# VK100

## TECHNICAL MANUAL

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| UNIBUS | EduSystem | VMS |
| VAX | IAS | VT |
| | MASSBUS | |

CHAPTER 3   OPERATING INFORMATION

APPENDIX A    VK100 TERMINAL SPECIFICATIONS

APPENDIX B    CALCULATION

FIGURES

**TABLES**

## 1.1 INTRODUCTION

The VK100 terminal is an interactive graphics terminal designed for use with a user supplied monitor. The terminal can operate in either an on-line or off-line mode and can execute programs written in GIGI BASIC.

This chapter provides a general overview of the VK100 terminal. The following chapters describe and summarize installation, operation, programming characteristics, theory of operation, and maintenance procedures for the VK100 terminal.

## 1.2 GENERAL DESCRIPTION

The VK100 or GIGI (General Imaging Generator and Interpreter) is designed as a terminal subsystem that connects to a host computer. The VK100 provides local (in terminal) processing using a microprocessor. The microprocessor supports two interpreters; a ReGIS graphics interpreter and the GIGI BASIC language interpreter. ReGIS (Remote Graphics Instruction Set) is a graphics language; GIGI BASIC is a BASIC language that uses VK100 unique graphics capabilities.

The VK100 is a separate keyboard which requires a user-supplied monitor for displaying screen images. Either black and white or color (RGB) monitors can be used. Also, the VK100 can display images on an optional LA34VA Graphics Printer which attaches directly to the terminal.

The VK100 can be used as a text terminal and as a graphics terminal. The VK100 terminal's basic mode of operation is as a text terminal. In this mode the terminal acts as a translator between the operator and the host computer. When the operator types a message or command on the keyboard, the terminal sends it immediately to the host computer. The host computer receives the message or command and executes it. Then the host computer sends an acknowledgement to the terminal, indicating the message or command was received and executed. The terminal receives the acknowledgement and displays it on the monitor screen. Figure 1-1 shows a simple diagram of the VK100 terminal operating in text mode.
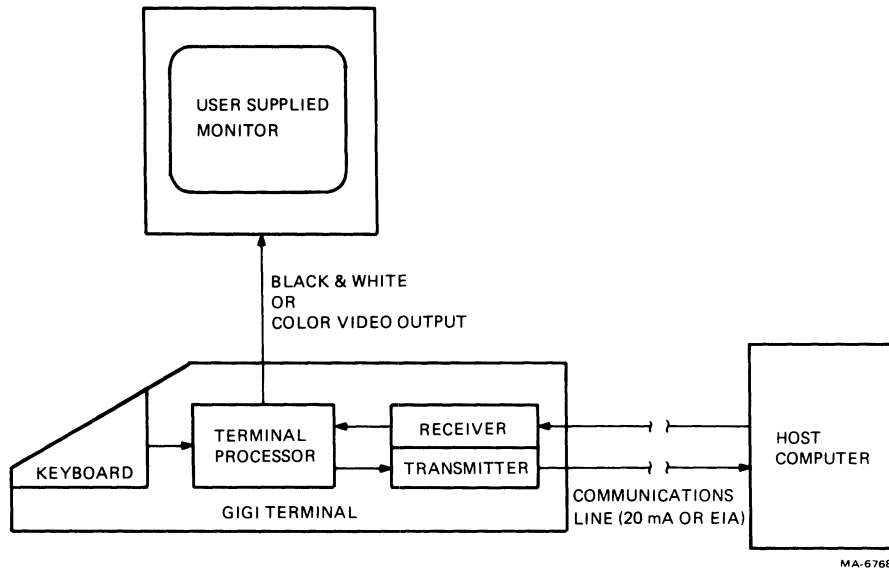
Figure 1-1 Text Mode Operation

The VK1ØØ terminal always enters text mode when powered on or reset.

The VK1ØØ (GIGI) terminal's primary operating mode is as a graphics terminal. The name GIGI derives from this capability as a General Imaging Generator and Interpreter.

Generally, the host computer places the terminal in graphics mode. In this mode the terminal interprets all data received from the host computer or the terminal keyboard as graphics commands and data. The interpreter and image generator translates the commands and data into the images displayed on the monitor screen. Figure 1-2 shows a simple diagram of the VK1ØØ terminal operating in graphics mode.

The commands to the interpreter come from a new graphics command set called ReGIS (Remote Graphics Instruction Set). ReGIS command set consists of a few simple instructions and options.

Within the graphics mode is a locator mode. This mode helps the operator locate a point on the screen and report that point to the host computer. The VK1ØØ terminal enters locator mode through the keyboard or a command from the host computer. When the terminal enters locator mode, a large cross-hair cursor appears ont he screen. The point where the two lines cross is the point reported to the host computer.

```
                    ┌─────────────────────┐
                    │   ┌─────────────┐   │
                    │   │ USER SUPPLIED │   │
                    │   │ MONITOR       │   │
                    │   │               │   │
                    │   └─────────────┘   │
                    └──────────▲──────────┘
                               │ BLACK & WHITE
                               │ OR
                               │ COLOR VIDEO OUTPUT
```
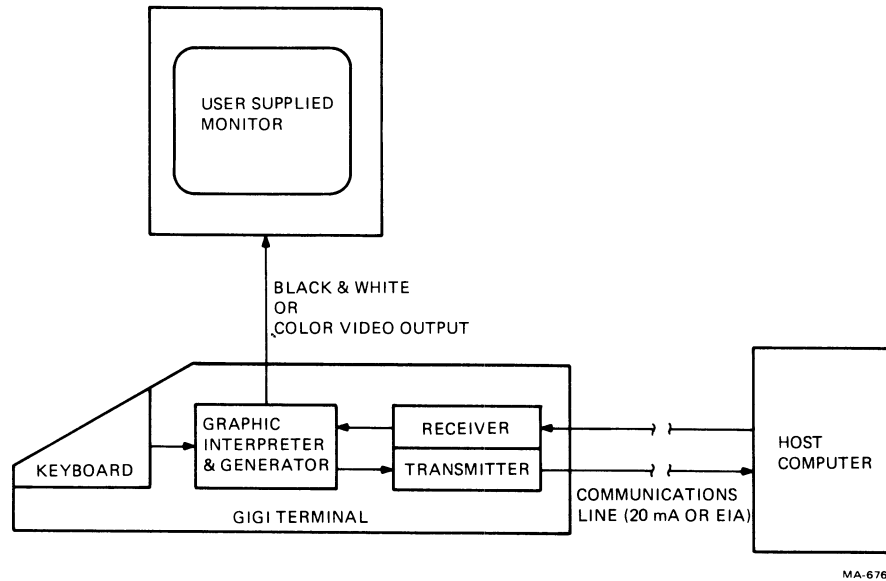
Figure 1-2 Graphics Mode Operation

The operator can return the terminal to the text mode at any time.
When in text mode, the terminal interprets all graphics data and
commands as text characters only and not as graphics.

The VK100 terminal also contains a BASIC language interpreter.
This interpreter allows the terminal to run BASIC language
programs. The terminal enters BASIC mode through the SET-UP mode
(described in Chapter 3) or a command from the host computer.

The BASIC program comes from one of two places, the keyboard or
the host computer. The operator selects the program source with a
SET-UP parameter. If the keyboard is the program source, the
operator types the BASIC program directly into the terminal
memory. When the program runs, the output normally goes to the
monitor screen. If the host computer is the program source, the
program loads into the terminal memory from the host computer.
When the program runs, the output normally returns to the host
computer. Figure 1-3 shows a simple diagram of the VK100 terminal
operating in both cases.

When the terminal enters the BASIC mode, the BASIC indicator above
the keyboard lights. The operator can return the terminal to text
mode at any time, either through the keyboard or the SET-UP mode.
When the terminal is in text mode, it interprets all data as text
only and not as BASIC language commands.

USER SUPPLIED
MONITOR

BLACK & WHITE
OR
COLOR VIDEO OUTPUT

BASIC
INTERPRETER
& MEMORY

KEYBOARD

RECEIVER

TRANSMITTER

HOST
COMPUTER

GIGI TERMINAL

COMMUNICATIONS
LINES
(20 mA OR EIA)

KEYBOARD AS THE BASIC PROGRAM SOURCE

USER SUPPLIED
MONITOR

BASIC
INTERPRETER
& MEMORY

KEYBOARD

RECEIVER

TRANSMITTER

HOST
COMPUTER

GIGI TERMINAL

COMMUNICATIONS
LINES
(20 mA OR EIA)

HOST COMPUTER AS THE BASIC PROGRAM SOURCE

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Figure 1-3 BASIC Mode Operation

The VK100 terminal hardware is contained in a light weight plastic case. The terminal contains three major assemblies; the keyboard, the processor board, and the power supply, a color or monochrome (black and white) monitor is supplied by the customer.

1.3      ACCESSORIES AND SUPPLIES
DIGITAL offers the following accessories and supplies for the VK100 terminal.

1.3.1    VK100 (GIGI) Carrying Cases (VK10K-CA)
These cases are specially designed to hold the VK100 terminal and all associated cables. They are constructed of high-density, charcoal brown, textured plastic and include two chrome-plated latches with locks.

1.3.2    VK100 Keyboard Overlays
Two types of overlays are available with the VK100 terminal: preprinted keypad and keypad overlays. These overlays are easy-to-install, plastic key covers representing the VK100 terminal's special function keys or user-defined character sets.

Keypad overlays cover VK100's auxiliary keypad and are used with the following software packages.

        CAI Primer (VK10K-AA)
        Graphics Editor (VK10K-AB)
        ReGIS Illustrated Text Editor (VK10K-AC)
        Character Set Editor (VK10K-AD)

Keyboard overlays cover the VK100 terminal's entire keyboard, including the auxiliary keypad, and include the following.

        Preprinted APL character set overlays (VK10K-BB) Blank, full keyboard overlays for user-defined character sets (VK10K-BA)

1.3.3    VK100 Cables and Connectors
Table 1-1 describes the cables and connectors used by the VK100 terminal.

In the future, additional options will be available. Contact the nearest DIGITAL Sales Office for further information.

Table 1-1 VK100 Cables and Connectors

| Cable | Description |
|---|---|
| BC26M-05 | RGB cable with BNC connectors for user-supplied monitor |
| BC26B-01 | Y-cable for daisy-chaining the LA34VA graphics printer to multiple VK100 terminals |
| P/N 7015503-00 | 20 mA loopback connector |
| P/N 1215336-00 | EIA loopback connector |
| BC22B-25 | EIA extension to second VK100 terminal from Y-cable (BC26B-01) |
| BC05F-15 or BC05F-50,A0 | 20 mA cable with Mate-N-Lok connectors for connecting VK100 terminal (with 20 mA option) directly, to a line unit |
| BC22A-10 or BC22A-25 | EIA null modem; connects VK100 terminal directly to a line unit (6 conductor cable) |
| BC22B-10 or BC22B-25 | EIA extension to modem (14 conductor cable) |

RELATED DOCUMENTATION
Table 1-2 lists the related documentation that is available from
DIGITAL's Accessory and Supplies Group. For specific ordering
information, see the end of this chapter.

1.4      ORDERING ACCESSORIES AND SUPPLIES
You can order accessories and supplies (including documentation)
either by mail or phone.

1.4.1     Toll-Free Telephone Orders
Call DIGITAL Direct Catalog Sales from 8:30 a.m. to 5:00 p.m. at
one of the following numbers.

     Continental United States
     1-800-258-1710

     New Hampshire, Alaska, and Hawaii
     1-603-884-6660

Canada
1-800-267-6146

Northern California
1-408-984-0200

Chicago
1-312-640-5612

Outside North America
contact your local A & SG business representative or local
DIGITAL sales office.

The following information applies to all telephone orders.

Minimum order is $35 unless charged to Master Card, Visa, or
American Express.

Maximum order is $5,000.

Phone orders are accepted at current list price only.

Phone orders are accepted per DIGITAL standard terms and
conditions only.

1.4.2    Direct Mail Orders
Mail all purchase orders directly to one of the following
addresses.

**For U.S. Customers**
Digital Equipment Corporation
ATT: A&SG
P.O. Box CS2008
Nashua, New Hampshire 03061

**For International Customers**
Digital Equipment Customers
A&SG Business Manager
c/o DIGITAL's local subsidiary

The following information applies to all direct mail orders.

Minimum order is $35 unless paid by check, money order, or
credit card (Visa, Master Card, or American Express accepted).
No maximum order value.

