If the CRT display appears blank, adjust the brightness and contrast controls.

- m. Power OFF (0) the 2336DW.
- n. Power the 2336DW ON (1) while depressing the special function '13' key. This initiates the alignment pattern for the 2336DW monitor. Perform the CRT display alignment procedures (section 6.2.3)
- o. Depress special function '15' key to return control to the terminal microcode. The operator must now depress SHIFTED RESET to obtain control of 2200 system.
- p. Refer to the 2200 operator guide; verify terminal operation and ensure that all keys and special keys produce the correct results before proceeding. Figures 4-2 and 4-3 show the physical layout of the standard and international (expanded) keyboards.
- q. If the terminal fails during initial operational checkout, refer to section 7.1 (Troubleshooting).
- r. Set the electronics module cover straight down on the unit so that the rear of the cover extends approximately two inches behind the rear of the unit. The top and side edges of the cover fit onto a track on the corresponding portions of the unit. Push the cover forward along these tracks until it locks in place. Secure the hardware on the rear of the module.
- s. Refer to section 3.4.1(1) to replace CRT module cover.

SECTION

4

OPERA-

TION

SECTION 4

OPERATION

4.1 INDICATORS AND CONTROLS

The controls for the 2336DW are located on the CRT module and the keyboard.

4.1.1 CRT MODULE

a. Left side of CRT module - under the cabinet, at top of pedestal (figure 4-1)

BRIGHTNESS wheel - front

CONTRAST wheel - rear

b. Rear of CRT module

SPEAKER pot - right

CLICKER pot - left

4.1.2 KEYBOARD

The 2336DW terminal is equipped with a new combination keyboard which features the conventional typewriter format plus a numeric keypad as well as cursor control and editing and special function keys normally associated with Wang Word Processing systems (figure 4-2). The expanded DW keyboard has an additional four keys (figure 4-3). The following paragraphs describe the actions associated with each group of keys. For convenience of discussion, the keyboard has been divided into four zones as shown in figure 4-2.

Zone 1 - Typewriter Keyboard -- Similar to a standard typewriter, this zone contains the alphanumeric characters, the special purpose characters such as @ # \$ ¢ and the arithmetic operators "+ - * / = ", TAB, GL, RETURN and SHIFT keys which perform the following functions:

- . TAB sets the format line zone and advances the cursor through successive zones on the screen to facilitate table creation.
- . GL (glossary) is a useful function in Word Processing whereby repeatedly used text may be created once, stored on disk and retrieved again with two keystrokes; GL followed by the glossary number.
- . RETURN terminates the present text line and repositions the cursor at the beginning of the next line.

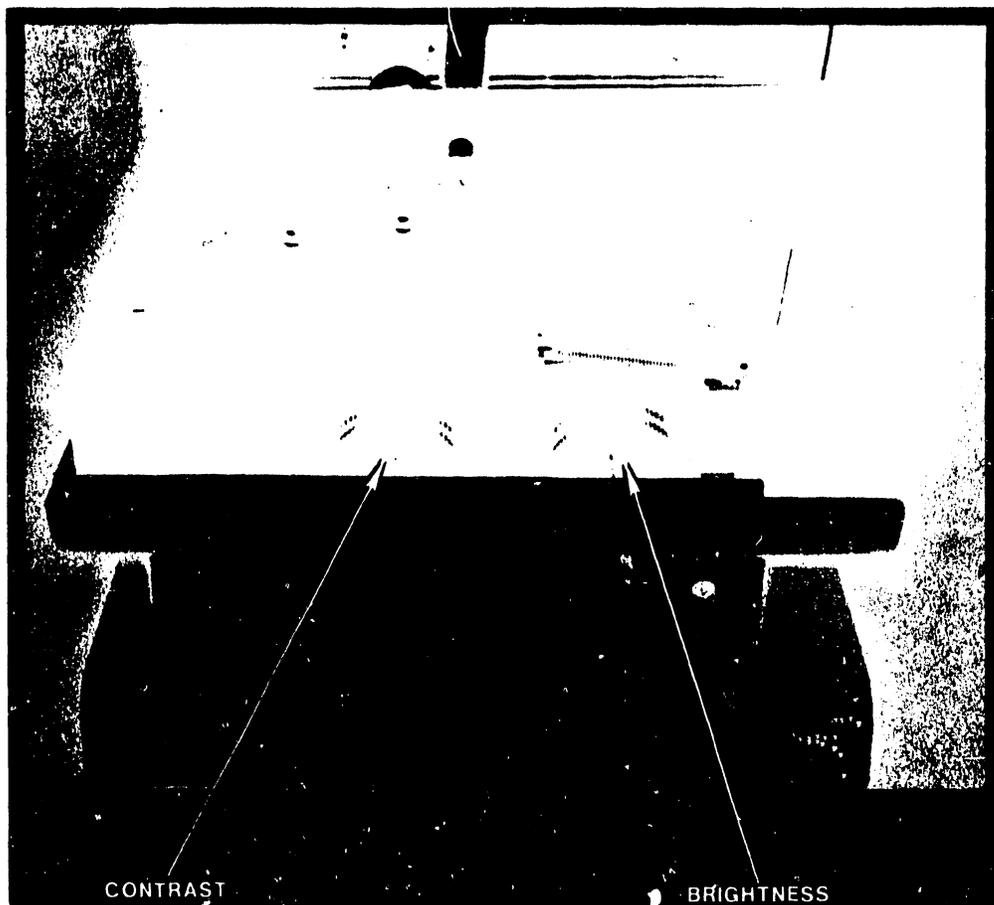


FIGURE 4-1 BRIGHTNESS AND CONTRAST CONTROLS

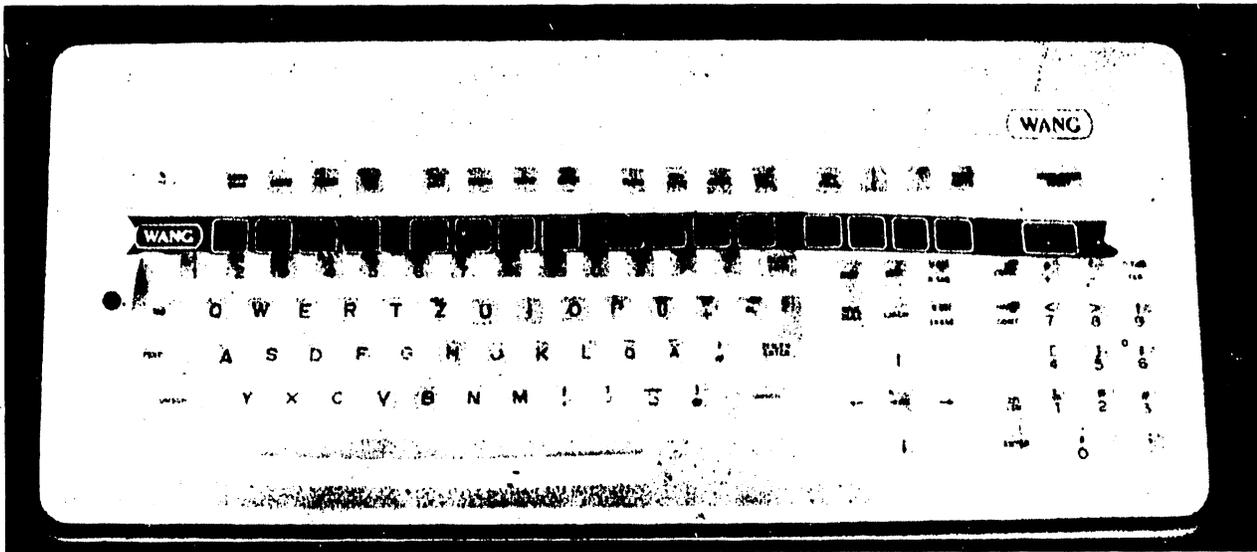


FIGURE 4-3 EXPANDED 2336DW KEYBOARD

Zone 2 - Cursor Control and Editing Keys -- This zone contains Editing keys (INSERT and DELETE), Location keys (NEXT SCRNL and PREV SCRNL), and Cursor Control keys (control movement of cursor in indicated direction -- up, down, right, and left).

Zone 3 - Numeric Keypad -- The numeric zone is designed like a standard 10-key numeric pad for rapid entry of numeric characters. The numeric keys are grouped here for convenience. Digits may be entered by using the numeric keys in either the numeric or the alphanumeric zone. This zone also includes such keys as ERASE, HALT/CONT, and RETRN.

Zone 4 - Word Processing/Special Function Keys -- Across the top of the keyboard are 16 Word Processing/Special Function keys. When using the word processing software, the Word Processing Function keys simplify document creation and revision. For example, the CENTER key automatically centers a line of text, the MOVE key allows any amount of text to be moved within a document, and the REPLC key allows a character-defined sequence to be replaced with another within a document.

The word processing keys also serve as special function keys that can be set up by the programmer to perform program-defined functions. Since each of these 16 keys may be pressed in conjunction with the SHIFT key, a total of 32 special functions are available. The keys are numbered '0 -- '15 (lowercase) and '16 -- '31 (uppercase). Simultaneously pressing a key numbered '0 -- '15 with SHIFT accesses a function key from '16 -- '31. The function key number is labeled on the front surface of each key. Additionally, the TAB key and the GL key in Zone 1 can be used as special function keys.

Special function keys may be used to perform a variety of tasks, e.g., start program execution, access subroutines, or enter a predefined text string. The operator is informed of the meanings of the special function keys either by screen prompts or by means of the label strip located immediately below this row of keys. In order to perform a given task, a special function key must be defined by the user with a DEFFN' statement in the currently loaded program. The special function keys are also used during master initialization to load the BASIC-3 interpreter and operating system.

The keyboard has two modes of operation, selected by a toggle switch labeled A/A and A/a. The dual mode keyboard is designed for both data processing and word processing applications.

In Programmer's mode (A/A), uppercase alphabetic characters are produced, whether the keyboard is shifted or unshifted. Shifted numeric keys produce symbols and special characters. In Operator's mode (A/a), the keyboard functions as a standard typewriter, producing uppercase and special characters when shifted, and producing lowercase and numeric characters in unshifted operation.

The 2336DW also includes a Caps Lock feature. In either A/A or A/a mode: Caps Lock (activated by pressing the lock key) produces uppercase alphabetic characters; all other characters, such as the numeric keys, are lowercase.

The keyboard allows characters to be underlined. On non-English versions of the keyboard, characters can also be accented. All keys on the keyboard will repeat if held down. The microprocessor in the terminal automatically adjusts the repeat key rate according to the rate at which characters are being echoed to the CRT. The keyboard clicker sounds each time the repeated character is transmitted. Thus, both aural and visual evidence of the repeated character are given to the user. (The repeating key is particularly useful for moving the cursor when editing.)

Special features of the 2336DW keyboard include the following:

- Keyboard Clicker -- The clicker provides an audio response when a key is sufficiently pressed. The volume of the keyboard clicker may be adjusted.
- N-key Rollover -- This feature permits a new key to be pressed and output to the terminal while a previous key is still being held down. This process can continue for any number of keys; each new key pressed takes precedence over any keys already held down. The N-key rollover feature helps eliminate errors during high-speed typing.
- Terminal Alarm -- The alarm provides audio feedback to indicate the occurrence of errors or special conditions, e.g., pressing an undefined special function key, typing beyond a specified field, displaying an error message. The volume of this audio alarm may also be adjusted.

The RESET key, located in the upper-left corner of the keyboard, immediately stops program execution, listing, and I/O operations; clears the CRT; homes the cursor; signals ready; and returns to the console user (Console Input mode). RESET is also used during master initialization and hardware diagnostic operations. The RESET key is an undesirable means of terminating execution and generally should not be used to end program execution; HALT should be used for this purpose. As a protective feature, RESET and HALT are active only in Programmer's mode (A/A), and only if pressed in conjunction with the SHIFT key.

NOTE

On a 2200, RESET affects only the partition to which the terminal is currently attached (the terminal's foreground partition). No other partitions are affected by RESET.

4.2 OPERATIONAL FEATURES

4.2.1 THE SCREEN DUMP

The screen dump feature allows the user to obtain a hard copy record of the CRT on a printer attached to the terminal. Screen dump is a temporary off-line terminal operation which may be initiated only by the terminal operator. In fact, a BASIC-3 program can neither initiate nor detect the activation of a screen dump. Therefore, the screen dump may be used to preserve hard copy records of the screen even after the program has stopped with an error or after a CPU failure. However, this also means it is the terminal operator's responsibility not to activate screen dump while the terminal printer is in use. If screen dump is activated while a program is using the printer, the screen dump output will be inserted on its own separate page, and printing will then resume without missing any characters. To activate a screen dump, use the following procedure.

1. Press the EDIT key and hold it down for approximately two seconds. An immediate click will be heard. The CRT image will be frozen with the image to be dumped.
2. When a second click is sounded, the screen dump has been activated. (If the EDIT key is released before the second click is heard, the key is treated as the EDIT key and the screen image is unfrozen.)
3. The screen image is transmitted to the printer, preceded by a carriage return and form feed, which neatly formats the output. (If a screen dump is activated while a program is using the printer, the screen dump output will be inserted on its own separate page.)
4. The screen dump ends with another form feed.
5. Normal processing of output from the CPU is resumed. (No data is lost, even if the CPU has attempted output to the CRT or printer while the screen dump was in progress.)

During a screen dump, the keyboard remains active. Pressing any key will terminate the screen dump and restore normal processing. If the screen dump fails, make sure the printer is selected and try again. If the screen dump still fails, use the CLEAR button found on many printers. Do not use the terminal's RESET, because it will clear the screen.

It is not possible for a screen dump to produce an exact image of the screen because the terminal microprocessor cannot tell what type of printer is attached to the terminal. A conservative subset of the CRT character set is therefore employed during a screen dump. The USA version of the 2336DW can screen dump all characters between HEX(20) and HEX(7E), including all uppercase and lowercase characters on the keyboard. Underlined characters are translated to their non-underlined equivalents. The actual character set used for screen dump varies among the international versions of the terminal. However, the following general rules do apply.

- a. Any character not in the screen dump character set is translated to the number symbol (#).
- b. Display attributes are ignored. All characters are printed in the same font and pitch.
- c. Character set graphics are also translated to the number symbol (#).
- d. Box graphics are ignored.

CAUTION

Since normal printing is interrupted when a screen dump is requested, the screen dump will be inserted into a report already printing. Although screen dumps eject a page before and after a dump, the user's report may be temporarily halted in the middle of the page. For some reports, this may be acceptable; but for preprinted forms such as invoices or customer statements, a screen dump which interrupts current printing could present problems.

4.2.2 DISPLAY VARIATIONS

4.2.2.1 Character Display Attributes

In order to highlight information on the screen, the terminal provides several display attributes that can be selected for any character displayed on the screen. The available display attributes are the following:

- a. Bright -- Characters are displayed in high intensity.
- b. Blink -- Characters blink.
- c. Reverse Video -- The character itself is dark while the character background display is light (dark on light).
- d. Underline -- Characters are displayed with an underscore.

4.2.2.1.1 HEX Codes Used to Invoke Display Attributes

Immediately after power is turned on, the terminal displays characters in normal intensity, non-blinking, normal video (light on dark), and non-underlined (this attribute shall henceforth be referred to as simply "normal intensity"). The power-on default meaning of HEX(0E) is bright, non-blinking, normal video, and non-underlined.

The display attribute to be used is selected by sending a command of the following form to the CRT.

```

                HEX(02 04 xx yy 0E)
    or
                HEX(02 04 xx yy 0F)

```

where:

02 04 = The control code sequence which indicates to the terminal that special character display attributes are to be selected.

xx yy = The HEX codes specifying the display attributes to be selected, where:

```

xx = 00 for normal intensity, no blink
     02 for bright, no blink
     04 for normal intensity, blinking
     0B for bright, blinking

```

```

yy = 00 for normal video, no underline
     02 for reverse video
     04 for underline
     0B for reverse video, underline

```

OE or OF = A terminator character which causes the display attributes selected by xx yy to be turned on or off; HEX(0E) turns the selected attributes on, HEX(0F) turns them off.

Note that there are two ways to code the attribute "blinking". However, on the 2336DW, blinking normal intensity and blinking high intensity characters both appear as blinking, high intensity.

4.2.2.1.2 Special Uses of Alternate Display Attributes

a. LIST D

The CPU sends out a HEX(0E) at the beginning of each REM% statement in the program. Thus, comment statements appear in the most recently selected alternate display attribute.

b. 100 PRINT "PROMPT";: LINPUT HEX(0E), A\$: PRINT A\$

The field to be entered appears in the most recently selected alternate display attribute. When entry is terminated with a carriage return, the alternate attribute is cancelled, so the PRINT statement prints A\$ in normal intensity.

c. 150 PRINT HEX(0E); "PROMPT"; HEX(0F);

160 LINPUT A\$

This time, only the prompt appears in the most recently selected alternate attribute.

4.2.2.1.3 Summary of Display Attribute Rules

The following list contains the general rules for governing the use of display attributes.

- a. HEX(02 04 xx yy 0E) selects and activates a display attribute. Attributes activated in this manner are turned off only by HEX(0F) or by another HEX(0204... sequence. The attribute is not turned off by carriage return, HEX(0D). Thus, it is possible to highlight a portion of either one or several lines.
- b. HEX(02 04 xx yy 0F) selects, but does not activate, a display attribute. Normal intensity is activated instead.
- c. An isolated HEX(0E) activates the attribute selected by the last HEX(0204... sequence for a maximum of one text line. The attribute remains in effect until the occurrence of either an automatic carriage return, a programmed HEX(0D), or a HEX(0F).
- d. Rule 1 takes precedence over Rule 3. If an attribute is selected and activated by Rule 1, a subsequent HEX(0E) will not cause the attribute to be turned off by the next carriage return.
- e. An isolated HEX(0F) always turns off the alternate attribute and restores normal intensity.
- f. Screen clear, HEX(03), clears the screen to black, but otherwise has no effect on the meaning of HEX(0E) or the attribute currently in effect. Likewise, scrolling the screen scrolls in a black line, but otherwise has no effect on attributes.

