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CALLAN DATA SYSTEMS

CD100-M INTEGRATED WORKSTATION

Multibus Intelligent Video Terminal

USERS' GUIDE

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CD100-M INTEGRATED WORKSTATION

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CHAPTER 1. OVERVIEW

1.1 PRODUCT DESCRIPTION

The CD100-M Integrated Workstation provides the framework for the system manufacturer to conveniently and compactly assemble a Multibus based micro computer system within a video terminal. The workstation consists of a CRT controller and display, a detachable keyboard, a front panel control unit, a Multibus card cage, a switching power supply and fan.

The -01 option provides a Multibus P2 motherboard which includes power fail sense and interrupt logic as well as address extension to 16 MB.

The -02 option provides wirewrap connectors for the Multibus P2 connectors for custom wiring requirements.

The -03 option provides an AC low detection circuit which operates in conjunction with the -01 option to perform the power fail interrupt and latching capability per the Intel Multibus specification (Intel Document 9800683). Proper operation requires a custom supplied backup power source (e.g. battery pack).

The workstation can be ordered with various combinations of 5-1/4" micro disk drives, either the floppy or the Winchester type. Alternatively, the terminal may be ordered such that the disk drives can be installed in the field.

Thus, the system integrator selects the computer, memory, disk units, controller and other special purpose boards to tailor a workstation to his exact requirements. Communication between the selected computer with the terminal section of the workstation is accomplished via a standard RS 232 interface.

The very intelligent terminal section off-loads the main CPU sections from a multitude of compute bound functions; this allows many common functions to be implemented conveniently and, when implemented, are performed efficiently. In addition, the terminal provides many less common functions which enhance the usefulness of the system. These functions include the dual screen feature, a smooth scroll mode and comprehensive line and character editing capabilities.

Note: In this manual, the terms workstation, station and terminal are used interchangeably.

1.2 FEATURES

1.2.1 Display Features

- -12" CRT, non-glare glass and P4 phosphor, 25 lines x 80 characters
- -Clear characters on 9 x 13 Dot Matrix with 3 dot descenders
- -Split screen capability with separate scrolling regions in each screen

- -Smooth scrolling capability
- -Complete cursor control commands
- -Read and write cursor commands
- -Comprehensive tabulation commands
- -Comprehensive erasure commands
- -Comprehensive line and character edit commands
- -Control of LED indicators
- -Alternate character ROM
- -Invisible character attributes, to reduce intensity, underline, blink, reverse video and overstrike characters
- -95 display characters plus 11 form drawing characters
- -Monitor mode to display all 33 control characters
- -Local self diagnostic

1.2.2 Indicators

- -16 status lights on keyboard and front panel, 11 are programmable
- -Programmable audio alarm

1.2.3 Keyboard

- -Detachable micro computer controlled with 5 foot coiled cord
- -82 typewriter like keys (cursor control keys, function keys and a separate auxiliary keypad)
- -2 computer controlled keyboard modes
- -Smooth scroll control key

1.2.4 Communications Interface (RS232 CPU Interface)

- -50 to 9600 baud rate
- -7 or 8 data bits
- -Parity enable or ignore
- -Odd or even parity

1.2.5 Internal Controls

- -Video Adjustments
- -Reverse video intensity
- -Reduced intensity adjustment

Switch Selectable Features:

-Reverse Video
-Auto line wrap
-Auto line feed
-Monitor mode
-Blinking or steady cursor
-XON/XOFF transmission enable

1.2.6 External Controls

-Video intensity adjustment
-Video contrast adjustment
-Keyclick enable/disable

1.2.7 Front Panel Controls

-Reset switch
-Interrupt switch

1.2.8 CPU Card Cage

-Easily accessible
-Fan cooled
-200w switching power supply + 5V@20A, $\pm$ 12V@ 4A -5V@ 4A
-Six Multibus card slots
-P_1 motherboard with terminators, jumper, selectable interrupt location

1.2.9 Disk Unit Provisions

-Two 5-1/4" floppy disk or Winchester type drives can be mounted within the system

1.2.10 Rear Panel Access For Front Cable

-Four Cannon 25D type connectors
-Four Cannon 37D type connectors
-Flat cable access

1.2.11 Operating Specifications

-Power, Switch Selectable:
-105VAC-125VAC @ 60HZ, 4A (RMS)
-210VAC-250VAC @ 50HZ, 2A (RMS)

Operating Temperature:

10° to 40°C (50° to 104°F) with rear access cover in place

10° to 26.7°C (50° to 80°F) with rear access cover removed

Non Operating Temperature:

-40° to 66°C (-40° to 151°F)

Input Power Maximum:

500 VA apparent

1.2.12 Dimensions and Weight

-Width: 20-1/2" (52cm)

-Depth: 19-1/4" (53cm); 25-1/2" with keyboard (64cm)

-Height: 14-1/2" (37cm)

-Weight: 64 Lbs

-Shipping Weight (Packed): 75 Lbs.

1.2.13 Options

-01 Motherboard extension card provides addressing to 16MB with power fail

-02 Connector provides wirewrap connectors installed for custom wiring of P2 connectors

-03 Provides AC low circuit for -01 option

1.3 CONTROLS

Following is a brief description of user controls. (Refer to Chapter 2, OPERATOR INFORMATION for a complete description of User Controls)

VIDEO UNIT

This screen displays 25 lines of 80 characters each.

REAR ACCESS COVER

This removable cover provides easy access to the Multibus modules located in the card cage and provides access to a number of video adjustments without exposing the CRT, the video processor and the power supply. The Multibus cards can be operated on extenders with this cover removed. The case is secured with two screws at the rear of the cover.

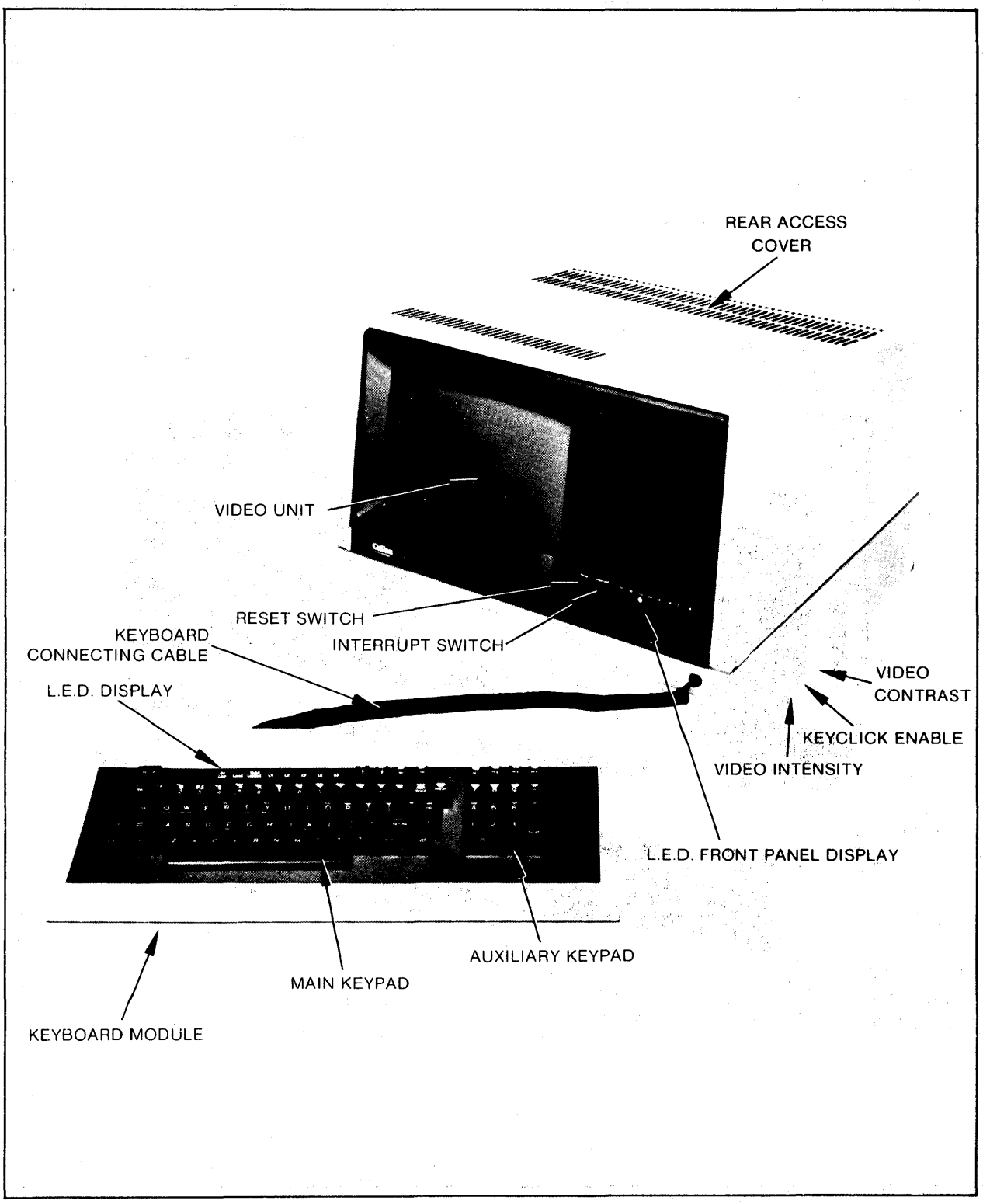


Figure 1.1: CD100 VIDEO WORKSTATION (FRONT VIEW)

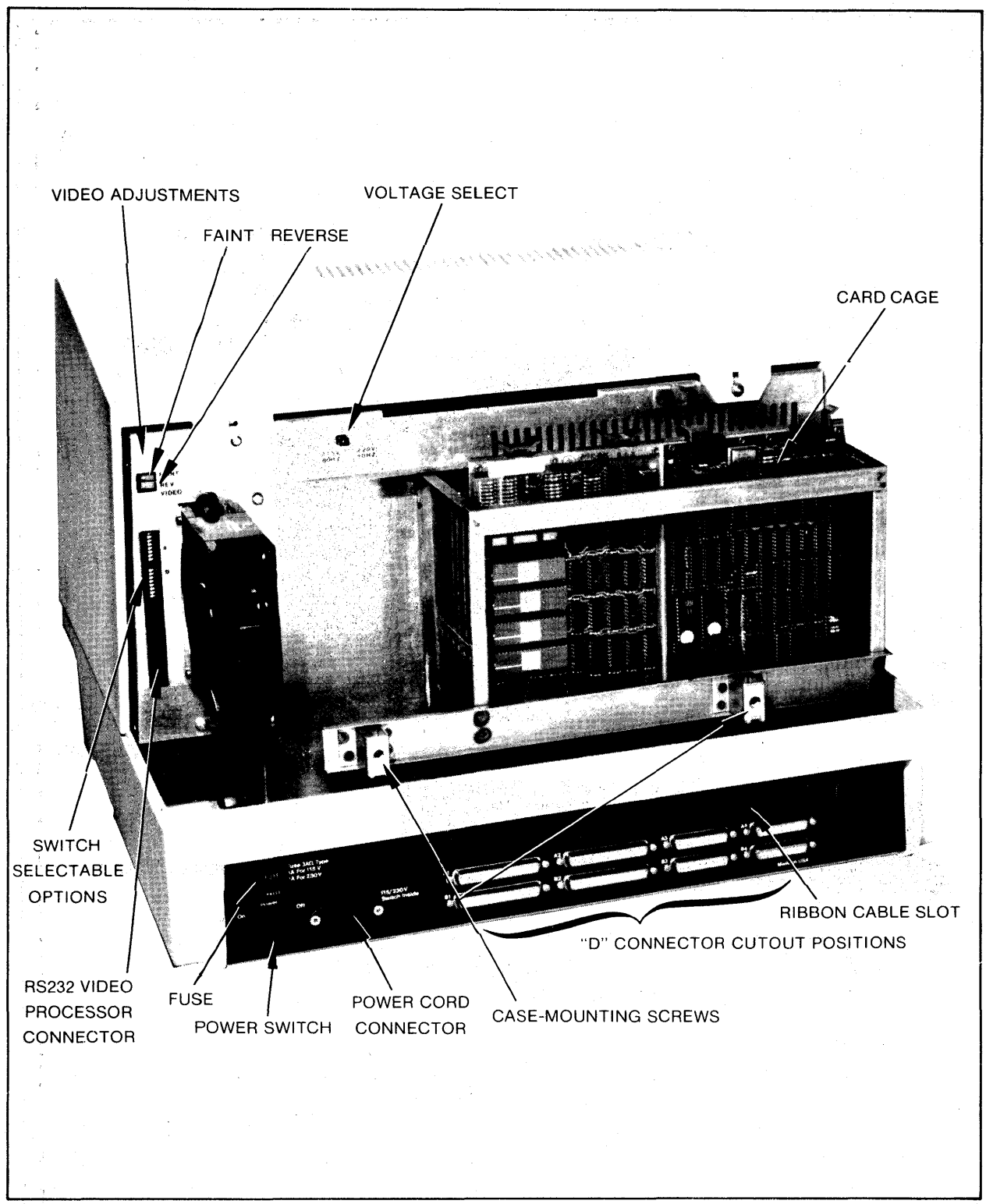


Figure 1.2: CD100 VIDEO WORKSTATION (REAR VIEW — CASE REMOVED)

KEYCLICK ENABLE SWITCH

This rotary two position switch controls the automatic electronic keyclick feature when a key is depressed. Facing the switch, rotate the switch clockwise to activate this feature. Refer to Section 2.6.2 for further discussion of this switch.

VIDEO INTENSITY CONTROL

Rotate control clockwise to increase the brightness of the display. Refer to Section 2.6.1 for further discussion of this control.

VIDEO CONTRAST CONTROL

Rotate control clockwise to increase contrast of the display. Refer to Section 2.6.3 for further discussion of this control.

RESET SWITCH

This front panel reset momentary switch provides a Multibus system reset function. Refer to 2.5.1 for a further discussion of this switch.

INTERRUPT SWITCH

This momentary switch allows the operator to provide a non-bus vectored interrupt to the Multibus system. Refer to 2.5.2 for a further discussion of this switch.

KEYBOARD CONNECTING CABLE

A telephone style, coiled keyboard cable provides easy disconnect at either the keyboard or workstation and allows flexible keyboard positioning for operator comfort.

KEYBOARD MODULE

The keyboard module consists of an LED display and two keyboard modules, a main and an auxiliary keypad.

The keyboard features sculptured keys and contoured keyrows arranged like an office typewriter permitting convenient operator use.

THE MAIN KEYPAD

The main keypad is organized like a conventional typewriter and consists of the majority of alphanumeric keys, the control keys, the space bar, the scroll control key, the PF1 function key and the cursor control keys.

THE AUXILIARY KEYPAD

The auxiliary keyboard is often used for high speed data input. The keyboard contains a comma, a minus, a period, an ENTER, four function and 10 numeric keys. Refer to Section 2.3.2 for a discussion of the main and auxiliary keypads.

LED FRONT PANEL DISPLAY

The keyboard LED display is used to indicate a number of workstation states, such as power on, which are independent of the application program; and to indicate programmable system states which are dependent on the application program. Refer to Section 2.3.1 for a discussion of these lights.

VIDEO ADJUSTMENTS

These are factory adjustments and should not normally be changed. These adjustments require a screwdriver. The top faint adjustment controls the faint field attribute intensity. Rotate clockwise to increase intensity. The bottom reverse adjustment controls the reverse attribute field intensity. Rotate clockwise to increase intensity.

VOLTAGE SELECT

This switch selects the units power line voltage. Place the switch in the left position for 115V/60 HZ; place the switch in the right position for 230V/50 HZ operation. To set the switch in either position, remove set screw, move switch to the desired position then replace the set screw.

WARNING: Set this switch PRIOR to turning the unit on.

SWITCH SELECTABLE OPTIONS

There are two banks of DIP switches which determine a multitude of hardware selectable options. For initial checkout and operating the diagnostic described at the end of this chapter and in Section 2.13, all switches should be in the ON position (to the right when facing the switches).

The exact setting of these switches is critical for the correct operation of the workstation. Set these switches cautiously with respect to the ON and OFF positions. A switch being in the ON position does not necessarily imply its designated function is enabled. Refer to Section 2.7 for a complete description of these switches.

FAN

An AC Fan is incorporated for system and card cage cooling

FUSE

115V: 4amp Type 3AG

230V: 2amp Type 3AG

RIBBON CABLE SLOT

A flat cable slot is provided with strain relief hardware for external peripheral interfaces which cannot be accommodated with the "D" connector positions required.

"D" CONNECTOR CUTOUT POSITIONS

The rear panel provides four 25 pin and four 37 pin "D" type communication connector cutouts.

1.4 INITIAL CHECKOUT PROCEDURE

1. Connect keyboard to main unit via the keyboard connecting cable.

2. Remove the two rear cover mounting screws and remove the cover. Verify or set voltage selector and line frequency to match the line power requirements.