Table 1-2 Related DIGITAL Documentation

| Title | Document No. | Description |
|-------|-------------|-------------|
| GIGI Terminal Installation and Owner's Manual | EK-VK100-IN | This manual describes the VK100 (GIGI) terminal. It provides information on installing the terminal and connecting the optional peripheral devices, performing terminal SET-UP, proper terminal operating specifications, and repair procedures. It also provides full specifications for all terminal outputs. A copy of this manual is shipped with each VK100 terminal. |
| GIGI Programming Reference Card | EK-0GIGI-RC | This pocket size reference card summarizes the programmable features of the VK100 (GIGI) terminal. It includes a summary of both the ReGIS and BASIC command sets. A copy is shipped with each VK100 terminal. |
| GIGI Terminal SET-UP Reference Card | EK-VK100-RC | This pocket size reference card summarizes the VK100 (GIGI) terminal SET-UP parameters. The card also contains the default SET-UP switch pack settings. A copy is shipped with each terminal. |
| VK100 Pocket Service Guide | EK-VK100-PS | This manual is a module-level repair manual. It provides troubleshooting information, testing information, and removal and replacement information for the VK100 terminal. |

Table 1-2 Related DIGITAL Documentation (Cont)

| Title | Document No. | Description |
|-------|--------------|-------------|
| VK100 Technical Manual | EK-VK100-TM | This manual provides a detailed block-diagram-level discussion of the VK100 terminal. It also provides information on troubleshooting the terminal. The manual does not contain a set of schematic drawings. These drawings are a part of the VK100 print set, which must be ordered separately. |
| VK100 Illustrated Parts Breakdown (IPB) | EK-VK100-IP | This manual provides a detailed parts breakdown of the terminal. It does not provide part numbers for printed circuit board components. That information is contained in the VK100 print set, which must be ordered separately. |
| VK100 Print Set | MP-00893-00 | This document provides a complete set of electrical and mechanical schematic diagrams for the VK100 terminal. |
| GIGI/ReGIS Handbook | AA-K336A-TK | This book provides user information to program the VK100 (GIGI) terminal, including system-dependent information. It provides comprehensive descriptions of ReGIS commands, organized alphabetically for easy reference. Extensive examples of the VK100 graphics capabilities are used throughout. A copy of this book is shipped with each VK100 terminal. |

Table 1-2 Related DIGITAL Documentation (Cont)

| Title | Document No. | Description |
|---|---|---|
| GIGI BASIC Manual | AA-K335A-TK | This is a BASIC language manual for the VK100 terminal. It provides comprehensive descriptions of the GIGI BASIC commands and functions, organized alphabetically for easy reference. A copy of this manual is shipped with each VK100 terminal. |
| GIGI Graphics Editor Manual | AA-J942A-TK | This manual describes the Graphics Editor software package within the entire VK100 package. The manual also includes descriptions of each Graphics Editor command. A copy of this manual is shipped with the GIGI Graphics Editor software package. |
| GIGI Data Plotting Package Manual | AA-J956A-TK | This manual describes the GIGI Data Plotting software package: the functional modes, the steps to create a table, defining and displaying plots from that table, and performing statistical analysis. It also describes each of the plot commands and file structures for the table data and statistical results. A copy of this manual is shipped with the GIGI Data Plotting software package. |
| GIGI Slide Projector Manual | AA-J943A-TK | This manual describes the GIGI Slide Projector software package. It describes the file formats and the use of the automatic and manual modes. It also describes each command and provides syntax and usage information. A |

Table 1-2 Related DIGITAL Documentation (Cont)

| Title | Document No. | Description |
|---|---|---|
| | | copy of this manual is shipped with the GIGI Slide Projector software package. |
| GIGI Character Set Editor User Guide | AA-K337A-TK | This manual describes the GIGI Character Set Editor. It describes each command and provides syntax and usage information. A copy of this manual is shipped with the GIGI Character Set Editor software package. |
| GIGI ReGIS Illustrated Technical Manual | AA-J944A-TK | This manual describes the GIGI ReGIS Illustrated Technical Manual software package. It describes the ReGIS Illustrated Technical Manual its editing and graphics capabilities, and the use of picture files. It also describes the keypad commands. A copy of this manual is shipped with the GIGI ReGIS Illustrated Technical Manual software package. |
| GIGI/ReGIS CAI Primers Student Guide | SDC AA-K329A-TE | This manual is used with any of the GIGI/ReGIS CAI Primers. It provides an overall introduction to the primers, including their objectives and recommended course of study. It also tells new users how to start the course. |
| VAX/VMS GIGI/ReGIS CAI Primers | SDC BE-K391A-BC (TU58) SDC AS-K327A-BE (Floppy) | This computer-assisted instruction (CAI) course runs on VAX/VMS. It helps new VK100 users to begin using the terminal and ReGIS. |

Table 1-2 Related DIGITAL Documentation (Cont)

| Title | Document No. | Description |
|-------|-------------|-------------|
| VAX/VMS GIGI/ReGIS CAI Primers Course Administrator Guide | SDC AA-K328A-TE | This manual provides an overview of the course administrator's role and describes how to install and maintain the CAI software on VAX/VMS. |
| RSTS/E GIGI/ReGIS CAI Primers | SDC BC-K346A-BC (RLØ2) SDC AP-K392A-BC (Magtape 9-track 8ØØ bits/in) SDC BB-K393A-BC (Magtape 9-track 16ØØ bits/in) | This computer-assisted instruction (CAI) course runs on RSTS/E. It helps new VK1ØØ users to begin using the terminal and ReGIS. |
| RSTS/E GIGI/ReGIS CAI Primers Course Administrator Guide | SDC AA-K347A-TC | This manual provides an overview of the course administrator's role and describes how to install and maintain the CAI software on RSTS/E. |

2.1     INTRODUCTION
This chapter contains the following information.

    Site considerations
    Unpacking and inspection
    Repacking
    Installation
    Interface information

Included in the interface information are special programming
considerations to observe for effective use of the interface.

2.2     SITE CONSIDERATIONS
The VK100 terminal is a lightweight, single-piece unit that fits
on a desk or tabletop. Figure 2-1 shows the dimensions of the
terminal.
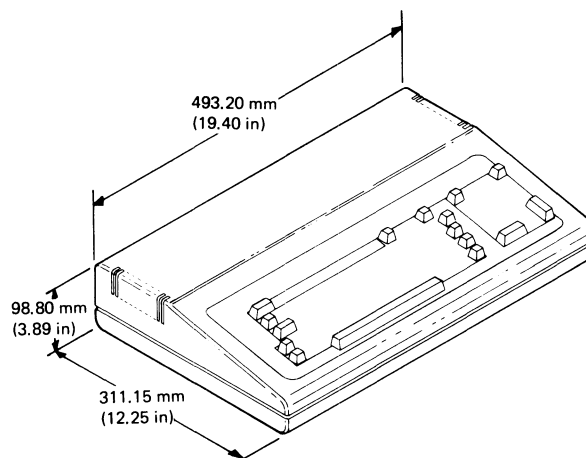


Figure 2-1 VK100 (GIGI) Terminal Dimensions

The VK100 terminal usually connects to a user-supplied monitor (display) device. The monitor always operates with the terminal and should be located close to the terminal. Be sure to consider the monitor's size and weight when planning the terminal's location.

The VK100 terminal places few limits on the operating environment. Avoid areas that have extremes in temperature and humidity or are subject to high levels of industrial contaminates. Appendix A describes the guaranteed operating conditions and terminal specifications.

A small fan in the VK100 terminal cools the terminal's electronic components. Keep all ventilation slots and an area of about six inches around the terminal clear. Do not place papers or similar materials on top of or under the terminal.

The terminal controls and cable connections are on the rear of the terminal. When installing the terminal, allow an adequate area to access the rear of the terminal.

NOTE
When installing the terminal, keep all
power and signal cables free from
obstructions, sharp bends, and stress.

2.3      UNPACKING AND INSPECTION
The VK100 terminal is packed in a reinforced shipping carton. The carton contains the following items.

    VK100 terminal
    VK100 terminal power cord
    VK100 terminal video cable
    GIGI Terminal Installation and Owner's Manual
    GIGI/ReGIS Handbook
    GIGI BASIC Manual
    GIGI Terminal SET-UP Reference Card
    GIGI Programming Reference Card
    GIGI Installation Card

Figure 2-2 shows the packaging used with the VK100 terminal. Use the following procedure to unpack the terminal from the shipping carton.
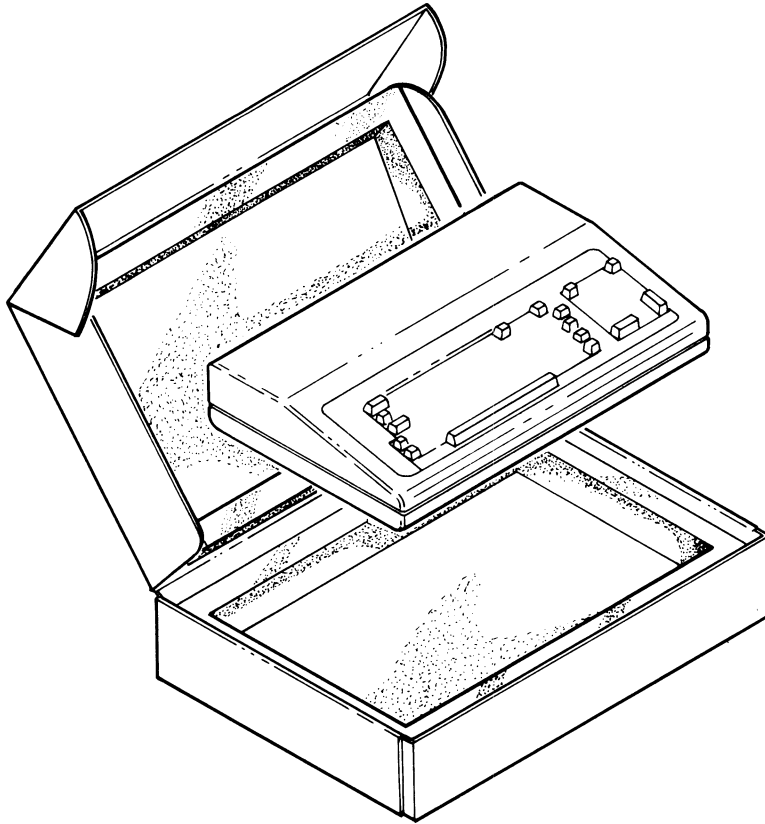
MA-6723

Figure 2-2 VK100 (GIGI) Terminal Shipping Container

1.  Carefully cut the shipping tape and open the shipping carton by pulling out the front flap and lifting the top of carton.

2.  Remove the power cord, video cable, and documentation from the packing material.

3.  Lift out the top piece of packing material and remove the terminal from the shipping carton. Save the packing material and shipping carton. They are needed to ship the terminal back to the repair center if the terminal ever fails.

4.  Visually inspect the terminal for physical damage. If the terminal is damaged, notify your local DIGITAL Sales Office.

5.  Install the terminal as described in the Installation section of this chapter.

## 2.4    REPACKING

Use the following procedure when repacking the VK100 terminal for shipment. Figure 2-3 shows all of the switch and cable locations.

1.    Turn the ac power switch off.

2.    Disconnect all cables from the rear of the terminal.

3.    Locate the original packing material. If the original materials are not available, they can be ordered from DIGITAL. Refer to Chapter 1 for ordering information.

4.    Repack the terminal in the shipping carton (Figure 2-2). Include the power cord and video cable in the shipping carton.

5.    Seal the shipping carton with reinforced tape.
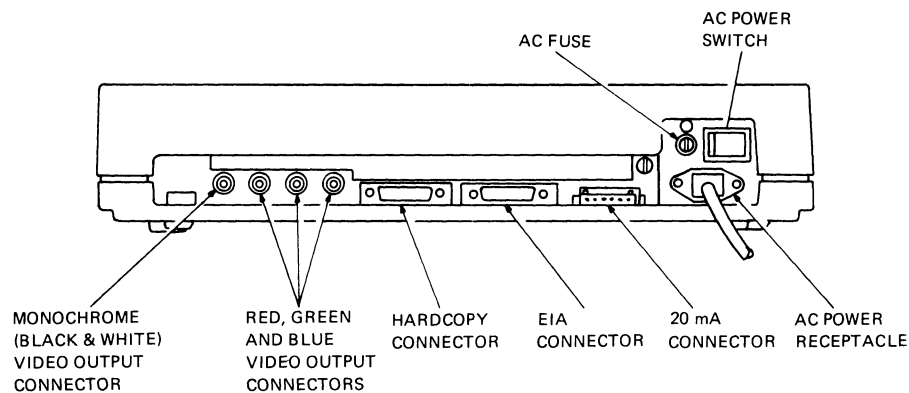
Figure 2-3 VK100 (GIGI) Terminal Switch and Cable Locations

## 2.5     INSTALLATION

The VK100 terminal is very easy to install. The only tool required is a flat blade screwdriver. Use the following procedure to install the terminal.

1.    Remove the terminal from the shipping carton or optional carrying case and place in the desired work area.

2.    Locate the access opening on the rear of the terminal (Figure 2-4). The eight-position default SET-UP switch pack will be visible in the opening.
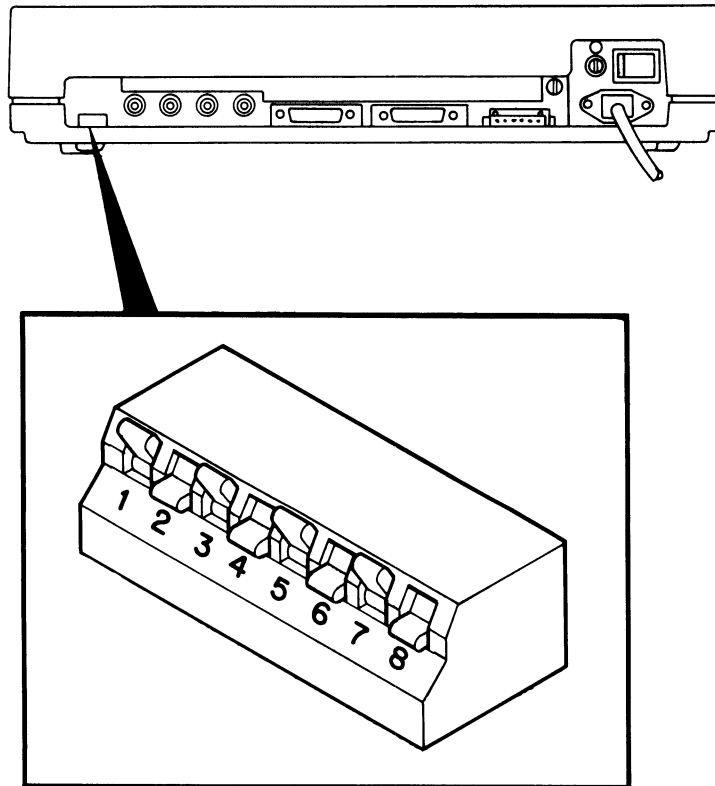


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Figure 2-4 Default SET-UP Switch Pack Location

3.  Note the switch positions and determine if the switch settings are correct for the host computer system. Figure 2-5 shows all the switch settings and what they mean to the host computer. Chapter 3 provides more detailed information on the SET-UP parameters.