- g. Programmers are reminded that reverse video spaces are white, not black. Zoned format PRINT statements, i.e., PRINT, PRINT TAB, and the third parameter of PRINT AT, use spaces to clear the screen. These statements will leave white areas on the screen when reverse video is activated.
- h. Terminal power on and the RESET key cause normal intensity characters to be selected and the meaning of HEX(0E) to be defined as high intensity.
- i. The system considers all codes HEX(00) to HEX(0F) to occupy no space on the output medium. Thus, attribute selection sequences do not cause the system to issue automatic carriage returns or throw off the column count used by TAB and zoned format PRINT statements.
- j. Control codes HEX(00) to HEX(0F) do not have attributes. It is not possible to change the attribute of a character by passing the cursor through it with a PRINT AT statement.
- k. The meaning of isolated HEX(0E) is maintained by the terminal, not the partition. If a program gives up control of the CRT with \$RELEASE TERMINAL, there is a good chance that a program in another partition will change the meaning of HEX(0E) in the course of using attributes.

4.2.2.2 Selection of Character Selection

The 2336DW actually offers two character sets: the normal character set (figure 4-4) and the alternate character set (figure 4-5). The following sequence is used for selecting either character set.

HEX (02 02 xx 0F)

where:

02 02 = The control code sequence which indicates to the terminal that a character set will be selected.

xx = A HEX code specifying the character set to be selected.

If xx = 00 The normal character set is selected. The codes HEX(90) to HEX(FE) are underline versions of characters from HEX(10) to HEX(7E).

If xx = 02 The alternate character set is selected. The codes HEX(80) to HEX(FE) represent the graphic characters and symbols.

0F = A terminator character that signals the end of the character selection sequence.

Any character of either character set can be underlined by using the underline character attribute. Either character set may differ on foreign language versions of the terminal. All versions of the terminal are capable of producing uppercase alphabet, numbers, and most of the special characters used in BASIC programming.

In the character set selection, the following items should be noted.

1. In the alternate character set, the codes HEX(9C) to HEX(BF) are presently undefined and reserved for future expansion. Any use of these codes involves the risk of being incompatible with future use of the terminal.
2. With the exception of the following HEX codes, the character sets of both the DE and the DW terminals are identical. The following HEX code values have been redefined for the normal character set of the DW terminal.

<u>HEX</u>	<u>DW Normal Character Set</u>	<u>DE Normal Character Set</u>
5F	down arrow	left arrow
7F	up/down arrow	section symbol
80	dotted space	blank
8D	left arrow	up/down arrow
8F	page character	paragraph symbol
DF	underlined down arrow	underlined left arrow
FF	underlined up/down arrow	underlined section symbol

3. The following Hex code values have been redefined for the alternate character set of the DW terminal.

<u>HEX</u>	<u>DW Alternate Character Set</u>	<u>DE Alternate Character Set</u>
5F	down arrow	left arrow
7B	up/down arrow	section symbol

NOTE

1. Character set is identical for DE and DW units when terminal is turned on.
2. Print Hex (0202040F) will "turn on" a translation table which is describe above.
3. Print Hex (0202000F), Reset or Clear will "turn off" translation table.

LOW-ORDER HEX DIGIT

HIGH-ORDER HEX DIGIT

	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	â	Space	0	@	P	°	p	.	â	_	0	@	P	°	p
1	ê	!	1	A	Q	a	q	◆	ê	!	1	A	Q	a	q
2	î	"	2	B	R	b	r	▶	î	"	2	B	R	b	r
3	ô	#	3	C	S	c	s	◀	ô	#	3	C	S	c	s
4	û	\$	4	D	T	d	t	→	û	\$	4	D	T	d	t
5	ä	%	5	E	U	e	u	└	ä	%	5	E	U	e	u
6	ë	&	6	F	V	f	v	|	ë	&	6	F	V	f	v
7	ï	'	7	G	W	g	w	..	ï	'	7	G	W	g	w
8	ö	(	8	H	X	h	x	'	ö	(	8	H	X	h	x
9	ü	)	9	I	Y	i	y	'	ü	)	9	I	Y	i	y
A	à	·	:	J	Z	j	z	^	à	·	:	J	Z	j	z
B	è	+	;	K	[	k	]	■	è	+	;	K	[	k]
C	ù	,	<	L	\	l	£	!!	ù	,	<	L	\	l	£
D	Ä	-	=	M	]	m	é	-	Ä	-	=	M	]	m	é
E	Ö	.	>	N	†	n	ç	ß	Ö	.	>	N	†	n	ç
F	Ü	/	?	O	↓	o	€	⊥	Ü	/	?	O	↓	o	€

FIGURE 4-4 THE NORMAL CHARACTER SET OF THE DW TERMINAL

LOW-ORDER
HEX DIGIT

HIGH-ORDER HEX DIGIT

	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	â	Space	0	@	P	°	p	·	·			☐	☐	☐	☐
1	ê	!	1	A	Q	a	q	◆	◇			☐	☐	☐	☐
2	î	"	2	B	R	b	r	▶	▲			☐	☐	☐	☐
3	ô	#	3	C	S	c	s	◀	▼			☐	☐	☐	☐
4	û	\$	4	D	T	d	t	—	↓			☐	☐	☐	☐
5	ä	%	5	E	U	e	u	└	┘			☐	☐	☐	☐
6	ë	&	6	F	V	f	v	|	√			☐	☐	☐	☐
7	ï	'	7	G	W	g	w	¨	°			☐	☐	☐	☐
8	ö	(	8	H	X	h	x	·	|			☐	☐	☐	☐
9	ü	)	9	I	Y	i	y	·	|			☐	☐	☐	☐
A	à	·	:	J	Z	j	z	ˆ	Δ			☐	☐	☐	☐
B	è	+	:	K	[	k	l	■	□			☐	☐	☐	☐
C	ù	,	<	L	\	l	£	!!				☐	☐	☐	☐
D	Ä	-	=	M	]	m	è	↓				☐	☐	☐	☐
E	Ö	·	>	N	|	n	ç	ß				☐	☐	☐	☐
F	Û	/	?	O	↓	o	e	ř				☐	☐	☐	☐

FIGURE 4-5 THE ALTERNATE CHARACTER SET OF THE DW TERMINAL

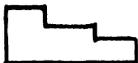
The 64 graphic characters, HEX(C0) to HEX(FF), are represented by all the combinations of sixths of a character space, where the character space is divided as shown in Figure 4-6. When displayed, graphic characters are extrapolated to fill the entire character position. For this reason, adjacent areas of two graphic characters will touch; thus, continuous lines (bars) of light or dark areas can be displayed on the screen. When combined with display attributes, character graphics are useful for the construction of bar graphs, histograms, and other special displays.



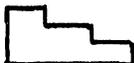
FIGURE 4-6 DIVISION OF A CHARACTER SPACE

The HEX codes for each specific graphic design are determined in the following manner. Use HEX(C0) as the base, with each different segment (each sixth of a character space) equal to the following HEX values.

01	02
04	08
10	20

Suppose the design  was desired. To obtain the appropriate HEX value add desired segments to the base. For example:

C0	Base
01	
02	Desired segments
+ 04	
C7	Resulting HEX code for desired design

Therefore, the design  would be coded as HEX(C7). For a quick and easy reference, programmers should also refer to figure 4-5, The Alternate Character Set of the DW Terminal.

4.2.2.2.1 Examples of the Character Sets

```
PRINT HEX(02 02 00 0F); HEX(C6 C5 C2 D2 D5 C1 D2 D9)
```

This statement selects codes HEX(90) to HEX(FF) to represent normal characters HEX(10) to HEX(7F) with underline. Thus, the screen would display the word FEBRUARY with an underline.

```
PRINT HEX(02 02 02 0F); HEX(FF FC F0);
```

This statement selects the alternate character set and displays three character boxes of decreasing heights (). These are the characters most useful for constructing vertical bar graphs.

4.2.2.2.2 Summary of Character Set Selection

The rules concerning the use of character set selection can be summarized as follows.

1. HEX(02 02 00 0F) selects the normal character set. The meaning of codes HEX(90) to HEX(FF) are defined to be the normal characters HEX(10) to HEX(7F) with underline.
2. HEX(02 02 02 0F) selects the alternate character set. The codes HEX(80) to HEX(FF) represent the graphic characters and other special symbols.
3. Power on and RESET select the default character set (the normal character set for the standard USA Model 2336DW).
4. Carriage return does not affect character set selection. The sequences given in Rules 1 to 3 are the only methods for changing character sets.
5. As with attributes, the character set selection sequences affect the interpretation of characters at the time they are received by the terminal. Therefore, underlined and graphic characters may be used in different areas of the same display. Once on the screen, a character is modified only by explicitly striking over it with another character or by screen clear.
6. All display attributes can be used with both the normal and the alternate character set.

4.2.2.3 Graphic Box Function

General Form:

BOX (height, width)

where:

height = Expression specifying the height of the box; each unit is the height of a character space.

width = Expression specifying the width of the box; each unit is the width of a character space.

Purpose:

The BOX function is used within a PRINT statement to draw or erase a box or line on a CRT which has box graphics capability. The first expression specifies the height of the box; the second is the width of the box. The sign of the arguments determines whether lines are drawn or erased. If the signs are nonnegative, lines are drawn; negative signs cause lines to be erased. If the box height is zero, a horizontal line is drawn or erased. A width of zero causes a vertical line to be drawn or erased. The BOX function positions the box so that the upper-left corner is at the current cursor position. Drawing a box does not move the CRT cursor.

Examples:

PRINT BOX (3, 4);	-- Draws a 3 x 4 box
PRINT BOX (-3, -4);	-- Erases a 3 x 4 box
PRINT BOX (0, X);	-- Draws a horizontal line X units long
PRINT BOX (-7, 0);	-- Erases a vertical line 7 units long
PRINT AT (5, 10); BOX (1, 6); "TITLE"	-- Displays TITLE enclosed in a box

Note that in order to include the field TITLE in the last example, the box had to be one character wider than the length of the field, and the left edge of the box had to be one character position to the left of the field to be enclosed. Therefore, to box a field in general, use the statement:

```
PRINT BOX (1, LEN(A$)+1); "␣"; A$
```

where A\$ is the given field, LEN(A\$) is the length of the field A\$, and the symbol ␣ represents one space.

Box graphics can also be used for highlighting entry fields as shown in the following example.

```
CLEAR
10 PRINT "PROMPT"; BOX(1, 17);:LINPUT A$
RUN
```

4.2.2.3.1 Box Graphics

The DW Integrated Terminal can display continuous horizontal or vertical lines, enabling forms to be drawn or information to be separated by lines or boxes. The horizontal line unit is a line segment the width of a character space, but positioned from the middle of one character space to the middle of the next character space. Horizontal lines are displayed between rows of characters.

The vertical line unit has the height of a character space. Vertical lines are drawn through the middle of a character space; the line coexists with the character at that location. (Note that since the height and width of a character space are not the same unit measurement, boxes are not drawn proportionally. However, because of these measurements, a programmer can easily box fields of characters.)

Figures 4-7 and 4-8 illustrate the placement of box graphic lines. Figure 4-7, which shows the smallest possible box, was produced by the statement PRINT BOX(1,1); "AB". It illustrates the placement of horizontal and vertical box graphic lines relative to the character position. Figure 4-8, which was produced by the statement PRINT BOX(1,1); HEX(0202020F); HEX(E1CC), demonstrates where box graphic lines appear relative to character set graphic blobs.

The terminal allows the programmer to consider the CRT as both a box graphics display and a character display that just happen to be displayed on the same screen. While in Character mode, only the characters and their attributes are modified while box graphics remain intact. For example, within a boxed area used to highlight a prompt, the prompt may be rewritten a number of times without altering or erasing the box itself. The one exception to this rule is screen clear, HEX(03) which clears both characters and box graphics. During a box graphics sequence, characters and their attributes are undisturbed.

Because the Character and Box Graphic modes are independent, it is easy to update portions of either display. The third argument of PRINT AT is useful for clearing portions of the display. Though slower than screen clear, the statement PRINT AT (0,0,) is useful for clearing the characters from the screen without disturbing the box graphics.

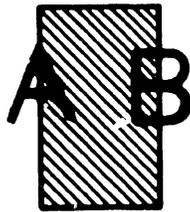


FIGURE 4-7 BOX GRAPHIC LINE PLACEMENT RELATIVE TO CHARACTER POSITION

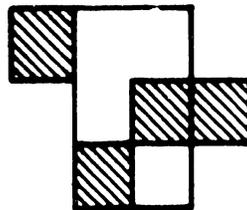


FIGURE 4-8 BOX GRAPHIC LINE PLACEMENT RELATIVE TO GRAPHIC CHARACTER SET

SECTION

5

THEORY

OF

OPERA-

TION

SECTION 5

THEORY OF OPERATION

5.1 TERMINAL CONTROLLER PCB

The 2336DW is a software-intensive terminal which is controlled by the master CPU. The hardware contained on the logic board, PCB 210-7743 is concerned mainly with the management of the display on the screen and the transfer of data and commands between the terminal and the CPU.

The following discussion describes the functions performed by the major components indicated in the block diagram shown in figure 5-1.

5.1.1 Z-80 CPU

This chip supervises the operation of the above cited components, provides control signals and services for their functions and programs them during initialization and performs limited local processing. The Z80 is sequenced with an operating program in two 2k Bytes of PROMs, L9 and L10 including a power-up diagnostic routine.

The major components of the board are tied together by four main buses:

- a. Buffered Address Bus which leads to PIO, "IO Address Decode", CTC and memory
- b. Data Bus which connects to PIO, CTC, and UART.
- c. Buffered Data Bus which leads to memory and VTAC.
- d. Buffered Control Bus which connects to PIO and CTC.

When power is applied to the terminal, the microprocessor is reset and begins executing its program at location 0000 of PROMs L9,10. The program contains the code necessary to initialize the programmable components, VTAC, CTC, UART and PIO for their default functions. The processor also administers a series of tests to verify that vital functions of the board are operational.

When all functions have passed the power-up diagnostics, the microprocessor reads and displays a message which identifies the terminal, its baud rate, parity and the keyboard translation table (USA, international).

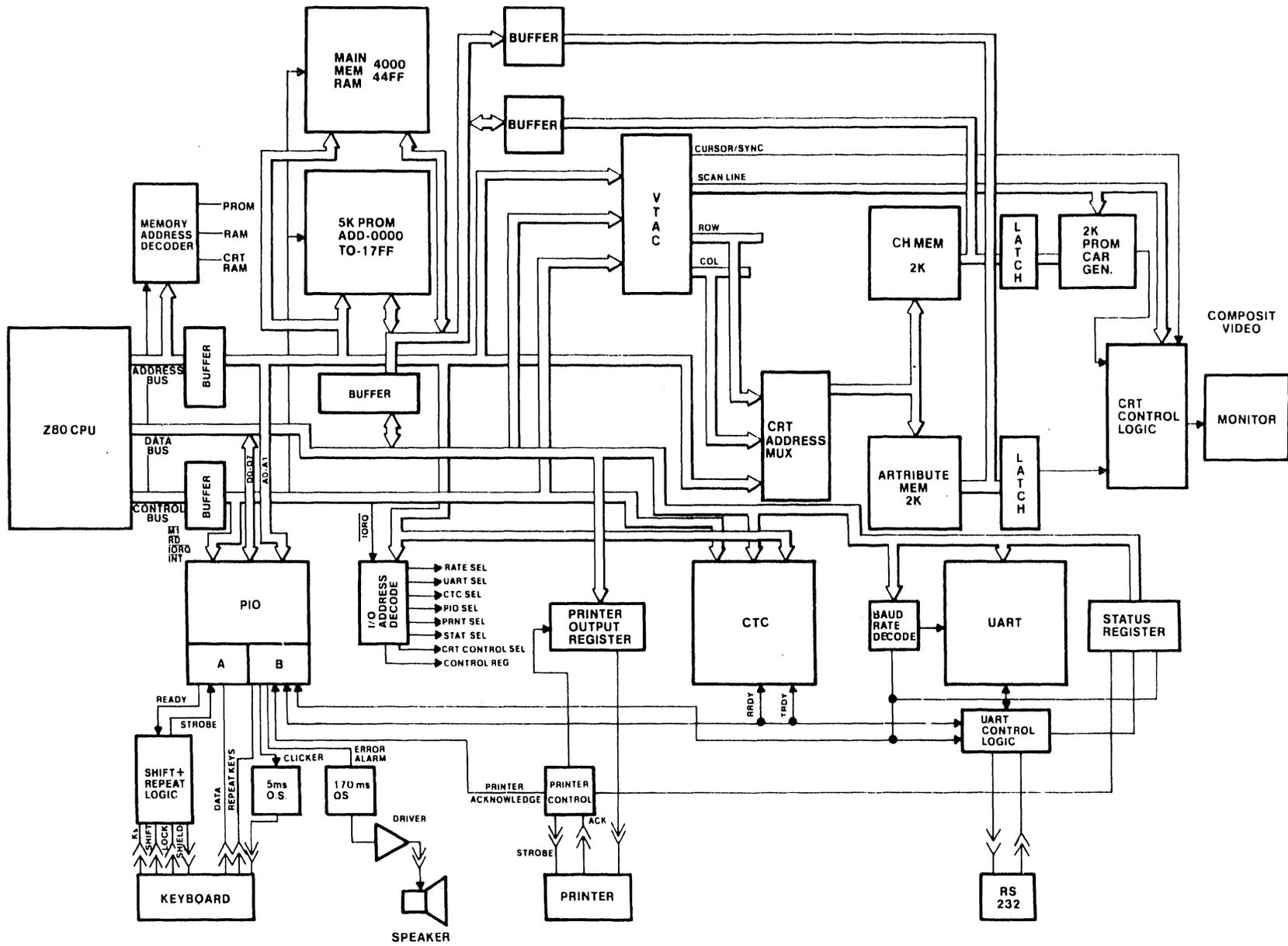


FIGURE 5-1 2336 BLOCK DIAGRAM

Clock Frequency - 2.175 MHZ with a T cycle time of 460 ns.