   The voltage and frequency are both selected by voltage selector switch. The left position is 60 HZ/115V and the right position is 50 HZ/230V.

   Set the local/Online switch to local (OFF) to prepare for running the diagnostic. Be sure all other switches are set to the right (ON) position.

3. Turn the power switch OFF, check to verify that the line cord is properly installed and plug into the appropriate power outlet.

4. Turn on the power switch. The station will execute the self-test diagnostic when power is applied to the unit and the local/Online switch is set to Local.

   The following sequence of events occurs if the unit is operating satisfactorily:

   a. The local LED on the main keyboard will illuminate, indicating the keyboard unit is receiving power.

b. After a one second delay, the eight lights on the keyboard and front panel will illuminate. After one half second, all lights will be off (except Online).

c. Light D0 on front panel will be on, indicating end of Test 1, the CPU test.

d. After one second, light D1 will be on, indicating end of Test 2, the PROM integrity test.

e. After approximately 80 seconds, light D2 will be on, indicating the end of Test 3, the Memory diagnostic.

f. After one second, light D3 will be on, indicating the end of Test 4, indicating the Memory to Memory hardware logic is properly functioning.

g. After one second, light D4 will be on, indicating the end of Test 5, indicating the internal clocks are properly functioning.

h. Lastly, the unit will display the 95 displayable character set on the screen.

7. Enable keyclick by rotating the keyclick enable switch clockwise.

8. Press the return key. A slight audible click will be heard and the cursor will move to Position 1, the uppermost position of the second line.

9. Type 22 linefeeds; the top line will scroll off the screen and what was the second line will move to the top of the screen, and the bottom line will be blank.

10. Turn off unit and configure for on-line operation. Reset Local/Online DIP switch to Online (ON).

1.5 GENERAL SYSTEM SETUP PROCEDURE

1. Configure Multibus motherboard jumper options. (Refer to Section 4.2)

2. Configure the Multibus host CPU I/O port for desired baud rate, byte length and parity to match the terminal's. Refer to Section 2.7 or Appendix K. This port should be configured as a "Data Set" interface RS232 Type D, non switched, asynchronous channel.

Install the RS232 cable to the video processor connector.

3. Refer to Section 4.1 for other video processor options.

4. Configure remaining Multibus options per customer specifications.

5. Secure rear access cover. The workstation is now operational.

CHAPTER 2 OPERATOR INFORMATION

2.1 GENERAL INFORMATION

The CD100-M Integrated Worstation is a video terminal containing a six slot Multibus card cage, backplane and power supply. Data generated by the keyboard is asynchrounously transmitted via an internal serial connection to user supplied computer and circuit boards in the card cage; data generated by these boards and transmitted by the same connection either is displayed on the screen or implements a terminal control operation (such as erase the screen or turn on an LED).

Also, inputs generated by the front panel are directly transmitted to the card cage motherboard, which may be utilized by the computer.

Detailed operation of the terminal is modified by hardware switch settings described in this chapter and by software commands described fully in Chapter 3.

This chapter describes, from the operator's viewpoint, the operation of the various sections of the workstation. The last part of the chapter describes the power up/self diagnostic sequence.

2.2 THE VIDEO SECTION

2.2.1 Displayed Characters

Characters received from the RS232 interface are displayed on the screen. Normally the 95 characters of the primary character set (20H through 76H), called the G0 graphic set, are displayed; and the 32 control characters (00H through 1FH), called the C0 set, are not displayed.

Characters in the C0 set either perform specified control functions or are ignored. However, if the terminal is in Monitor Mode, described in Section 2.7.4, special graphics associated with these codes are displayed and any control action is ignored.

The host computer may use an alternate character ROM. (Refer to Section 2.10). The control character portion is called the C1 set and the graphic (displayable) portion is called the G1 set. Techniques are available to display both portions of the alternate character ROM. (Refer to Section 3.1.4).

The actual graphics displayed are completely user-defined. Refer to Section 4.4 for alternate ROM generation procedure.

In addition, the host computer may display 11 different form characters. Refer to Section 3.1.5 or to Appendix G for a description of the form characters.

2.2.2 Attributes

Under software control, the terminal assigns a number of attributes or renditions to displayable characters. Examples of these attributes are blinking characters and blinking reduced intensity characters.

2.2.3 Partitions

The terminal's video controller displays 25 lines of 80 characters each.

The terminal supports a split-screen capability whereby these 25 lines are considered to be divided into two groups called partitions. One partition may contain p complete lines ($0 \leq p \leq 25$); therefore, the other contains 25-p lines. A partition is defined and selected under software command. (Refer to Section 3.1.1). On power up, the screen is separated so that the top partition contains the customary 24 lines and the bottom partition contains 1 line.

2.2.4 Scroll Area

Under software control, a partition itself may be divided into 2 regions: a scroll region nested within the partition and a fixed line region, part of which is above and part of which is below the scroll region.

Display or control operations may, under software control, be restricted to the scroll region. (Refer to Section 3.1.2 and MARGIN mode in Section 3.5.22).

2.2.5 AUTOSCRL Mode

AUTOSCRL is a software selectable mode which defines the display process when the cursor is at the last line of the scroll region. If AUTOSCRL mode is set, as it is on power up, the receipt of a line feed shifts all lines in the scroll region up 1 row; the original top row is lost; and the bottom line is blanked. If AUTOSCRL mode is reset, receipt of a line feed does not shift the display.

2.3 THE KEYBOARD MODULE

2.3.1 Keypay LED Display

Eight LED's are on the keyboard. Three, L0 through L2, are software controllable, whereas the remaining 5 represent states of the terminal. The LED's are described in the following sections.

Online LED

The Online light indicates that the station is set by the rear panel Local/Online switch to the Online position. In this mode, the usual mode, characters and controls typed on the keyboard are transmitted to the host computer via the RS232 connection. When this light is on, then the Local light is off.

Local LED

The Local light indicates that the station is in the Local mode as set by the rear panel Local/Online switch. In this mode, characters and controls generated at the keyboard are "looped back" and are received as an input from RS232 interface. This mode is useful for diagnostic purposes. In fact, when in this mode, and power is first turned on, the terminal initiates the self-test diagnostic. (Refer to Section 2.13). When this light is on, the on/line light is off.

Keyboard Locked LED

The Keyboard Locked light indicates that the host computer has deactivated the keyboard keys. Until the keyboard is unlocked by the host computer, struck keys will be ignored.

Note that if the terminal is locked and in the Local mode, the terminal cannot be unlocked unless it is repowered.

APP Mode LED

If this light is off, the keypad is in the numeric mode. In this mode, the cursor control keys (including HOME) transmit code sequences which, if echoed by the host computer, moves the cursor in a manner indicated by the key caption. Also, auxiliary keypad character keys transmit the ASCII codes corresponding to their key captions.

If the APP mode light is on, the keyboard is in the keypad application mode; and the keys described above transmit unique code sequences. Thus, in this mode, the application program can differentiate between the user's striking the same captioned keys on either keyboard.

Scroll Disabled LED

The Scroll Disabled light indicates that the terminal is not processing input characters and controls therefore, scrolling cannot occur. This condition occurs only when the unit is in smooth scroll mode, the XON/XOFF feature is enabled (switch 1-7 off) and control S has been entered at the keyboard. To exit this condition, the user must type control Q, whereby the light will go off and scrolling may resume.

L2 through L0 LED's

These lights are turned on and off by software commands from the host computer. (Refer to Section 3.1.11).

2.3.2 Main and Auxiliary Keypads

The main keypad contains control and alphanumeric keys which are arranged like a standard office typewriter. The keypad also contains one of the 5 function keys and 5 cursor control keys. The auxiliary keypad contains the 4 remaining function keys and the numbers, characters and controls often used for high speed input.

The keys, when struck individually or in combination with the shift and control keys, produce codes which are transmitted to the host computer. All 128 ASCII codes may be generated. (Refer to Appendices B and C for the code sequences produced).

Under software control, the keyboard may be placed into either of two modes: the Numeric or the Keypad Application mode.

The default or power up mode is called the Numeric mode. In this mode, the APP mode light is off; the 5 cursor control keys generate code sequences which, if echoed by the host computer, will implement the indicated cursor control functions.

Also, on the auxiliary keypad the 10 numerals, the minus, the period, the comma, and the ENTER keys send the same ASCII codes as the corresponding keys on the main keypad.

The alternate keypad mode is called the Keypad Application mode. In this mode the APP mode light is on. The cursor control keys and the auxiliary keypad (except the function keys) send different sequences than in the numeric mode. Refer to Appendix C.

An additional advantage of the Keypad Application mode is that in many applications it is useful for the application program to differentiate between the same captioned keys on the main and auxiliary keypads. Refer to Appendices B and C for a description of the code sequences generated by these two keypad modes.

Standard Alphanumeric Keys

On the main keypad, the non-control keys generate codes dependent on the combination, if any, of the CAPS LOCK, SHIFT, and CTRL keys, which may be depressed simultaneously. However, the auxiliary keypad is not affected by these three control keys.

Backspace

Depression of this key will transmit the ASCII code for backspace (08H) to the host computer.

Caps Lock

The CAPS LOCK Key is a toggle action key. When the CAPS LOCK function is enabled, the LED on the key is illuminated and the terminal transmits upper case alphabetic characters regardless of the state of the SHIFT key. To disable this function, press the key again, whereby the LED will go off and the terminal will transmit the codes as adjusted by the SHIFT key.

Cursor Control Keys

The 5 cursor control keys are used to control the position of the cursor. In the keypad numeric mode, keypad APP light off, these keys transmit code sequence which, if echoed by the host, will enable the terminal to perform the indicated cursor movements.

Up arrow, ↑, moves the cursor up one row, unless at the top row of the scrolling region. The down arrow, ↓, moves the cursor down one row, unless at the bottom row, in the scrolling region. The left arrow, ←, moves the cursor left one character position unless at the left margin. Right arrow, →, moves the cursor right one character position, unless at the right margin. The Home Key positions the cursor to the upper left corner of the scrolling region.

If the keyboard is in the Keypad Application mode, Keypad APP mode light on, the code sequences generated will be ignored by the terminal, if echoed by the host computer.

CNTRL

This key is used in conjunction with an alphanumeric key to generate an ASCII control code. (Refer to Appendix B for the specific codes generated.

DELETE

Depression of this key transmits the delete character code (7FH) to the host computer.

ENTER

In the Numeric mode, the ENTER key functions identically with the return key on the main keypad. These keys generate the ASCII carriage return code (0DH). In the Keypad Application mode, the ENTER key generates a unique code sequence, which is listed in Appendix C.

ESC

This key transmits the ASCII escape character code (1BH).

Function Keys (PF0 through PF4)

The 5 function keys, PF0 on the main keypad and PF1 through PF4 on the auxiliary keypad, transmit special code sequences, which are described in Appendix B. The sequences generated are not affected by the keypad application mode. Also, these sequences are ignored if echoed by the host computer.

Linefeed

This key transmits the ASCII line feed code (0AH).

Return

This key transmits the ASCII carriage return code (0DH).

SHIFT

The shift key is used in conjunction with other keys to generate specific codes. Usually the shift used with an alphabetic key produces codes for upper case characters. (Refer to Appendix B for the specific codes generated).

Smooth Scroll

This key does not generate and transmit a code but rather controls the smooth scroll feature. Smooth scroll is enabled and disabled by successive depressions of this key.

Scrolling is the process whereby all lines of the partition are shifted up one row to make room for a new line of incoming data. After the display is shifted, the original top line is lost and the bottom line is erased. The incoming data is displayed at the bottom of the partition. When the smooth scroll feature is disabled, the scrolling process appears to occur instantly and discontinuously. When the feature is enabled, the scrolling process occurs relatively slowly and continuously.

As long as sufficient data is available, the smooth scroll rate is maintained at 4.6 and 3.9 lines per second at 60 and 50 HZ operation. The effect is as if the data is on a continuously and steadily moving scroll behind the partition.

Control of the incoming data rate, which could be greater than the smooth scroll rate, is accomplished by two mechanisms. The first, activated by the rear panel XON/XOFF switch, is the process of having the terminal automatically transfer an XOFF (DC3) when the terminal's input buffer is fairly full. The host's software must be designed to stop transmitting until the terminal automatically sends an XON (DC1), which is done when the input buffer is almost empty.

The second mechanism, independent of the XON/XOFF switch, is when the buffer is very full Request To Send (RTS) of the RS232 terminal is deactivated. Then when the buffer is fairly empty, Request To Send is reactivated. Thus, the host computer's RS232 interface, in the many cases which use these signals, automatically limits its own transmission rate. If the terminal is in smooth scroll mode and the operator types either XON (Control Q) or XOFF (Control S), the terminal does not necessarily transmit these codes.

Under these circumstances, XON and XOFF are used by the terminal alone to resume and suspend, respectively the scrolling process. Of course, if XOFF is used to suspend the scrolling process, the terminal subsequently transmits an XOFF when the input buffer has been filled. Likewise, an XON subsequently is sent to the host when the terminal's input buffer is empty.

2.4 FRONT PANEL LED'S

The 8 Front Panel LED's operate completely under software control. Refer to Section 3.1.11 for a description of the operation of these lights.

2.5 FRONT PANEL SWITCHES

The reset and the interrupt momentary switches are directly wired to the Multibus motherboard.

2.5.1 Reset Switch

This momentary switch initializes the host system.

2.5.2 Interrupt Switch

This momentary switch activates a Multibus Non-Bus Vectored interrupt within the host system.

2.6 THUMB WHEEL ADJUSTMENTS

Three user adjustments are located on the right underside of the unit:

2.6.1 Video Intensity

This adjustment sets the overall screen intensity.

It is operated in conjunction with the video contrast adjustment described in Section 2.6.3. First, adjust video intensity to its maximum. Then adjust the contrast until the characters appear clear. Then readjust the video intensity to a comfortable operational level. Contrast can then also be fine-tuned as required.

Rotate the thumbwheel clockwise to increase display intensity and rotate counter clockwise to decrease intensity.

2.6.2 Keyclick Enable

Keyclick provides an acoustic feedback when a key, other than a control, is depressed. Rotate the switch clockwise to enable keyclick; rotate counter clockwise to disable keyclick.

2.6.3 Video Contrast

This control is used to adjust the background and character intensity. This control is used in conjunction with Video Intensity described in Section 2.6.1.

Rotate clockwise to increase contrast, rotate counter clockwise to decrease contrast.

2.7 REAR PANEL DIP SWITCH SETTINGS

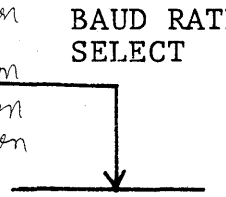
Access to the 2 banks of 8 switches is gained by removing the outer case. These switches modify the terminal's behavior. The ON position is to the right and the OFF is to the left. Note that if a switch is in the ON position it does not necessarily imply that the associated function is enabled. The following is a description of the various switch options:

SW1 - UPPER SWITCH BANK

Switch Number	Switch Name	OFF Position (Left)	ON Position (Right)
1-8 on	Auto WRAP	Auto WRAP enabled	Auto WRAP Disabled
1-7 off	XON/XOFF	Enable XON/XOFF Transmission	Disable XON/XOFF Transmission
1-6 on	Auto Line Feed	Follow Carriage Return With Linefeed	Do Not Follow Carriage Return With Linefeed
1-5 on	Monitor Mode	Enable Monitor Mode	Disable Monitor Mode
1-4 on	Not Used	----	----
1-3 off	Cursor Blink	Non-Blinking Cursor	Blinking Cursor
1-2 on	Cursor Shape	Dash Cursor	Block Cursor
1-1 on	Reverse Video	Reverse Video	Normal Video

SW2 - LOWER SWITCH BANK

2-8 on	LOCAL/ONLINE	Local Mode	Online Mode
2-7 off	DATA LENGTH	8 Data Bits	7 Data Bits
2-6 on	PARITY	Even Parity	Odd Parity
2-5 off	PARITY ENABLE	No Parity	Parity
2-4 on	BAUD RATE SELECT		
2-3 on			
2-2 on			
2-1 on			



4	3	2	1	
N	N	N	N	= 9600
N	N	N	F	= 7200
N	N	F	N	= 4800
N	N	F	F	= 3600
N	F	N	N	= 2400
N	F	N	F	= 2000
N	F	F	N	= 1800
N	F	F	F	= 1200
F	N	N	N	= 600
F	N	N	F	= 300
F	N	F	N	= 150
F	N	F	N	=134.5
F	F	N	N	= 110
F	F	N	F	= 75
F	F	F	N	= 50
F	F	F	F	= XX

where N = ON (Right)
F = OFF (Left)

Figure 2-1 Rear Panel DIP Switch Settings

2.7.1 AUTOWRAP

The AUTOWRAP feature defines the cursor movement when the cursor is at column 80 and the terminal receives a carriage return. If and only if the AUTOWRAP feature is enabled (Switch 1-8 OFF), the terminal displays the character at column 80 and then executes an automatic carriage return followed by a linefeed.