SET-UP FEATURE DEFAULT SETTINGS FOR BOTH TRANSMIT AND RECEIVE
SPEEDS (TS AND RS) CONT.
(SWITCHES 6, 7, & 8)
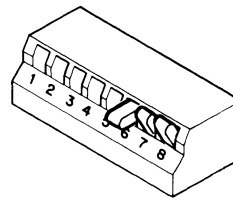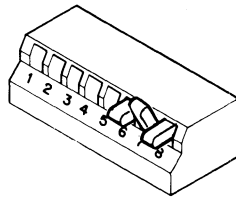


TRANSMIT AND RECEIVE SPEED
FEATURES DEFAULT SET FOR
600 (RS2 AND TS2)



TRANSMIT AND RECEIVE SPEED
FEATURES DEFAULT SET FOR
1200 (RS3 AND TS3)
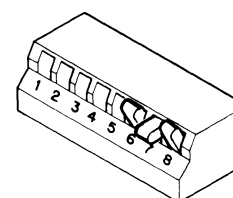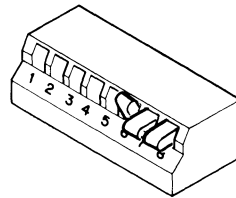


TRANSMIT AND RECEIVE SPEED
FEATURES DEFAULT SET FOR
2400 (RS4 AND TS4)



TRANSMIT AND RECEIVE SPEED
FEATURES DEFAULT SET FOR
4800 (RS5 AND TS5)
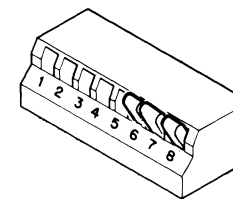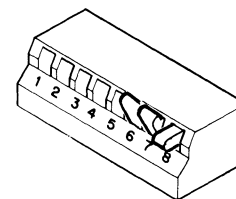


TRANSMIT AND RECEIVE SPEED
FEATURES DEFAULT SET FOR
9600 (RS6 AND TS6)



TRANSMIT AND RECEIVE SPEED
FEATURES DEFAULT SET FOR
19,200 (RS7 AND TS7)

MA-6722

Figure 2-5 Default SET-UP Switch Pack
Settings (Sheet 1 of 3)

SET-UP FEATURE DEFAULT SETTINGS FOR PARITY ENABLE (PE)
(SWITCHES 4 & 5)
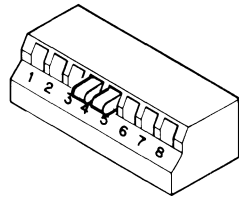


PARITY ENABLE FEATURE
DEFAULT SET FOR OFF (PE0)
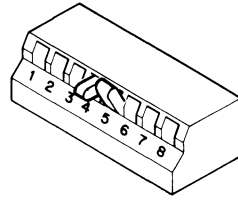
PARITY ENABLE FEATURE
DEFAULT SET FOR EVEN (PE1)
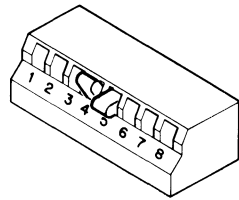


PARITY ENABLE FEATURE
DEFAULT SET FOR ODD (PE2)

---

SET-UP FEATURE DEFAULT SETTINGS FOR BOTH TRANSMIT AND RECEIVE
SPEEDS (TS AND RS)
(SWITCHES 6, 7, & 8)
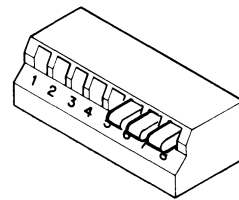


TRANSMIT AND RECEIVE SPEED
FEATURES DEFAULT SET FOR
110 (RS0 AND TS0)
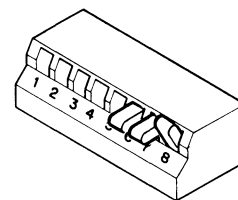
TRANSMIT AND RECEIVE SPEED
FEATURES DEFAULT SET FOR
300 (RS1 AND TS1)

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Figure 2-5 Default SET-UP Switch Pack
Settings (Sheet 2 of 3)

2-7

SET-UP FEATURE DEFAULT SETTINGS FOR POWER FREQUENCY (PF)
(SWITCH 1)
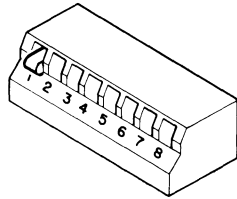
POWER FREQUENCY FEATURE
DEFAULT SET FOR 60 Hz
(PF0)
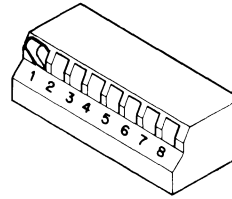
POWER FREQUENCY FEATURE
DEFAULT SET FOR 50 Hz
(PF1)

SET-UP FEATURE DEFAULT SETTINGS FOR COMMUNICATIONS INTERFACE (CI)
(SWITCH 2)
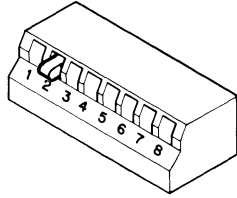
COMMUNICATIONS INTERFACE
FEATURE DEFAULT SET FOR
EIA (CI0)
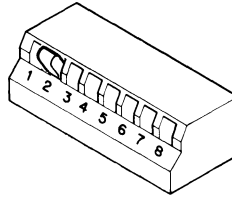
COMMUNICATIONS INTERFACE
FEATURE DEFAULT SET FOR
20 mA (CI1)

SET-UP FEATURE DEFAULT SETTINGS FOR UK CHARACTER SET (UK)
(SWITCH 3)
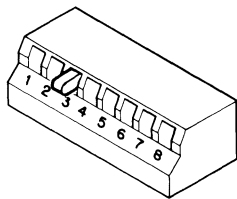
UK CHARACTER SET FEATURE
DEFAULT SET FOR US (UK0)
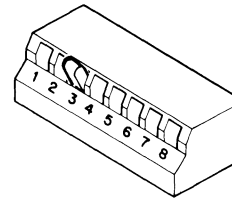
UK CHARACTER SET FEATURE
DEFAULT SET FOR UK (UK1)

MA-6720

Figure 2-5 Default SET-UP Switch Pack
Settings (Sheet 3 of 3)

4.   If the default SET-UP switch pack settings are incorrect
     for the host computer, carefully change the switch
     settings with a pencil or a similar object. Once the
     switches are set, verify the new settings. If the
     settings are wrong, the terminal may not be able to
     communicate with the host computer.

5.   Remove the user-supplied monitor from its shipping carton
     and place in the desired work area. Perform the
     installation instructions packed with the monitor.

6.   Connect the VK100 terminal to the user-supplied monitor.
     (The next section of this chapter provides specific
     instructions for connecting to the Barco Model GD33
     monitor.)

7.   Connect the communications cable to the appropriate
     communications connector. If you select EIA
     communications, connect the ground wire to the terminal
     communications connector. Figure 2-6 shows the cable
     connector with the ground wire connected.



GREEN GROUND WIRE          SCREW

MA-6730
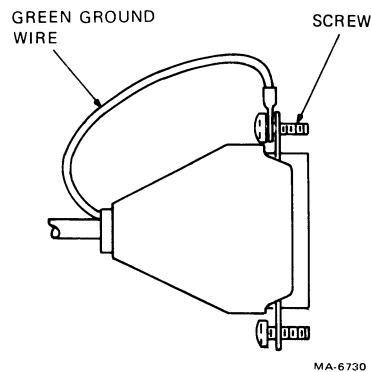
Figure 2-6 EIA Communications Cable Connector

8.  Connect the VK1ØØ terminal to the optional LA34VA graphics printer. There are two methods for this. Section 2.5.3 provides detailed instructions.

9.  Connect the power cord to the power cord receptacle on the rear of the terminal. Plug the other end of the power cord into a nearby wall outlet.

1Ø. Turn the monitor power switch on. Allow the monitor one or two minutes to warm up before performing the next step.

11. Turn the terminal power switch on. The terminal automatically performs the power-up self-test. Once the power-up self-test is successfully completed, the ON LINE indicator above the keyboard lights and the cursor appears in the upper left corner of the monitor screen. If any other indications are present, the terminal self-test may have found a fault in the terminal. Chapter 6 outlines the procedures to follow if this occurs.

**NOTE**
On some monitors the cursor does not appear immediately because of a monitor condition called overscan. To eliminate the overscan, set the HP or HM SET-UP parameters. Chapter 3 describes these parameters.

12. Select the terminal SET-UP parameters. Chapter 3 describes the SET-UP parameters and how to select them.

13. After selecting the SET-UP parameters, record their settings and keep them with the terminal for future reference.

14. Fill out the GIGI Installation Card and return it to DIGITAL. Postage is prepaid if mailed within the United States.

**2.5.1    Connecting to the Barco Model GD33 Monitor**
This section provides specific instructions for connecting the
VK100 terminal to the Barco Model GD33 monitor. This monitor is
not supplied by DIGITAL. The monitor must be purchased separately
from a local Barco distributor. Monitor operating instructions are
packaged with the monitor.

1.    Locate the VK100 video cable. It is a single cable with
      three connectors on each end.

2.    Connect the color-keyed red, green, and blue cable
      connectors to the RED, GREEN, and BLUE output connectors
      on the rear of the VK100 terminal.

3.    Connect the color-keyed red, green, and blue cable
      connectors to the RED, GREEN, and BLUE input connectors
      on the rear of the Barco Model GD33 monitor (Figure 2-7).

4.    Locate the white switches on the rear of the monitor
      above the input connectors.  Slide the white switches to
      the 75 position. This switches in a 75-ohm cable
      impedance and provides the best possible monitor display.

5.    Locate the G/X switch on the rear of the monitor. Slide
      the G/X switch to the G position. This sets the monitor
      synchronization for green signal sync.

6.    Connect the monitor power cord.
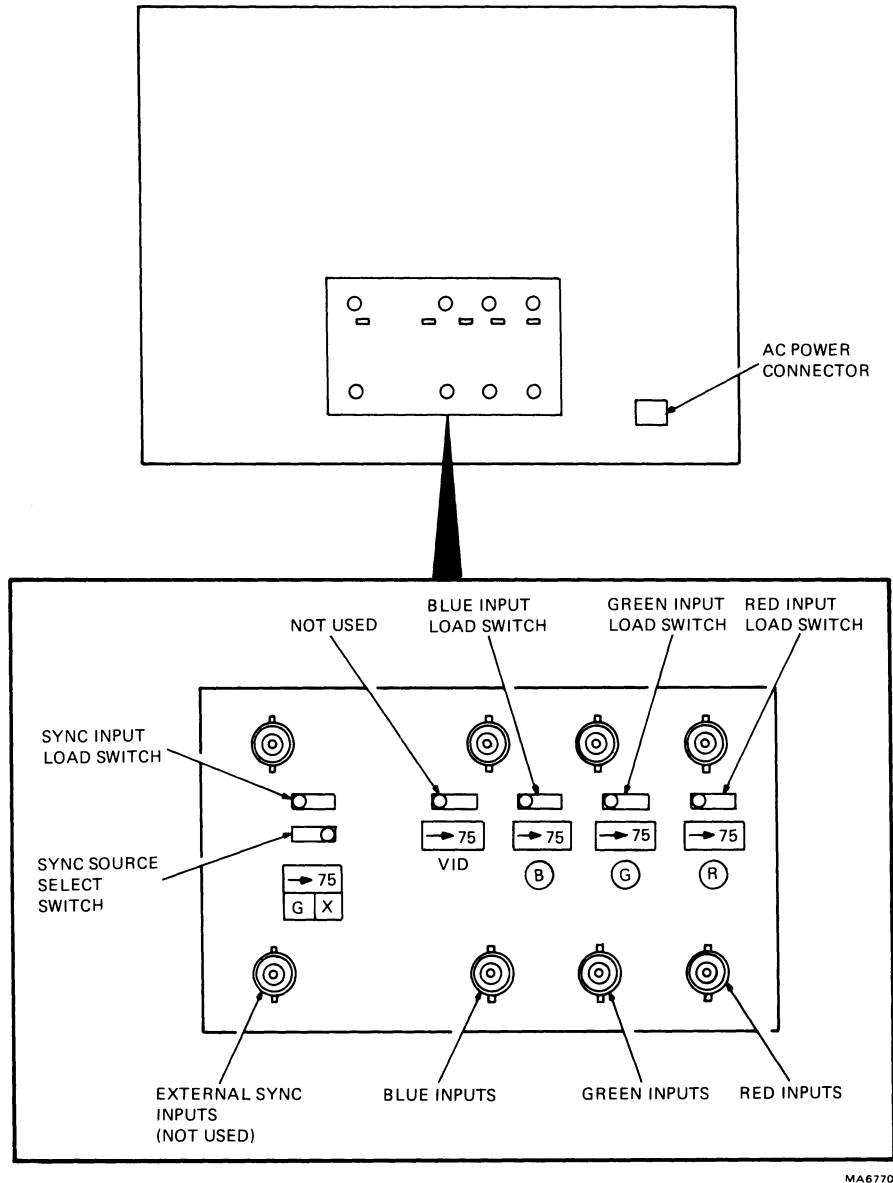
Figure 2-7 Barco Model GD33 Monitor Connections

## 2.5.2 Connecting to a Typical Black and White Monitor

The VK100 terminal can connect to a black and white (monochrome) monitor. DIGITAL does not supply a black and white monitor. Any black and white monitor must be obtained from local suppliers.