Interupts - vectored (Z80 mode 2)
 Priorities

- a. Receiver ready
- b. Transmitter ready
- c. CTC CH2
- d. CTC CH3
- e. Keyboard Character Available
- f. Printer Acknowledge

5.1.2 CTC

The Counting and Timing Circuit provides the terminal with a general purpose interval timer, mainly used to generate interupts for the Z80 microprocessor in order to initiate actions which require the use of the Z80 buses such as during transmit or receive.

5.1.3 MEMORY

2336DW memory is divided into three basic sections:

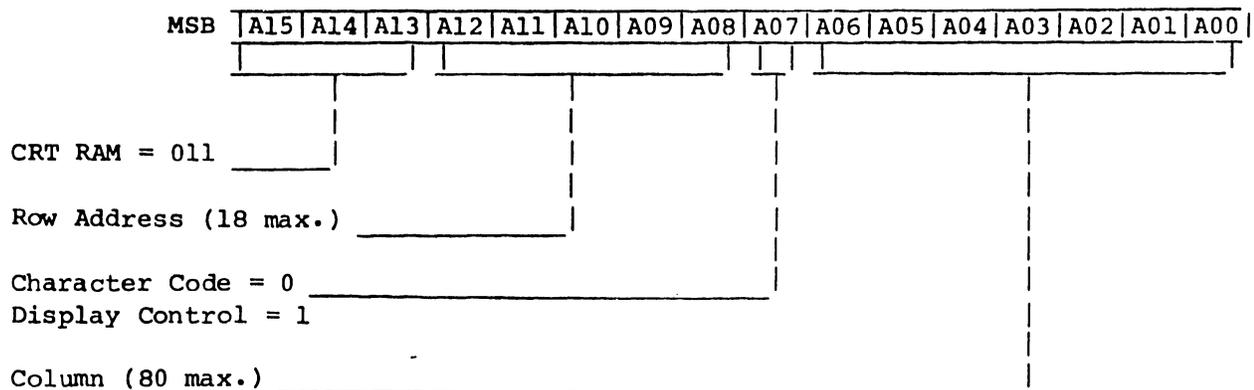
- a. PROM, 8K bytes
- b. RAM, 2K bytes
- c. CRT RAM, 4K bytes

CRT RAM is further divided into two sections:

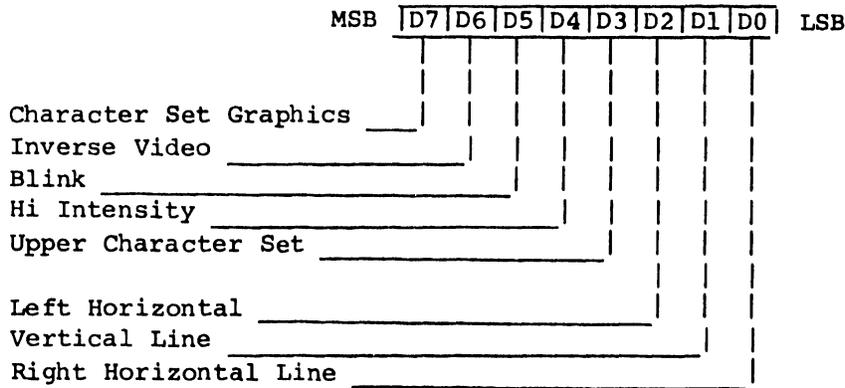
- a. Character Code 2K bytes
- b. Display and Forms Control

CRT RAM is addressed by the Z80 as two separate sections, but when operating with the CRT display, it is merged into one section of 2K words by 16 bits.

The CRT RAM ia mapped to the display screen, i.e., a character is addressed according to its row and column position on the screen. Address assignment is as follows :



The upper byte is the CRT Display and Forms Control portion and has the following bit assignments:



NOTE

The 25th line on the display can only display a left and/or right horizontal line, no character can be displayed.

Underscore is used to underline a character; it should not be used as part of the box graphics.

Upper character set is used to indicate that the character code should be decoded as the upper 128 character set. This set is optional and is used for special characters and/or extended box graphics.

NOTE

Character set graphics is used to indicate to the hardware that the displayed character is graphic and it must fill in the dots between characters.

The heart of the CRT control circuitry is the CRT Video Time Controller (VTAC) intergrated circuit. The VTAC contains the major portion of the logic required to generate the timing signals necessary to present video data on the CRT monitor. This includes the generation of dot-matrix outlines of characters, the horizontal and vertical sweep signals and the placement of characters in a given row and column . In conjunction with "Character Memory", the VTAC maintains the display on the screen through the block labeled "CRT Control Logic" which provides the drive for the CRT.

The VTAC must be initialized after power on and before anything is displayed. The following output commands must be executed to initialize the VTAC:

I/O Address	Output Data(Hex)	Function
'40'	'63'	Horizontal Character Count (=100)
'41'	'26'	Mode (non-interlaced)
		Horizontal Sync Width (=4)
		Horizontal Sync Delay (=6)
'42'	'55'	Scans/Data Row (=11)(1)
		Character/Data Row (=80)
'43'	'97'	Skew Bits (=1)
		Data/Row Frame (=24) (3)
'44'	'11'	Scans/Frame (=290) (2)
'45'	'19'	Vertical Data Start (=25)
'46'	'17'	Last Displayed Data Row (=24) (3)

All of the above parameters can be changed at any time during an operation; to insure a 'clean' display, a 'blank screen' command should first be executed.

- a. Output Data = '5D' for 50 HZ operation (Scans/Data Row = 12)
- b. Output Data = '2B' for 50 HZ operation (Scans/Frame =342)
- c. When 25 lines are required I/O address '43' should have a date value of 98 and and address '46' a value of 18.

The VTAC provides the following I/O commands:

Address	CPU I/O	Function
'48'	Input	Read cursor row address
'49'	Input	Read cursor column address
'4A'	Output	Blank screen reset VTAC
'4B'	Output	Up scroll
'4C'	Output	Load cursor column address
'4D'	Output	Load cursor row address
'4E'	Output	Unblank screen

Scrolling without the need to shift the entire CRT RAM is provided by the 'Up Scroll' and 'Last Data Row' commands. When scrolling, software must maintain a last displayed data row count as a memory pointer. Upward scrolling is accomplished by using an 'Up Scroll' command, or loading the incremented data row count, then changing the data of the last displayed data row. When downward scrolling, the decremented data row count is loaded, then the previous last displayed data row data is changed. The data row count must be module 24 when using this scrolling method. The horizontal line graphics in the 25th row cannot be used.

5.1.5 COMMUNICATIONS

The 2336DW terminal communicates with the MVP CPU via the standard 2236 async protocol. The 2236DW may be located up to 2000 ft. from the MXD terminal controller. The data is transferred to the UART chip via the OUT '7X' (the low value address lines do not influence chip select). The incoming data is input from the UART chip via an IN '7X'. The UART chip supplies the Z80 CPU with the following status information:

<u>STATUS</u>	<u>LOCATION</u>	<u>ACTIVE</u>
Transmitter Register Empty	Status Reg D4	1
UART Error (Framing, Parity, Overrun)	Status Reg D0	0
Receiver Ready	Status Reg D5	0
Transmitter Buffer Ready	Status Reg. D7	0

Receiver ready and transmitter buffer ready also go to channels 0 and 1 of the CTC so that they can cause interrupts when they become active (both go active low).

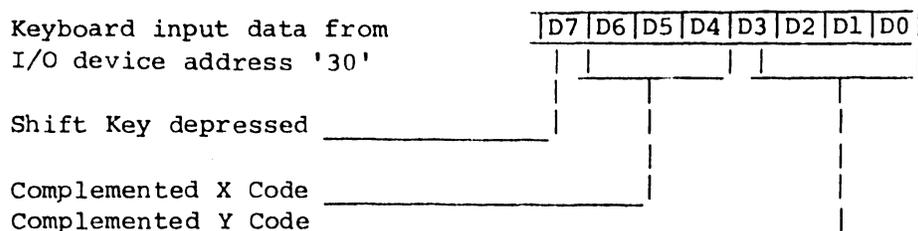
There is a single five-switch, switch bank that also provides control to the communications logic. The low order three switches determine the baud rate selected (they are status bits D3, D2 and D1). The fourth switch selects the word length (0 indicates seven data bits, 1 indicates eight data bits), the switch is read as bit D5 of the PIO channel B. The fifth switch controls even or odd parity (ON is odd parity, OFF is even parity).

The request to send signal is equal to the value in bit D7 of the PIO channel B. The PIO channel B bit D4 is used to enable or disable parity checking/generation at the UART (1 enables parity).

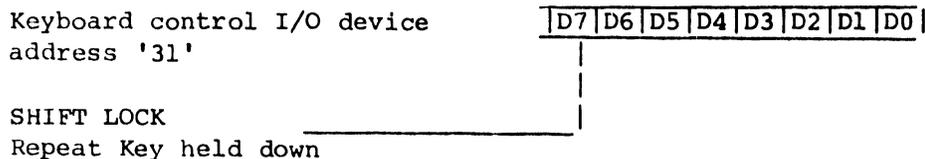
5.1.6 KEYBOARD

This external device interfaces with the PIO when dealing with the terminal's logic. When a key is struck a code is generated and an interrupt is issued to the Z80 which accepts it based on a priority scheme. Repeated interrupts will be generated when a key is depressed for more than 300 ms, and will continue for as long as the key is held down. The clicker will sound when the key code is accepted.

Keyboard data is input thru the Z80-PIO chip port A; I/O device address '30'. The keycode is presented in complemented binary coded X and Y coordinates as follows:



Keyboard control is handled thru the I/O Control Port (Z80-PIO port B), I/O device address '31', as follows:



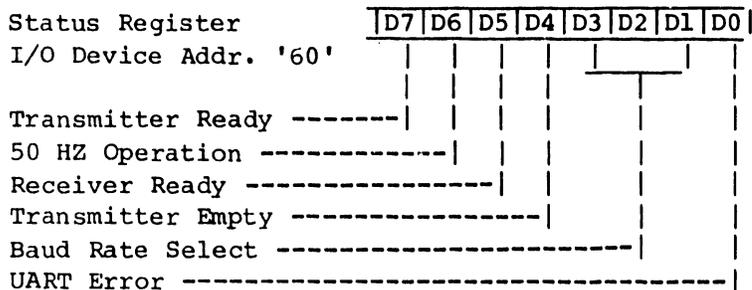
Repeat Key held down indicates an auto repeat key is depressed. Keyboard clicker is activated by OUT '2X' with D0 ON.

Repeat key timing is controlled by the Z80-CTC channel 3, I/O device address '13'.

When a repeat key is detected, a time constant of 19 is loaded (304ms, edge interval = 16ms). CTC channel 3 is set to counter mode, negative edge decrement, interrupt vector already loaded. When the interrupt occurs the 'Repeat Key Held Down' input bit is tested, if '1' the keycode is read from port A again. The time constant is now set to '8' (128ms) for each successive character until the 'Repeat Key Held Down' input bit is returned to '0'.

5.1.7 STATUS REGISTER

The status register, I/O device address '60' is used to detect the following terminal status bits:



- D7 will be zero if the transmitter buffer is empty and the data set is ready and the clear to send signal at the modem interface is active.
- D6 will be zero if the unit is to operate at 50 HZ.
- D5 will be zero if the receiver buffer is full.
- D4 will be one if the transmitter register is empty.
- D3-D0 will represent the baud rate selected by the baud rate switches.

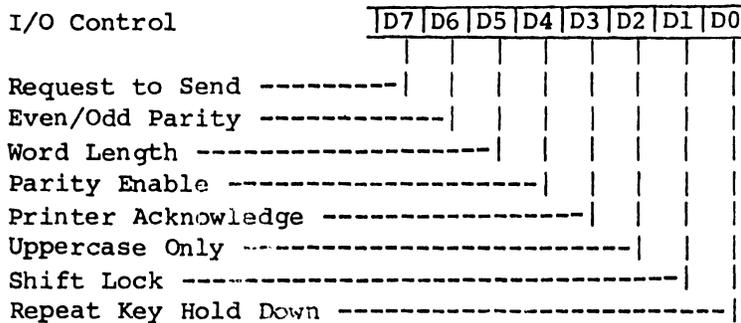
Use the following table to set the baud rate switches.

D3	D2	D1	Baud Rate
C	B	A	
0	0	0	300
0	0	1	600
0	1	0	1200
0	1	1	2400
1	0	0	4800
1	0	1	9600
1	1	0	19200
1	1	1	19200 (Burn-in test position)

D0 will be a zero if there is an UART error (parity error, overrun or framing error)

5.1.8 I/O CONTROL

This section reviews the bit assignments presented in previous sections for the I/O Control Port (Z80-PIO port B), I/O device address '31'.



D5 will be a one if eight bit data is selected; zero if seven bit data is selected.

D6 will be a one if even parity is selected.

Before I/O operations can begin PIO port B must be initialized. The following information is output to the port B control, address '33'.

- a. Set Vector Interrupt
- b. Set mode to control (mode 3)
- c. Set bits D7, D4 to outputs and set bits D6, D5, D4, D2 and D0 to inputs.
- d. Set for high state interrupt (Interrupt Control Word)
- e. Set interrupt mask to allow the Printer Acknowledge interrupt (bit D3 = '0', all others = '1').

5.1.9 TO PRINT

Print data is output to a 1 byte buffer register, I/O device address '50'. Each time a byte is loaded the hardware generates a data strobe to the printer.

Printer Acknowledge is returned from the printer each time it receives a character. The I/O control port (Z80-PIO port B) detects the acknowledge and generates a vectored interrupt.

5.1.10 CONTROL REGISTER

One register that is used to control some terminal I/O functions. The register is write only and its bit meanings are described below.

<u>BIT</u>	<u>MEANING</u>
D0	Sound the Keyboard Clicker
D1	Sound the Audio Alarm
D2	Stop Cursor from Blinking
D3	Start Cursor Blinking
D4	Allow CRT Writes Only on Hor. Retrace
D5	Allow CRT Writes at any time

5.2 TERMINAL CONTROLLERS

The 2336DW is attached locally to a CPU by means of either of two devices: a 22C32 Triple Controller that connects the terminal to either a 2200VP or a 2200MVP system, or a 2236MXD Terminal Processor that connects the terminal to a 2200MVP system. By using a combination of two 2236MXDs and one 22C32, a total of nine terminals can be connected to an MVP System. Only one terminal can be connected to a VP system.

The 22C32 and 2236MXD handle I/O operations between the terminal and CPU and act as buffers for data transmitted to/from the terminal. Communications between the terminal and the CPU by means of either a 2236MXD or 22C32 is asynchronous, full-duplex. The 2236MXD offers selectable line speeds ranging from 300 to 19.2K Baud; the 22C32 Triple Controller has a fixed communication rate of 19.2K Baud.

The Wang 3451 modem is capable of handling transmission rates of up to and including 19.2K . Because of this, the 22C32 triple controller, with its fixed 19.2K baud rate, and the 2236MXD selectable baud rate controller can both handle remote terminal applications.

NOTE

Installation of modifications for utilizing the cursor control pad on the terminal in the program development mode will be on a next call basis. When a 2236 MXD Terminal Controller or a 22C32 Triple Controller is repaired, the ECNs (No. 18474 for the Triple and No. 18475 for the MXD) should be installed on the board before it is returned to stock.

5.2.1 CONTROLLER SWITCH SETTINGS

Refer to Paragraphs 3.3.2 through 3.4.2 of the 2200MVP Maintenance Manual (03-0071-1) for information concerning device address and baud rate settings for the 2236MXD. PROMs used on the 2236MXD must be R5 or above, the 210-7290-1 PCB must be at Rev. 1 or greater, and the 210-7291-1 PCB must be at Rev. 2 or greater in order to use an 2336DW with a 2236MXD controller.

Because the 22C32 Triple Controller has a fixed 19.2K baud rate, only device address switches, located on the lower right side of the 210-7515 PCB, are set in the controller. There are three switch banks on the 7515 PCB, the bottom right-most bank is used to set the terminal device address. Set these switches as follows:

Number of Switch Settings*						<u>Device Address</u>
<u>Terminals</u>	<u>Sw1</u>	<u>Sw2</u>	<u>Sw3</u>	<u>Sw4</u>	<u>Sw5</u>	
One	1	0	0	0	0	00 ₁₆
Five**	1	0	0	1	0	40 ₁₆
Nine***	1	0	0	0	1	80 ₁₆

* 0 = OFF; 1 = ON. Sw1 is the Terminal Enable, it is always set to 1; Sw2 - Sw5 are the Terminal Device Address Switches.

** One 2236MXD; One 22C32 (MVP System only)

*** Two 2236MXDs; One 22C32 (MVP System only)

SECTION

6

PREVENTIVE

MAINTENANCE AND

ADJUSTMENTS

SECTION 6

PREVENTIVE MAINTENANCE AND ADJUSTMENTS

This section describes preventive maintenance and adjustment procedures for the 2336DW terminal.

6.1 PREVENTIVE MAINTENANCE

6.1.1 GENERAL

Preventive Maintenance should be performed on a regular semi-annual basis to help prevent terminal equipment failures. The suggested plan for the performance of preventive maintenance follows.

6.1.1.1 Cleaning

Remove power from the terminal and clean as follows:

- a. Dust keyboard with a soft-bristled brush.
- b. Clean the CRT screen, using a good quality glass cleaner and a soft, lint-free cloth.
- c. Wipe exterior of terminal, using a damp lint-free cloth.

6.1.1.2 Checks and Adjustments

- a. Check and adjust the terminal power supply voltages, as described in section 6.2.1.
- b. Check and adjust the CRT display voltages, as described in section 6.2.2.
- c. Check for proper character display. Perform the Video Display Alignment Procedure (section 6.2.3), as required.

6.2 GENERAL MAINTENANCE

General maintenance and adjustment procedures are discussed in this section.