2.7.2 XON/XOFF

The XON/XOFF feature provides a technique for coordinating the incoming data rate with the scroll rate of the display during smooth scroll mode. Because the smooth scroll rate of 4.6 lines/second (@60HZ) may require a slower character rate than the incoming character rate, the terminal regulates the host computer's data rate by transmitting the XON/XOFF control characters.

When the XON/XOFF feature is enabled (Switch 1-7 OFF), and the input buffer is almost full, the terminal transmits the XOFF control character (DC3). Later, when a number of scrolls have occurred and the buffer is almost empty, the terminal transmits the XON control character (DC1). Incidentally, the terminal automatically resorts to another technique to regulate the data rate if the XON/XOFF feature is not enabled. Again, if the internal buffer gets very full the video terminal deactivates its Request To Send (RTS) RS232 status signal.

If the receiving hardware responds to these signals, it may suspend transmission to the terminal until the terminal reactivates Request To Send (RTS) which is done when the input buffer is about one half full.

2.7.3 AUTO LINEFEED

The AUTO LINEFEED feature prepares the terminal to execute an automatic linefeed after receiving a carriage return. This feature is enabled when switch 1-6 is in the OFF position and disabled in the ON position.

2.7.4 MONITOR Mode

Monitor mode determines the terminal's response to the 32 control characters (00H to 1FH) and the delete character (7FH). Usually monitor mode is disabled (Switch 1-5 ON) whereby the control characters implement their control function but are not displayed.

When Monitor mode is enabled (1-5 OFF), the control operation is not implemented but an associated graphic character is displayed. APPENDIX A contains the graphics associated with these control characters.

2.7.5 Cursor Blink

If this switch (1-3) is in the ON position, the terminal generates a blinking cursor; if in the OFF position, the cursor does not blink.

2.7.6 Cursor Shape

If this switch (1-2) is in the ON position, the terminal generates a reverse video block cursor; if the switch is in the OFF position, the terminal generates a dash cursor.

2.7.7 Reverse Video

If this switch (1-1) is in the ON position, character representation is light characters on a dark block matrix; if the switch is in the OFF position, character representation is dark characters on a light block background.

2.7.8 Local/Online

This switch (2-8) determines if the keyboard communicates with the external host computer or internally with the terminal itself.

In the Online mode (Switch 2-8 ON), data generated by keyboard action is transmitted through the RS232 connection to the host computer. The transmission itself will in no way change the status or display of the workstation. Only when a receiving CPU processes the data and transmits the data back to the station is the state of the station altered. If the switch is in the Offline mode (switch OFF), however, the characters generated by the keyboard are processed as if they were received directly from a host computer.

Also, if the switch is in the Local mode when power is turned on, the terminal initiates the self-test program. Refer to Section 2.13 for a description of the diagnostic.

2.7.9 Data Length

If this switch (2-7) is in the ON position, the terminal transmits 8 data bits and expects to receive 8 data bits over the communication line. If the switch is in the OFF position, the communication uses 7 data bits. The data bits are exclusive of the start, stop or parity bits.

2.7.10 Parity

If parity is enabled (Refer to 2.6.11), and the Parity switch (2-6) is on, odd Parity is generated for transmission over the RS232 communication line and odd Parity is verified on received data. If the switch is off, even Parity is generated or verified.

2.7.11 Parity Enable

If this switch (2-5) is in the ON position, Parity is generated on transmission over the communication line and is checked on reception. The sense of the Parity is according to that outlined in the previous section.

When a parity, end of frame or data overrun error is detected during reception, the ASC11 graphic for a null is displayed. If the switch is in the ON position, Parity is neither generated nor checked.

2.7.12 Baud Rate Select

The Baud rate is determined by switches 4 through 1 on the lower switch bank. Refer to Figure 2.1 for the switch settings. If the selected baud rate is strictly greater than 150 Baud, then 1 stop bit is generated by the terminal for transmission, and the hardware checks for 1 stop bit on reception.

If the Baud rate is less than or equal to 150 Baud, then 2 stop bits are generated and checked.

2.8 REAR VIDEO ADJUSTMENTS

Two attribute intensity adjustments are located on the rear panel for Faint and Reverse Video character fields. Both are factory set and should not normally require readjustment.

2.8.1 Faint

This adjustment is rotated clockwise to increase intensity.

2.8.2 Reverse Video

This adjustment is rotated clockwise to increase intensity.

2.9 VOLTAGE SELECT

This two position switch is located on the rear panel. Facing the rear of the terminal, left is 115V, 60HZ and right is 230V, 50HZ.

This switch must be set in the proper position before turning on power.

2.10 INSTALLATION OF ALTERNATE ROMS

An additional character set can be implemented via the installation of a custom programmed 2716 EPROM. Refer to 4.4 for installation procedures.

2.11 JUMPER OPTIONS

Jumper options are provided for front panel and RS232 interface functions. Refer to Chapter 4 for implementation details.

2.12 INSTALLATION OF DISK UNITS

The CD100-M is available with installed 5-1/4" disk units. These are either Mini floppies or Winchester types with or without controllers. Alternatively, the units may be ordered such that disk units may be field installable. Consult the factory and the appropriate disk and controller manuals for operating and set-up procedures.

2.13 POWER UP AND DIAGNOSTIC SEQUENCES

When power is first applied to the unit, approximately a 2 second delay occurs after which one of two sequences occurs: if the rear panel Local/Online switch is in the Online position, the screen is erased, the cursor is in the home position and the terminal is ready to communicate via the RS232 line.

If the switch is in the Local position, the diagnostic is initiated. This diagnostic is briefly described in Chapter 1. If the test pattern is not displayed on the screen, then the front panel light indicates the last successful test. (Consult factory if remedial assistance is required).

see section 1.4

CHAPTER 3 PROGRAMMERS INFORMATION

3.1 GENERAL INFORMATION

This chapter concentrates on those aspects of the workstation that are controlled by the host computer. Communication with the terminal and LED display sections of the workstation is done via RS232 (Type D) connection using asynchronous 7 bit ASCII code sequences. The programmer should be aware that a computer installed in the card cage may receive reset and interrupt signals from the front panel.

Using intelligence in the terminal section, the host computer can display, organize and manipulate characters on the screen; control and read the cursor; control the LED's on the keyboard or on the front panel; and, he can modify the operation of the keyboard.

3.1.1 Partitions

Physically, the screen displays 25 lines of 80 characters each. From the software point of view, however, the screen is divided into two logical screens called partitions. The top partition, partition 0, may contain p lines of 80 characters and the bottom partition, partition 1, contains 25-p lines.

A partition may contain 0 lines; but if smooth scroll is to occur in the partition it must contain at least 2 lines. When the terminal is initialized either on power up or by execution of the RIS command, the screen is partitioned with partition 0 having 24 lines and partition 1 having 1 line. This organization is convenient for the operation of much existing software. A partition is activated by the SSPR (Select) command.

3.1.2 Scroll Area

Each partition may be further divided into a scroll region embedded within the partition and a fixed line area having some of its lines above and some below the scroll region. The scroll area is defined by the SSCRL (Set Scroll Limits) command.

The transfer of characters and command control may be restricted to the scroll area by setting MARGIN mode. The default scroll area is the partition itself.

3.1.3 Character Processing

Display character processing consists of the received character being entered at the current cursor location, called the active position. The cursor then advances one position to the right on the current line, called the active line. The cursor movement, when at the last column, depends on the rear panel switch settings and a number of software setable modes described in this chapter.

3.1.4 Alternate Character ROM

An alternate character set is available if the alternate ROM is installed. The characters are displayed using two mechanisms: the 95 displayable characters (20H through 7EH) comprising the G1 set is activated using the SO, shift out control character. The 32 control characters (00H through 1FH) comprising the C1 set are displayed using specific 2 character escape sequences. The C1 characters are displayed and do not invoke any terminal control functions.

3.1.5 Graphic Form Characters

Eleven graphic Form characters are available for display using the GRAPH command. These are necessary for the construction of forms and charts.

3.1.6 Attributes

Using the SGR command, characters may be assigned a number of attributes: characters may blink, can be displayed at reduced intensity, can be displayed in reverse video, can be underlined and can be overstriken. Or, any combinations of these attributes may be used simultaneously. Once a rendition is defined, all characters transferred to the partition have this rendition until changed by the SGR command. Thus, the attributes associated with a character are defined when they are transferred to the screen and not, as in some systems, where they are placed. Prime rendition means non-blinking, normal intensity, normal video, not underlined and not over striken characters. Reverse video means dark characters on a light block matrix unless the reverse video rear panel switch is in the reverse position (whereby reverse video means light characters on a dark block matrix).

3.1.7 Terminal Control

Terminal control is executed by using the 32 control characters of the C0 set, the delete character or by

escape sequences all of which are discussed in this chapter.

3.1.8 Smooth Scroll Considerations

Activation of the smooth scroll capability is not under computer control but is controlled by the smooth scroll key as described in Chapter 2. However, if the host computer's RS232 connection does not respond to the hardware's Request To Send (RTS) signal then the host's software explicitly must be designed so as to accommodate the smooth scroll feature.

Specifically, the host's RS232 driver must be designed to recognize the XON (DC1) and XOFF (DC3) control characters. When the host receives XOFF it should transmit no more than 8 characters until it receives an XON.

3.1.9 Modes

The terminal section's behavior or response to various commands is affected by a number of terminal modes which are defined by the SET MODE and RESET MODE. Briefly, these modes define if the keyboard is active (KAM mode), determines the operation of the INSERT and DELETE line commands (VEM mode), determines the terminal's action after receipt of a linefeed (LMN mode), determines the scrolling region boundaries within a partition (MARGIN mode), activates automatic scrolling (AUTOSCRL mode), and defines a number of conditions which clears the screen (AUTOCLR Mode).

3.1.10 Keyboard Modes

The keyboard may be placed into either of two modes by using a two character escape sequence. In the Numeric mode, the default, the Keypad APP mode LED is off and all keys send the natural code sequences which are indicated by their key captions.

The alternate keyboard mode is called the keypad application mode. In this mode the APP mode light is on: the cursor control keys and the auxiliary keypad (except PF1 through PF4) generate different sequences than they do in the Numeric mode. Many programs will find it useful to differentiate between the same captioned key on the main and auxiliary keypads.

3.1.11 LED Control

Using the LED command, the computer can control 11 LED's. These are the three rightmost LED's (L2 through L0) on the keyboard and the 8 LED's (D7 through D0) on the front panel.

3.1.12 Power Up Sequence 3.5.23

The power up sequence is described in Section 3.4.3, RIS command.

3.2 CONTROL CHARACTER PROCESSING

The following paragraphs describe the C0 set control characters and their processing. The characters not discussed are ignored. Refer to Appendix A for the Hexidecimal values of each of the control characters.

CHARACTER	ASCII	ACTION
Bell	BEL	Sounds the alarm at the terminal; no other action.
Backspace	BS	Moves cursor left one position, if possible.
Horizontal Tab	HT	Moves the cursor to next defined tab position as defined by the CTS Command. If the active position is at or past the last tab, the cursor does not move.
Linefeed	LF	Moves the cursor down, if possible, one row. If LNM mode is set, the terminal automatically executes a carriage return. If AUTOSCRL is set and the cursor is at the last line of the partition, all lines are scrolled up 1 line and the last line will be erased. The cursor, in this case, does not move. If AUTOSCRL is reset and the cursor is at the last row, two possibilities may occur: one if AUTOCLR is reset, the cursor does not move; and two, if AUTOCLR is set, the scrolling region within the partition is cleared and the cursor is sent to the home position.
Form Feed	FF	If AUTOSCRL is reset, clear the scrolling region within the partition and the cursor is moved to home. If AUTOSCRL is set, the form feed is treated precisely as a linefeed.

CHARACTER	ASCII	ACTION
Carriage Return	CR	Moves the cursor to column 1. Then, if the Auto Linefeed rear panel switch is enabled, the terminal automatically executes a linefeed.
Shift OUT	SO	Activates, if necessary, the alternate G1 character set. If the alternate character ROM is not installed full character field blocks are displayed.
Shift IN	SI	Revert to, if necessary, the standard G0 character set.
Cancel	CAN	Cancels an incomplete escape sequence.
Escape	ESC	Announces the initiation of an escape sequence.

3.3 ESCAPE SEQUENCE OVERVIEW

This section describes the format and structure of escape sequences. Terminal control operations other than those outlined in Section 3.2 are implemented using escape sequences. The actual control functions are described in Sections 3.4 and 3.5.

3.3.1 Standards

The ASCII code structure used by the terminal is defined by ANSI Standard X3.4 - 1977. Control function communication is accomplished using a subset in accordance with ANSI Standard X.3.64 - 1979.

3.3.2 Control Sequence Format

The terminal section uses either two character control sequences or multiple character (more than two) control sequences.

Two character control sequences use the form:

ESC F

where ESC is the escape character (1BH) and F is a single character indicating the control function. From the computer to the terminal, two character sequences are used to transmit, for display purposes, a C1 alternate ROM control character and to transmit a number of simple commands. Refer to Section 3.4 for a discussion of these commands.

From the keyboard to the host computer, two character sequences are used to indicate certain keys were typed when the keyboard is in the APP mode. Refer to Appendix C.

Multiple character escape sequences are used in communicating to and from the workstation a number of more complex commands and to indicate that certain keys were struck at the keyboard while in the numeric mode. The format of multiple character control sequences is:

$$\text{ESC } [\; P_1 \; ; \; P_2 \; ; \; \ldots \; F$$

where ESC is the escape characters (1BH), [is the left bracket character (5BH), p1 is an ASCII character sequence which represents a decimal number (and possibly proceeded by an equals sign) " ; ", is the semicolon character (3BH) and F is a single final character indicating the specific sequence. The P_1 are command parameters, separated by semicolons. A command may contain 0 (Null) parameters.

Example: The sequence to move the cursor to row 10, column 31 of the partition is ESC [0010; 31H

An escape sequence is restricted to less than 29 characters.

If incorrect syntax, an illegal or out of range parameter is detected during processing, the command processing will be aborted; the terminal resumes processing after the character which induced the error condition. An incomplete control sequence may be aborted by transmitting the CAN (18H) character.

3.4 TWO CHARACTER CONTROL SEQUENCES

Appendix C describes the 2 character sequences which are sent by the keyboard to the host.

The following sections describe the two character escape sequences that are sent to the terminal from the host.

The command names and sequences are listed in the following table. The commands themselves are described in the following four sections:

COMMAND	COMMAND SEQUENCE
Set Keypad Numeric Mode	ESC >
Set Keypad Application Mode	ESC =
Reset To Power On State	ESC ~
Display Alternate Control Character	ESC F_e
Where F_e is a G0 Graphic Character Between 40 Hex and 5F Hex, Inclusive	

3.4.1 Set Keypad Numeric Mode

This command sets the keyboard into the keyboard numeric mode. In this mode, the keypad APP mode LED is off. The 5 cursor control keys, when struck, generate the multi character control sequence which, if echoed by the host computer, will implement the cursor movement indicated on the keycap. The keys on the auxiliary keypad will produce the ASCII codes indicated on the keycaps. Refer to Appendix C for the code sequences generated in this mode.

3.4.2 Set Keypad Application Mode

This command sets the keyboard into the keypad application mode. In this mode, the keypad APP mode LED is on. The cursor control keys and the auxiliary keypad keys (except PF1 through PF4) generate different code sequences than in the numeric mode. Refer to Appendix C for the code sequences generated in the mode.

3.4.3 Reset To Power On State

This command resets the terminal to the power on state. This includes:

a. Clearing the terminal's RS232 input and output character buffers;

b. Erasing the screen;

c. Resetting partition 0 to 24 lines and partition 1 to 1 line;

d. Selecting partition 0;

e. Positioning the Cursor to Home;

f. Selecting the primary, G0, character ROM;

g. Restoring the character rendition to Prime;

h. Resetting the tabs; and,

i. Redefining the Station's software modes according to the following chart:

MODE	NAME	STATE
KAM	Keyboard Action	Reset
VEM	Vertical Editing	Reset
LNM	New Line	Reset
MARGIN	Margin	Reset
AUTOSCRL	Auto Scroll	Set
AUTOCLR	Auto Clear	Reset

3.4.4 Display Alternate ROM Control Character

This command enables the host computer to display a single control character from the alternate C1 character set, assuming it has been installed. The Fe character is a character in the primary, G0, graphic character set and whose value is between 40H and 5FH. The C1 character is displayed and does not initiate any control operation in the terminal. Refer to Appendix D for the code sequence required to display a specific C1 character. Notice that the C1 character corresponding to 1BH (left bracket) cannot be displayed.

Example: ESC A will display the graphic associated with 01H in the alternate character ROM.

3.5 MULTI CHARACTER ESCAPE SEQUENCES

The following sections describe the multi character control sequences. The commands are roughly divided into 4 groups: the first group consists of the partition commands; the second group consists of the cursor movement commands; the third group consists of the edit commands; and, the fourth group contains the remaining commands. Appendix H is an alphabetic list of the commands.