Use the following general instructions to perform the interconnection. Specific operating instructions for the monitor are packaged with the monitor.

1. Locate the VK100 video cable. It is a single cable with three connectors on each end.

2. Connect one of the three cable connectors to the MONO output connector on the rear of the VK100 terminal. Note the cable connector color key (red, green, or blue).

3. Locate the video input connector on the black and white monitor. This connector should be a BNC-type connector. If not, put a BNC adaptor on the connector.

4. Connect the video cable to the video input connector on the monitor. Be sure to use the same color-keyed cable connector that was used on the terminal end of the cable.

## 2.5.3 Connecting to the LA34VA Graphics Printer

The VK100 terminal connects to the LA34VA graphics printer in one of two ways.

1. The terminal connects directly to the printer.

2. The terminal is added to the end of a multiterminal string.

If the terminal connects directly to the printer, the printer is dedicated to that terminal. This means the printer is always available to the terminal.

In a multiterminal string, two or more VK100 terminals connect to one printer. Each terminal contains a hardcopy protocol. This protocol prevents problems when more than one terminal tries to use the printer. To request using the printer, press the SHIFT and PF1/HARDCOPY keys together. The terminal looks to see if the printer is busy. If the printer is not busy the terminal immediately sends its data to the printer.

If the printer is currently printing the terminal generates a print request and waits until the printer is available. The print request tells all other VK100 terminals that a terminal is waiting to use the printer. When the printer completes the copy the waiting terminal then sends its data to the printer.

When more than one terminal is waiting to use the printer an internal sequence system takes effect. The sequence system determines which terminal uses the printer next. The sequence system continues in effect until all of the waiting terminals have used the printer.

When using a multiterminal string, all terminals in the string must be powered on. If any terminal in the string is turned off, that terminal and all terminals after it in the string cannot use the printer. Figure 2-8 shows this point. Terminal 3 is turned off, so terminal 4 cannot use the printer. Disconnect any terminal that is turned off in a multiterminal string from the string. Paragraph 2.5.3.2 provides a disconnection procedure.

The following paragraphs provide the two procedures for connecting the VK100 terminal to the LA34VA graphics printer.
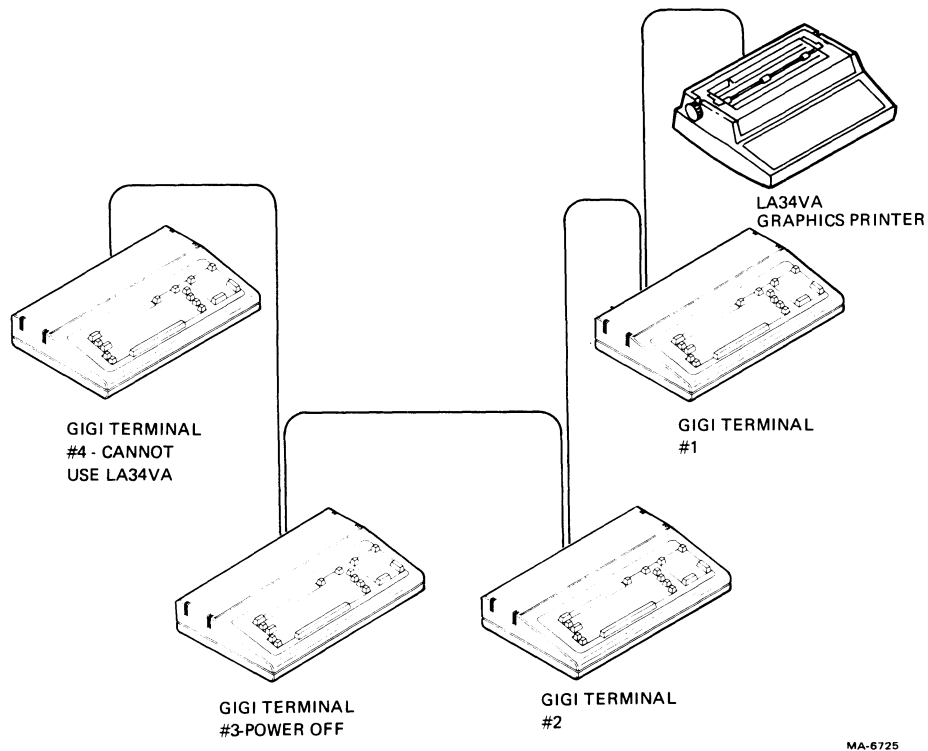
Figure 2-8 Multiterminal String with Terminal Turned Off

**2.5.3.1 Connecting Directly to the LA34VA Graphics Printer -- Use** the following procedure for connecting a single VK100 terminal to the LA34VA graphics printer. Maximum cable length is 50 feet. Figure 2-9 shows a simple block diagram of this configuration.

To perform the procedure use a flat blade screwdriver, a BC22A-xx interface cable, and one 8-32 X 5/8 inch screw.

1.  Locate and connect the BC22A cable to the HARDCOPY connector on the rear of the VK100 terminal. The connector can only plug in one way. Connect the ground wire to the HARDCOPY connector. Figure 2-6 shows the cable connector with the ground wire connected.

2.  Plug the other cable connector into the the EIA connector on the rear of the LA34VA graphics printer. This connector can only plug in one way (Figure 2-10).
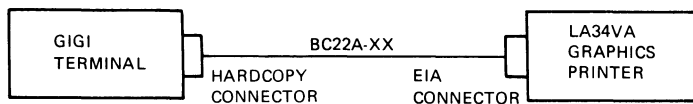


MA-6719

Figure 2-9 Single VK100 (GIGI) Terminal to LA34VA Graphics Printer
   Connection
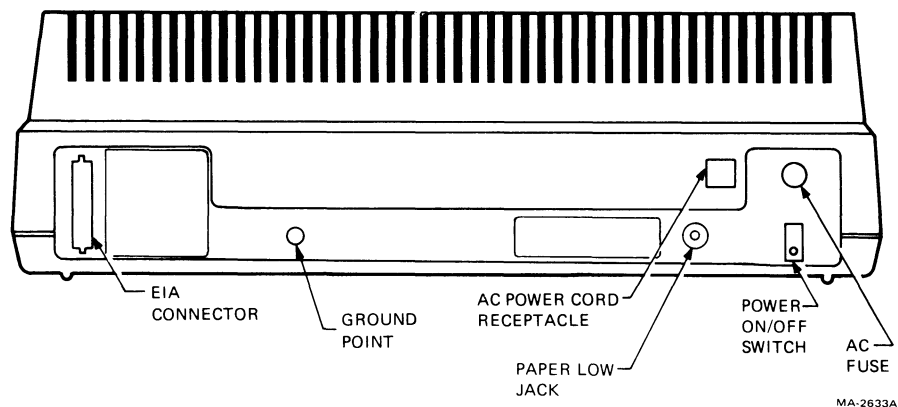


MA-2633A

Figure 2-10 LA34VA Graphics Printer (Rear View)

3.  Push the 8-32 X 5/8 inch screw through the ring terminal
    on the end of the ground wire coming out of the cable
    connector. Locate the grounding screw hole on the LA34VA
    graphics printer (about 3 inches to the right of the EIA
    connector). Attach the cable ground wire to the LA34VA
    graphics printer grounding point.

4.  Perform the installation and SET-UP procedures outlined
    in the DECwriter IV Graphics Printer User Guide
    (EK-L34RO-UG).

5.  Apply power to both terminals.

6.  To verify the LA34VA graphics printer connection, place
    the screen alignment video pattern on the monitor screen.
    Do this by pressing the following keys in order: **SET-UP**,
    **S, T, 4,** and **SET-UP** again.

7.  Print the screen alignment video pattern on the LA34VA
    graphics printer. Do this by pressing the **SHIFT** and
    **PF1/HARDCOPY** keys together.

**2.5.3.2  Adding a Terminal to a Multitermimal String** -- Use the
following procedure if one or more VK100 terminals are connected
to the LA34VA graphics printer. Figure 2-11 shows a simple diagram
of this configuration.
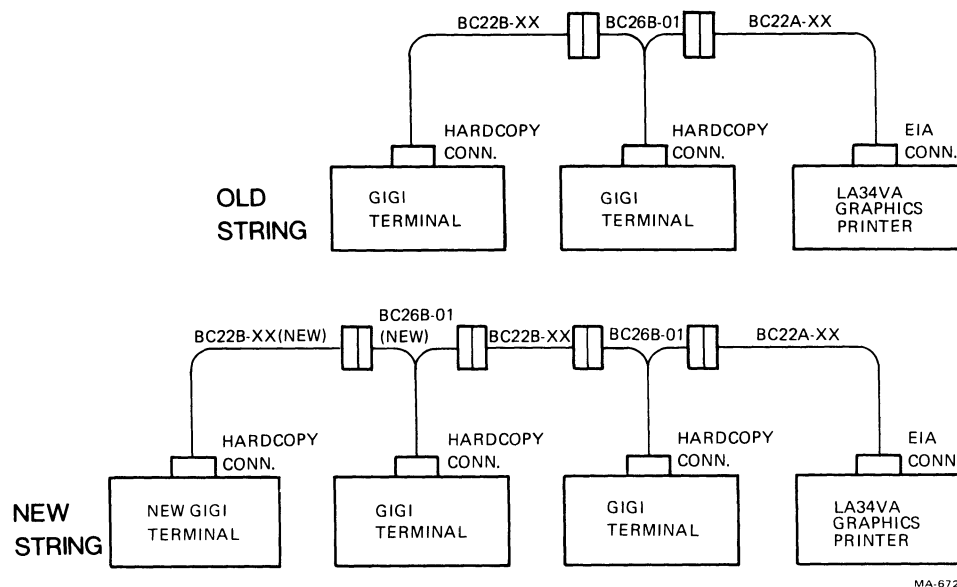


Figure 2-11  Adding a Terminal to a Multiterminal String

To perform the procedure use a flat blade screwdriver, a BC22B-xx interface cable, and a BC26B-01 Y-type cable.

1.  Locate the last VK100 terminal in the string attached to the LA34VA graphic printer. Disconnect the cable connected to the HARDCOPY connector on the rear of this terminal.

2.  Locate and connect the BC26B-01 Y-type cable to the HARDCOPY connector on the last VK100 terminal. The connector can only plug in one way. Connect the ground wire to the HARDCOPY connector. Figure 2-6 shows the cable connector with the ground wire connected.

3.  Connect the cable disconnected from the terminal in step 2 to the female connector of the BC26B-01 Y type cable.

4.  Locate the new BC22B cable. Plug one BC22B cable connector into the male BC26B-01 cable connector. The connector can only plug in one way. Connect the ground wire between the two connectors. Figure 2-6 shows the cable connector with the ground wire connected.

5.  Plug the other BC22B cable connector into the HARDCOPY connector on the VK100 terminal being added to the string. The connector can only plug in one way. Connect the ground wire to the HARDCOPY connector. Figure 2-6 shows the cable connector with the ground wire connected.

6.  Apply power to both terminals.

7.  To verify the LA34VA graphics printer connection, place the screen alignment video pattern on the monitor screen. Do this by pressing the following keys in order: SET-UP, S, T, 4, and SET-UP again.

8.  Print the screen alignment video pattern on the LA34VA graphics printer. Do this by pressing the SHIFT and PF1/HARDCOPY keys together.

**2.5.3.3 Removing a Terminal from a Multiterminal String --** Use the following procedure if two or more VK100 terminals are connected to the LA34VA graphics printer. Figure 2-12 shows a simple diagram of the procedure.

1.   Locate the VK100 terminal you want to disconnect.

2.   Locate the BC26B-01 Y-type cable connected to the HARDCOPY connector on the rear of this terminal. Disconnect the two cables connected to the BC26B-01 Y-type cable.

3.   Connect the two cables that were removed from the BC26B-01 Y-type cable. Be sure to connect the cable ground wires between the two connectors. Figure 2-6 shows the cable connectors with the ground wire connected.