6.2.1 POWER SUPPLY VOLTAGE CHECKS

WARNING

```

*****
*
* DO NOT OPEN THE SWITCHING POWER SUPPLY UNDER ANY
* CIRCUMSTANCE. EXTREMELY DANGEROUS VOLTAGE AND
* CURRENT LEVELS (IN EXCESS OF 300 VOLTS DC AND UN-
* LIMITED CURRENT) ARE PRESENT WITHIN THE POWER SUPPLY.
*
* DO NOT ATTEMPT TO REPAIR THE SWITCHING POWER
* SUPPLY; IT IS FIELD REPLACEABLE ONLY.
*
* AFTER POWERING THE UNIT DOWN AND DISCONNECTING THE AC
* POWER PLUG FROM THE WALL OUTLET, ALLOW ONE MINUTE
* BEFORE REMOVING THE POWER SUPPLY TO PROVIDE ADEQUATE
* TIME FOR ANY RESIDUAL VOLTAGE TO DRAIN THROUGH THE
* BLEEDER RESISTORS.
*
*****
    
```

Only the +5v and +12v dc levels are adjustable in this power supply. The -12v and the +22v levels are not adjustable.

- a. Power off the 2336DW terminal.
- b. Disconnect the RS-232 cable from the rear of the terminal.
- c. Power on the 2336DW terminal.
- d. Using a digital voltmeter, check the pin 16 on the 25-pin RS-232 connector for +5v. Adjust the switching power supply for +5v as required.(figure 6-1)
- e. Using a digital voltmeter, check the pin 19 on the 25-pin RS-232 connector for +12v. Adjust the switching power supply for +12v as required.(figure 6-1)

Use connector RS-232 connector, pin 1 as a 0V reference. The power supply voltages should be within the ranges:

<u>Adjust</u>	<u>Voltage</u>	<u>Tolerances</u>
See fig. 6-1	+5v	+4.9 V to +5.1v
See fig. 6-1	+12v	+11.8 V to +12.2v
NOT ADJUSTABLE	-12v	-11.8 V to -12.2v

6.2.2 PCB 7456 CRT DISPLAY VOLTAGE CHECKS

NOTE

Test point A is the heavy etch located at the upper end (furthest from the board connector) of resistor R7 (33 ohm, 1W).

- a. Adjust the +12v regulated voltage to $+12v \pm 0.1v$ on the power supply (figure 6-1). Use a DVM to check test point A on PCB 210-7456, with pin D, E, or F on the board and L1-1 as $\pm 0v$ ground references (figure 6-2).

CAUTION

Use a non-metallic standard tuning wand when adjusting dynamic focus coil Z1

- b. Adjust the Dynamic Focus Coil (Z1) to register an amplitude of 300v ac peak-to-peak on an oscilloscope, using pin M as a test point (figure 6-2).

6.2.3 PCB 7456 VIDEO DISPLAY ALIGNMENT PROCEDURE (figure 6-2)

- a. Remove the front panel from the CRT module to gain access to the 7456 PCB adjustment pots. To do this, remove the two screws securing the panel to the CRT base.
- b. Set both Horizontal hold (R33) and Vertical hold (R15) to the middle of the stable display range.
- c. Adjust the vertical size (R24) for a vertical height of 6.5 inches (16.5 cm) on the 12" display. (Use a standard or metric scale.)
- d. Adjust the vertical linearity (R18) for character rows of equal height.
- e. Repeat c and d until both requirements are met.
- f. Adjust the width coil (Z2) for 8 inches (20.3 cm) of horizontal deflection on the 12" display. (Use standard or metric scale.)
- g. Adjust the horizontal phasing (R35) for characters centered horizontally on the raster. (Turn up the brightness sufficiently to observe the raster frame.)
- h. Adjust the focus (R28) for the best overall screen display.
- i. Replace the CRT front panel.

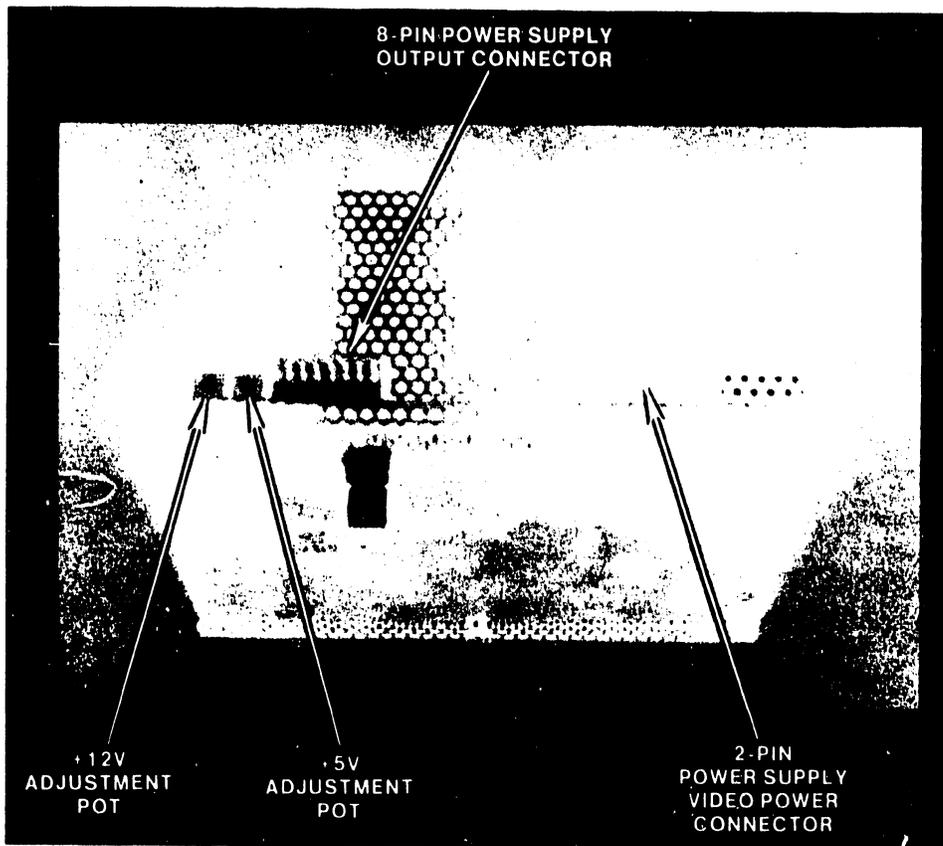


FIGURE 6-1 SWITCHING POWER SUPPLY VOLTAGE ADJUSTMENTS

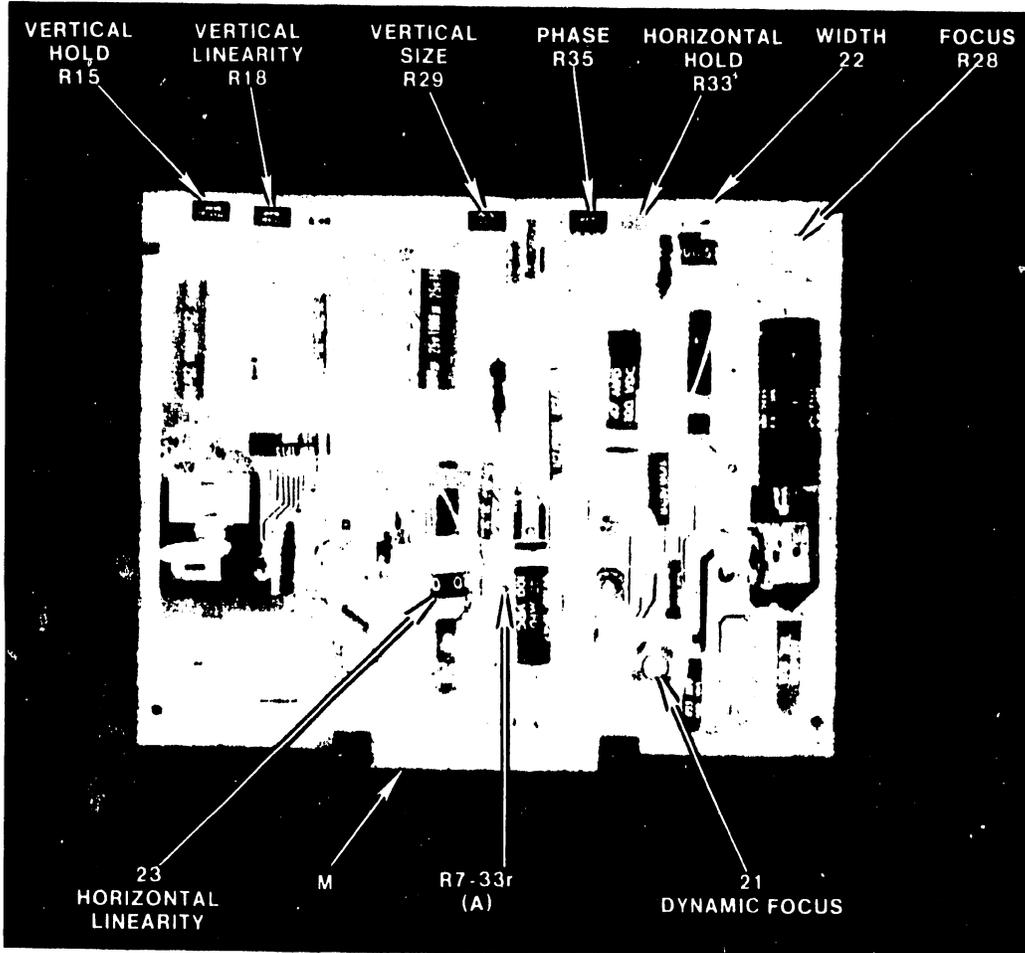


FIGURE 6-2 PCB 7456 CRT DISPLAY ADJUSTMENTS

SECTION

7

**TROUBLESHOOTING
AND DIAGNOSTICS**

SECTION 7

TROUBLESHOOTING AND DIAGNOSTICS

7.1 TROUBLESHOOTING

7.1.1 GENERAL

Effective troubleshooting is carried out from a system viewpoint. No procedure can list every potential problem or combination of problems for even a very simple device. Use the troubleshooting chart and supplementary information provided in this section as an aid in the systematic investigation, diagnosis, and repair of the 2336DW.

NOTE

When using the troubleshooting flowchart, procedures that indicate a check process will require either replacing the item being checked or going on to the next procedure.

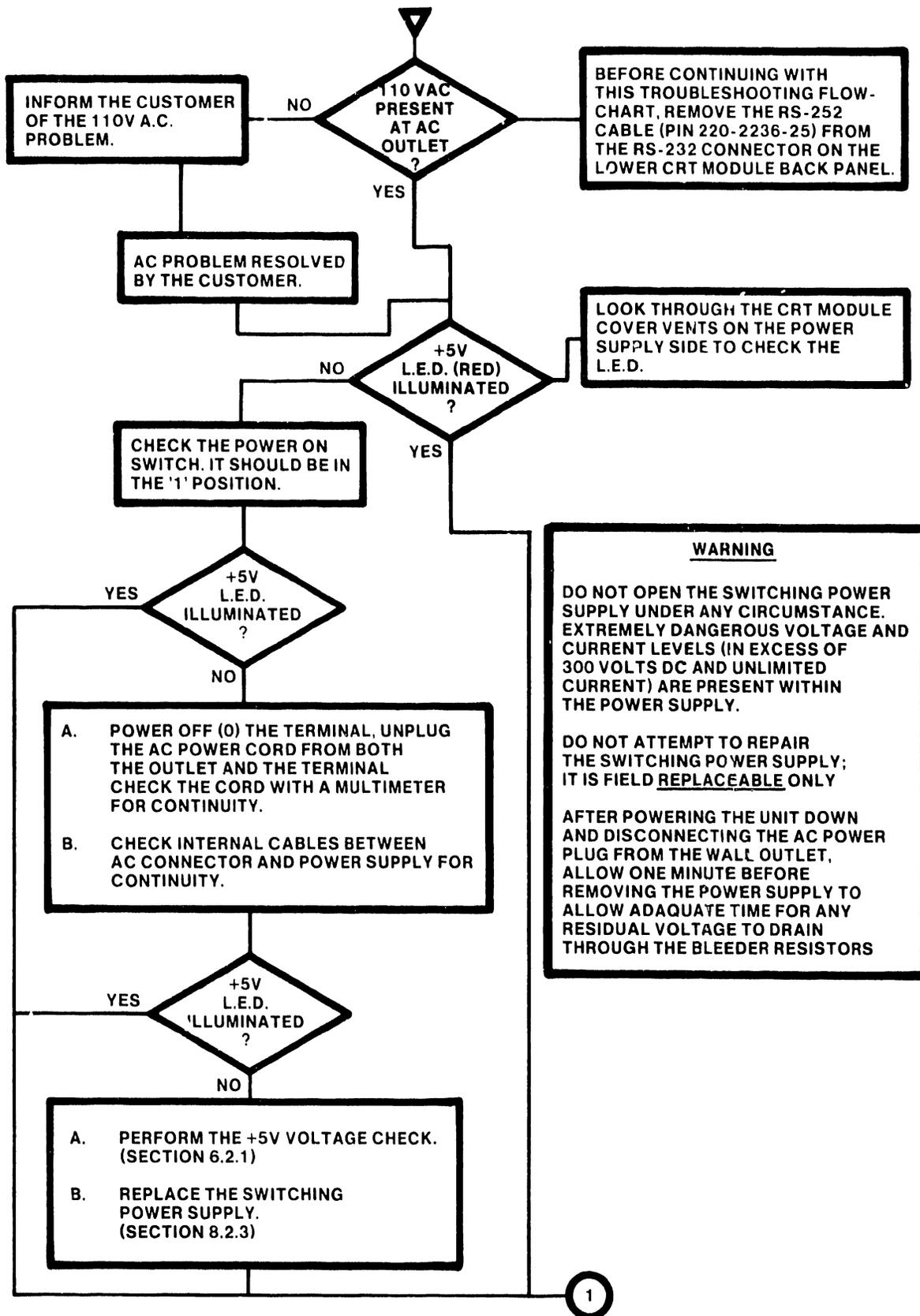


FIGURE 7-1 2336DW TROUBLESHOOTING FLOWCHART (SHEET 1 OF 3)

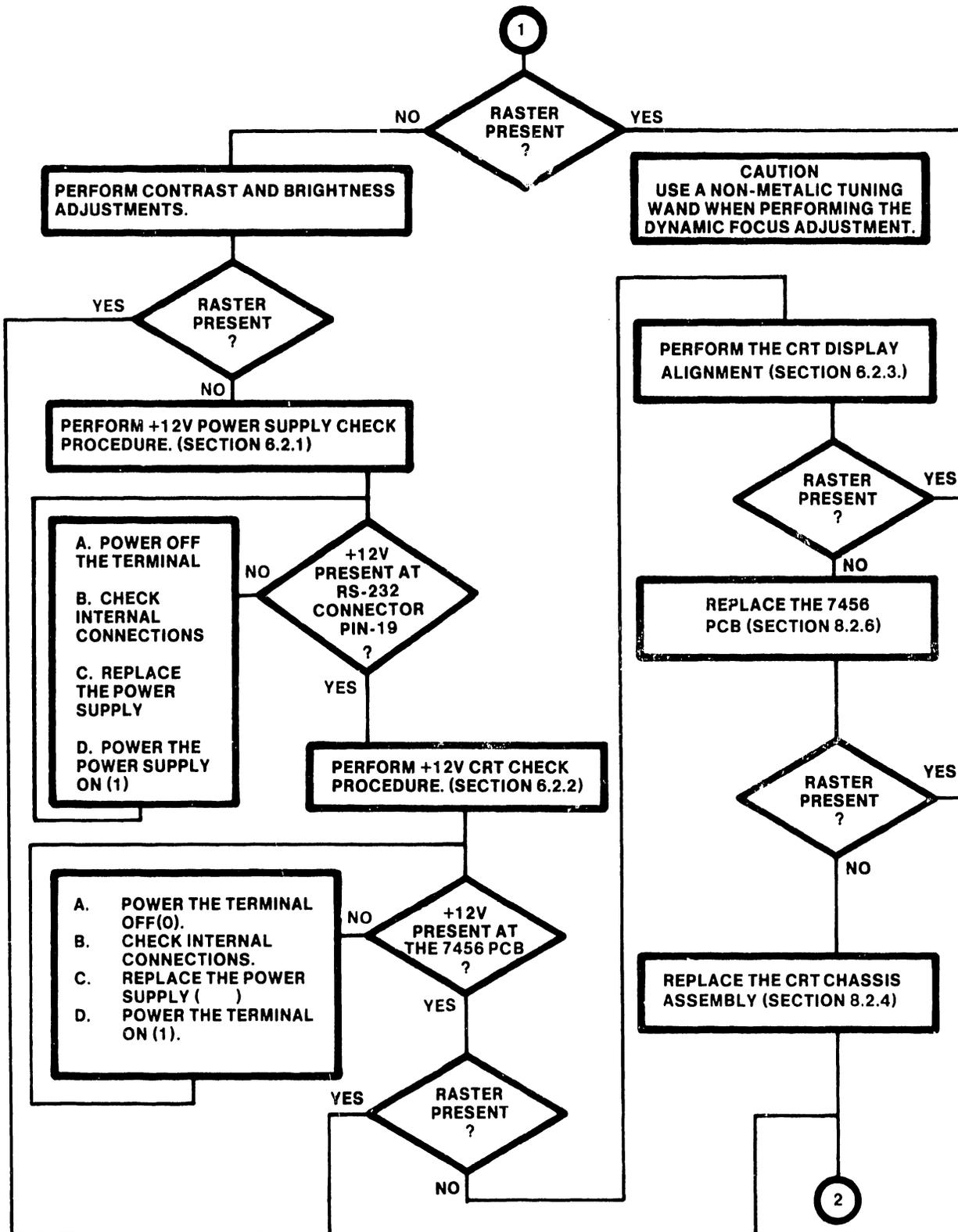


FIGURE 7-1 2336DW TROUBLESHOOTING FLOWCHART (SHEET 2 OF 3)