Each command section is headed by the command Mnemonic, the command name, the permissible formats and the command direction.

3.5.1 PSR - Partition Screen

ESC [P1 p - (Host to terminal)
ESC [P

PSR divides the 25 lines of the screen into 2 logical groups called partitions. A partition may consist of n lines ($0 \leq n \leq 25$) and the other partition must contain 25-n lines. Partition 0 is the top group of lines and partition 1 is the bottom group. If P1 is null or zero, partition 0 will consist of the complete 25 line screen and partition 1 will consist of 0 lines. If P1 is not null or not zero, then P1 is the first line of partition 1. Thus, partition 0 contains P1-1 lines and partition 1 contains 25-P1+1 lines. A partition is selected using the SSPR command described in Section 3.5.3. If an illegal partition is requested, the command is ignored. The state of the terminal after this command is executed as follows:

a. The screen is erased;

b. Partition 0 is selected;

c. The cursor is moved to the home position;

d. The scroll regions are set to the partition boundaries, i.e., MARGIN mode is reset;

e. The graphic rendition in each partition is set to NORMAL; and,

f. The tab settings are cleared.

Smooth scrolling can only occur in a partition containing two or more lines.

Example: ESC [11 p will divide the screen such that the top partition contains 10 lines and the bottom partition contains 15 lines.

3.5.2 SSCRL - Set Scroll Area

ESC [P1 ; P2 r (Host to terminal)

ESC [r (Host to terminal)

SSCRL defines the scroll region within the selected partition. If MARGIN mode is reset, data transfer and scrolling are restricted to this region. Furthermore, the cursor movement and the edit commands are also restricted to this area. If MARGIN mode is set, the above operations are restricted only by the partition boundaries.

P1 is the top line number of the scroll region and P2 is the bottom line number. If both parameters are null, the scroll area is reset to the full partition. In any case, the cursor is moved to the home position in the scroll area. When MARGIN mode is reset and referencing lines in the scroll region, the first line in the scroll region is line 1.

Example: Partition 1 is selected and contains 15 lines numbered from 1 through 15. ESC [3 ; 15 r will subdivide the partition into a 13 line scroll region with 2 lines fixed above and no fixed lines below. The lines are then numbered from 1 to 13 within the scroll region.

3.5.3 SSPR - Select Partition

ESC [P1 s (Host to Terminal)

ESC [s (Host to Terminal)

SSPR selects or activates a specified partition. If P1 is 0 or null, partition 0 is selected; if P1 is 1, partition 1 is selected. Other values of P1 are ignored.

For programming convenience, a 0 line partition may be selected. Of course, any characters sent to the terminal are ignored. When a partition is selected, the cursor position and the graphic rendition are restored to those values when the partition was deselected.

Example: ESC [1 s will select the lower partition.

3.5.4 CUU - Cursor Up

ESC [P1 A (Host to terminal)

ESC [A (Host to terminal)

CUU moves the cursor up the number of rows indicated by P1. If P1 is 0 or null, a move of 1 is done. The move is always confined within the scrolling region defined by MARGIN mode. If P1 is greater than the number of lines above the active line, the cursor moves to the top line in the scroll region.

Example: The cursor is at line 10 of partition 1; MARGIN mode is reset, ESC [8A will move the cursor to line 2 of partition 1.

3.5.5 CUD - Cursor Down

ESC [P1 B (Host to terminal)

ESC [B (Host to terminal)

CUD moves the cursor down the number of rows indicated by P1. If P1 is 0 or null, a move down of 1 occurs. The move is always confined within the scroll region defined by MARGIN mode. If P1 is greater than the number of lines below the active line, the cursor moves to the bottom line of the scroll region.

Example: The selected partition contains 10 lines. The scrolling region starts at line 2 (counting from 1) and ends at line 8 with respect to the partition boundaries. The cursor is at line 2 of the scroll region and MARGIN mode is set. ESC [20 B moves the cursor to line 10 with respect to the partition.

3.5.6 CUF - Cursor Forwards

ESC [P1 C (Host to terminal)

ESC [C (Host to terminal)

CUF moves the cursor right P1 positions. If P1 is 0 or null, a move of 1 is done. If P1 is greater than the number of character positions to the right of the cursor, the cursor moves to the last character position, column 80.

Example: The cursor is at column 5, row 10. ESC [C advances the cursor to column 6 of the same line.

3.5.7 CUB - Cursor Backwards

ESC [P1 D (Host to terminal)

ESC [D (Host to terminal)

CUB moves the cursor left P1 positions. If P1 is 0 or null, a move of 1 is requested. If P1 is greater than the number of characters to the left of the cursor, the cursor moves to the first column position.

Example: The cursor is at column 2 of row 10. ESC [0 D backspaces the cursor to column 1 of row 10.

3.5.8 CUP - Cursor Position

ESC [Pr ; Pc H (Host to terminal)

ESC [H (Host to terminal)

CUP will move the cursor to a specified row and column number within the active scroll region. Pr is the row number and Pc is the column number. If both Pr and Pc are null, the cursor moves to the home position of the active scroll region. A parameter value of 0 will be treated as 1. If either parameter is such that the requested move would be off the scroll region, the command is ignored.

Example: Partition 0 contains 10 lines numbered 1 to 10. The scroll area begins at line 2 and ends at line 9; MARGIN mode is set. ESC [H homes the cursor to row 1, column 1 of the scroll region. This is line 2, column 1 with respect to the partition boundries.

3.5.9 DSR - Device Status Report

ESC [P1 N (Host to terminal if P=0)

ESC [P1 N (Terminal to Host if P=5 or 6)

The DSR command is used by the host to request either the terminal position or terminal status.

The options are described by the following table:

P1	DIRECTION	ACTION
0	Terminal to Host	This is a response to the status request (P1 = 5), described below. This response implies the terminal is available to process commands.
5	Host to terminal	This is a request by the host for the terminal status
6	Host to terminal	This is a request by the host for the current cursor position. Refer to Section 3.5.10.

Example 1. The host transmits ESC [5 N to the terminal; the terminal responds with ESC [0N indicating the terminal is ready.

Example 2: The host transmits ESC [6 N requesting the cursor position; the terminal responds with the cursor position report described in Section 3.5.10.

3.5.10 CPR - Cursor Position Report

ESC [PR ; Pc R (Terminal to host)

ESC [R (Host to terminal)

CPR data sequence is used to report the cursor position to the host. The report is requested by either the DSR request with Pl = 6 described in Section 3.5.9, or by the CPR request with null parameters. Either way, the terminal responds with the cursor position. P_R is the row number with respect to the scroll region and P_C is the character position (column) number.

Example: Partition 0 contains a scroll region embedded within the partition. MARGIN mode is reset. The cursor is at home. The cursor position is requested by: ESC [R. The terminal responds with ESC [01 ; 01 R.

3.5.11 CTC - Tabulation Control

ESC [Pl G (Host to terminal)

ESC [G (Host to terminal)

CTC sets and resets the terminal's tab settings. If a tab is set at a character position to the right of the active position, a subsequent HT (Horizontal tab = 09 HEX) character sent to terminal will move the cursor to that tab setting. Three options are available:

Pl	ACTION
0 or Null	Set a tab at the current cursor position
2	Clear tab setting at the current cursor position
5	Clear all tab settings

If P_1 is any other value than these listed, the command is ignored. A maximum of 8 tab settings are permitted; and requests to add a tab after this number are ignored. Tab settings are independent of the partition selection.

Example: The cursor is at column 5. The following sequence is sent to the terminal: ESC [5 G ESC [0 G CR HT. The cursor moves to column 5.

3.5.12 ED - Erase In Display

ESC [P_1 J (Host to terminal)

ESC [J (Host to terminal)

ED erases a specified position of the selected scroll region. Erasure means setting the specified area to prime rendition blanks. Three variations of this command are available:

P1	ACTION
0 or Null	Erase from the current cursor position, inclusive to the end of the scroll region. The cursor does not move.
1	Erase from the beginning of the scroll region to the cursor position, inclusive. The cursor does not move.
2	Erase the entire scroll region. The cursor is moved to the home position

Example: The cursor is at line 2, column 10 in the scroll region. ESC [J erases the top line and characters 1 through 10 on line 2. The cursor does not move.

3.5.13 EL - Erase In Line

ESC [P_1 K (Host to terminal)

ESC [K (Host to terminal)

EL erases part or all of the active line. Erasure means setting the specified area to prime rendition blanks. Three variations of this command are defined:

P1	ACTION
0 or Null	Erase from the cursor position, inclusive, to the end of the active line.
1	Erase from the beginning of the active line to the active cursor position, inclusive.
2	Erase the entire active line.

In each of the above cases, the cursor position does not change.

Example: The cursor is at column 10. ESC [K erases characters 1 through 10, inclusive, on the active line.

3.3.14 DL - Delete Line

ESC [P_1 E (Host to terminal)

ESC [E (Host to terminal)

DL deletes P_1 lines from the current scroll region. If VEM mode is reset, then P_1 lines from the active line, inclusive, down are deleted; the remaining lines are moved up, replaced by prime rendition blank lines. If VEM mode is set, the P_1 lines from the active line, inclusive, up are deleted; the remaining lines at the top of the scroll region are moved down replaced by prime rendition blank lines. If P_1 is null or 0, one line is deleted. If P_1 is greater than the number of lines remaining in the scroll region, the remaining lines are deleted.

Example: The scrolling region contains lines 1 through 10; the active line number is 2; VEM mode is reset. ESC [3 E deletes lines 2, 3 and 4; lines 5 through 10 move up 3 rows; and lines 8, 9 and 10 are erased.

3.5.15 IL - Insert Line

ESC [P_1 F (Host to terminal)

ESC [F (Host to terminal)

IL Inserts P_1 lines at the active line. If VEM mode is reset, P_1 prime rendition lines are inserted at and below the active line. Lines pushed passed the bottom scroll region boundary are lost. If VEM mode is set, P_1 prime rendition lines are inserted at and above the active line. Lines from and including the active line. Lines from and including the active line are pushed up. Lines pushed up past the top scroll region boundary are lost. In either case, the cursor does not move.

If P_1 is 0 or null, 1 line is inserted. If P_1 is greater than the number of lines remaining from the active line to the scroll boundary, then that number will be used for P_1.

Example: The selected scroll region has 10 lines. The active line is line 4; VEM mode set. ESC [F moves lines 2 through 4 up one row; the original top line is last and line 2 is now at the partition top. The original line 4 is erased.

3.5.16 DCH - Delete Character In-Line

ESC [P_1 I (Host to computer)

ESC [I (Host to computer)

DCH deletes P_1 characters at the active line. The characters starting from the cursor position, inclusive and going from left to right are deleted. The characters remaining on the line are shifted left filling up the vacancies created by the deleted characters. The vacated character psoitions on the left are erased. If P_1 is 0 or null, one character is deleted. If more characters are specified than remain on the line, then the remainder of the line is erased.

Example: The cursor is at column 78; the SGR of character positions 78, 79 and 80 is reverse video.

ESC [2 I moves the reverse video character at column 80 to column 78. Positions 79 and 80 are set to Normal Video blanks.

3.5.17 ICH - Insert Character In-Line

ESC [P_1 L (Host to computer)

ESC [L (Host to computer)

ICH inserts P_1 prime rendition blanks at the active position. The characters beginning at and to the right of the active position are shifted right P_1 positions.

Characters shifted off the screen are lost. If P_1 is 0 or null 1 character is inserted. If P_1 is greater than the number of characters to the right of the cursor, only that number of blanks are inserted. This command does not change the cursor position.

Example: The cursor is at column 1. ESC [0L shifts all the characters on the active line 1 position right; the character previously at column 80 is lost and column 1 contains a blank.

3.5.18 SGR - Select Graphic Rendition

ESC [P_1 ; P_2 ... M (Host to terminal)

ESC [M

The SGR command sets the rendition or auxiliary attributes that are associated with the characters as they are received and displayed. These attributes are described in the following table:

P1	ATTRIBUTES
0 or Null	Primary Rendition
2	Faint
4	Underline
5	Slow Blink
7	Reverse Video
99	Overstrike

The above attributes may be assigned singly or in any combination. If an undefined parameter is used in the command string, the entire command is ignored.

The terminal uses the transparent attribute philosophy whereby the assignment of character attributes do not consume character positions on the screen. However, each line is restricted to 15 rendition changes. If the active line already has 15 rendition changes and a character is received which would require an additional rendition change, the character will be laid into the line using the same graphic rendition as the overlaid characters. In other words, the New Graphic rendition is not yet honored. This use of the new rendition will be resumed as soon as the condition occurs where the active line has less than 15 rendition changes. An additional restriction is that a Form character (refer to 3.5.19) may not overlay any character where the rendition has changed from the preceding character on the current line. Furthermore, if a rendition is selected which has, as a component, the attributes of underline or reverse video, then these characteristics apply to a following Form character on the current line. The faint, blink or overstrike components of a rendition are not applied to following Form characters. However, the attributes faint and blink are intrinsic attributes of a Form character and can be specified directly. Refer to GRAPH, Section 3.5.19.

Example: ESC [5 ; 99 M is sent to the terminal. Henceforth all characters transmitted to the screen will blink and be overstriken.

3.5.19 GRAPH - Generate Graph Character

ESC [P_1 ; P_2 t (Host to terminal)
ESC [P_1 t (Host to terminal)

GRAPH displays a single Form character selected from the following table:

P1	GRAPHIC	DESCRIPTION
0	┌	Top left corner
1	┐	Top right corner
2	└	Bottom left corner
3	┘	Bottom right corner
4	┬	Top Intersect
5	┤	Right Intersect
6	├	Left Intersect
7	┴	Bottom Intersect
8	─	Horizontal Line
9	│	Vertical Line
10	┼	Crossed Lines

The first parameter, P1, specifies the Form character; the second parameter, P2, specifies the intrinsic attributes that are assigned to the selected character independent of the current graphic rendition. The attributes indicated by P2 are defined by the following table:

P2	RENDITION
0 or Null	Neither blink nor faint are assigned to the form character.
1	Faint (reduced intensity) only is assigned to the form character
2	Blink attribute only is assigned to the form character
3	Both Faint and Blink attributes are assigned to the form character

A Form character must not immediately be preceded by a non-form character which has a different rendition than the character preceding it. In fact, the GRAPH command checks for this condition and if found, the command is ignored.

Subsequently, it is possible (but not permissible) for the user to change the graphic rendition of a character immediately to the left of an existing Form character. It is now possible that this character will have different attributes than the character immediately to the left. In this case, the effect on the form character is unpredictable.

In addition, Form characters take on some, but not all of the attributes of the preceding character field on the same line. The Form character takes on the attributes of underline and reverse video but not of faint, blink or overstrike.

Example: The current line is displayed in Reverse Video. The sequence ESC [9 ; 2 t is transmitted to the terminal. Then a blinking, reversed video vertical line is written to the active position.

3.5.20 SM - Set Mode

ESC [P1 ; P2 ; P3 ... 0 (Host to terminal)

The SM command and the RM command described in the next section are designed to be used together to set and reset a number of terminal modes which alter the terminal's behavior. This command sets switches. Multiple switches may be set with one command. Refer to Mode Description in Section 3.5.22

3.5.21 RM - Reset Mode

ESC [P1 ; P2 ; P3 ...P (Host to terminal)

The RM command and the SM command described in the previous section are designed to be used together to set and reset a number of terminal modes. This command resets the terminal modes. Multiple modes may be reset with one command. The description of the modes follows in the next section.

3.5.22 Mode Description

Any or all of the modes may be simultaneously set or reset by using the set and reset mode commands, respectively.

A mode is specified by a decimal ASCII string. Certain modes must be preceded by an equal sign (3DH). The modes are described as follows. (The specifying parameter is enclosed in paranthesis following the Mode Mnemonic).

KAM (2) Keyboard Action Mode

In the reset (the default) state, the keyboard is unlocked. The KEYBD Lock LED is off. In the set state, the keyboard is locked and will not respond to characters typed at the keyboard. In this mode, the KEYBD LOCK LED is on.

Example: ESC [2 P enables the keyboard if locked.

VEM (7) Vertical Editing Mode

The Vertical Editing Mode affects the insert and delete line commands. The power up state of VEM is reset. In this state, lines are deleted from the active line down by the Delete Line command and the active line down is pushed down by the Insert Line commands. Refer to Sections 3.5.14 and 3.5.15.

If VEM is set, lines are deleted from the active line-up by the Delete Line command and the active line-up is pushed up by the Insert command. Refer to Sections 3.5.14 and 3.5.15 for further information on the VEM mode.

Example: ESC [7 ; 2 P resets the KAM and VEM mode.

LNM (20) Linefeed New Line Mode

This mode affects the operation of the terminal after receipt of a carriage return. If this mode is reset, the power up state, a linefeed is not automatically executed by the terminal after the carriage return. If this mode is set, a linefeed is automatically executed.

Example: ESC [20 o will obviate the host CPU from following a carriage return with a linefeed.