The terminal is now disconnected from the multiterminal string.
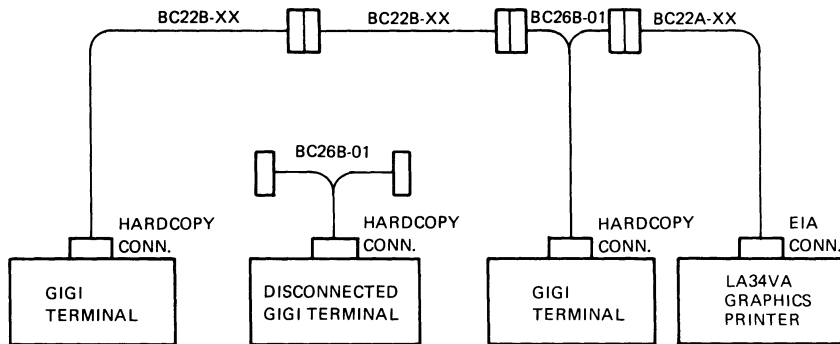


Figure 2-12 Removing a Terminal from a Multiterminal String

## 2.6    HARDWARE INTERFACE INFORMATION

### 2.6.1    General Communications Interface Information

The terminal operates on full-duplex, asynchronous communications lines. The physical interfaces are implemented using a 25-pin EIA connector and a 20 mA loop connector.

**2.6.1.1 Baud Rate** -- Transmit and receive baud rates are programmed through the keyboard using the SET-UP commands. Both transmit and receive baud rates can be set independently to: 110, 300, 600, 1,200, 2,400, 4,800, 9,600, or 19,200 baud.

The terminal (set up for jump scroll) supports text writing speeds up to 300 baud without using the XON/XOFF characters for synchronization.

**2.6.1.2 Character Format** -- The format of the asynchronous character is bit serial, consisting of a start bit (always SPACE), seven data bits (MARK equals binary 1, SPACE equals binary 0) an optional parity bit, and one or two stop bits (always MARK). The data bits are ASCII coded, and the least significant bit is transmitted or received first.

The parity bit can be programmed for odd or even parity. If parity is disabled, the eighth bit is set to SPACE and no parity checking occurs on input. If parity is enabled and parity errors are detected, the error character is displayed.

All baud rates have one stop bit per transmitted character, except 110 baud which has two stop bits per character.

The communication data format outlined here is programmed using SET-UP commands.

### 2.6.2    EIA Interface

**2.6.2.1 Physical Interface** -- The basic VK100 terminal operates on full-duplex, asynchronous communication lines. The terminal interfaces to the line with a 25-pin connector mounted on the back of the terminal. This connector meets the requirements of EIA Std RS-232-C. Table 2-1 summarizes the EIA connector signals. The following paragraphs explain how the basic VK100 terminal uses each signal.

**Protective Ground - Pin 1** -- This conductor connects to the terminal system ground via a jumper. The conductor cannot be used for reference potential purposes.

**Transmitted Data (from VK100 terminal)** -- **Pin 2** -- The VK100 terminal transmits serially encoded characters and break signals on this circuit. The circuit is held in the mark state when the terminal is not transmitting characters or break signals.

Table 2-1   EIA Connector Signals

| Pin | Description | EIA/CCITT Circuit |
|-----|-------------|-------------------|
| 1 | Protective ground | AA/101 |
| 2 | Transmitted data | BA/103 |
| 3 | Received data | BB/104 |
| 4 | Request to send | CA/105 |
| 5 | (not used) | -- |
| 6 | Data set ready | CC/107 |
| 7 | Signal ground* | AB/102 |
| 8 | (not used) | -- |
| 9 | (not used) | -- |
| 10 | (not used) | -- |
| 11 | (not used) | -- |
| 12 | (not used) | -- |
| 13 | (not used) | -- |
| 14 | (not used) | -- |
| 15 | (not used) | -- |
| 16 | (not used) | -- |
| 17 | (not used) | -- |
| 18 | (not used) | -- |
| 19 | (not used) | -- |
| 20 | Data terminal ready | CD/108.2 |
| 21 | (not used) | -- |
| 22 | (not used) | -- |
| 23 | (not used) | -- |
| 24 | (not used) | -- |
| 25 | (not used) | -- |

* Common return

Received Data (to VK100 terminal) -- Pin 3 -- The VK100 terminal receives serially encoded characters generated by the user's equipment on this circuit. The terminal is always ready to accept and interpret data after power-up, except in local mode.

Request To Send (from VK100 terminal) -- Pin 4 -- This signal is always asserted (SPACE state) when the terminal is powered up and in the on-line mode.

Clear To Send (from VK100 terminal) -- Pin 5 -- A circuit exists for this signal, but the signal is ignored at all times.

Data Set Ready (to VK100 terminal) -- Pin 6 -- A receiver exists for this signal, but the signal is ignored at all times.

Signal Ground -- Pin 7 -- This conductor establishes the common ground reference potential for all voltages on the interface. It connects to the VK100 terminal system ground.

Data Terminal Ready (from VK100 terminal) -- Pin 20 -- The data terminal ready (DTR) signal is always asserted, except under the following conditions.

    1.    When the terminal is not powered up

    2.    When the terminal is in local mode

    3.    During the 3.5 second interval following the pressing of SHIFT and BREAK.

> NOTE
> This use of data terminal ready (DTR) signal disconnects local and remote data sets when you press SHIFT and BREAK. It also prevents automatic answering when the terminal is in local mode or powered off. This use of DTR also causes the line to disconnect when the VK100 terminal switches from on-line to local mode.

2.6.2.2 Electrical Characteristics -- The EIA interface has the following characteristics. On all signals generated by VK100 terminal, the mark or unasserted state is -6 V to -12 V; the space or asserted state is +6 V to +12 V. On signals received by VK100 terminal, -25 V to +0.75 V or an open circuit is interpreted as a mark or unasserted state; and +25 V to +2.25 V is interpreted as a space or asserted state. Voltages greater than +25 V are not allowed. These levels are compatible with EIA Std RS-232-C and CCITT Recommendation V.28.

**2.6.2.3 EIA Interface Cables** -- Table 2-2 lists the recommended communication cables for use with the EIA interface.

Table 2-2 EIA Interface Cables

| Cable Part Number | Cable Function |
|---|---|
| BC22A-1Ø | EIA null modem; connects VK1ØØ terminal directly to a line unit (6 conductor cable) |
| BC22A-25 | EIA null modem; connects VK1ØØ terminal directly to a line unit (6 conductor cable) |
| BC22B-1Ø | EIA extension to modem (14 conductor cable) |
| BC22B-25 | EIA extension to modem (14 conductor cable) |

**2.6.3    2Ø mA Current Loop Interface**
The VK1ØØ terminal current loop interface is a passive configuration, that is, current must be supplied to the VK1ØØ terminal. The transmitter and receiver are both passive and optically isolated; the transmitter goes to the mark state when power is turned off. Table 2-3 lists the recommended 2Ø mA current loop characteristics.

Table 2-3 2ØmA Current Loop Characteristics

| Condition | Transmitter Min | Max | Receiver Min | Max |
|---|---|---|---|---|
| Open circuit voltage | 5V | 5ØV | N/A | N/A |
| Voltage drop marking | ØV | 4V | — | 2.3V |
| Spacing current | — | 2mA | — | 3mA |
| Marking current | 2ØmA | 5ØmA | 15mA | 5ØmA |

**2.6.3.1  Electrical Characteristics** -- The 20 mA current loop interface has the following electrical characteristics.

**2.6.3.2  20 mA Interface Cables** -- Table 2-4 lists the recommended communication cables for use with the 20 mA interface.

**2.6.4    Buffer Overflow Prevention**
The VK100 terminal can operate at transmission speeds up to 19,200 baud. However, the terminal may not be able to keep up with incoming data. The terminal stores incoming characters in a 253-character buffer and processes them on a first-in, first-out basis. When the contents of the buffer reaches 100 characters, the terminal transmits XOFF ($023_8$ or DC3). On this signal the host computer should stop transmitting to the terminal. If the host stops transmitting, the terminal eventually depletes the buffer. When 50 characters remain in the buffer, the terminal transmits XON ($021_8$ or DC1) to signal the host that it may resume transmission. If the host fails to respond promptly to the XOFF signal, the buffer continues to fill. When the buffer exceeds its 253-character capacity, a buffer overflow occurs. When the buffer overflows, the VK100 terminal ignores any incoming characters.

Table 2-4 20mA Interface Cables

| Cable Part Number | Function |
| --- | --- |
| BC05F-15 | 20 mA cable with Mate-N-Lok connectors for connecting VK100 terminal directly to a line unit. |
| BC05F-50 | 20 mA cable with Mate-N-Lok connectors for connecting VK100 terminal directly to a line unit. |
| BC05F-A0 | 20 mA cable with Mate-N-Lok connectors for connecting VK100 terminal directly to a line unit. |

The only indication of a buffer overflow is the loss of data on the monitor screen. The terminal does not display special characters on the screen to indicate this condition. Use the following formula to determine a possible buffer.

Response time = 153 X 10 / rec speed -- 3 X (trans bits / trans speed)

where:

Rec speed = VK100 terminal receive speed in bits/second (baud).

Trans bits = 10, except at 110 baud where it is 11.

Trans speed = VK100 terminal transmit speed in bits/second (baud).

NOTE
The response time is less than 0 only when the receive speed is 19,200 baud and the transmit speed is 110 baud. Never use this combination of receive and transmit speeds.

Example 1
The VK100 terminal is transmitting at 1200 baud and receiving at 1200 baud. The terminal sends an XOFF signal which the host must respond to within 1.25 seconds to avoid the buffer overflow.

Response time = 153 X (10/1200) -- 3 X (10/1200) = 1.25 seconds

Example 2
The VK100 terminal is transmitting at 300 baud and receiving at 1200 baud. The terminal sends an XOFF signal which the host must respond to within 1.175 seconds to avoid a buffer overflow.

Response time = 153 X (10/1200) -- 3 X (10/300) = 1.175 second

The XON/XOFF synchronization scheme has an advantage over requiring the host to insert delays or filler characters in its data stream. Requiring a minimum of software support, XON/XOFF makes sure that every character or command sent to the VK100 terminal is processed in correct order. This scheme frees interface programs from all timing considerations and produces more reliable operation.

Software that does not support XON/XOFF signals from the VK100 terminal can still use the terminal in text or interactive mode. To do so limit the terminal receive speed to 300 baud in jump scroll mode, or 4800 baud in wrap scroll or scroll off modes. Set the receive higher only if the average line length of the data is known. Table 2-5 shows the maximum speeds (baud rates) for each scroll mode selection at different line lengths.

Table 2-5 Terminal Receive Speed Limits (No XON/XOFF Support)

| Scroll Mode | Ø | Average Line Length in Characters | | | | | | | |
| | | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 |
|---|---|---|---|---|---|---|---|---|---|
| Smooth | Ø | 600 | 1200 | 1200 | 1200 | 1200 | 2400 | 2400 | 2400 |
| Jump | 300 | 1200 | 2400 | 2400 | 2400 | 2400 | 2400 | 2400 | 2400 |
| Wrap/Off | 4800 | 4800 | 4800 | 4800 | 4800 | 4800 | 4800 | 4800 | 4800 |

Speeds are expressed as baud rates.

If XON/XOFF cannot be used, use fill characters after certain characters or character strings are sent to the VK100 terminal. Table 2-6 shows the number of fill characters required for these functions. Use either the NUL ($000_8$) or the DEL ($177_8$) as fill characters.

XON/XOFF support is required whenever the terminal is in the following modes.

    Auto Hardcopy (AH1)
    Graphics mode
    BASIC mode (BA1 or BA2)

If the host computer does not support XON/XOFF buffer synchronization, data will probably be lost. Fill characters and pauses after transmission do not prevent data loss due to the varying sequence execution times.

Table 2-6 Fill Character Requirements

| Character or Sequence Received | Receive Speed | | | | | | | |
| | 110 | 300 | 600 | 1200 | 2400 | 4800 | 9600 | 19200 |
|---|---|---|---|---|---|---|---|---|
| TAB | -- | -- | -- | -- | -- | -- | 1 | 2 |
| Text | -- | -- | -- | -- | -- | -- | 1 | 3 |
| ED (char) | -- | -- | -- | -- | -- | -- | 3 | 9 |
| CAN | -- | -- | -- | -- | -- | 1 | 2 | 4 |
| EL | -- | -- | -- | -- | 2 | 6 | 15 | 32 |
| FF | -- | 2 | 4 | 9 | 19 | 39 | 79 | 159 |
| DECALN | -- | 3 | 9 | 21 | 45 | 93 | 189 | 381 |
| ED (full) | 1 | 9 | 20 | 42 | 86 | 175 | 353 | 709 |

Two terminal functions, reset and self-test, reinitialize the terminal and erase the buffer. This means characters received after the commands to perform these two functions are lost without being processed.

To compensate for this, the host computer may act in one of the two following ways.

1.  Immediately after sending the terminal one of these commands the host may act as if it had received XOFF. Thus the host will not send additional characters until it receives XON. The terminal transmits XON only after it completes the specified operation and the XON/XOFF feature is enabled.

2.  When the first method cannot be implemented, the host may use a delay of no less than 10 seconds to allow the terminal time to complete the invoked function. If the invoked function detects an error, there is no guarantee against loss of data. This delay is currently adequate, however, future options may require a change in the delay period.

The VK100 terminal always recognizes received XOFF and XON signals. Receipt of XOFF inhibits the VK100 terminal from transmitting any codes except XOFF and XON. Up to 253 keystrokes are stored in a keyboard buffer (some keys transmit two or three codes, e.g., cursor controls). If the keyboard buffer overflows, keyclicks stop. Transmission resumes upon receipt of XON.

Entering and exiting SET-UP clears all stored keyboard characters and the keyboard locked condition.

2.6.5    Display Interface
The display interface provides the circuitry needed to drive one black and white monitor and one red, green, and blue (RGB) color monitor at the same time. Four separate BNC connectors are located on the rear of the terminal and are labeled as follows.