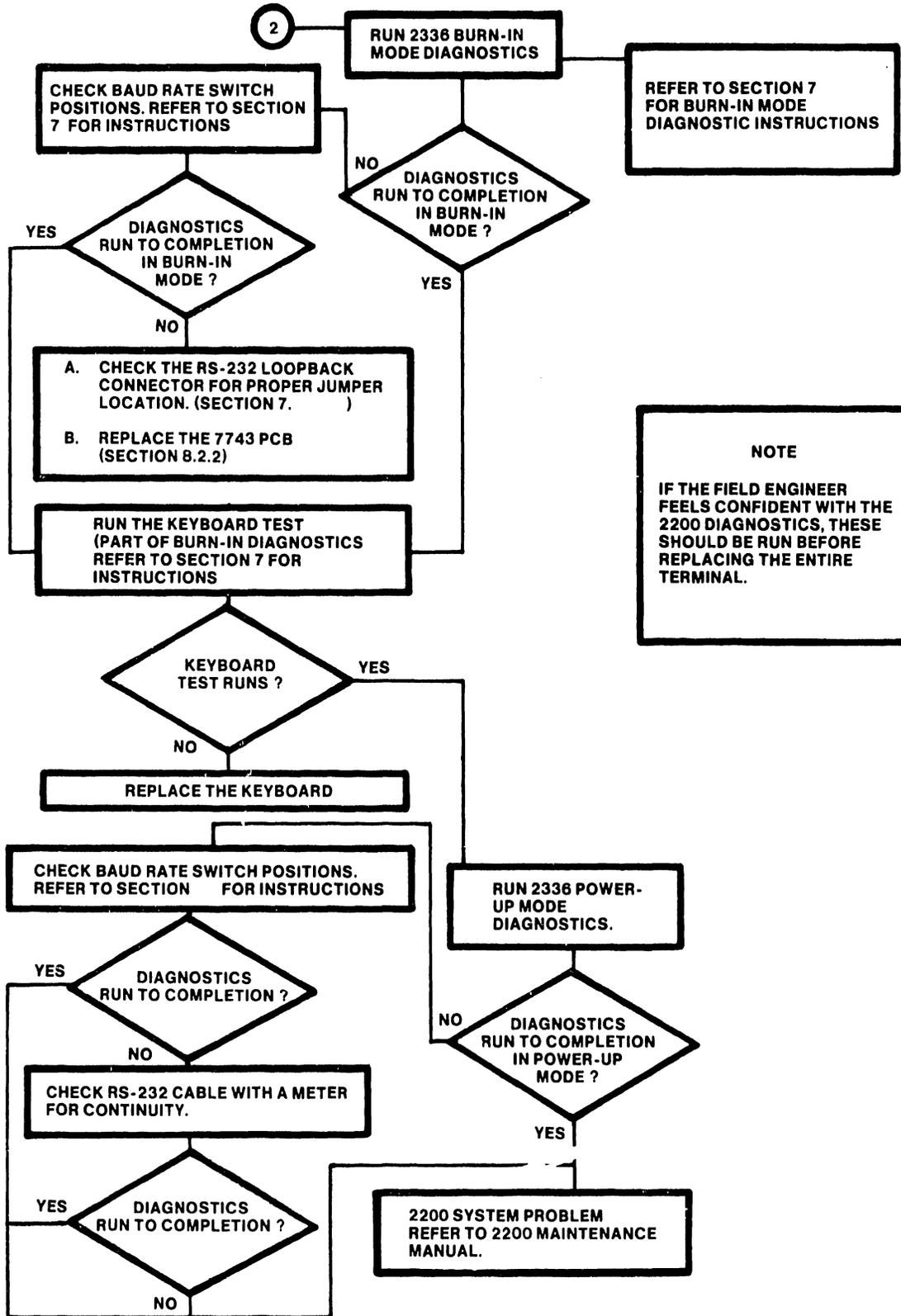


FIGURE 7-1 2336DW TROUBLESHOOTING FLOWCHART (SHEET 3 OF 3)

7.2 POWER-UP AND BURN-IN DIAGNOSTICS

7.2.1 DESCRIPTION

7.2.1.1 Power-up Mode

The diagnostic performs a power-up test and transfers control to the terminal system code.

In the power-up mode, baud rate switches set for 19.2k, ten tests are performed on the terminal before releasing the terminal to the system.

The first test consists of an A register and I register check to test the Z-80 for proper power-up conditions. The next test, after the initialization of VTAC, writes into and reads from the VTAC to insure proper addressing, voltages etc. Then the same tests are run on the PIO before initialization to insure the proper power-up state. Next, the final Z-80 register checks are performed on all foreground and background registers to test for shorts and opens. If the Z-80 or the VTAC fail, the terminal will appear inoperable. If any error occurs an attempt will be made to sound an alarm and display an error message on the screen. The next test is a PROM checksum calculation. The first and second PROMS are mathematically checked for data or addressing errors. If either PROM fails, an audible beep will be sounded and an error message will be displayed on the screen. Next, a RAM check is performed on the main RAM and the attribute IAM to detect shorts and/or opens in the data and addressing lines. If an error occurs, an audible beep is sounded and the failing address is displayed on the screen. The seventh, eighth ninth and tenth tests are performed on the CTC to verify addressing, counter, timer, interrupt and data line capabilities.

7.2.1.2 Burn-in Mode

If the baud rate switches are all switched to the ON (up) position and a loopback connector is installed, the burn-in tests will be performed. In the burn-in mode, the PROM, RAM and CTC tests are performed along with a UART and PIO keyboard test.

The UART test checks the status register for power-up conditions of the UART and then by transmit and receive patterns the UART is tested for functionality.

If the operator presses the lower case "s" on the keyboard, the keyboard test will be initiated. This test is a visual check of the keys on the keyboard. As each key is pressed, its key coordinates, and its upper or lower case state are displayed in the center of the display.

Example:

Lower Case "s" = Hex Code 31 or L31 for lower case

The operator must press the RESET key (unshifted) to return to the burn-in mode. When the RESET key is pressed, the burn-in resumes with the PROM checksum test.

7.2.2 LOAD PROCEDURE

The load procedure for the system code and diagnostic test is automatically accomplished by turning the 2336DW terminal power ON(1).

7.2.3 OPERATING PROCEDURES

After turning the power ON(1), the operator has several options and modes of operation to choose from.

MODE 1: Power-up for system operation

The operator will power-up the terminal. Then the diagnostic will perform its checks and pass control to the terminal microcode. The microcode will display the terminal type, baud rate and word length state.

The operator must depress the shifted RESET key to obtain control of the 2200 system.

MODE 2: Power-up and Screen alignment with abort to system operations

Power-up must be performed as in MODE 1 except special function key "13" must be depressed at power-up to obtain the alignment pattern on the screen. When the alignment has been completed, the operator must depress the special function key '15' to return to system code.

MODE 3: Power-up and Burn-in mode

Power-up is performed as in MODE 1 with all the baud rate switches, located at the lower rear of the terminal, in the ON (up) position.

MODE 4: Power-up or Burn-in with loop on error capability

Select the proper baud rate switch settings for either Power-up or Burn-in mode (section 7.2.1). If an error has been detected in Power-up or Burn-in modes and the operator wishes to loop on the error to check the signals being generated by the test in error; perform power-up as in MODE 1 then depress special function key '14'.

MODE 5: Power-up and diagnostics abort function

The operator must power-up as explained in MODE 1. When an error is detected he/she may abort the error by depressing special function key '15'. This operation should only be used if the operator determines the error will not cause fatal errors in data or operation.

7.2.4 ERROR CODE DEFINITIONS

TEST NAME	ERROR CODE	FAILING MODULE or DESCRIPTION
Z80-REG.	01	Z-80 A,I Register Failure
UART P-UP	02	UART Power-up State Failure
VINIT	03	VTAC Power-up Failure
PIOINIT	04	PIO Power-up Failure
Z-80 REG.	05	Z-80 Reg. Flag Register Failure
Z-80 REG.	06	Z-80 Reg. Foreground and Prime Failure
PROM CHECK	07	PROM Checksum Failure
RAM TEST	08	Main, Char. or Cont. RAM Failure
CTC REG.	09	CTC Reg. Read/Write Failure
CTC T/CNT	09	CTC Timer Counter Failure
CTC INT.	09	CTC Interrupt Failure
CTC HOR.	09	CTC Vert. Sweep Sync Failure
UART	10	UART Trans. Not Ready
UART	11	UART Rec. Not Ready
UART	12	Transmit Error
UART	13	Rec. Not Ready
UART	14	Receiver Error
UART	15	CTC Trans. Ready Counter Failure
UART	16	CTC Rec. Ready Counter Failure
UART	17	UART Error Set
UART	18	Overrun Cleared

7.2.5 LOOPBACK CONNECTOR

The loopback connector is a standard RS-232C male connector with the following pins wired together:

- 2 to 3
- 4 to 5
- 6 to 20

7.2.6 KEYBOARD COORDINATE HEX CODES

KEYCAP	CODE	KEYCAP	CODE
INDENT	01	LOCK	NO CODE
PAGE	02	SHIFT	NO CODE
CENTER	03	A	30
DEC TAB	04	S	31
FORMAT	05	D	32
MERGE	06	F	33
NOTE	07	G	34
STOP	08	H	35
SRCH	09	J	36
REPLC	0A	K	37
COPY	0B	L	38
MOVE	0C	;	39
COMMAND	0D	'	3A
ARROW	0E	RETURN	3B
Blank Key	0F	Z	40
GO TO PAGE	6E	X	41
CANCEL EDIT	6D	C	42
1	11	V	43
2	12	B	44
3	13	N	45
4	14	M	46
5	15	,	47
6	16	.	55
7	17	/	48
8	18	SPACE BAR	53
9	19	EXECUTE	2C
0	1A	INSERT	1D
-	50	PREV SCR N	1E
=	1B	DELETE	2D
BACKSPACE	54	NEXT SCR N	2E
TAB	10	UP ARROW	56
Q	20	DOWN ARROW	57
W	21	RIGHT ARROW	51
E	22	LEFT ARROW	52
R	23	ERASE	67
T	24	HALT	66
Y	25	RETURN	63
U	26	[	6C
I	27	D TAB RCALL	6B
O	28	KEYPAD 7	2F
P	29	KEYPAD 8	6A
]	2A	KEYPAD 9	69
GL	2B	KEYPAD 4	3E
KEYPAD 5	3F	KEYPAD 6	68
KEYPAD 1	4E	KEYPAD 3	4F
KEYPAD 0	4B	KEYPAD 2	4D

SECTION

8

REMOVAL

AND

REPLACE-

MENT

SECTION 8

REMOVAL AND REPLACEMENT

8.1 GENERAL

This section contains removal and replacement procedures for several major 2336DW assemblies. Before removing a particular assembly, ensure that the power switch is OFF and the ac power cord is unplugged. Remove the CRT display module cover as described in section 3.1. Refer to section 9 (Illustrated Parts Breakdown) for parts location and identification.

WARNING

Before performing any of the CRT procedures in this section, discharge the CRT anode. Even with power removed, the terminal cathode ray tube can hold a charge of several thousand volts. To eliminate the risk of accidental CRT discharge, which can result in serious injury, discharge the CRT anode as follows:

8.2 REMOVAL AND REPLACEMENT PROCEDURES

8.2.1 CRT DISCHARGE PROCEDURE

- a. Attach one end of a length of insulated wire to the metal shaft of a plastic-handled, heavy-duty screwdriver.
- b. Attach the other end of the wire to CHASSIS GROUND.
- c. Using a non-conductive tool such as a plastic alignment tool, carefully raise the edge of the rubber anode cap high enough to insert the screwdriver.
- d. Taking care not to touch the metal shaft of the screwdriver or any metal part of the terminal, discharge the CRT anode by touching the anode clip with the grounded screwdriver.
- e. After discharging the CRT, remove the grounding wire and reseal the rubber anode cap.

8.2.2 7743-A PCB

Removal

- a. Turn the 2336DW on its side so that the underside of the base is accessible.
- b. Remove the four phillips screws and rubber feet from the base.
- c. Remove the metal screen from the base, thus exposing the 7743 PCB.
- d. Gently pull the 7743 PCB/Rear Panel assembly away from the base until the connectors are accessible.
- e. Unplug the 9-pin power supply and 3-pin video connectors.
- f. Remove the 7743 PCB/Rear Panel assembly.

Replacement

To replace the CRT Chassis Assembly, reverse the above procedure.

WARNING

```

*****S*****
*
* DO NOT OPEN THE SWITCHING POWER SUPPLY UNDER ANY *
* CIRCUMSTANCE. EXTREMELY DANGEROUS VOLTAGE AND *
* CURRENT LEVELS (IN EXCESS OF 300 VOLTS DC AND UN- *
* LIMITED CURRENT) ARE PRESENT WITHIN THE POWER SUPPLY. *
*
* DO NOT ATTEMPT TO REPAIR THE SWITCHING POWER *
* SUPPLY; IT IS FIELD REPLACEABLE ONLY. *
*
* AFTER POWERING THE UNIT DOWN AND DISCONNECTING THE AC *
* POWER PLUG FROM THE WALL OUTLET, ALLOW ONE MINUTE *
* BEFORE REMOVING THE POWER SUPPLY TO PROVIDE ADEQUATE *
* TIME FOR ANY RESIDUAL VOLTAGE TO DRAIN THROUGH THE *
* BLEEDER RESISTORS. *
*
*****

```

8.2.3 SWITCHING POWER SUPPLY

Removal

- a. Unplug the 8-pin power output connector from the top of the switching power supply.
- b. Unplug the 2-pin CRT power connector from the top of the switching power supply.
- c. Disconnect the two top internal AC input wires (blue and brown) from the AC switch.

- d. Remove the three philips screws, washers and posts that secure the power supply to the CRT chassis assembly.
- e. Remove the power supply.

Replacement

To replace the power supply, reverse the above procedure.

8.2.4 CRT CHASSIS ASSEMBLY

Removal

- a. Follow the procedures described in section 5.2.2 to remove the switching power supply.
- b. Remove the two (3/16") hex head mounting screws and washers that secure the rear of CRT to the support posts. Loosen the two (3/16") hex head screws and washers that secure the front of the CRT to the support posts.
- c. Slide the chassis (1/4") forward; lift chassis out of terminal and place on a flat surface.
- d. Take off the CRT bezel by removing the four mounting screws (two on each side).

Replacement

To replace the CRT Chassis Assembly, reverse the above procedure.

8.2.5 CRT REAR PANEL ASSEMBLY

Removal

- a. Remove the two 1/4-inch nuts and washers that secure the rear panel to the CRT chassis.
- b. Remove the black grounding wire.
- c. Remove the rear panel.

Replacement

To replace the CRT rear panel assembly, reverse the above procedures.

8.2.6 7456 CRT ELECTRONICS PCB

Removal

- a. Remove two screws, one from each side of front base plate.
- b. Grasp the CRT 7456 PCB and remove it from the CRT chassis.

Replacement

To replace the CRT PCB, reverse the above procedure.

SECTION

9

ILLUSTRATED

PARTS

BREAKDOWN

SECTION 9

ILLUSTRATED PARTS BREAKDOWN

9.1 INTRODUCTION

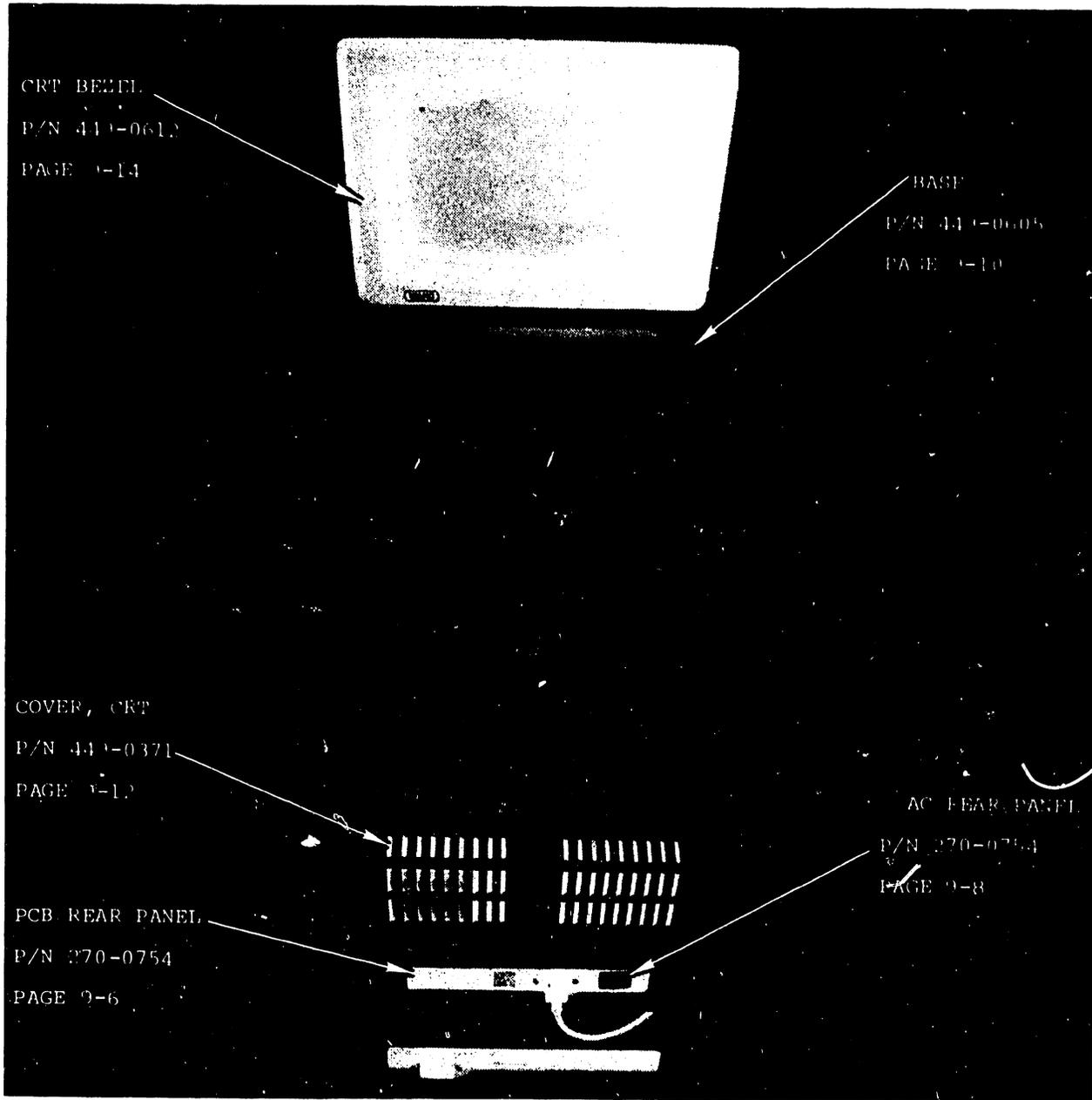
This section contains the illustrated parts breakdown for the 2336DW terminal. Use this IPB to identify parts during removal/replacement, alignment, adjustment, when troubleshooting or performing PM, or when ordering parts. The chart below shows the title and parts list page number for each sub-assembly in this section. The PCB parts breakdown is located in appendix C (schematics). Each schematic contains its own component layout and part number listing.