MAR (=0) MARGIN Mode

MARGIN mode defines the operational boundries of the cursor movement and line edit commands. If this mode is reset, the default state, the operational boundries are with respect to the Scroll area as defined by the set Scroll area command in Section 3.5.2; and, these operational areas may not be identical to the partition boundries. If this mode is set, the operational boundries are with respect to the partition regardless of the scroll boundries.

Example: The command sequence ESC [= 0 P ESC [H moves the cursor to the upper left corner of the scroll region.

AUTOSCRL (=1) Autoscroll Mode

AUTOSCRL feature defines the action of the terminal after receiving a linefeed when the cursor is at the last line of the scroll region. The default mode is set; and in this state when the above conditions prevail, the lines in the scrolling region shift up 1 row. The original top line is lost and the bottom line is erased providing space for the incoming characters.

If AUTOSCR is reset, the lines in the scrolling region, under the above conditions, do not scroll; but two cases exist: one, if AUTOCLR mode is reset, the cursor and active position do not change; and two, if AUTOCLR mode is set, the scroll region is erased and the cursor is moved to the home position.

Example: ESC [= 1 P inhibits the terminal from auto scrolling.

AUTOCLR (=4) Autoclear Mode

AUTOCLR Mode affects the terminals action on receipt of a linefeed when the cursor is at the last row of the scroll region. This mode is ignored when AUTOSCRL mode is set. If AUTOCLR is reset, the default state, and the aforementioned conditions prevail, the display is not altered. If AUTOCLR is set, the scroll region is erased and the cursor is moved to home.

Example: The sequence ESC [= 1 P
ESC [= 4 0 guarantees the operation of the Auto Clear feature.

3.5.23 LED Control

ESC [P0 ; P1 ; P2 ... q (Host to computer)
ESC [q (Host to computer

The LEDS command controls LED's L2 through L0 on the keyboard and D7 through D0 on the front panel. From the host computer's point of view, the lights are numbered as follows:

LIGHT NAME	LED NUMBER
L2	1
L1	2
L0	3
D7	4
D6	5
D5	6
D4	7
D3	8
D2	9
D1	10
D0	11

If the first parameter P0 is 0, then the command turns off lights; if P0 is 1, the command turns on lights. If P0 is 0, the command turns off lights. The parameters P1 ; ... indicate the lights to be controlled. The command ESC [q turns off all lights.

Example: ESC [1 ; 1 ; 11 q turns on L0 and D0 on the keyboard and front panel respectively.

CHAPTER 4 HARDWARE CONFIGURATION GUIDE

This section provides the information necessary to configure the CD100-M workstation's hardware options. Subsections cover configuring the terminal's RS232 port, the Multibus Card Cage and Motherboard, Power Fail Motherboard and ACLOW Circuit, and development and installation of Alternate Character Sets.

4.1 TERMINAL RS232 PHYSICAL INTERFACE

The CD100-M terminal controller board provides a standard 25 pin "D" type female communication connector and circuitry per EIA Standard RS-232C. Configuration interface type "D" is used for Duplex operation with Request to Send used to indicate a non-transmit mode to the local host (Multibus System Processor). The one exception to the type "D" interface is that the CD100-M is not microprogrammed (on the terminal controller) to respond to the Modem Ring indicator signal (RS232C Circuit CF).

Data transmission protocol is industry standard asynchonous start-stop protocol. One stop bit is used at 300 and above baud rates and two bits at 150 and below.

The CD100-M terminal controller can be configured to disable use of various interchange circuits to accommodate simpler host interfaces which perhaps do not generate the required status signals. Refer to figure 4-1 for shunt (jumper) locations on the terminal controller board.

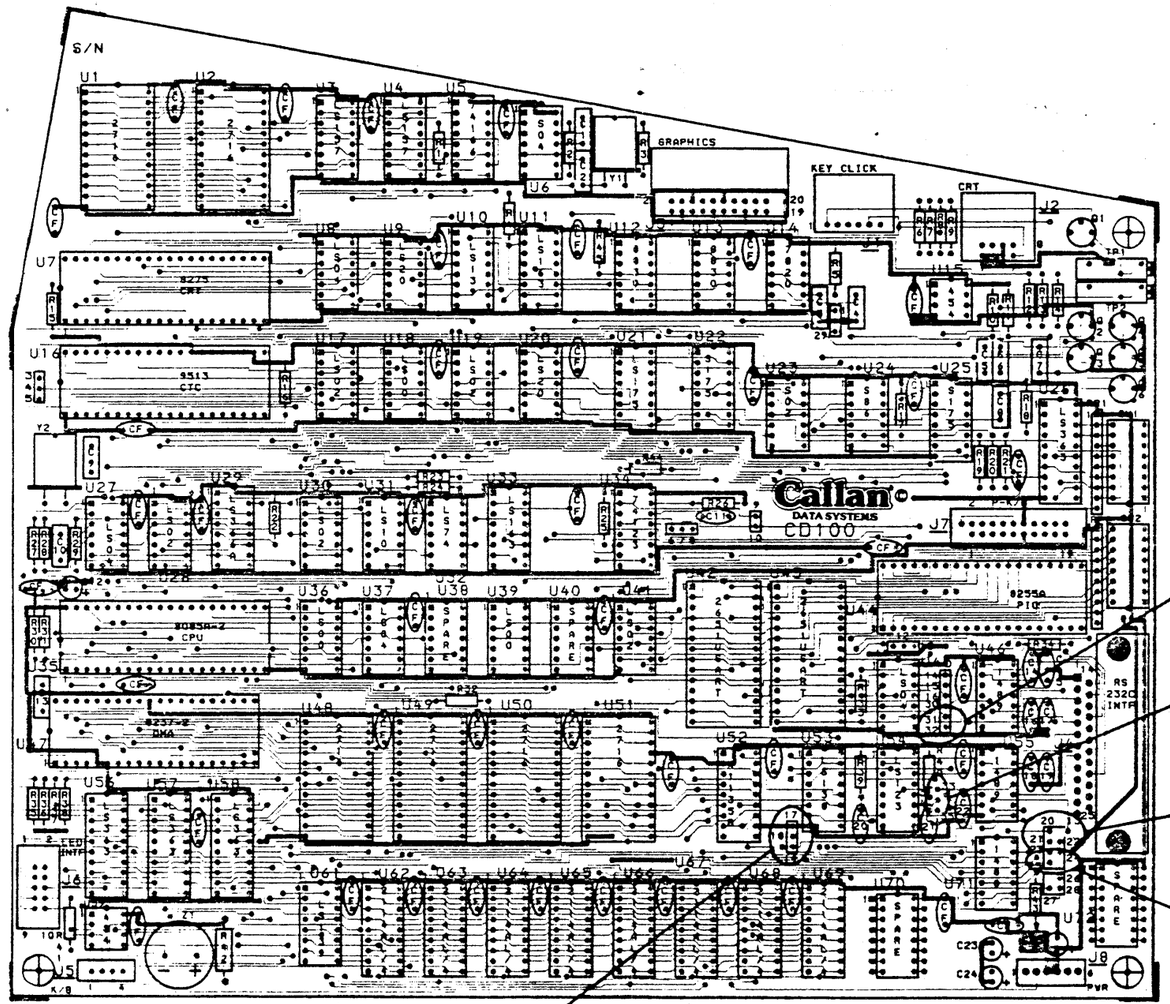
SHUNT		RS-232 INTERCHANGE CIRCUIT
31-32*	ENABLE CLEAR TO SEND FROM HOST	(CKT CB)
31-30	DISABLE CLEAR TO SEND FROM HOST	
34-33*	ENABLE DATA SET READY FROM HOST	(CKT CC)
34-35	DISABLE DATA SET READY FROM HOST	
18-19	ENABLE CARRIER DETECT FROM HOST	(CKT CF)
17-18*	DISABLE CARRIER DETECT FROM HOST	
23-24*	USE INTERNAL TERMINAL RECEIVE CLOCK	
23-25	USE RECEIVE SIGNAL ELEMENT TIMING FROM HOST FOR RECEIVE DATA CLOCK	(CKT DD)
20-21	USE TRANSMITTER SIGNAL ELEMENT TIMING FROM HOST FOR TRANSMIT CLOCK	(CKT DB)
21-22*	USE INTERNAL TERMINAL BAUD CLOCK	
*	NORMAL FACTORY INSTALLED SHUNT	

Table 4-1
RS-232 JUMPER SELECTION

DWG. NO.	SH	REV

REVISIONS

ZONE	REV.	DESCRIPTION	DATE	APPROVED



USER'S RS-232 OPTION JUMPER LOCATIONS
FIGURE NO. 4 - 1

QTY REQD	FSCM NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS DECIMALS ANGLES
XX -
XXX -

MATERIAL

FINISH

NEXT ASSY | USED ON

APPLICATION

DO NOT SCALE DRAWING

CONTRACT NO.

APPROVALS | DATE

DRAWN

CHECKED

ISSUED

Callan DATA SYSTEMS
26 17 Townsgate Road
Westlake Village CA 91361
(805) 497-6647

VIDEO PROCESSOR

SIZE | FSCM NO | DWG. NO | REV
D

SCALE | SHEET

The latter four jumpers allow reconfiguration of the transmit and receive clocks of the RS232 terminal interface in order to use host supplied clocks.

In order to gain access to the terminal controller board remove the four access screws (two in bottom front and the two under the rear cover at the top of the unit).

4.2 MULTIBUS BACKPLANE CONFIGURATION GUIDE

4.2.1 Introduction

This section provides a description of user configurable options available on the Callan Data Systems Multibus Backplane Motherboard CD100-M. User options are configured by the installation of shunts or by wirewrap. Options affect bus arbitration and use of the front panel reset and interrupt switches. For further information regarding operation and use of the Multibus refer to Intel document order no. 98000683.

4.2.2 Bus Arbitration Options

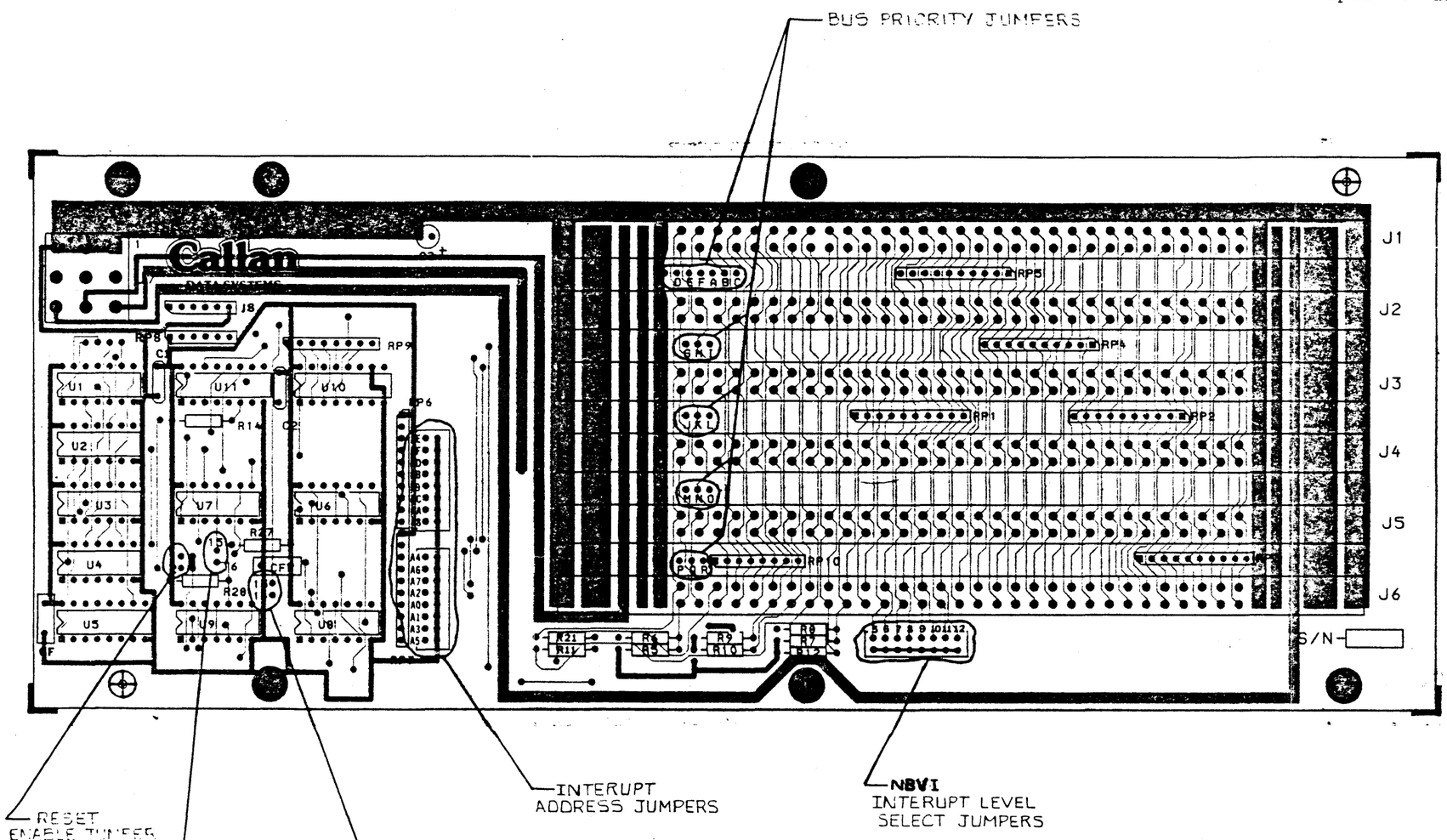
The Callan Multibus Motherboard is factory configured for serial bus arbitration. Connector and card position J6 is the lowest priority slot (closest to the rear of the unit) while J1 is the highest. Normally the processor would be installed in slot J6. The Motherboard provides the chaining of the BPRO/ to BPRN/ signal between card slots. Additionally wirewrap posts are provided to connect parallel generated BPRO/ (grant) signals for parallel bus arbitration and the posts also allow the BPRN/ input of the last card slot used to be grounded thus making it the highest priority. Normally the card cage would be populated by cards from the lowest priority slot J6 toward the highest (J1).

IMPORTANT: The highest priority slot of the serial arbitration chain must have the shunt installed to ground its BPRN/input in order for the arbitration signal chain to work properly. The factory installed shunt between posts A and B for slot J1 maybe moved as appropriate. Refer to figure no. 4-2 which is a copy of the Motherboard silkscreen layer for location of all wirewrap posts. The wirewrap posts are defined as follows:

DWG. NO.	SH	REV.

REVISIONS

ZONE	REV.	DESCRIPTION	DATE	APPROVED



MULTIBUS JUMPER LOCATIONS
FIGURE NO. 4 - 2

QTY REQD	FSCM NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION
			PARTS LIST	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES . XX - . XXX - .	CONTRACT NO	Callan DATA SYSTEMS 2645 Townsgate Road Westlake Village, CA 91361 (805) 497-9637	
	APPROVALS DATE	MULTIBUS MOTHERBOARD	
MATERIAL	DRAWN		
FINISH	CHECKED		
NEXT ASSY USED ON	ISSUED	SIZE D FSCM NO. DWG. NO. REV	
APPLICATION DO NOT SCALE DRAWING		SCALE SHEET	

LABELED PAIR	FUNCTION
A-B	Grounds BPRN/signal for J1 (factory installed)
D-E	" J2
G-H	" J3
J-K	" J4
M-N	" J5
P-Q	" J6

Table 4-2
Serial Priority Chain Configuration

Parallel bus arbitration maybe implemented with the Callan Backplane Motherboard. The user will need to determine whether this step is necessary by referring to the specifications for the Multibus boards that are being used. If the total on-board serial delays exceed the period of the bus arbitration clock minus input setup times and safety margins then parallel arbitration is required.

Parallel arbitration is implemented by installing U10 (74148) and U11 (74S138) in the sockets provided on the Motherboard. Refer to figure No. 4-2 for their locations. Any grounding shunts initially installed for serial arbitration must be removed for proper operation.

IMPORTANT: When parallel arbitration is used the Multibus boards installed must be configured to disconnect the BPRO/signal from reaching the P1 connector. For instance, Intel short E151-E152 would be removed on the 86/12A board. Boards installed in slot J6 need not have this done since its BPRO/signal is not used. Failure to do this will result in contention between TTL output drivers in the arbitration logic and the on-board BPRO/driver. Additionally for parallel arbitration shunts must be installed to provide BPRO/signals from the arbitration logic on the Motherboard to each slot which contains a bus master. The wirewrap shorting posts to accomplish this are as follows:

LABELED PAIR	FUNCTION
B-C	Connects BPRO/ (parallel grant) to J1
E-F	" J2
H-I	" J3
K-L	" J4
N-O	" J5
Q-R	" J6

Table 4-3
PARALLEL PRIORITY JUMPERS

4.2.3 Reset Switch Logic

The Callan CD100-M Multibus workstation provides a front panel switch which may be used to reset boards installed in the backplane. Debounce logic and drivers are provided on the Motherboard. A factory installed shunt between posts labeled "1" and "2" connects the reset signal to the INIT/signal on the backplane (initialization signal). The shunt can be removed to disable the reset switch.