    MONO
    RED
    GREEN
    BLUE

These connectors provide the signals needed to drive both black and white and color monitors.

2.6.5.1 Composite Video Port (MONO) -- This interface connector drives an external black and white monitor. The output conforms to EIA RS-330 and has the following nominal characteristics.

|  |  |
|---|---|
| Output impedance | 75 ohms, dc coupled |
| Sync level | 0.0 V to 0.1 V |
| Black level | 0.3 V +/- 10% when terminated with 75 ohms |
| White level | 1.0 V +/- 10% when terminated with 75 ohms |

**2.6.5.2  Color Monitor Port (RED, GREEN, BLUE)** -- These interface
connectors drive an external RGB color monitor. The RED, GREEN,
and BLUE outputs have the following nominal characteristics.

Output impedance          75 ohms, dc coupled

Red and blue signal outputs

    Signal level          1.0 V +/- 10%

Green signal outputs

    Signal level          1.0 V +/- 10%
    Sync level            0.0 V to 0.1 V
    Black level           0.3 V +/- 10%

**2.6.5.3  Composite Sync Waveform Timing** -- The composite sync
waveform conforms to EIA RS-330 and has the following nominal
characteristics.

| | |
|---|---|
| Horizontal period | 63.131 ~s  (15.840 KHz) |
| Horizontal sync width | 4.735 ~s |
| Front porch | 0.789 to 7.891 ~s. The exact timing depends upon the HP SET-UP feature setting. When set to HP5 the front porch is 3.945 ~s. |
| Back porch | 7.891 ~s minus front porch time |
| Active video time | 50.505 ~s |
| Frame rate | |
|     Noninterlaced (IL0) | 60.00 Hz (PF0) or 49.97 Hz (PF1) |
|     Interlaced (IL1) | 29.94 Hz (PF0) or 24.95 Hz (PF1) |
| Vertical sync width | 189.394 ~s |
| Serration during vertical sync | none |
| Vertical blank | 1.262 ms minimum (PF0) <br> 4.609 ms minimum (PF1) |
| Horizontal scans per frame | 264 (PF0 and IL0) <br> 317 (PF1 and IL0) <br> 529 (PF0 and IL1) <br> 635 (PF1 and IL1) |

**2.6.5.4 Monitor Selection** -- The display interfaces to drive a number of commercially standard monitors. Monitors connected to the VK100 terminal should have the following capabilities.

Video bandwidth                8 MHz minimum

Horizontal flyback time        12 ~s maximum

Vertical flyback time          1.0 ms maximum (525-line monitor) 4.3 ms maximum (625-line monitor)

Line rate                      15.840 KHz

Frame rate                     60 Hz or 50 Hz

Aspect ratio                   adjustable to 1:1.6

DC restoration

To present the best possible display, the VK100 terminal contains a number of SET-UP selectable features to tailor the video output of the terminal to the monitor. These features are as follows.

Feature              Function

PF0                  For 60 Hz, 525-line monitors

PF1                  For 50 Hz, 625-line monitors

HP0 to HP9           For horizontal centering

HM0 to HM9           To horizontally limit the text display area for monitors with overscan

VM0 to VM9           To vertically limit the text display area for monitors with overscan

EM1                  For 40 characters per line display text on low resolution monitors

IL0                  For a noninterlaced display to reduce flicker

IL1                  For an interlaced display on a monitor with a slow phospher, or for taking monitor screen photographs

**2.6.5.5 Video Interface Cables** -- Table 2-7 lists the recommended communication cables for use with the video interfaces.

Table 2-7 Video Interface Cables

| Cable Part Number | Function |
|---|---|
| BC26M-Ø5 | RGB cable with BNC connectors for user-supplied monitor |

### 2.6.6    Hardcopy Interface

The terminal has a serial interface port for interfacing to a LA34VA graphics printer; this allows dumping of bit map information to obtain a hardcopy. A series-chaining scheme allows more than one VK1ØØ terminal to share a single graphics printer.

**2.6.6.1 Physical Interface** -- The interface to an external hardcopy device uses a standard 25-pin female EIA connector. Table 2-8 lists the pin assignments.

Table 2-8 Hardcopy Interface Pin Assignments

| Pin | Signal Name |
|---|---|
| 1 | Protective Ground |
| 2 | Downstream Transmitted Data (DTXD) |
| 3 | Downstream Received Data (DRXD) |
| 4 | Downstream Request To Send (DRTS) |
| 5 | Downstream Clear to Send (DCTS) |
| 7 | Signal Ground |
| 13 | Upstream Clear To Send (UCTS) |
| 14 | Upstream Transmitted Data (DTXD) |
| 16 | Upstream Received Data (DRXD) |
| 19 | Upstream Request To Send (URTS) |

**2.6.6.2 Electrical Interface** -- The electrical characteristics of the hardcopy interface are as follows. On signals generated by the VK100 terminal, the mark or unasserted state is -6 V to -12 V; the space or asserted state is +6 V to +12 V. These levels are compatible with EIA Std RS-232-C and CCITT Recommendation V.28.

On signals received by the VK100 terminal, -25 V to +0.75 V or an open circuit is interpreted as a mark or unasserted state, and +25 V to +2.25 V is interpreted as a space or asserted state. Voltages greater than +25 V are not allowed. These levels are compatible with EIA Std RS-232-C and CCITT Recommendation V.28.

**2.6.6.3 Hardcopy Interface Cables** -- Table 2-9 lists the recommended communication cables for use with the hardcopy interface.

**2.6.6.4 Hardcopy Device Sharing** -- The VK100 terminal contains the necessary logic for series-chaining to another VK100 terminal to time share a single hardcopy device. For every series-chained VK100 terminal, a Y-cable (BC26B-01) and a modem cable (BC22B-x) are needed. Chapter 5 provides instructions on how to connect the terminal in a series chain.

There is no limitation on the number of VK100 terminals chained to the hardcopy device as long as the maximum cable length between adjacent terminals is 50 ft. The 50 ft maximum cable length conforms to RS-232-C/CCITT V.28 interface specifications. In practice the number of VK100 terminals served by a single printer is limited by the maximum response time users will accept.

When a VK100 terminal is powered off, all upstream terminals (those farther away from the hardcopy device) are broken off the chain. The cabling system allows downstream terminals to bypass the Y-cable on the powered-off terminal and remain in the chain. As a general practice disconnect all powered-off terminals from the chain. This eliminates the possibility of inducing noise pulses in the chain, which may cause an erroneous printout.

**Table 2-9 Hardcopy Interface Cables**

| Cable Part Number | Function |
|---|---|
| BC26B-Ø1 | Y-cable for daisy-chaining the LA34VA graphics printer to multiple VK1ØØ terminals |
| BC22B-25 | EIA extension to second VK1ØØ terminal from Y-cable (BC26B-Ø1) |
| BC22A-1Ø | EIA null modem; connects VK1ØØ terminal directly to a line unit(6 conductor cable) |
| BC22A-25 | EIA null modem; connects VK1ØØ terminal directly to a line unit (6 conductor cable) |

## 3.3    KEYBOARD CONTROLS

The VK100 terminal has two keypads. The main keypad has a key arrangement and sculpturing styled like a standard office typewriter. The auxiliary or numeric keypad allows you to enter numeric data in a calculator-like fashion.

The following paragraphs describe the different VK100 terminal keyboard control groups and their functions.

       Standard keys
       Special function keys
       SET-UP mode keys
       Special mode keys

### 3.3.1    Standard Keys

Figure 3-2 identifies the VK100 terminal keyboard keys that usually operate like standard typewriter and calculator keys. These keys generate ASCII codes which the terminal transmits to the host computer. The minus, comma, period, and numeric keys of the auxiliary keypad normally generate the same codes as the corresponding unshifted keys of the main keypad. The SHIFT key on the main keypad does not affect the codes generated by the keys on the auxiliary keypad.

The auxiliary keypad has two alternate modes of operation: keypad application mode and programmed keypad mode. The terminal can enter either mode through the SET-UP parameters or a command from the host computer. In both modes the auxiliary keypad generates control functions.
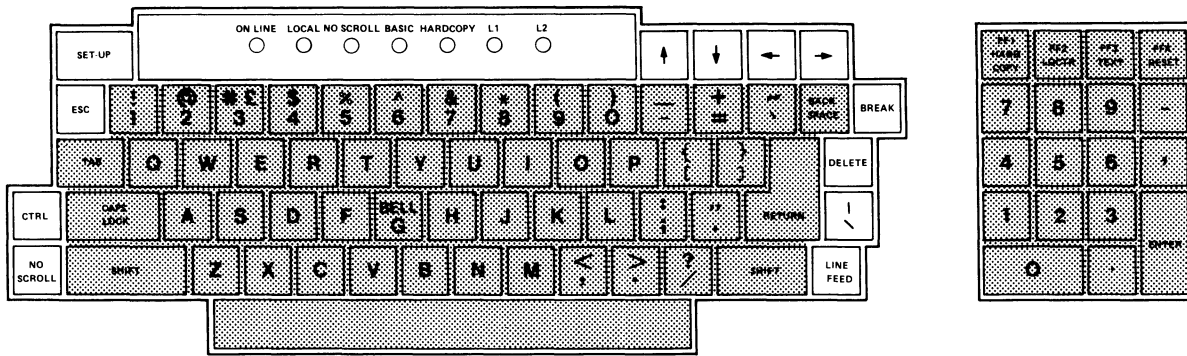
Figure 3-2 Standard Keys
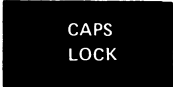
**CAPS LOCK**

This key enables the uppercase function of alphabetic keys only. All numeric and special symbol keys remain in lowercase.

**SHIFT**

This key enables the uppercase function of all keys. If a key does not have an uppercase function, the **SHIFT** key has no effect.
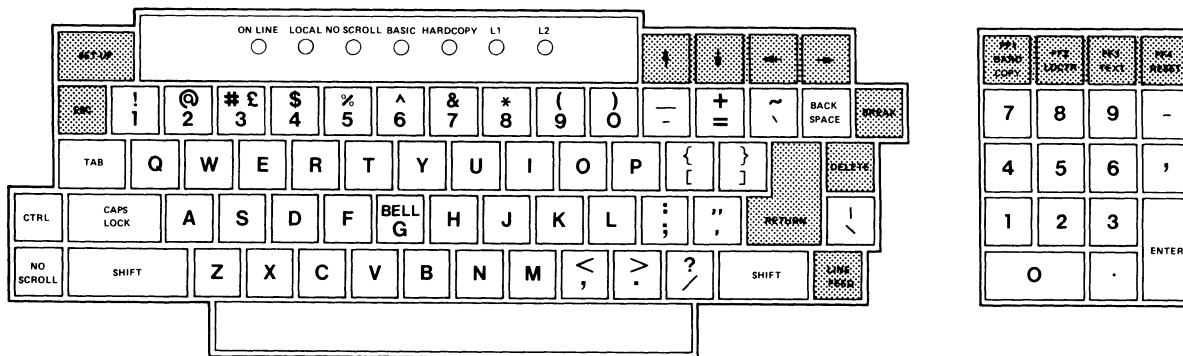
Figure 3-3 Special Function Keys

## 3.3.2 Special Function Keys

Figure 3-3 identifies the special function keys on the VK100 terminal keyboard. The following paragraphs provide a general description.

**SET-UP**

Pressing this key causes the VK100 terminal to enter SET-UP mode. Terminal parameters such as scrolling can be changed in this mode.

**Arrows**

Each of these keys causes the VK100 terminal to transmit a control function code to the host computer. Usually the control functions are interpreted as commands to move the cursor in the direction of the arrow.

**BREAK**

This key transmits a break signal. Pressing BREAK with either of the SHIFT keys transmits the long break signal.

**PF1/HARDCOPY**

Pressing this key by itself causes the VK100 terminal to transmit a control function code.

Pressing this key with either of the SHIFT keys causes the optional printer to copy the current contents of the monitor screen. During the copying process the screen is frozen. Once the

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printer finishes the copy, the screen resumes normal operation. If a printer is not connected to the terminal, pressing this key freezes the screen for a short time just as if a printer was copying the screen.

Pressing the **SHIFT** and **PF1/HARDCOPY** keys a second time stops the printing of the screen contents. When this occurs the terminal returns to the previous operating mode.

**PF2/LOCATOR**

Pressing this key by itself causes the VK100 terminal to transmit a control function code.

Pressing this key with either of the **SHIFT** keys causes the terminal to enter locator mode and display the locator cursor ( + ) on the screen. Section 3.3.4 provides more information on the locator mode.

**PF3/TEXT**

Pressing this key by itself causes the VK100 terminal to transmit a control function code.

Pressing this key with either of the **SHIFT** keys causes the terminal to enter text mode and disable graphics mode. When it enters text mode, the terminal cancels any special graphics display parameters that were selected. If the terminal was already in text mode, pressing this key resets any special text features.

**PF4/RESET**

Pressing this key by itself causes the VK100 terminal to transmit a control function code.

Pressing this key with either of the **SHIFT** keys resets the terminal. This action is almost the same as turning the power switch off and on. All of the contents of memory are lost except the SET-UP parameter settings, soft character sets, BASIC program, graphics mode macrographs, and any special key definitions. This reset function does <u>not</u> change the SET-UP parameter settings.

**DELETE**

This key causes the VK100 terminal to transmit a delete character code to the host system. The deleted character may or may not be erased from the screen.