The locator on pages 9-2 and 9-3 provides a quick method for identifying sub-assemblies.

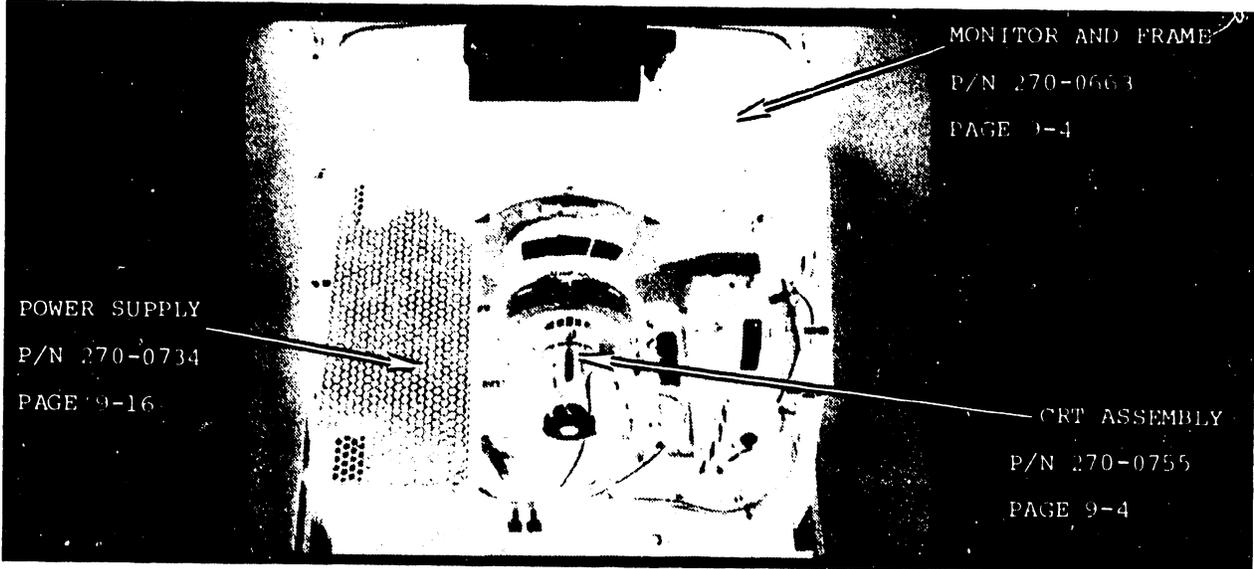
NOTE

Items that are included on the RSL are highlighted with an asterisk (*) in the IPB.

SUB-ASSEMBLY	PAGE NUMBER
2336 PARTS LOCATOR	9-2
CRT Assembly	9-4
PCB Rear Panel	9-6
AC Rear Panel	9-8
Base	9-10
Cover	9-12
Bezel	9-14
Power Supply	9-16
Other	9-18



2336 PARTS LOCATOR



OTHER COMPONENTS - PAGE 9-18

2336 PARTS LOCATOR

CRT ASSEMBLY(270-0755)

NOTE

Components of the CRT assembly not called out on the list below,
are shown under the heading Hardware Not Shown.

LOCATION	PART NUMBER	DESCRIPTION
	270-0633	Monitor and Frame *
1	340-0108	12"CRT *
2	210-7456	PCA 12" Mon. Elec.
3	451-5055	Bracket, connector
4	452-2198	Plate,LH CRT Chassis
5	452-2199	Plate,RH CRT Chassis
6	458-1043	Support,CRT
7	350-2073	Anode Connector
8	270-3177	Flyback Trans. Harn.
9	220-1580	Wire & Lug Assemb.
10	270-3092	Yoke Assemb. 12" Mon
11	270-3171	CRT Harn. Assemb.
12	380-3011	Diode,Rect., 20KV
13	449-0499	Bushing
14	449-0500	Spacer
15	449-0501	Rack, detent
16	452-0210	Plate,Spacer Adj.
17	465-1643	Spring,grounding
18	465-1755	Extension spring
19	465-1756	Spring,plunger
20	452-4125	Guide,card
21	462-0023	Spacer
22	650-2081	SCR4-40x1/4Phil,FHD.
23	651-0037	SCR#8x3/8,HX,HD,ST
24	651-0053	SCR,TRAP#10x3/8,HXHD
25	651-0054	SCR,#4-24x1/2,HXHD
26	652-3004	Nut 6-32,Hex,SM,SS
27	653-3001	Washer#6 .150x.288
28	653-6001	Washer#10
HARDWARE NOT SHOWN		
RFI Plate	650-3129	SCR 6-32x3/8 Whiz
	458-1171	RF Plate
RFI Plate	652-0032	Nut #6
	452-2700	Clips, Hold-down
H.D. Clip	651-0037	SCR 8x3/8 Self-tap
	449-0367	Knobs, Adjustment
Knob,Adj.	650-2043	SCR 4-4-x3/8 Set

PCB REAR PANEL (270-0753)

NOTE

Components of the PCB rear panel assembly not called out on the list below, are shown under the heading Hardware Not Shown.

LOCATION	PART NUMBER	DESCRIPTION
1	452-2287	Panel, Logic Board
2	451-4981	Bracket, Mounting
HARDWARE NOT SHOWN		
	654-0530	Terminal, Lug, Male
	651-0478	Rivet, Domed, Pull
KB/Print	651-0027	SCR, 4x3/8, Self Tap
RS-232	650-2120	SCR, 4-40x3/8 Pan Hd.
RS-232	652-2005	Nut, #4
	462-0518	Spacer, Stand Off

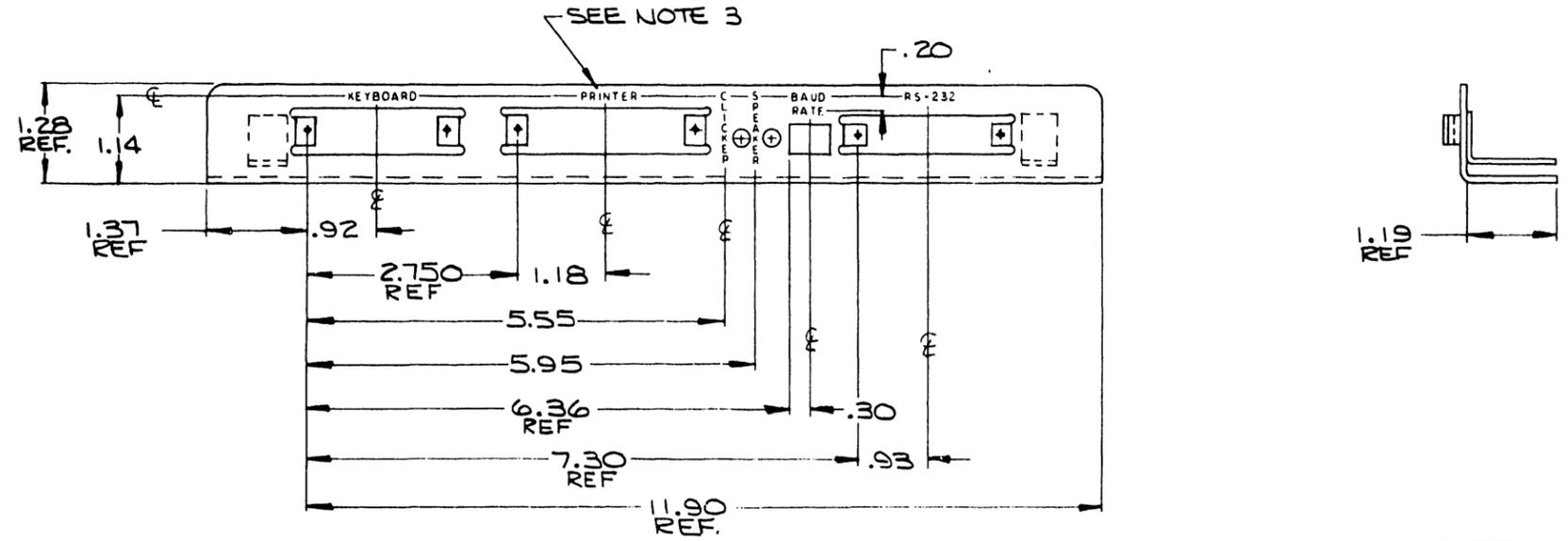
11 10 9 8 7 6 5 4 3 2 1

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G MILLIMETERS IN PARENTHESIS TOLERANCES TO BE EQUIVALENT TO INCH DIMENSIONS

HOLE LEGEND & TOLERANCES		
HOLE DIA	TOLERANCE	
.015 - .125	+ .003 - .001	
.125 - .250	+ .004 - .001	
.251 - .500	+ .005 - .001	
SIZE	DESCRIPTION	QTY

- NOTES:
1. DEBURR & BREAK ALL SHARP EDGES.
 2. INSIDE BEND RAD. TO BE .06 UNLESS OTHERWISE SPECIFIED.
 3. NOMENCLATURE TO BE 10 PT (.10 HIGH) HELVETICA REGULAR, UPPER CASE LETTERING CENTERED ON Φ 'S SHOWN, SILKSCREEN WANG OYSTER WHITE.



REV	DATE	BY	DESCRIPTION
1	10/11/74	ASB/PEL	DWG 2474

QTY	ITEM	WANG PART NO.	DRAWING NO.	DESCRIPTION	BY	DATE	APPROVED BY	DATE
2	2			BOX, PANEL				
1	1			PANEL, LOGIC BOARD				
NEXT ASSY:				DWG: <i>J. Rankin</i> 3-4-82 CHK: <i>J. Rankin</i> 3/4/82 M ENGR: <i>J. Rankin</i> 3-4-82				
MATERIAL		MODEL NO. LOW COST DW		TITLE				
SEE SHT 2		SEE ENGR. SPECIFICATIONS #. ES-1001		PANEL, LOGIC BOARD (SILKSCREEN)				
FINISH BLACK ZINC (CONDUCTIVE)		TOL. EX. AS NOTED XX ± .010 FRAC ± 1/64 XXX ± .005 ANG ± 1° 30' FINISH		452-2287-XA		D 10101-5006 A		
SCALE: 1:1		SHT 1 OF 2		WANG PART NUMBER		DRAWING NUMBER		REV
		900S-10101 D						

11 10 9 8 7 6 5 4 3 2 1

A.C. REAR PANEL (270-0754)

NOTE

Components of the A.C. rear panel assembly not called out on the list below, are shown under the heading Hardware Not Shown.

LOCATION	PART NUMBER	DESCRIPTION
1	451-3164	Panel, A.C.
HARDWARE NOT SHOWN		
	325-0059	Switch, Rocker
	220-1755	Cable, A.C. Recep.
	220-1828	Cable, A.C. Switch
	650-3120	SCR, 6-32x3/8
	652-0032	Nut, #6

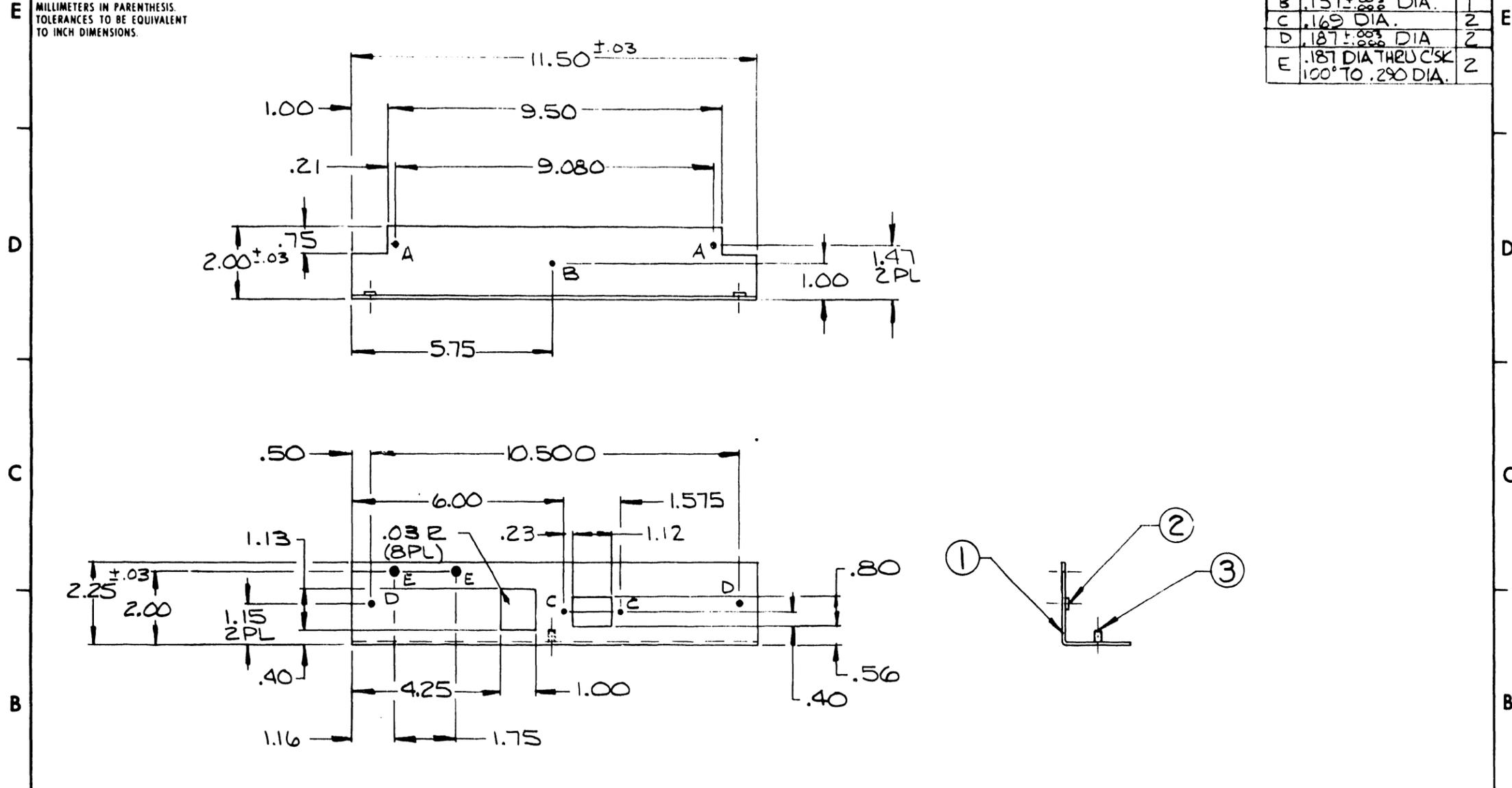
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MILLIMETERS IN PARENTHESIS. TOLERANCES TO BE EQUIVALENT TO INCH DIMENSIONS.

NOTES:

1. DEBURR & BREAK ALL SHARP EDGES.
2. INSIDE BEND RAD. TO BE .06.

HOLE LEGEND & TOLERANCES		
HOLE DIA	TOLERANCE	
0.135 - .125	+ .003 / - .001	
.126 - .250	+ .004 / - .001	
.251 - .500	+ .005 / - .001	
SYM	DESCRIPTION	QTY
A	.187 DIA.	2
B	.137 ± .003 DIA.	1
C	.169 DIA.	2
D	.187 ± .003 DIA.	2
E	.187 DIA THROUGH SK	2
	100° TO .290 DIA.	



REV	BY	DATE	DESCRIPTION
1	DWE	2-17-80	GEN PER DWE #2474

QTY	ITEM	WANG PART NO.	DRAWING NO.	DESCRIPTION
3		651-1048		STUD CLINCH, PEM #FH-632-621 (SEE "B" HOLE)
2		652-0891		NUT CLINCH, PEM #S-632-221 (SEE "D" HOLES)
1				PANEL, A.C.

BY	DATE	APPROVED BY	DATE
DWN J.B. 7/2-4-82		E ENGR	
CHK R. J. 2-12-80		M ENGR	3-4-82
		MFG ENGR	

WANG LABORATORIES, INC. LOWELL MASS U.S.A.	MODEL NO. LOW COST DW	TITLE. PANEL, A.C.
.06 THK CRS 1018	SEE ENGR SPECIFICATIONS No. ES-1001	451-3164-XA C 10101-5005 A
FINISH BLACK ZINC (CONDUCTIVE)	TOL. EX. AS NOTED XX = 010 FRAC ± 1/64 XXX = 005 ANG ± 1'30" FINISH V	WANG PART NUMBER SIZE DRAWING NUMBER REV

5005-10101 C

BASE (449-0605)

NOTE

Components of the base assembly not called out on the list below, are shown under the heading Hardware Not Shown.