4.2.4 Interrupt Switch Logic Configuration

The front panel Interrupt switch can be configured to provide a NON-BUS VECTORED type of interrupt to the Multibus System using any of the eight Multibus interrupt request lines. It can be further configured to respond to an 8 or 16 bit IO address for clearing or reading of the Interrupt request flip flop.

Option posts for the interrupt logic are defined as follows. Refer to Figure No. 4-2 for location on the Motherboard PCB.

POST(S) LABEL	FUNCTION
13-14	Connects the Interrupt flip flop to data bus bit line DAT0/to allow the CPU to read its value.
15-16	Connects the upper 8 address bit comparator to allow response to 16 bit IO addresses. When not installed only 8 bit IO addresses are used.

POST(S) LABEL	FUNCTION
A0-A9 AA-AF	These positions configure the IO address to which the Motherboard Interrupt logic will respond. If an address bit is to be recognized as a logic one then the corresponding shunt must be installed in the position labeled with the address (i.e. ADR0=A0, etc).
5	Connects Front Panel Interrupt to INT6/line
6	" INT7/line
7	" INT4/line
8	" INT5/line
9	" INT2/line
10	" INT3/line
11	" INT0/line
12	" INT1/line

Table 4-4
INTERRUPT CONFIGURATION JUMPER

Performing an IO write cycle to the configured interrupt IO address port will clear the interrupt flip flop after it has been set by the leading edge of the interrupt switch signal. Reading the same address will allow the processor to read the status of the interrupt flip flop in the least significant data bit.

4.2.5 Multibus/IEEE 796 Differences

The Callan CD100-M Multibus Motherboard was designed to the requirements of the Intel Multibus specifications as outlined in the Manual order No. 98000683 available from Intel. However, the Intel P1 connector PIN 25 is used as the LOCK signal as required by the IEEE Standard. The Callan backplane also provides - 5V which is not required by the IEEE specification but is by the Intel Multibus.

4.2.6 Backplane Power Capacity

The following table provides the maximum available power to the Multibus backplane (subtract P2 Motherboard requirements if installed).

Voltage	Maximum Available Current Capacity	With Floppies Installed
+12V ± 2.5%	4.0 AMPS	2.4 AMPS
+ 5V ± 1%	23 AMPS	22 AMPS
- 5V ± 4%	4 AMPS	
-12V ± 2.5%	3.5 AMPS	

Table 4-5
POWER SPECIFICATIONS

4.3 POWER FAIL OPTION BOARD (P2 MOTHER BOARD)

The -01 option of the CD100-M workstation provides the user with a motherboard for the Multibus card P2 connectors. Refer to the Intel Multibus document for details on the signal definitions and use of this connector group. All signals on the P2 connectors are bussed.

4.3.1 Extended Address

The P2 Motherboard provides four additional address lines for extension to 16m bytes of addressibility. Pin assignments on P2 are as follows:

ADR14 = PIN 57
ADR15 = PIN 58 2.2k ohm pull-ups provided
ADR16 = PIN 55
ADR17 = PIN 56

4.3.2 Power Fail Interrupt

The -01 Power Fail option board can be utilized to provide a power fail interrupt to the Multibus system when it is used in conjunction with the -03 AC LOW detection option. This latter option provides a circuit in the CD100-M power supply and its connection to the P2 power fail motherboard in order to allow it to generate the Power Fail Interrupt (PFIN/), Power Failed Sense Latch (PFSN/) and Protect Line (MPRO/) signals. The MPRO/ (Memory Protect) is asserted after a 3m Sec delay from the AC LOW indication and returns inactive when the AC LOW signal is inactive. If MPRO/ is used within the system to protect memory, then circuitry should be provided within the users' Multibus system to insure that the MPRO/ signal does not return inactive until the DC voltages applied to the memory have returned to written specifications. The P2 motherboard also responds to the

REVISION OF TABLE 4-5. IT IS REVISED TO THE FOLLOWING:

CARD CAGE POWER SPECIFICATIONS:

NOTE: FAILURE TO COMPLY WITH LIMITS IN THIS TABLE WILL VOID THE CD-100-M WARRANTY

VOLTAGE SPECIFICATION:	MAXIMUM AVAILABLE CURRENT	
+12V ± 5%	2.4 AMPS	
+ 5V ± 3%	22 AMPS	COMBINATION NOT TO EXCEED POWER LIMITS
-12V ± 5%	1.5 AMPS	
- 5V ± 5%	.5 AMPS	

POWER LIMITS: (AVAILABLE TO CARD CAGE) CONFIGURATION:	LIMIT
NO DISKS	165 WATTS
-61 OR -62 OPTION INSTALLED	135 WATTS
-71 OPTION INSTALLED	120 WATTS

Power Fail Sense Latch Reset Signal provided to the P2 Multibus by one of the Multibus boards in order to reset the Power Failed Sense Latch. Refer to Appendix M for detail logic diagram of the P2 motherboard. The Power Fail Sense Latch is also reset by the front panel reset switch. All the logic on the P2 motherboard is powered by the +5VB back-up power suppy.

4.3.3 P2 Motherboard Connection

Table 4-6 provides a list of circuit connections provided on the P2 motherboard connector J7. The connections are available as a convenience for custom user wiring. An AMP 1-10224-6 descrete wire housing can be used for interfacing to this connector. For use of the power fail interrupt logic a +5V ± 5% Battery Back-up supply connection must be provided by the user to the P2 motherboard or the +5VB must be jumped to +5 if no battery back-up supply is being used. This can be accomplished by a user installed battery pack or on a Multibus board with provisions for batteries.

PIN	FUNCTION
1	GND
2	GND
3	+5VB
4	+5VB (Jumper to +5 if no battery
5	CCPP (To P2 PIN 6) back-up)
6	-5VB
7	+5V
8	+12VB
9	+12VB
10	-12VB
11	-12VB
12	+15V
13	+15V
14	-15V
15	-15V
16	ACLOW/
17	RESET
18	AUX RESET (To P2 PIN 38)

Table 4-6
J7-P2 MOTHERBOARD CONNECTOR

4.3.4 P2 Motherboard Power Requirements

Power requirements of the on-board circuitry of the P2 Motherboard is as follows:

+5V = 10ma Typ, 20ma MAX

+5VB = 16ma Typ, 30ma MAX; Battery Back-up

4.4 ALTERNATE CHARACTER ROM GENERATION

An alternate character set can be incorporated in the CD100-M by installation of a 2716 EPROM or equivalent device in IC Location 42 on the terminal controller board. Software driven commands are available for invoking the character set (See Section 3.0 herein). Up to 128 characters can be included in the alternate character ROM. Sixteen bytes are stored in sequence for each character to define its character font (see Figure 4). A seven bit binary code is used to address each character as it is displayed in the same way that ASCII character codes are used to address characters in the standard set EPROM. Therefore, the seven bit character code is used on address lines A4-A10 of the 2716 where A4 is the least significant bit of the character code sent to the terminal. Address lines A0-A3 are used to select the rows of the character matrix as each character is displayed.

Within the data stored in the Character Generator EPROM each byte stored represents a row of the character matrix Bit 7 output is not used since the character matrix is 7 x 13 (Columns x Rows). Refer to figure 4.3 for an example of the character matrix format.

4.5 AC LOW CIRCUIT

The CD100-M with a -03 option provides a signal to the P2 Motherboard which allows it to assert the power fail interrupt. It is adjusted to be active when the AC line is 10% below the minimum AC input voltage.

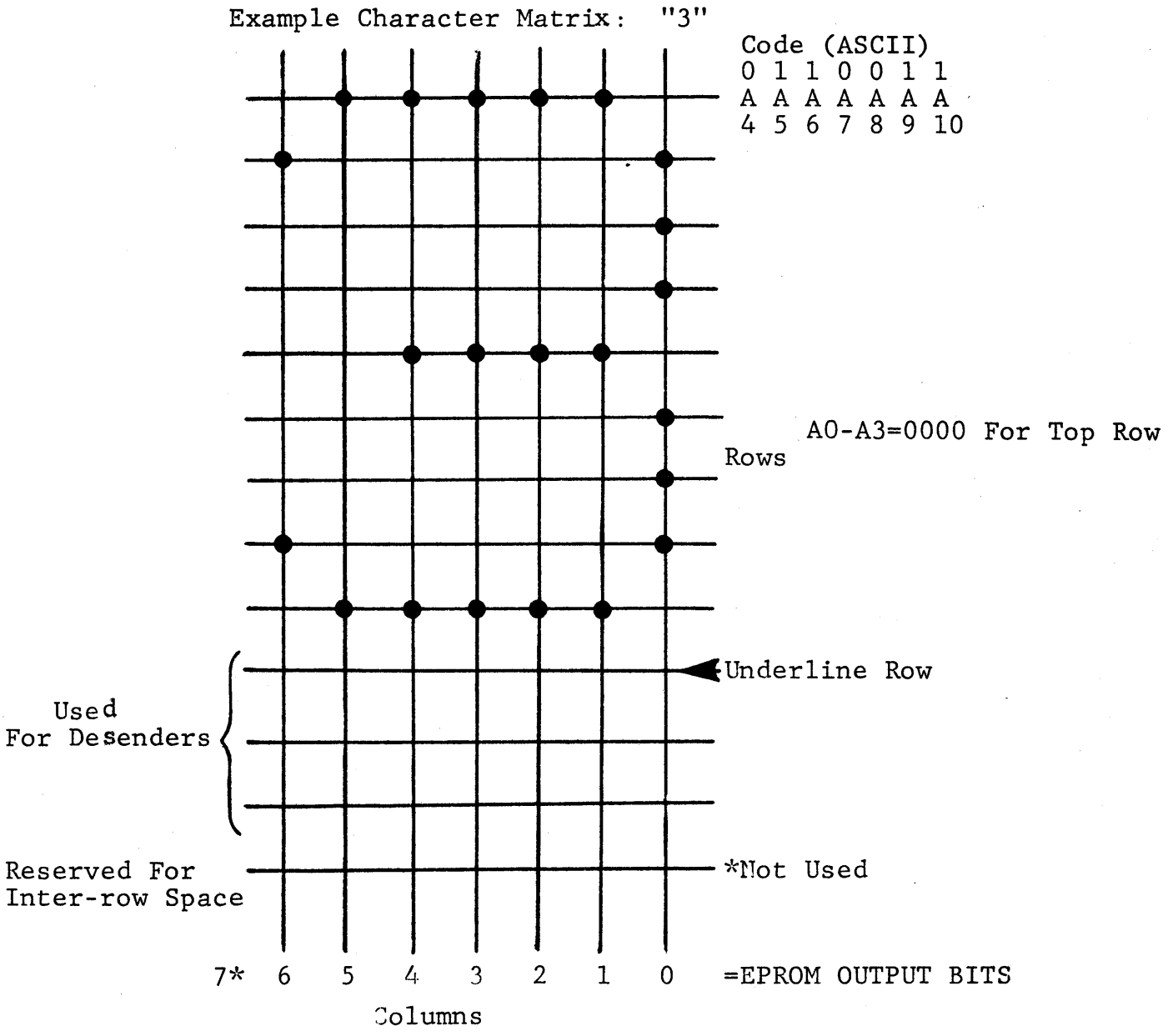


Figure 4-3
CHARACTER MATRIX FORMAT

APPENDIX A

CHARACTER CODES AND GRAPHICS DISPLAYED ON RECEPTION

HEX	ASCII	DISPLAY MONITOR MODE	DISPLAY NON-MONITOR MODE	HEX	ASCII	DISPLAY MONITOR MODE	DISPLAY NON-MONITOR MODE
00	NUL	•		40	@	@	@
01	SOH	S_H		41	A	A	A
02	STX	S_X		42	B	B	B
03	ETX	E_X		43	C	C	C
04	EOT	E_T		44	D	D	D
05	ENQ	E_Q		45	E	E	E
06	ACK	A_K		46	F	F	F
07	BEL *	E_T		47	G	G	G
08	BS	B_E		48	H	H	H
09	HT	H_T		49	I	I	I
0A	LF	L_F		4A	J	J	J
0B	VT	V_T		4B	K	K	K
0C	FF	F_F		4C	L	L	L
0D	CR	C_R		4D	M	M	M
0E	SO	S_O		4E	N	N	N
0F	SI	S_I		4F	O	O	O
10	DLE	D_L		50	P	P	P
11	DC1	D_1		51	Q	Q	Q
12	DC2	D_2		52	R	R	R
13	DC3	D_3		53	S	S	S
14	DC4	D_4		54	T	T	T
15	NAK	N_K		55	U	U	U
16	SYN	S_Y		56	V	V	V
17	ETB	E_B		57	W	W	W
18	CAN	C_N		58	X	X	X
19	EM	E_M		59	Y	Y	Y
1A	SUB	S_B		5A	Z	Z	Z
1B	ESC	E_C		5B	⌊	⌊	⌊
1C	FS	F_S		5C	/	¬	/
1D	GS	G_S		5D	¬		¬
1E	RS	R_S		5E	^	^	^
1F	US	U_S		5F	-	-	-

* Sounds Bell

APPENDIX A

CHARACTER CODES AND GRAPHICS DISPLAYED ON RECEPTION

HEX	ASCII	DISPLAY MONITOR MODE	DISPLAY NON-MONITOR MODE	HEX	ASCII	DISPLAY MONITOR MODE	DISPLAY NON-MONITOR MODE
20	Space			60	'	'	'
21	!	!	!	61	a	a	a
22	"	"	"	62	b	b	b
23	#	#	#	63	c	c	c
24	$	$	$	64	d	d	d
25	%	%	%	65	e	e	e
26	&	&	&	66	f	f	f
27	'	'	'	67	g	g	g
28	(	(	(	68	h	h	h
29	)	)	)	69	i	i	i
2A	*	*	*	6A	j	j	j
2B	+	+	+	6B	k	k	k
2C	,	,	,	6C	l	l	l
2D	-	-	-	6D	m	m	m
2E	.	.	.	6E	n	n	n
2F	/	/	/	6F	o	o	o
30	0	0	0	70	p	p	p
31	1	1	1	71	q	q	q
32	2	2	2	72	r	r	r
33	3	3	3	73	s	s	s
34	4	4	4	74	t	t	t
35	5	5	5	75	u	u	u
36	6	6	6	76	z	z	z
37	7	7	7	77	w	w	w
38	8	8	8	78	x	x	x
39	9	9	9	79	y	y	y
3A	:	:	:	7A	z	z	z
3B	;	;	;	7B	{	{	{
3C	<	<	<	7C	|	|	|
3D	=	=	=	7D	}	}	}
3E	>	>	>	7E	~	~	~
3F	?	?	?	7F	DEL	▯	

APPENDIX B
KEYS NOT AFFECTED BY NUMERIC/APP MODE

KEY CAPTION	UNSHIFTED		SHIFTED		CONTROL UNSHIFTED		CONTROL SHIFTED	
	ASCII	HEX	ASCII	HEX	ASCII	HEX	ASCII	HEX
ESC	ESC	1B	ESC	1B	ESC	1B	ESC	1B
! 1	1	31	!	21	1	31	!	21
@ 2	2	32	@	40	.	00	.	00
# 3	3	33	#	23				
$ 4	4	34	$	24	4	34	$	24
% 5	5	35	%	25	5	35	%	25
^ 6	6	36	^	5E	6	36	RS	1E
& 7	7	37	&	26	7	37	&	26
* 8	8	38	*	2A	8	38	*	2A
(9	9	39	(	28	9	39	(	28
) 0	0	30	)	29	0	30	)	29
_ -	-	2D	—	5F	US	1F	US	1F
+ =	=	3D	+	2B	=	3D	+	2B
~ '	'	60	~	ME	'	ME	~	7E
BACK SPACE	BS	08	BS	08	BS	08	BS	08
TAB	HT	09	HT	09	HT	09	HT	09

APPENDIX B

KEYS NOT AFFECTED BY NUMERIC/APP MODE

KEY CAPTION	UNSHIFTED		SHIFTED		CONTROL UNSHIFTED		CONTROL SHIFTED	
	ASCII	HEX	ASCII	HEX	ASCII	HEX	ASCII	HEX
Q	q	71	Q	51	DC1	11	DC1	11
W	w	77	W	57	ETB	17	ETB	17
E	e	65	E	45	ENQ	05	ENQ	05
R	r	72	R	52	DC2	12	DC2	12
T	t	74	T	54	DC4	14	DC4	14
Y	y	79	Y	59	EM	19	EM	19
U	u	75	U	55	NAK	15	NAK	15
I	i	69	I	49	HT	09	HT	09
O	o	6F	O	4F	SI	0F	SI	0F
P	p	70	P	P	DLE	10	DLE	10
{ [	[	5B	{	7B	ESC	1B	ESC	1B
}]	]	5D	}	7D	GS	1D	GS	1D
DEL	DEL	7F	DEL	7F	DEL	7F	DEL	7F
A	a	61	A	41	SOH	01	SOH	01
S	s	73	S	53	DC3	13	DC3	13
D	d	64	D	44	EOT	04	EOT	04
F	f	66	F	46	ACK	06	ACK	06
G	g	67	G	47	BEL	07	BEL	07
H	h	68	H	48	BS	08	BS	08
J	j	6A	J	4A	LF	0A	LF	0A
K	k	6B	K	4B	VT	0B	VT	0B
L	l	6C	L	4C	FF	0C	FF	0C
: ;	;	3B	;	3A	:	3B	;	3A
'	'	27	"	22	'	27	"	2d