**RETURN**

This key transmits either a carriage return (CR) code or a carriage return (CR) and line feed (LF) code. Select the desired function through the New Line (NL) SET-UP parameter.

**LINE FEED**

This key transmits a line feed (LF) code.

**NO SCROLL**

This key is controlled by the XO SET-UP parameter. If the XO parameter is on, pressing this key the first time stops data transmission from the host computer to the VK100 terminal. This also lights the NO SCROLL indicator above the keyboard, to show that the terminal is not sending or receiving data. Pressing the key a second time resumes transmission from where it stopped. This also turns off the NO SCROLL indicator. If the XO parameter is off, this key is inactive and has no effect on the terminal.

**CONTROL**

Pressing this key in combination with another key causes the VK100 terminal to transmit a control code.

**ESCAPE**

This key transmits an escape code.
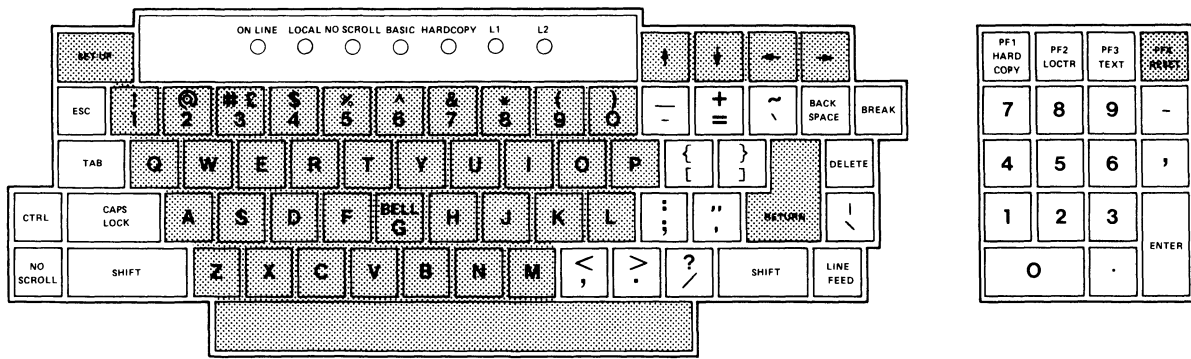
Figure 3-4 SET-UP Mode Keys

### 3.3.3    SET-UP Mode Keys

Figure 3-4 identifies the keys available in SET-UP mode. Section 3.5 provides a detailed description of the SET-UP mode.

**SPACE BAR or UP ARROW**
Either key steps to the next higher setting for a SET-UP parameter. When the highest value is reached, the setting returns to Ø and starts the cycle over again. Each key performs the same function.

**DOWN ARROW**
This key steps to the next lower setting for a SET-UP parameter. When Ø is reached the setting returns to the highest value and starts the cycle over again.
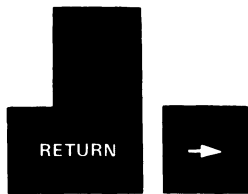
**RETURN or RIGHT ARROW**
Either key steps the terminal to the next SET-UP parameter. When the last parameter appears on the screen, the terminal automatically returns to the first SET-UP parameter. Each key performs the same function.

**◄ LEFT ARROW**

This key steps the terminal backwards to the previous SET-UP parameter. When the first parameter appears on the screen, the terminal automatically returns to the last SET-UP parameter.

**Alphabetic Keys** -- These keys enter the two-letter code for each SET-UP parameter. This displays any SET-UP parameter without stepping through all the parameters. If the operator types an incorrect code, the terminal sounds the bell tone and displays the last correct parameter.

**Numeric Keys** -- These keys enter the numeric parameter setting of a SET-UP parameter. This sets a parameter without stepping through all the parameter settings. If the operator types an incorrect setting, the terminal sounds the bell tone and displays the last correct parameter setting.

**PF4/RESET**

Pressing this key with either of the SHIFT keys resets the terminal to the power-up state. All the contents of memory, including the SET-UP parameter settings, are lost. Pressing these keys in SET-UP mode is the same as turning the terminal power switch off and on.

When the operator presses this key by itself, the terminal sounds the bell tone.
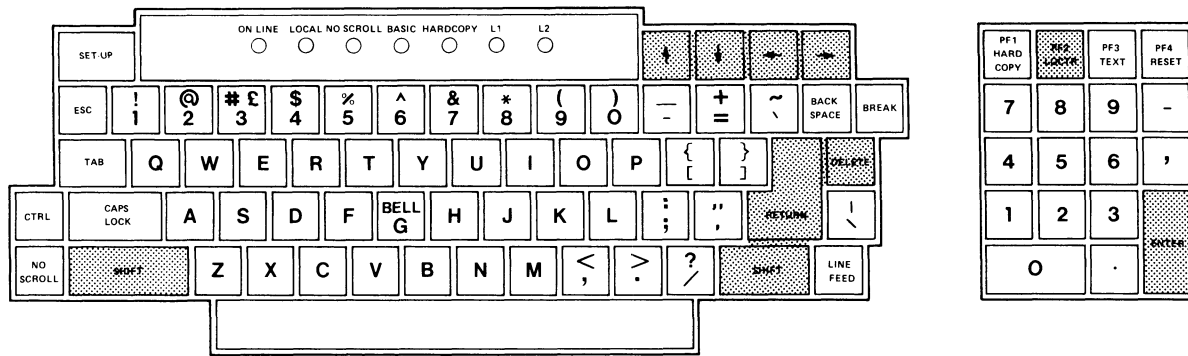
Figure 3-5 Locator Mode Keys

### 3.3.4     Locator Mode Keys

Figure 3-5 identifies the keys that have a special meaning to the terminal in locator mode. The following paragraphs briefly describe the function of the locator keys in locator mode. If the operator presses any keys other than those described, the terminal exits locator mode, sends the code of the key pressed, and then sends the screen location of the locator cursor. If the terminal enters locator mode through the host computer, the terminal sends a carriage return (CR) code followed immediately by the key code.

**PF2/LOCATOR**

Pressing this key with either of the SHIFT keys causes the terminal to enter locator mode and display the locator cursor ( + ) on the screen.

**ARROWS**

These keys move the locator cursor ( + ) around the screen. Each time the operator presses the key, the locator cursor moves one dot in the direction shown by the arrow on the key. Pressing SHIFT with one of the arrow keys moves the locator cursor ( + ) ten dots in the direction shown by the arrow on the key.

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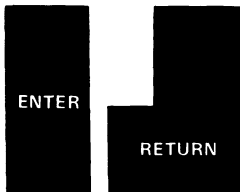
**ENTER or RETURN**

Either of these keys end the locator mode. The terminal sends the screen position of the locator cursor to the host computer.

**DELETE**

This key ends the locator mode; however, the terminal does <u>not</u> send the screen position of the locator cursor to the <u>host</u> computer. If the terminal enters locator mode through the host computer, the terminal sends a carriage return (CR) code.

**3.4     VISUAL AND AUDIBLE INDICATORS**

The VK100 terminal has two types of indicators: visual indicators above the keyboard, and audible alarms.

**3.4.1     Visual Indicators**

Figure 3-6 shows the location of the keyboard indicators. The following paragraphs describe the function of each indicator.

**ON LINE**

This indicator lights to show that the VK100 terminal is on-line and ready to transmit or receive messages from the host computer. The ON LINE indicator can also show self-test errors.

**LOCAL**

This indicator lights to show that the terminal is off-line and cannot communicate with the host computer. In local mode the keyboard remains active and all typed characters appear on the screen. The LOCAL indicator can also show self-test errors.
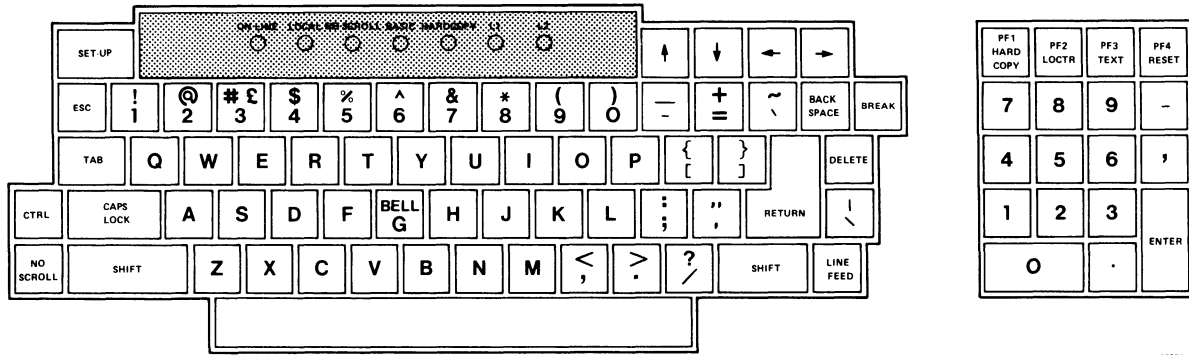
Figure 3-6 Keyboard Indicators

**NO SCROLL**
This indicator lights to show that the **NO SCROLL** key was pressed and the terminal is no longer receiving or sending data to the host computer. The codes for any keys pressed while the NO SCROLL indicator is on are stored in the terminal and sent after the indicator turns off. To continue sending or receiving data, press **NO SCROLL** a second time. The NO SCROLL indicator is inactive if the XO SET-UP parameter is off (XO0).

**BASIC**
This indicator lights to show that the terminal is in the BASIC program mode. In this mode the terminal interprets all data entered on the keyboard or received from the host computer as BASIC language commands. The BASIC indicator also shows self-test errors.

**HARDCOPY**
This indicator lights to show that the optional hardcopy printer is copying the screen. When the operation is complete, the terminal turns the indicator off. The HARDCOPY indicator also shows self-test errors.

**L1 and L2**
These indicators are turned on and off by the host computer. The L1 and L2 indicators also show self-test errors.

### 3.4.2   Audible Indicators

The VK100 terminal has two audible alarms: a short tone (click) and a long tone (beep).

**Short Tone (click)** -- The terminal sounds the short tone whenever the operator presses a key, with the following exceptions.

   1.   SHIFT and CTRL keys do not generate a keyclick, because these keys do not transmit codes. These keys only modify the codes transmitted by other keys.

   2.   No key generates a keyclick if the keyclick parameter is turned off in SET-UP mode.

**Long Tone (beep)** -- The terminal sounds the long tone when one of the following conditions occurs.

   1.   The terminal enters SET-UP mode.

   2.   The terminal receives a bell code from the computer.

   3.   The cursor is eight characters away from the right margin, and the margin bell parameter is enabled.

   4.   The operator enters an incorrect parameter code or parameter setting in SET-UP mode.

### 3.5   SET-UP MODE DESCRIPTION

The VK100 terminal contains many features. Some of these features help the operator in the daily use of the terminal. Other features allow the terminal to talk to many different types of computers and computer programs. To change these features to the required settings the terminal contains a special mode of operation called SET-UP mode.

In SET-UP mode, the terminal displays the status of each parameter stored in the terminal memory individually on the monitor screen. Once the parameter code appears, the operator can change the parameter setting. Changing the parameter setting causes the terminal to operate according to the new setting. The effect is the same as turning a switch on or off.

Enter SET-UP mode by pressing SET-UP. The following events occur.

   1.   The monitor screen scrolls down six character lines.

   2.   The long tone sounds.

   3.   The monitor enters the expanded mode.

   4.   A message similar to the following appears at the top center of the screen.

SET-UP TS4 2400

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The word SET-UP indicates the terminal is in SET-UP mode.

The next two characters are the SET-UP parameter code. This code represents the SET-UP parameter the operator can change. In this case the code is TS and stands for Transmit Speed.

Immediately following the SET-UP parameter code is its current setting (4 in this case). This parameter setting code changes when the parameter setting changes.

The last four characters in the message are an abbreviation of the current parameter setting. The abbreviation in this case is 2400, to show that the terminal transmit speed is set for 2400 baud (bits per second). The parameter setting abbreviation varies from setting to setting.

The parameter settings entered in SET-UP mode are not permanent. Every time the operator turns terminal power off, the parameter settings return to a condition known as default. The default conditions reside in two different physical locations in the terminal, the default SET-UP switch pack and the read only memory (ROM).

The default SET-UP switch pack controls the following parameters.

Transmit (TS) and receive (RS) speed together
Parity (PE)
Default character (UK) sets
Communications interface (CI)
Power frequency (PF)

The operator can change the default values for these SET-UP parameters while installing the terminal. Refer to section 2.5 for the procedure to follow. This chapter discusses the specific function and possible settings for each SET-UP parameter.

All other default SET-UP parameter settings are controlled by the read only memory (ROM) in the VK100 terminal. These default parameter settings are permanent. For a parameter setting different from the default setting, change the setting each time terminal power is turned on.

### 3.5.1     SET-UP Parameter Summary

The VK100 terminal contains all the SET-UP parameters listed in Table 3-1. The first column in the table lists the SET-UP parameters in the order they appear on the monitor screen. The second column lists the parameter codes, and the third column lists the possible setting codes for each parameter. The next column lists the exact message that appears on the screen, and the last column briefly describes what the parameter does for that setting.

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This table serves only as a brief summary of the SET-UP parameters and how they affect the VK100 terminal. See the SET-UP Parameter Descriptions section of this chapter for a more complete description of each parameter.