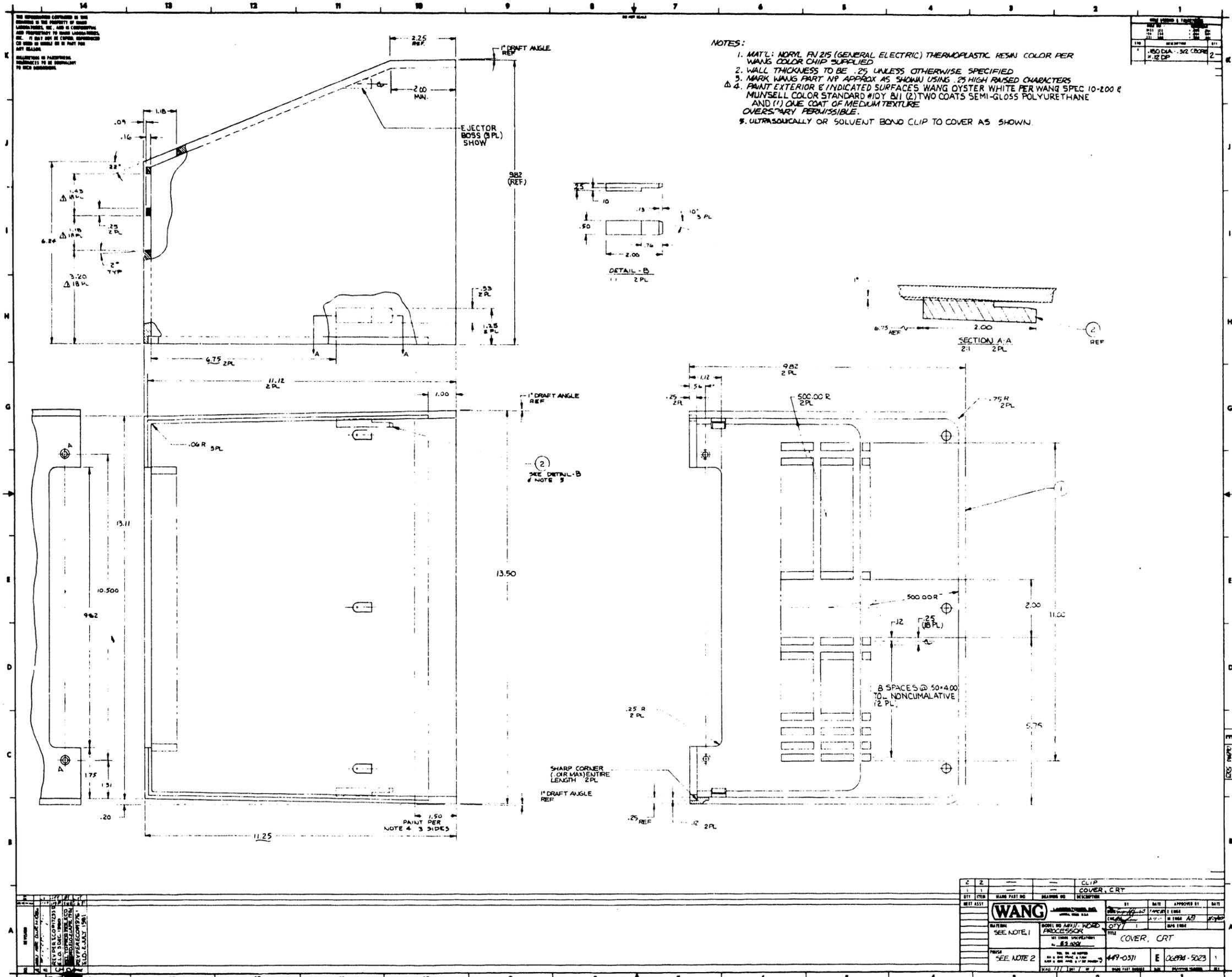
LOCATION	PART NUMBER	DESCRIPTION
HARDWARE NOT SHOWN		
	449-0605	Base, CRT
Base	220-1827	Cable, Video Ext.
Base	458-2034	Screen, Base
Base	655-0202	Feet, Base
Base	650-4160	SCR, 8-32x1/2

COVER (449-0371)

NOTE

Components of the cover assembly not called out on the list below, are shown under the heading Hardware Not Shown.

LOCATION	PART NUMBER	DESCRIPTION
HARDWARE NOT SHOWN		
	449-0613	Cover, Front
	449-0371	Cover, CRT
Cover CRT	650-3160	SCR, 6-32x1/2
Cvr Base	650-4243	SCR, 8-32x3/4



ALL DIMENSIONS UNLESS OTHERWISE SPECIFIED TO BE IN MILLIMETERS TO THE NEAREST .01 MM. DIMENSIONS TO THE PROPERTY OF WANG LABORATORIES, INC. AND IS CONFIDENTIAL AND PROPRIETARY TO WANG LABORATORIES, INC. IT MAY NOT BE COPIED, REPRODUCED OR USED IN ANY MANNER WITHOUT THE WRITTEN PERMISSION OF WANG LABORATORIES, INC.

- NOTES:
1. MAT'L: NYLON FN 215 (GENERAL ELECTRIC) THERMOPLASTIC RESIN COLOR PER WANG COLOR CHIP SUPPLIED
 2. WALL THICKNESS TO BE .25 UNLESS OTHERWISE SPECIFIED
 3. MARK WANG PART NO APPROX AS SHOWN USING .25 HIGH RAISED CHARACTERS
 4. PAINT EXTERIOR & INDICATED SURFACES WANG OYSTER WHITE PER WANG SPEC 10-200 & MUNSSELL COLOR STANDARD #10Y 8/1 (2) TWO COATS SEMI-GLOSS POLYURETHANE AND (1) ONE COAT OF MEDIUM TEXTURE OVERSTAIN PERMISSIBLE
 5. ULTRASONICALLY OR SOLVENT BOND CLIP TO COVER AS SHOWN.

REV	DESCRIPTION	DATE	BY
1	ISO DIA - 3/2 CROSS		
2	1/2 DIA		

REV	DESCRIPTION	DATE	BY
1	CLIP		
2	COVER, CRT		

WANG	LABORATORIES, INC.	1000 WASHINGTON BLVD	STAMFORD, CT 06904
MODEL NO. 2200	PROCESSOR	QTY 1	DATE 10/18/83
SEE NOTE 1	SEE NOTE 2	COVER, CRT	DATE 10/18/83
PRICE	449.0311	E	06/24/84 - 5023

11 10 9 8 7 6 5 4 3 2 1

AT 1000
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 MILLIMETERS IN PARENTHESIS TOLERANCES TO BE EQUIVALENT TO INCH DIMENSIONS

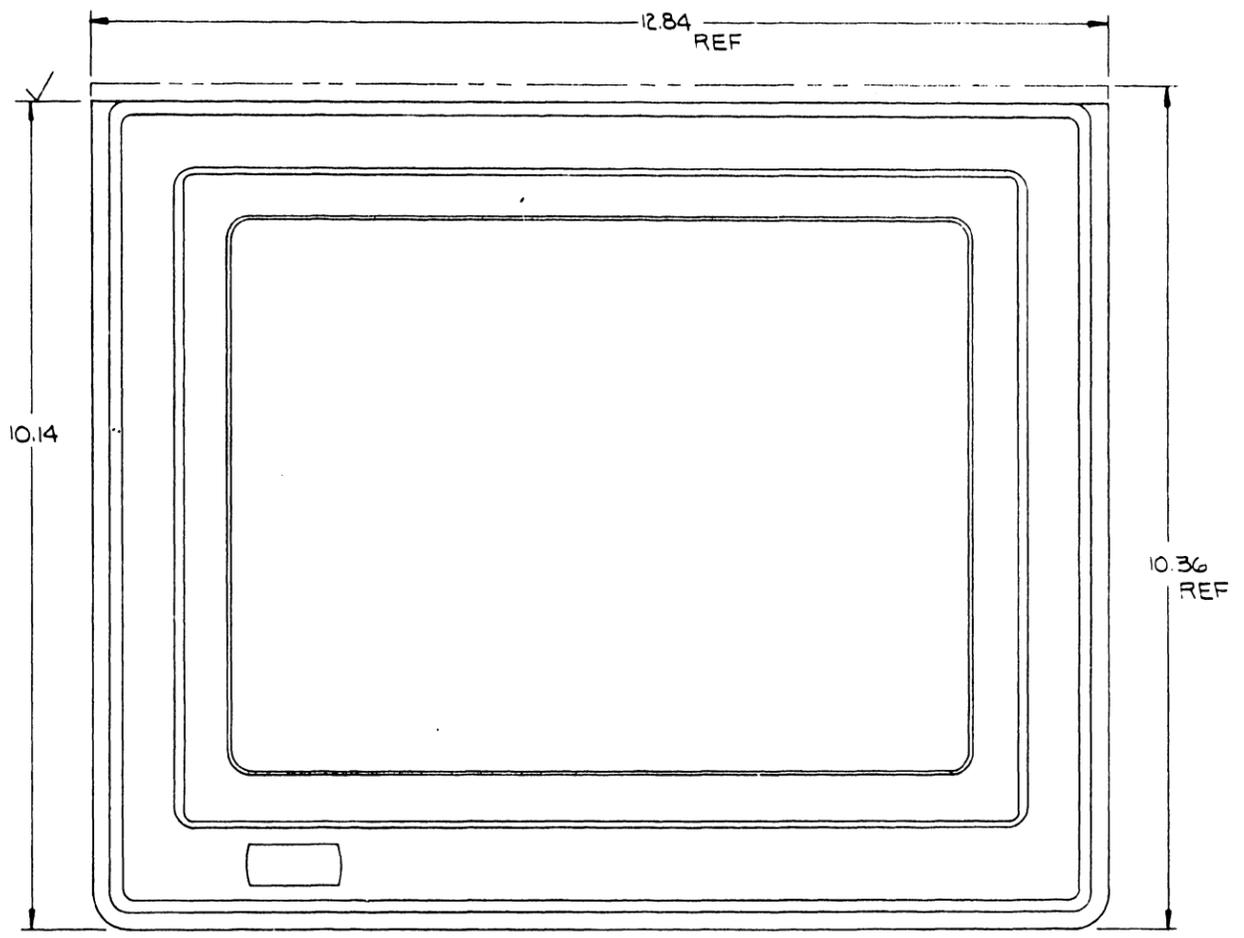
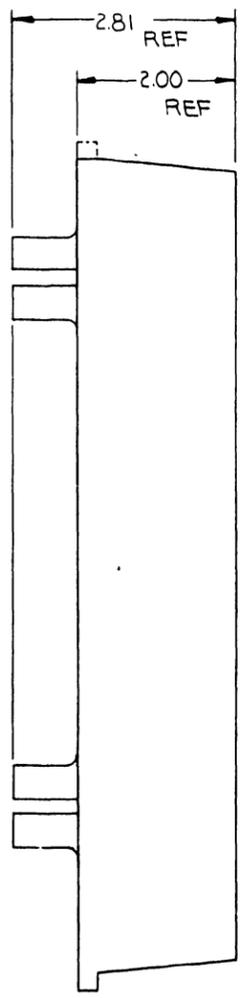
DO NOT SCALE

NOTES:
 1. MAT'L : MAKE FROM WPN# 449-0370, DWG NO. E06894-5039.
 2. PAINT MACHINED AREA PER WANG SPEC 10-200 USING CHARCOAL GREEN PER MUNSELL 10G 3.13/ 05 & (1) ONE FINAL COAT OF MEDIUM TEXTURE, OVERSPRAY PERMISSIBLE.

HOLE LEGEND & TOLERANCES			
HOLE DIA	TOLERANCE	QTY	BY
0.125	± 0.002	001	001
0.1875	± 0.002	001	001
0.250	± 0.002	001	001
0.3125	± 0.002	001	001
SYM	DESCRIPTION	QTY	BY
A			

G
F
E
C
B
A

G
F
E
C
B
A



REV	DATE	BY	DESCRIPTION	QTY	ITEM	WANG PART NO.	DRAWING NO.	DESCRIPTION	DATE	APPROVED BY	DATE
A			GENERATOR M-2569			WANG LABORATORIES, INC. LOWELL, MASS. U.S.A.			3-2-82	DWN HUDGINS ENGR	
						MATERIAL SEE NOTE 1	MODEL NO. LOW COST DW SEE ENG'G SPECIFICATIONS # ES-1001	TITLE BEZEL, 12" CRT	4-2-82	M ENGR / J... MFG ENGR	4-7-82
						FINISH SEE NOTE 2	TOL. EX. AS NOTED XX & 010 FRAC ± 1/64 XXX & 005 ANG ± 1° 30' FINISH ✓	449-0612-XA	D	10101-5014	A
						SCALE 1-1	SHT 01	OF 01	10101-5014	D	

11 10 9 8 7 6 5 4 3 2 1

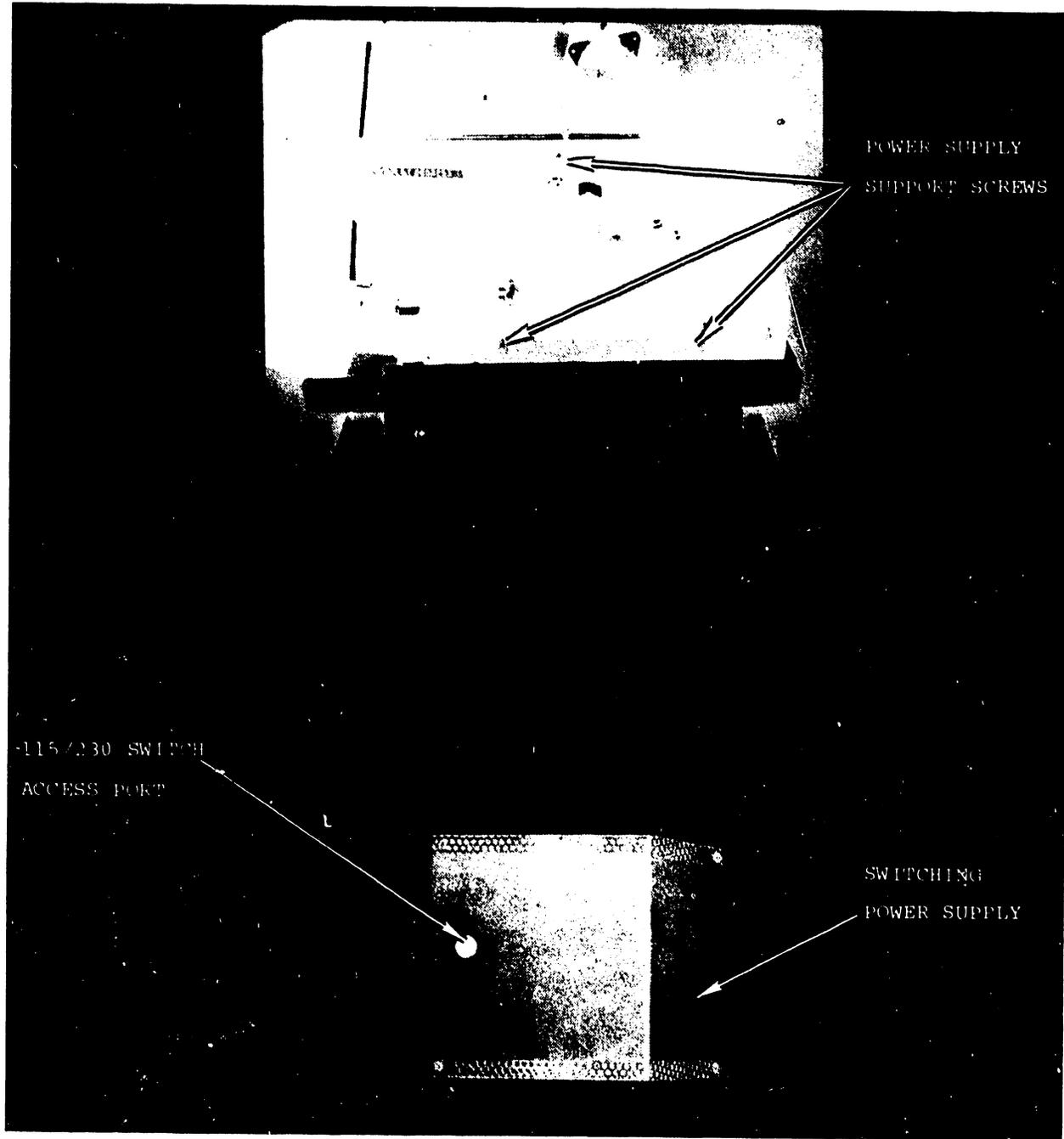
SWITCHING POWER SUPPLY (270-0734)

LOCATION	PART NUMBER	DESCRIPTION
	270-0734	Power Supply *

WARNING

```

*****
*
* DO NOT OPEN THE SWITCHING POWER SUPPLY UNDER ANY
* CIRCUMSTANCE. EXTREMELY DANGEROUS VOLTAGE AND
* CURRENT LEVELS (IN EXCESS OF 300 VOLTS DC AND UN-
* LIMITED CURRENT) ARE PRESENT WITHIN THE POWER SUPPLY.
*
* DO NOT ATTEMPT TO REPAIR THE SWITCHING POWER
* SUPPLY; IT IS FIELD REPLACEABLE ONLY.
*
* AFTER POWERING THE UNIT DOWN AND DISCONNECTING THE AC
* POWER PLUG FROM THE WALL OUTLET, ALLOW ONE MINUTE
* BEFORE REMOVING THE POWER SUPPLY TO PROVIDE ADEQUATE
* TIME FOR ANY RESIDUAL VOLTAGE TO DRAIN THROUGH THE
* BLEEDER RESISTORS.
*
*****
    
```



OTHER COMPONENTS

LOCATION	PART NUMBER	DESCRIPTION
	449-0614	Pan, CRT
Pan/Base	650-3167	SCR, 6-32x1/2 Whiz
CRT/Pan	650-3088	SCR, 6-32x1/4 Whiz
	220-1829	Cable Assy, DC
CRT/Panel	652-0032	Nut, #6
	420-1025	Cord, AC Line
	615-1671	Label, Model #
	290-0050	Package, Shipping

APPENDIX

A

TERMINAL

/CPU

CABLES

APPENDIX A

TERMINAL/CPU CABLES

One 8-ft (2.4-m) cable to power source. One 25-ft (7.6-m) direct connection cable is provided with each Model 2336DW, unless an optional direct connection cable is ordered for a terminal. Nonextendable cables are available optionally for direct connection up to 2000 ft (606.1 m). as described below.