APPENDIX B
KEYS NOT AFFECTED BY NUMERIC/APP MODE

KEY CAPTION	UNSHIFTED		SHIFTED		CONTROL UNSHIFTED		CONTROL SHIFTED	
	ASCII	HEX	ASCII	HEX	ASCII	HEX	ASCII	HEX
RETURN	CR	0D	CR	0D	CR	0D	CR	0D
/	/	5C	↓	7C	FS	1C	FS	1C
Z	z	7A	Z	5A	SUB	1A	SUB	1A
X	x	78	X	58	CAN	18	CAN	18
C	c	63	C	43	ETX	03	ETX	03
V	v	76	V	56	SYN	16	SYN	16
B	b	62	B	42	STX	02	STX	02
N	n	6E	N	4E	SO	0E	SO	0F
M	m	6D	M	4D	CR	0D	CR	0D

APPENDIX B
KEYS NOT AFFECTED BY NUMERIC/APP MODE

KEY CAPTION	UNSHIFTED		SHIFTED		CONTROL UNSHIFTED		CONTROL SHIFTED	
	ASCII	HEX	ASCII	HEX	ASCII	HEX	ASCII	HEX
< ,	,	2C	<	3C	,	2C	<	3C
> .	.	2E	>	3E	.	2E	>	3E
? /	/	2F	?	3F	/	2F	?	3F
LINE FEED	LF	OA	LF	OA	OF	OA	LF	OA
SPACE BAR	SPACE	20	SPACE	20	SPACE	20	SPACE	20

APPENDIX C

KEYS AFFECTED BY NUMERIC/APP MODE

CAPTION	LOCATION	NUMERIC MODE SEQUENCE	APP MODE SEQUENCE	
PF0	M	ESC '	ESC '	Note 3
↑	M	ESC [A	ESC a	
↓	M	ESC [B	ESC b	
←	M	ESC [D	ESC d	
→	M	ESC [C	ESC c	
HOME	M	ESC [H	ESC h	
PF1	A	ESC e	ESC e	Note 3
PF2	A	ESC f	ESC f	Note 3
PF3	A	ESC g	ESC g	Note 3
PF4	A	ESC i	ESC i	Note 3
7	A	7	ESC w	
8	A	8	ESC x	
9	A	9	ESC y	
-	A	-	ESC	
4	A	4	ESC t	
5	A	5	ESC u	
6	A	6	ESC v	
,	A	,	ESC l	
1	A	1	ESC g	
2	A	2	ESC r	
3	A	3	ESC s	
ENTER	A	CR	ESC m	
0	A	0	ESC p	
.	A	.	ESC n	

Note 1. M = Main Keypad
A = Auxiliary Keypad

Note 2. The above keys are not affected by Shift Control keys

Note 3. Key Sequences are the same in Numeric and APP Modes

APPENDIX D

GENERATION OF C_1 SET GRAPHICS

Fe	Fe (HEX)	C1	Fe	Fe (HEX)	C1
@	40	00	P	50	10
A	41	01	Q	51	11
B	42	02	R	52	12
C	43	03	S	53	13
D	44	04	T	54	14
E	45	05	U	55	15
F	46	06	V	56	16
G	47	07	W	57	17
H	48	08	X	58	18
I	49	09	Y	59	19
J	4A	0A	Z	5A	1A
K	4B	0B	⌐	5B	1B
L	4C	0C	½	5C	1C
M	4D	0D	¬	5D	1D
N	4E	0E	^	5E	1E
O	4F	0F	-	5F	1F

To generate alternate character ROM C_1 graphics use ESC Fe sequence.

APPENDIX E

MODE COMMAND OPTIONS

MODE NAME	MNEMONIC	VALUE	OPTIONS	
			Reset	Set
Keyboard Action	KAM	2	Unlock Keyboard*	Lock Keyboard
Vertical Editing	VEM	7	Edit Movement* Below Active Line	Edit Movement Above Active Line
Line Feed New Line	LNM	20	Follow CR With LF*	Do Not Follow CR With LF
Margin	MARGIN	=0	Edits & Cursor With Respect To Scroll*	Edits & Cursor Not With Respect To Scroll Area
Auto Scroll	AUTOSCRL	=1	Auto Scroll Not Active*	Auto Scroll Active*
Auto Clear	AUTOCLR	=4	Do Not Auto Clear*	Auto Clear

* Is the Default (Power Up) State

APPENDIX F

GRAPHIC RENDITIONS

NAME	P1
Primary Rendition	0
Faint (1/2 Intensity)	2
Underline	4
Slow Blink	5
Reverse Video	7
Over Strike	99

Use the Command: ESC [P_1 ; P_2 ...M to set the Rendition

APPENDIX G

FORM CHARACTERS

P_1	NAMES	GRAPHIC
0	Top Left Corner	⌜
1	Top Right Corner	⌝
2	Bottom Left Corner	⌞
3	Bottom Right Corner	⌟
4	Top Intersect	┬
5	Right Intersect	┤
6	Left Intersect	├
7	Bottom Intersect	┴
8	Horizontal Line	─
9	Vertical Line	│
10	Crossed Lines	┼

Use Command: ESC [P_1 ; P_2 t

The Rendition is determined by P_2:

If P_2 = Null or 0 Normal Rendition Graphic
If P_2 = 1 Half Intensity Graphic
If P_2 = 2 Blinking Graphic
If P_2 = 3 Half Intensity and Blinking Graphic
If P_2 > 3 Command Ignored

APPENDIX H

ALPHABETIC COMMAND SUMMARY

COMMAND SEQUENCE	COMMAND DESCRIPTION
ESC [A	Move Cursor Up 1
ESC [0A	Move Cursor Up 1
ESC [PnA	Move Cursor Up Pn
ESC [B	Move Cursor Down 1
ESC [0B	Move Cursor Down 1
ESC [PnB	Move Cursor Down Pn
ESC [C	Move Cursor Forwards 1
ESC [0C	Move Cursor Forwards 1
ESC [PnC	Move Cursor Forwards Pn
ESC [D	Move Cursor Backwards 1
ESC [0D	Move Cursor Backwards 1
ESC [PnD	Move Cursor Backwards Pn
ESC [E	Delete 1 Line
ESC [0E	Delete 1 Line
ESC [PnE	Delete N Lines
ESC [F	Insert 1 Blank Line
ESC [PnF	Insert Pn Black Lines
ESC [G	Set Tab At Cursor
ESC [0G	Set Tab At Cursor
ESC [2G	Clear Tab At Cursor
ESC [5G	Clear All Tabs
ESC [H	Move Cursor Home
ESC [Pr ; Pc H	Move Cursor to Row r, Column c
ESC [I	Delete 1 Character at Cursor
ESC [0J	Delete Pn Characters At Cursor
ESC [J	Erase From Active Position To End Of Region
ESC [0J	Erase From Active Position To End Of Region
ESC [1J	Erase From Beginning Of Region To Cursor
ESC [2J	Erase Region. Home Cursor
ESC [K	Erase From Cursor To EOL
ESC [1K	Erase From BOL To Cursor
ESC [2K	Erase Line
ESC [L	Insert Blank Character
ESC [0L	Insert Blank Character
ESC [PnL	Insert Pn Blank Character
ESC [M	Select Normal Rendition
ESC [0M	Select Normal Rendition
ESC [2M	Select Faint Characters
ESC [4M	Select Underline Characters
ESC [5M	Select Blinking Characters
ESC [7M	Select Reverse Video Characters
ESC [99 M	Select Overstriked Characters
ESC [Ps ; Ps ....M	Select Ps Attributes
ESC [0N	Terminal Is Ready Report
ESC [5N	Request To Report Terminal Status

COMMAND SEQUENCE	COMMAND DESCRIPTION
ESC [6N	Request To Report Terminal Position
ESC [Ps1 ; Ps2 ... O	Set Modes Ps ; Note 3
ESC [Ps1 ; Ps3 ... P	Reset Mode Ps ; Note 3
ESC [R	Same As ESC [6,N
ESC [P	Reset Default Screen Partition
ESC [Pn p	Partition Screen At Line Pn
ESC [0 ; P1; ... q	Turn Off LED I1 ; I2 ...
ESC [1 ; P_{21} ; P12 ... q	Turn On LED I1 ; I2 ...
ESC [s	React Scroll Region To Full Partition
ESC [P_T ; P_B r	Set Top And Bottom Of Scroll Region To P_T And P_B Respectively
ESC [s	Select Partition 0
ESC [Pn s	Select Partition Pn
ESC [Pn ; Pa t	Display Graph Character Pn With Attributes Pa (Note 4)
ESC >	Set Keypad Numeric Mode
ESC =	Set Keypad Application Mode
ESC ~	Reset to Power on State
ESC F_e	Display Alternate Control Character

Notes:

1. All Commands to terminal unless noted
2. Terminal to host
3. Refer to Appendix E for Modes
4. Refer to Appendix G for Character Description of Attributes

APPENDIX I

REAR PANEL DIP SWITCH SETTINGS

SW1 - UPPER SWITCH BANK

Switch Number	Switch Name	Off Position (Left)	On Position (Right)
1-8	Auto Wrap	Auto Wrap Enabled	Auto Wrap Disabled
1-7	XON/XOFF	Enable XON/XOFF Transmission	Disable XON/OFF Transmission
1-6	Auto Line Feed	Follow Carriage Return With Linefeed	Do Not Follow Carriage Return With Linefeed
1-5	Monitor Mode	Enable Monitor Mode	Disable Monitor Mode
1-4	Not Used	----	----
1-3	Cursor Blink	Non-Blinking Cursor	Blinking Cursor
1-2	Cursor Shape	Dash Cursor	Block Cursor
1-1	Reverse Video	Reverse Video	Normal Video

SW2 - LOWER SWITCH BANK

2-8	Local/Online	Local Mode	Online Mode
2-7	Data Length	8 Data Bits	7 Data Bits
2-6	Parity	Even Parity	Odd Parity
2-5	Parity Enable	No Parity	Parity
2-4	Baud Rate		
2-3	Select		
2-2			
2-1			

4	3	2	1	
N	N	N	N	= 9600
N	N	N	F	= 7200
N	N	F	N	= 4800
N	N	F	F	= 3600
N	F	N	N	= 2400
N	F	N	F	= 2000
N	F	F	N	= 1800
N	F	F	F	= 1200
F	N	N	N	= 600
F	N	N	F	= 300
F	N	F	N	= 150
F	N	F	N	=
F	F	N	N	= 110
F	F	N	F	= 75
F	F	F	N	= 50
F	F	F	F	= XX

where N = ON (Right
F = OFF (Left)

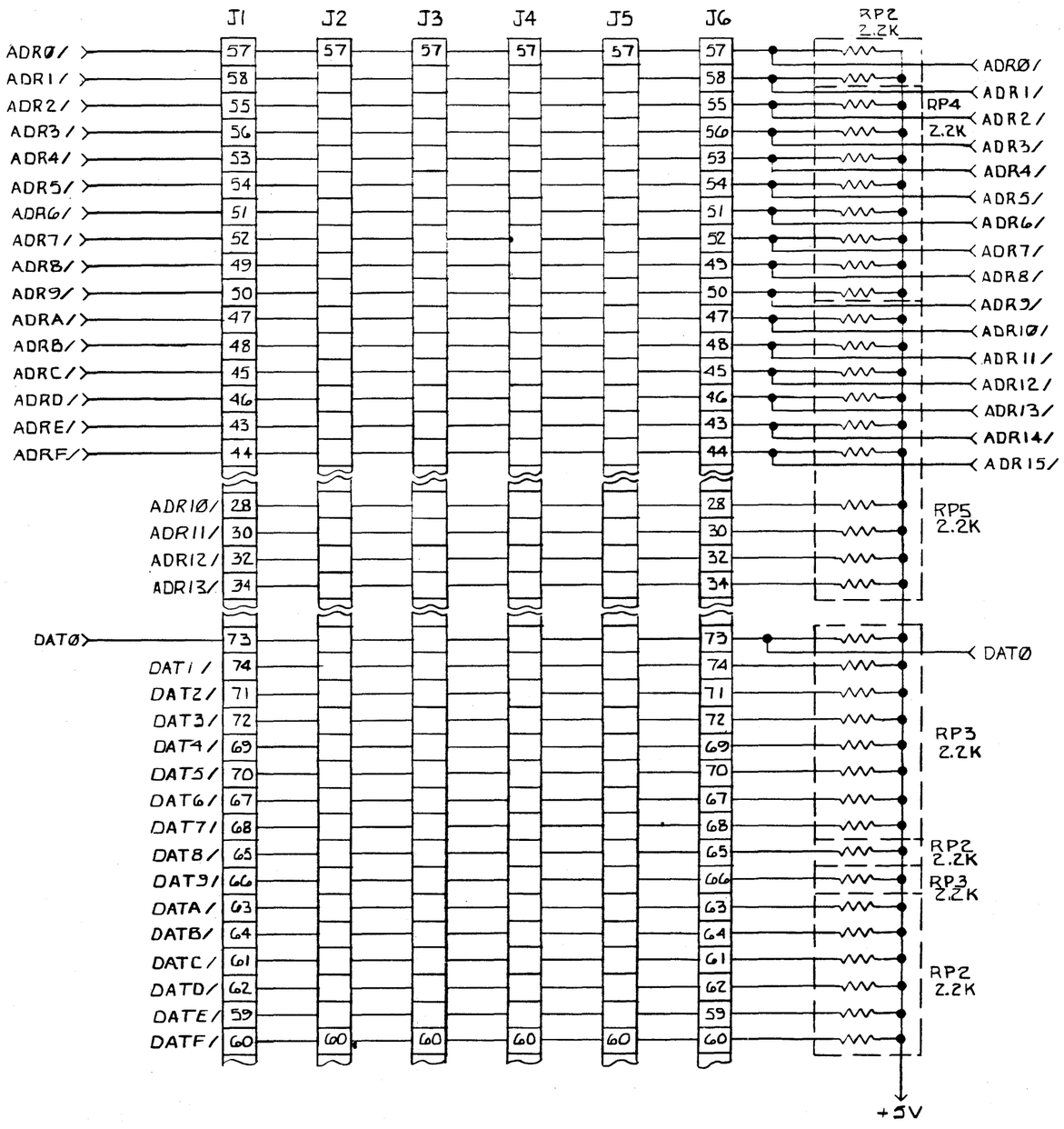
DWG. NO.	SH	REV.

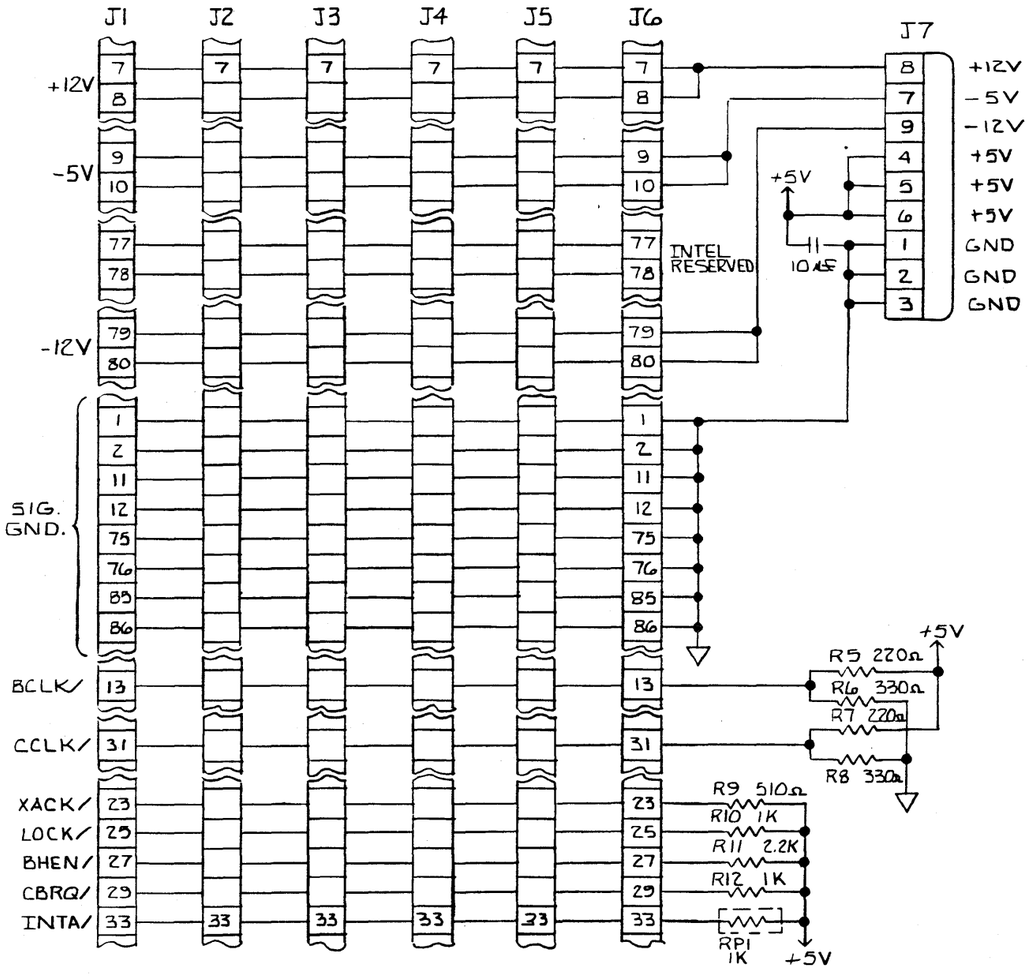
REVISIONS

ZONE	REV.	DESCRIPTION	DATE	APPROVED
	B	PRODUCTION RELEASE	3/25/81	WBP
	C	REVISED PER ECO #003	3/25/81	WBP

APPENDIX J

MULTIBUS SCHEMATIC FOR P1





QTY REQD	FSCM NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±

MATERIAL

FINISH

DO NOT SCALE DRAWING

CONTRACT NO.

APPROVALS	DATE
DRAWN	3/13/81
CHECKED WBP	3/25/81
ISSUED WBP	3/25/81

NEXT ASSY	USED ON
	CD100

APPLICATION

Callan DATA SYSTEMS
2637 Townsgate Road
Westlake Village, CA 91361
(805) 497-6837

SCHEMATIC
MULTIBUS MOTHERBOARD (P1)

SIZE	FSCM NO.	DWG. NO.	REV.
D		100041	C

SCALE

SHEET 1 of 2

BISHOP GRAPHICS, ACCUPRESS REORDER NO. A1-094

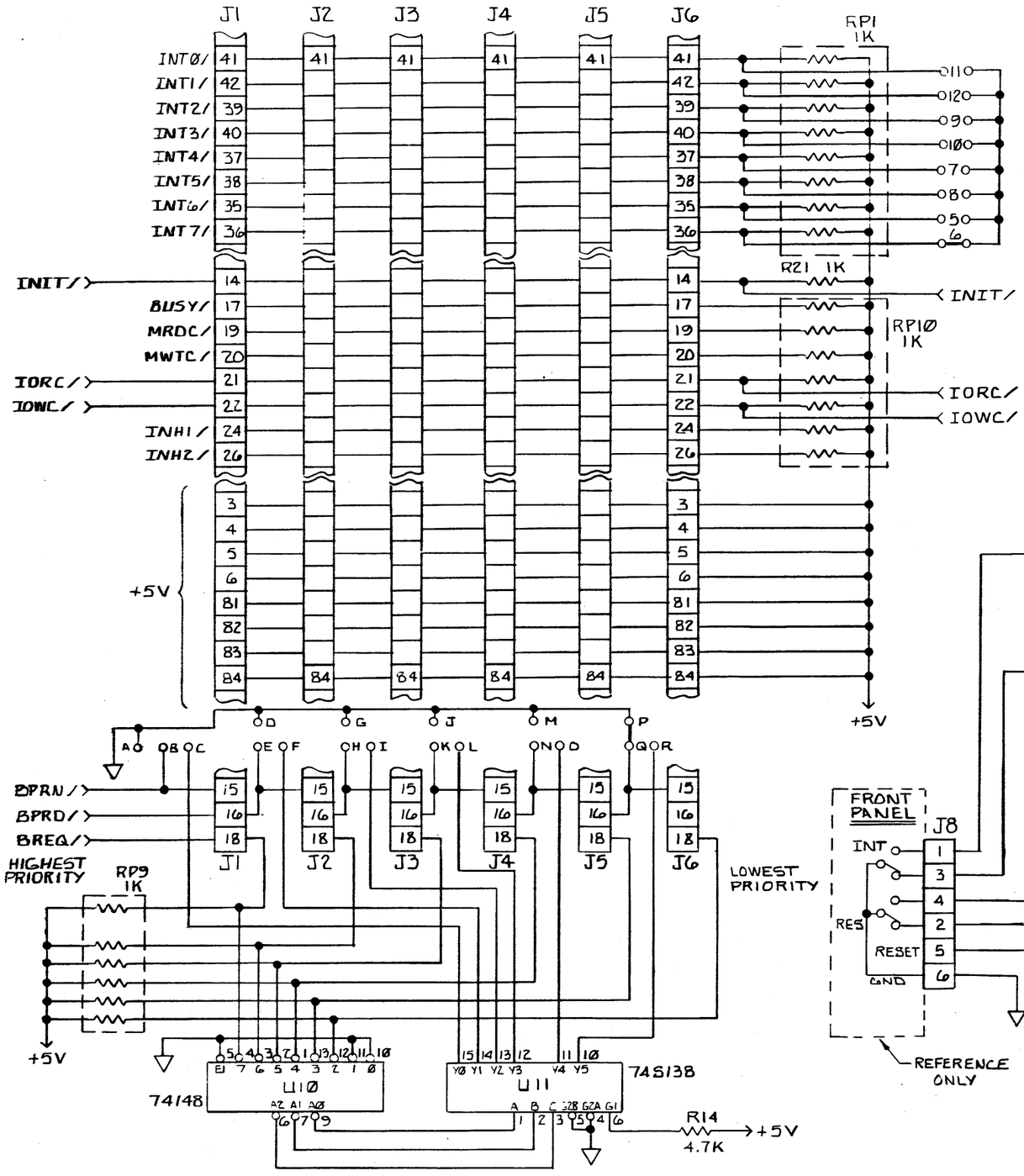
DWG. NO.	SH	REV.

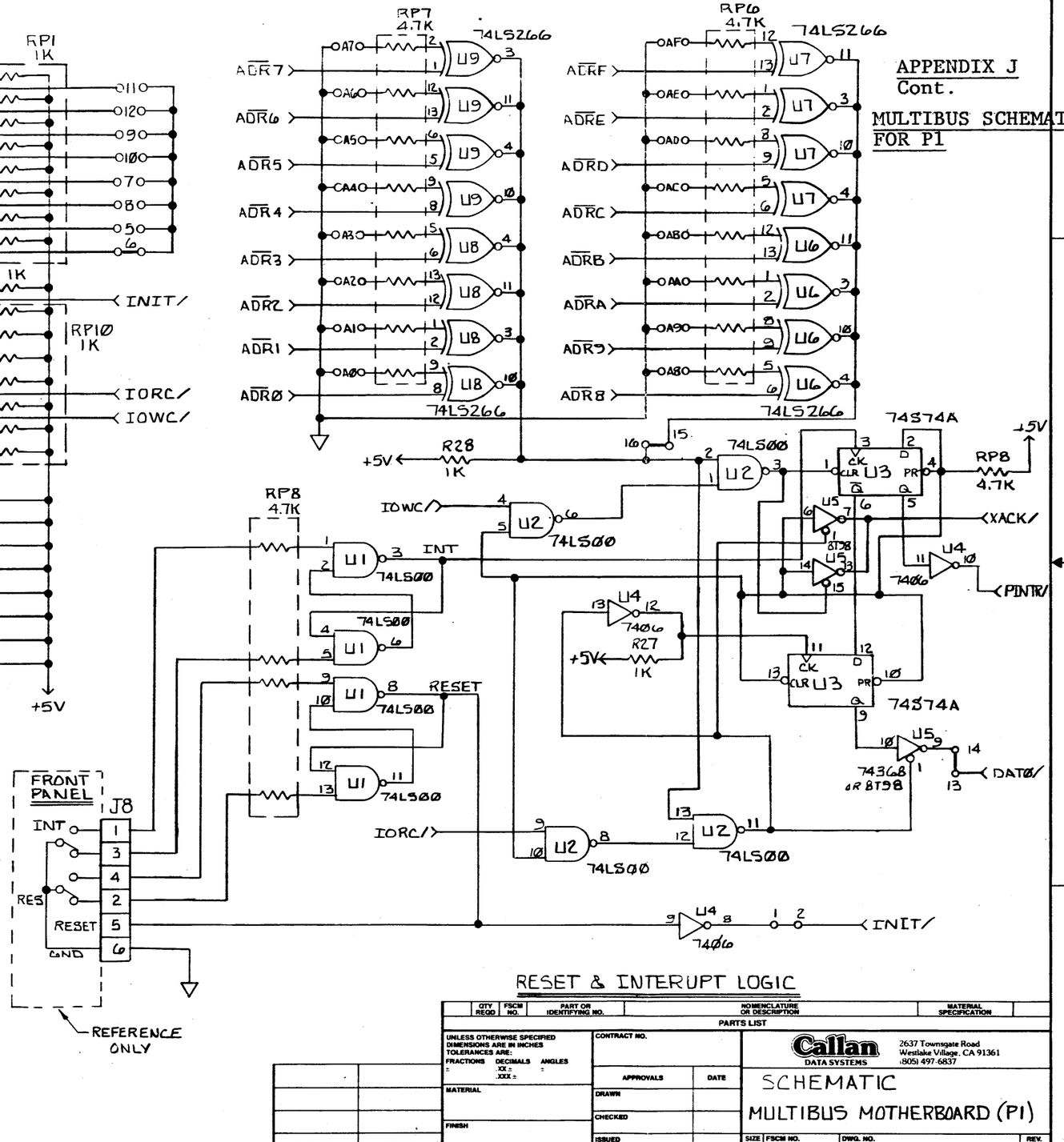
REVISIONS

ZONE	REV.	DESCRIPTION	DATE	APPROVED

APPENDIX J
Cont.

MULTIBUS SCHEMATIC FOR P1





RESET & INTERUPT LOGIC

QTY REQD	FSCM NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±	CONTRACT NO.
MATERIAL	APPROVALS / DATE
FINISH	DRAWN
NEXT ASSY / USED ON	CHECKED
APPLICATION	ISSUED
DO NOT SCALE DRAWING	

Callan DATA SYSTEMS
2637 Townsgate Road
Westlake Village, CA 91361
(805) 497-6837

SCHEMATIC
MULTIBUS MOTHERBOARD (P1)

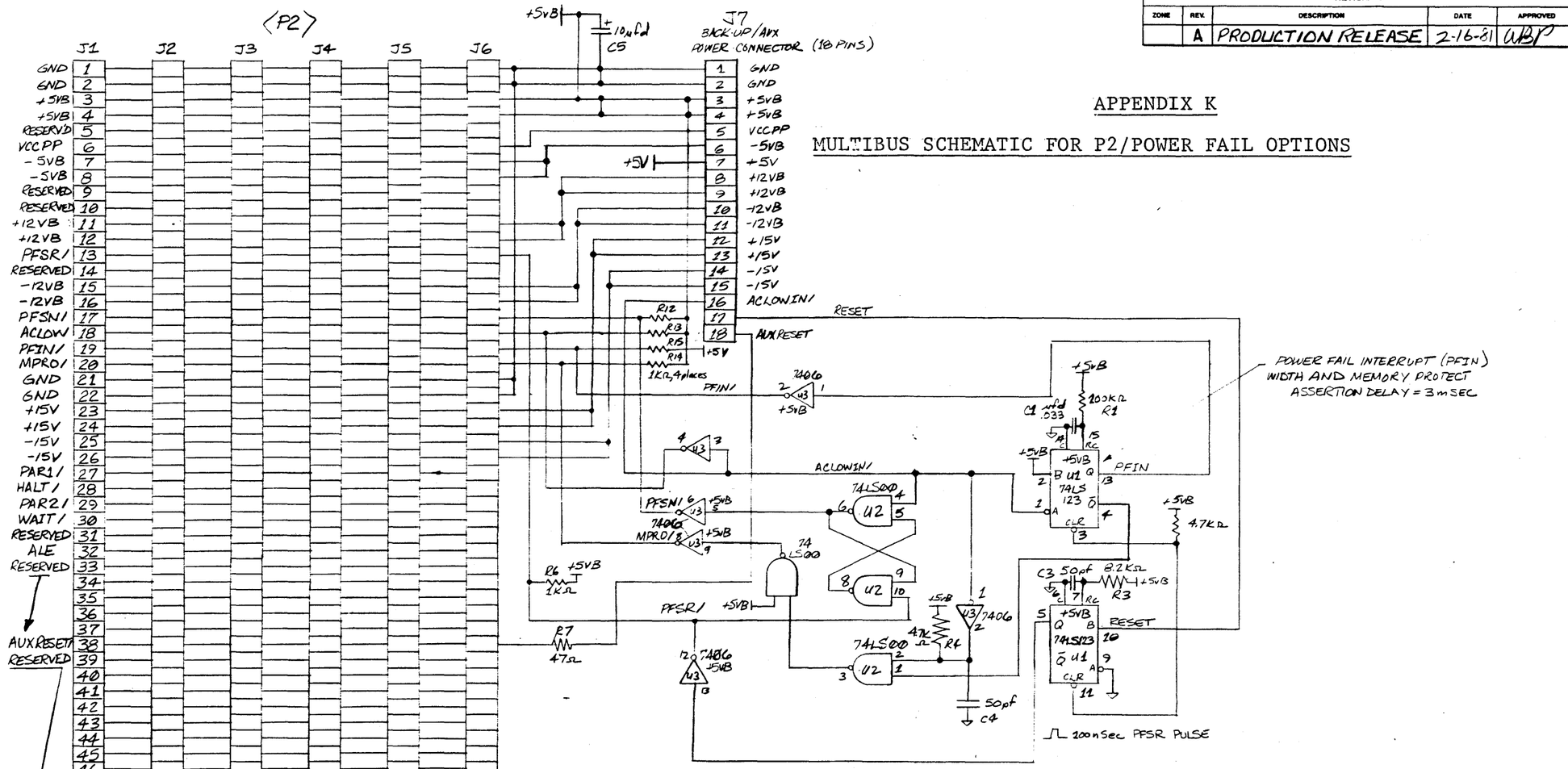
SIZE	FSCM NO.	DWG. NO.	REV.
D		100041	C
SCALE		SHEET	2 of 2

BUNKER RAMO-CS-ACCUPRESS REORDER NO. 871704

REVISIONS				
ZONE	REV.	DESCRIPTION	DATE	APPROVED
	A	PRODUCTION RELEASE	2-16-81	WBP

APPENDIX K

MULTIBUS SCHEMATIC FOR P2/POWER FAIL OPTIONS



NOTE: ALL THREE IC's POWERED BY +5VB (BACKUP +5V SUPPLY)
ALL RESISTORS 1/4 WATT
C_1 CAPAR CEM SERIES, SUBMINIATURE POLYESTER FILM 100V, ±10% .2" LEAD SPACING

QTY REQD	FSCM NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±

MATERIAL

FINISH

DO NOT SCALE DRAWING

CONTRACT NO.

APPROVALS	DATE
DRAWN WBP	1-30-81
CHECKED WBP	2-16-81
ISSUED WBP	2-16-81

Callan DATA SYSTEMS
2637 Townsgate Road
Westlake Village, CA 91361
(805) 497-6837

P2/POWER FAIL OPTION BOARD

NEXT ASSY	USED ON
	CD100

APPLICATION

SIZE C | FSCM NO. | DWG. NO. 100051 | REV. A

SCALE NONE | SHEET 1 OF 1

DWG. NO. | SH | REV.

BISHOP GRAPHICS/ACCUPRESS
REORDER NO. A11053

APPENDIX L

RS232 CONNECTOR PIN ASSIGNMENTS

SIGNAL NAME	RS232 CIRCUIT	CONNECTOR PIN NO.	I/O *
Transmitter Sig. Element Timing	DB	15	I
Receiver Sig. Element Timing	DD	17	I
Transmitter Clock	DA	24	O
Request To Send	CA	4	O
Data Terminal Ready	CD	20	O
Transmit Data	BA	2	O
Receive Data	BB	3	I
Clear To Send	CB	5	I
Data Set Ready	CC	6	I
Carrier Detect	CF	8	I
Signal Ground	AB	7	I/O
Protective Ground	AA	1	I/O

*I = Input To CD100-M Controller
O = Output From CD100-M Controller

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL
First Class Permit No. 130 Westlake Village, CA

Postage will be paid by addressee

Callan DATA SYSTEMS
2637 Townsgate Road
Westlake Village, CA 91361

Fold Fold

CUT ALONG DOTTED LINE

Note: Staples can cause problems with automated mail sorting equipment. Please use pressure sensitive or other gummed tape to seal this form.

Fold Fold

READER COMMENT FORM

CD100-M USERS' GUIDE

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