Length in Feet	Length in Meters	Part Number
25	7.6	120-2236-25
50	15.2	120-2236-50
100	30.3	120-2236-1
200	60.6	120-2236-2
300	90.9	120-2236-3
400	121.5	120-2236-4
500	151.5	120-2236-5
600	181.8	120-2236-6
700	212.1	120-2236-7
800	242.4	120-2236-8
900	272.7	120-2236-9
1000	303.0	120-2236-10
1250	378.8	120-2236-11
1500	454.5	120-2236-12
1750	530.3	120-2236-13
2000	606.1	120-2236-14

Modem cables are available optionally in lengths of 12 ft (3.7 m), with extensions of 25 ft (7.6 m) and 50 ft (15.2 m). (Refer to Table 9-2) Combined cable distance however, from Wang equipment to a modem is 50 ft (15.2 m) maximum according to Electronics Industries Association (EIA) standards.

Length in Feet	Length in Meters	Part Number
12	3.7	120-2227-12
25	7.6	220-0219
50	15.2	220-0220

APPENDIX

B

**RECOM-
MENDED
SPARES**

APPENDIX B

RECOMMENDED SPARES

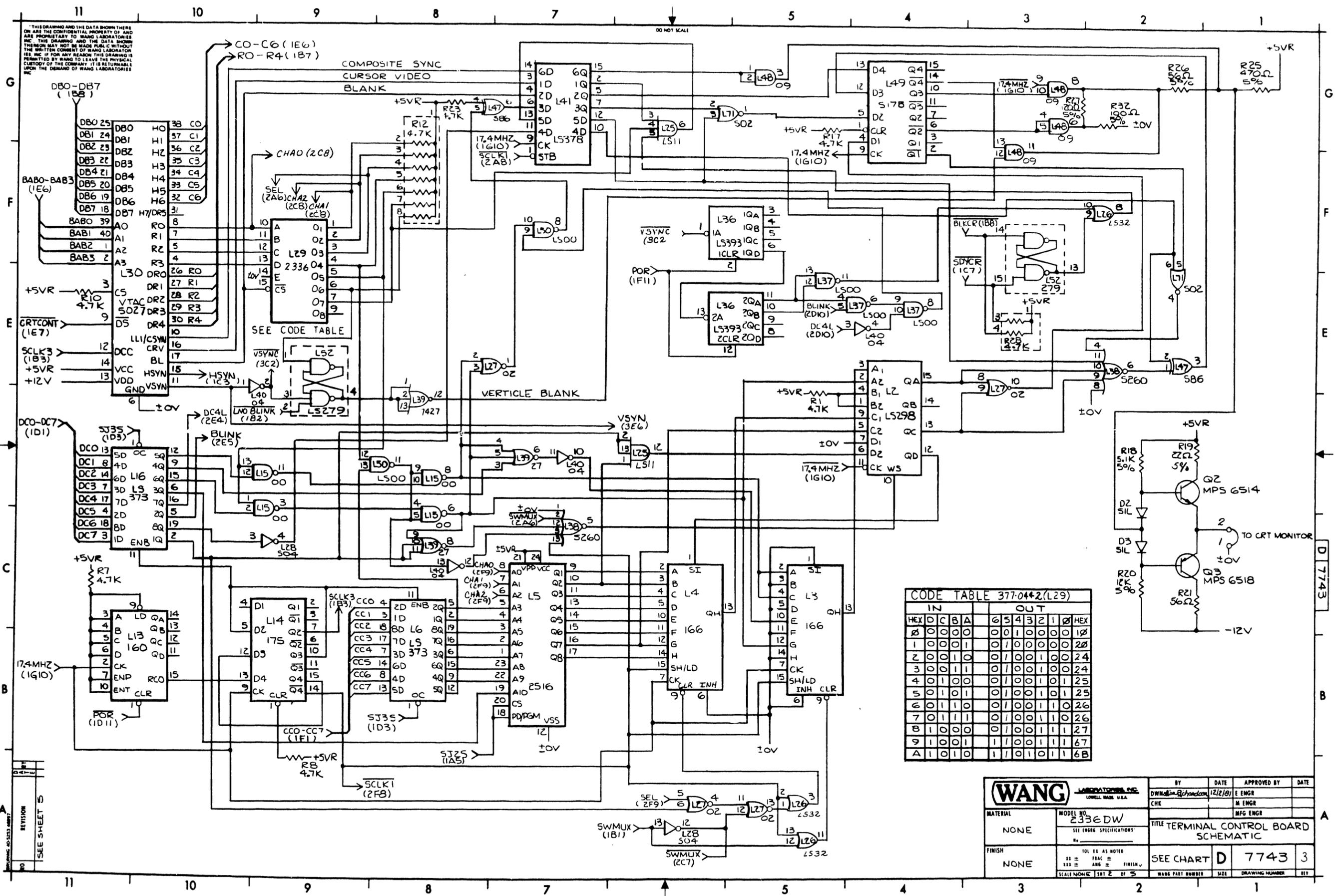
<u>Wang</u> <u>Part Number</u>	<u>OEM</u> <u>Part Number</u>	<u>Description</u>	<u>Comments</u>
210-7743-A 270-0633		PCA 2336DW Single Bd. 12 in. Monitor Assy Tilting	
340-0108 210-7456		CRT PCA 12 in. Monitor Electronics	
725-2637 725-2652		Standard Keyboard Expanded Keyboard	

APPENDIX

C

SCHE-

MATICS



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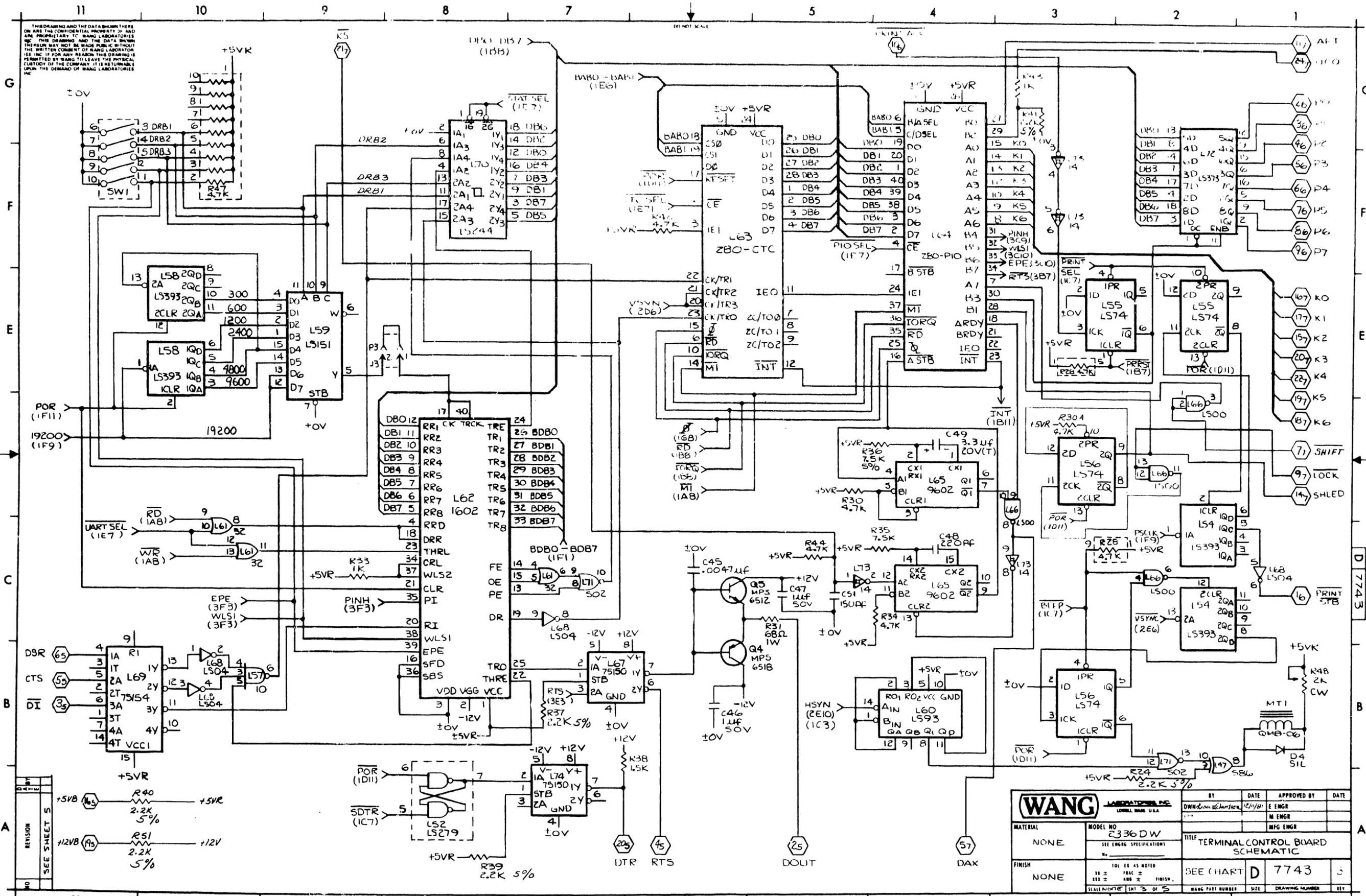
CODE TABLE 377-0442(L29)

IN	OUT							HEX				
HEX	D	C	B	A	6	5	4	3	2	1	0	HEX
0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	1	0	1	0	0	0	0	0	20
2	0	0	1	0	0	1	0	0	0	0	0	24
3	0	0	1	1	0	1	0	0	0	0	0	24
4	0	1	0	0	0	1	0	0	1	0	1	25
5	0	1	0	1	0	1	0	0	1	0	1	25
6	0	1	1	0	0	1	0	0	1	1	0	26
7	0	1	1	1	0	1	0	0	1	1	0	26
8	1	0	0	0	0	1	0	0	1	1	1	27
9	1	0	0	1	1	1	0	0	1	1	1	67
A	1	0	1	0	1	1	1	0	1	1	1	6B

WANG LABORATORIES, INC. LOWELL, MASS. U.S.A.		BY D.W. Richardson	DATE 12/2/69	APPROVED BY E ENGR	DATE
MATERIAL NONE	MODEL NO. 2336DW	CHK		M ENGR	
TITLE TERMINAL CONTROL BOARD SCHEMATIC		MFG ENGR			
FINISH NONE	101 IS AS NOTED 111 ± ANG ± FINISH SCALE NONE SH 2 OF 5	SEE CHART D	7743	3	
NO	REVISION	SEE SHEET 5			

NO	REVISION	SEE SHEET 5
----	----------	-------------

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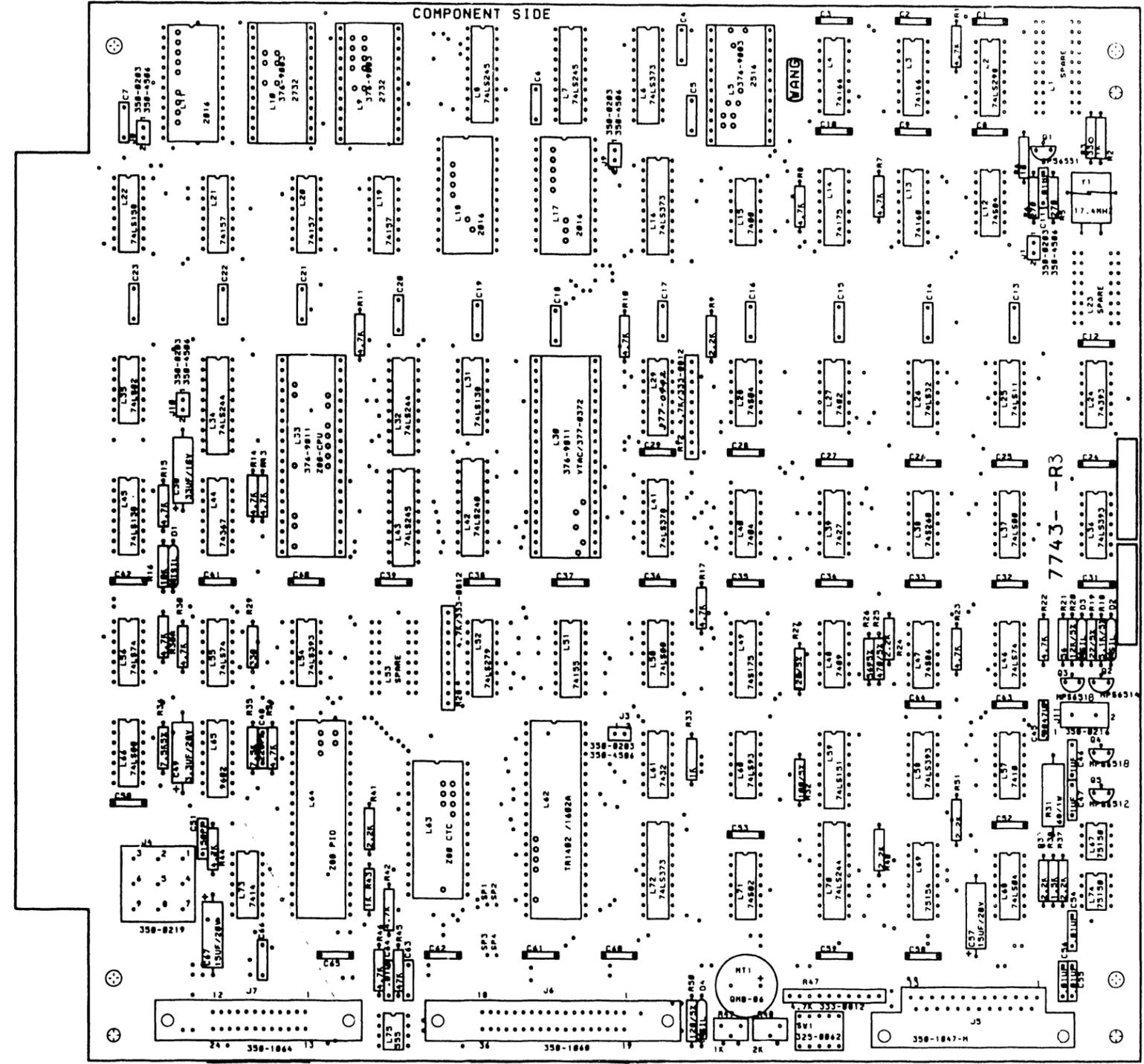
WANG LABORATORIES, INC. LORAIN, MASS. U.S.A.		BY: DWH/dm DATE: 12/1/71	APPROVED BY: E ENGR	DATE:
MATERIAL: NONE	MODEL NO: 2336 DW	TITLE: TERMINAL CONTROL BOARD SCHEMATIC		
FINISH: NONE	SCALE: 1:1	SEE CHART: D	DRAWING NUMBER: 7743	SHEET: 3

11 10 9 8 7 6 5 4 3 2 1

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DO NOT SCALE

COMPONENT SIDE



ECO
NO. 1111
PENDING

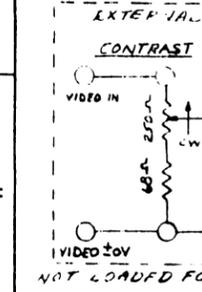
NO.	REVISION	DATE	BY
1	3/11 SPEC'S		

WANG LABORATORIES INC. LOWELL, MASS. U.S.A.		BY	DATE	APPROVED BY	DATE
MATERIAL		DW/LSK/RECH/MSM	11/81	E ENGR	
MODEL NO. 2336 DW		CHK D J CORBIN	11-82	M ENGR	
TITLE		TERMINAL CONTROL BOARD ASSEMBLY			
FINISH		SEE CHART	D	7743	3
SCALE: 1/8" = 1"		WANG PART NUMBER SIZE DRAWING NUMBER SET			

11 10 9 8 7 6 5 4 3 2 1

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MILLIMETERS IN PARENTHESES TOLERANCES TO BE EQUIVALENT TO INCH DIMENSIONS



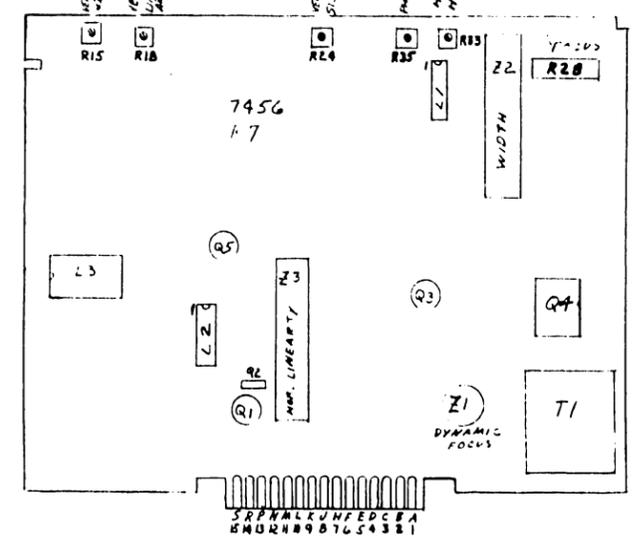
COMPONENTS NOT LOADED FOR 7456-2

R9,10,40	330-2047
R1	331-2010
R11	330-1023
R1E	337-3012
R44	330-1047
C3	300-1820
C15	300-4022
Q5	375-1014
Q2	375-1056
D4,10	380-1001
C32	300-1047
Q1	375-1012

VARIATION CHART

COMP	7456	7456-1	7456-2
R19	330-3068	330-4027	330-3063
C30	300-2412	300-2417	300-2412
C31	300-2413	300-2418	300-2413
Z2	320-0051	320-0056	320-0053
Z3	320-0051	320-0056	320-0051
HOR YOKE	320-0052	320-0057	320-0052
FLY-BACK	410-1007	410-1007	410-1007
R5	330-2068	330-2068	330-3068

Y YOKE L	YEL	BLU	YEL
Y YOKE K	BLU	RED	BLU
H YOKE H	RED	YEL	RED



WANG

LABORATORIES, INC.

ONE INDUSTRIAL AVENUE, LOWELL, MASSACHUSETTS 01851, TEL. (617) 459-5000, TWX 710 343-6769, TELEX 84-7421

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