Table 3-1  SET-UP Parameter Summary

| SET-UP Parameter | Para Code | Set Code | Displayed Message | Function |
|---|---|---|---|---|
| Transmit | TS | 0 | TS0  110*+ | Set transmit speed to 110 baud. |
| Speed | TS | 1 | TS1  300 | Set transmit speed to 300 baud. |
| | TS | 2 | TS2  600 | Set transmit speed to 600 baud. |
| | TS | 3 | TS3 1200 | Set transmit speed to 1,200 baud. |
| | TS | 4 | TS4 2400 | Set transmit speed to 2,400 baud. |
| | TS | 5 | TS5 4800 | Set transmit speed to 4,800 baud. |
| | TS | 6 | TS6 9600 | Set transmit speed to 9,600 baud. |
| | TS | 7 | TS7 19.2 | Set transmit speed to 19,200 baud. |
| Receive Speed | RS | 0 | RS0  110*+ | Set receive speed to 110 baud. |
| | RS | 1 | RS1  300 | Set receive speed to 300 baud. |
| | RS | 2 | RS2  600 | Set receive speed to 600 baud. |
| | RS | 3 | RS3 1200 | Set receive speed to 1,200 baud. |
| | RS | 4 | RS4 2400 | Set receive speed to 2,400 baud. |
| | RS | 5 | RS5 4800 | Set receive speed to 4,800 baud. |
| | RS | 6 | RS6 9600 | Set receive speed to 9,600 baud. |
| | RS | 7 | RS7 19.2 | Set receive speed to 19,200 baud. |
| Local/ | LL | 0 | LL0 Locl | Local mode. |
| Line | LL | 1 | LL1 OnLn* | On-line mode. |

Table 3-1  SET-UP Parameter Summary (cont)

| SET-UP Parameter | Para Code | Set Code | Displayed Message | Function |
|---|---|---|---|---|
| BASIC | BA | Ø | BAØ Off* | BASIC disabled. |
|  | BA | 1 | BA1 Locl | BASIC enabled in local mode. |
|  | BA | 2 | BA2 Host | BASIC enabled in host mode. |
| Parity Enable | PE | Ø | PEØ Off*+ | Parity off, bit 8 set to SPACE. |
|  | PE | 1 | PE1 Even | Even parity on, bit 8 set to even parity and checked. |
|  | PE | 2 | PE2 Odd | Odd parity on, bit 8 set to odd parity and checked. |
| XON/XOFF | XO | Ø | XOØ Off | XON/XOFF not sent automatically. |
|  | XO | 1 | XO1 On* | XON/XOFF sent automatically. |
| Scroll | SM | Ø | SMØ Off | No scrolling. |
|  | SM | 1 | SM1 Jump | Jump scroll. |
|  | SM | 2 | SM2 Smth* | Smooth scroll. |
|  | SM | 3 | SM3 Wrap | Wrap scroll. |
| Reverse Video | RV | Ø | RVØ Off* | Normal video. |
|  | RV | 1 | RV1 On | Reverse video. |
| Horizontal Margins | HM | Ø | HMØ* | No horizontal margins. |
|  | HM | 1--9 | HM(1--9) | Horizontal margins one to nine characters from left and right. |
| Vertical Margins | VM | Ø | VMØ* | No vertical margins. |
|  | VM | 1--9 | VM(1--9) | Vertical margins one to nine characters from top and bottom. |
| Expansion Mode | EM | Ø | EMØ Nørm* | Normal display. |
|  | EM | 1 | EM1 Expn | Expanded mode (double-width text characters). |
| Horizontal | HP | Ø--9 | HP(Ø--9) | Horizontal display position. |
| Position | HP | 5 | HP5* | Normal horizontal display position. |

* Indicates the default value of the parameter.

+ This default value is determined by the settings of the default SET-UP switch pack. Refer to Chapter 2 section 2.5 for the procedure to change these settings.

# Table 3-1   SET-UP Parameter Summary (cont)

| SET-UP Parameter | Para Code | Set Code | Displayed Message | Function |
|---|---|---|---|---|
| Overstrike | OS | Ø | OSØ Off* | Normal text replacement. |
|  | OS | 1 | OS1 On | Overlay text writing. |
| Visual Cursor | VC | Ø | VCØ Off | Disable visual cursor. |
|  | VC | 1 | VC1 Text | Enable text visual cursor. |
|  | VC | 2 | VC2 Grph | Enable graphics visual cursor. |
|  | VC | 3 | VC3 Both* | Enable both cursors. |
| Text Display | TD | Ø | TDØ Norm* | Normal processing of text display. |
|  | TD | 1 | TD1 Text | Display all characters as text (transparency mode); all characters are displayed as text and not processed, except LF which is displayed as next line. |
|  | TD | 2 | TD2 Ctrl | Process all characters normally, display all unrecognized characters as text. |
| Graphics Display | GD | Ø | GDØ Norm* | Normal processing of graphics. |
|  | GD | 1 | GD1 Text | Display graphics commands as text. |
|  | GD | 2 | GD2 Top | Display last line of ReGIS at top of screen. |
|  | GD | 3 | GD3 Bot | Display last line of ReGIS at bottom of screen. |
| Graphics Prefix | GP | Ø | GPØ Off* | Disable graphics prefix mode. |
|  | GP | 1 | GP1= "!" | Enable graphics prefix mode; character shown in quotes is prefix character. |
| Single Character | SC | Ø | SCØ Off* | Normal communications operation. |
|  | SC | 1 | SC1 On | Single character operation. |
| Local Echo | LE | Ø | LEØ Off* | No local echo. |
|  | LE | 1 | LE1 On | Local echo every key stroke. |
| New Line | NL | Ø | NLØ Off* | New line mode disabled. |
|  | NL | 1 | NL1 On | New line mode enabled. |

**Table 3-1  SET-UP Parameter Summary (cont)**

| SET-UP Parameter | Para Code | Set Code | Displayed Message | Function |
|---|---|---|---|---|
| Auto Hard-copy | AH | Ø | AHØ Off* | Disable auto hardcopy mode. |
|  | AH | 1 | AH1 On | Enable auto hardcopy mode. |
| Auto Wrap-around | AW | Ø | AWØ Off | Disable auto wraparound. |
|  | AW | 1 | AW1 On* | Enable auto wraparound. |
| Key Repeat | KR | Ø | KRØ Off | Disable key repeat parameter. |
|  | KR | 1 | KR1 On* | Enable key repeat parameter. |
| Keyclick | KC | Ø | KCØ Off | Disable keyclick. |
|  | KC | 1 | KC1 On* | Enable keyclick. |
| Margin Bell | MB | Ø | MBØ Off | Disable right margin bell. |
|  | MB | 1 | MB1 On* | Enable right margin bell. |
| Terminal Mode | TM | Ø | TMØ VT52 | VT52 mode. |
|  | TM | 1 | TM1 ANSI* | ANSI mode. |
| Keypad Mode | KP | Ø | KPØ Norm* | Numeric keypad mode. |
|  | KP | 1 | KP1 Appl | Application keypad mode. |
| Cursor Key Mode | CK | Ø | CKØ Norm* | Cursor key mode. |
|  | CK | 1 | CK1 Appl | Cursor key application mode. |
| Programmed Keypad Mode | PK | Ø | PKØ Off* | Programmed keypad disabled. |
|  | PK | 1 | PK1 On | Programmed keypad enabled. |
| Tablet Locator Mode | TL | Ø | TLØ Off* | Only four cursor keys control locator mode. |
|  | TL | 1 | TL1 On | Tablet or cursor keys control locator mode. |
| UK Character Set | UK | Ø | UKØ U.S.* + | US character set. |
|  | UK | 1 | UK1 U.K. | UK character set. |
| Comm. Interface | CI | Ø | CIØ EIA*+ | EIA comm. interface selected. |
|  | CI | 1 | CI1 20 mA | 20 mA comm. interface selected. |

\* Indicates the default value of the parameter.

+ This default value is determined by the settings of the default SET-UP switch pack. Refer to Chapter 2 section 2.5 for the procedure to change these settings.

**Table 3-1  SET-UP Parameter Summary (cont)**

| SET-UP Parameter | Para Code | Set Code | Displayed Message | Function |
|---|---|---|---|---|
| Hardcopy Speed | HS | 0 | HS0  110 | Set hardcopy speed to 110 baud. |
| | HS | 1 | HS1  300 | Set hardcopy speed to 300 baud. |
| | HS | 2 | HS2  600 | Set hardcopy speed to 600 baud. |
| | HS | 3 | HS3 1200 | Set hardcopy speed to 1,200 baud. |
| | HS | 4 | HS4 2400 | Set hardcopy speed to 2,400 baud. |
| | HS | 5 | HS5 4800 | Set hardcopy speed to 4,800 baud. |
| | HS | 6 | HS6 9600* | Set hardcopy speed to 9,600 baud. |
| | HS | 7 | HS7 19.2 | Set hardcopy speed to 19,200 baud. |
| Power Frequency | PF | 0 | PF0 60 Hz*+ | 60 Hz power frequency. |
| | PF | 1 | PF1 50 Hz | 50 Hz power frequency. |
| Interlace | IL | 0 | IL0 Off* | Interlace turned off. |
| | IL | 1 | IL1 On | Interlace turned on. |
| Self-Test | ST | 1 | ST1 PwUp | Select power-up self-test. |
| | ST | 2 | ST2 ExCm | Select external comm. test. |
| | ST | 3 | ST3 HcCm | Select hardcopy comm. test. |
| | ST | 4 | ST4 Dspl | Select display pattern test. |
| | ST | 5 | ST5 CBar | Select color bar test pattern. |
| | ST | 9 | ST9 Rept | Repeat selected test(s) until failure. |
| | ST | 0 | ST0 Clr | Clear all selected test(s). |

* Indicates the default value of the parameter.

+ This default value is determined by the settings of the default SET-UP switch pack. Refer to Chapter 2 section 2.5 for the procedure to change these settings.

**3.5.2    Changing a SET-UP Parameter (Operator)**
To change any or all of the SET-UP parameters perform the following simple procedure.

1.    Enter SET-UP mode by pressing **SET-UP**.

2.    Select the SET-UP parameter you want to change. Use one of the four following methods.

   a.    Type the two-character SET-UP parameter code on the keyboard.

   b.    Press **RETURN** until the SET-UP parameter code appears on the screen. This key is pressed, the code advances by one.

   c.    Press the > key until the SET-UP parameter code appears on the screen. Each time this key is pressed, the code advances by one.

   d.    Press the < key until the SET-UP parameter appears on the screen. Each time this key is pressed, the code advances by one.

3.    Change the parameter setting. Use one of the four following methods.

   a.    Type the single-digit parameter setting. This changes the parameter setting to the typed-in value without stepping through all the possible parameter settings.

   b.    Press the **SPACE BAR**. Each time the **SPACE BAR** is pressed the parameter setting advances to the next possible value.

   c.    Press the ↑ key. Each time this key is pressed, the parameter setting advances to the next possible value.

   d.    Press the ↓ key. Each time this key is pressed, the parameter setting goes back to the previous setting.

To change more than one SET-UP parameter, just repeat steps 2 and 3 as often as needed. Pressing either the **RETURN** or > key advances the terminal to the next parameter and displays the new parameter and its current setting. Pressing the < key steps the terminal back to the previous parameter and displays that parameter and its setting. The terminal always returns to the first parameter (TS) after stepping through all the parameters.

If the operator presses any keys other than **SPACE**, **RETURN**, **<**, **>**, ↑, ↓ , a parameter code letter, or a parameter value, the terminal bell sounds and the last correct parameter or parameter setting appears on the screen.

When all the SET-UP parameters are set, exit the SET-UP mode by pressing **SET-UP** once. The screen then scrolls back to its original position and the normal viewing area appears again.

### 3.5.3 Changing a SET-UP Parameter (Host Computer)
The host computer can change all VK100 terminal SET-UP parameters. It has this capability because the SET-UP parameters directly affect how the terminal acts with specific programs. To change the SET-UP parameters, the host computer sends escape sequences to the terminal. The terminal then changes the SET-UP parameters and acts according to the new settings.

The Device Control Strings (DCS) section in Chapter 4 describes the specific escape sequences and message formats that change the terminal SET-UP parameters.

### 3.6 SET-UP PARAMETER DESCRIPTIONS
This section describes each SET-UP parameter in detail and explains how each parameter affects the terminal. The SET-UP parameters are listed in the order they appear on the screen.

> **NOTE**
> Unless otherwise stated, entering SET-UP mode and changing parameters does not result in the loss of data on the screen.

### 3.6.1 Transmit Speed (TS)
Set the transmit speed to match the computer receive speed. The VK100 terminal can transmit at any one of the following preselected speeds: 110, 300, 600, 1,200, 2,400, 4,800, 9,600, and 19,200 baud.

Transmit speed is independent of receive speed; the terminal can transmit data at one speed and receive data at a different speed.

Select the default value of both this parameter and the receive speed (RS) parameter with the same default SET-UP switch pack settings.

> **NOTE**
> Setting this parameter to 110 baud (TS0) selects two stop bits; all other settings select one stop bit.

**3.6.2    Receive Speed (RS)**
Set the receive speed to match the computer transmit speed. The VK100 terminal can receive at any one of the following preselected speeds:    110, 300, 600, 1,200, 2,400, 4,800, 9,600 and 19,200 baud.

Receive speed is independent of transmit speed; the terminal can receive data at one speed and transmit data at a different speed.

Select the default value of both this parameter and the transmit speed (TS) parameter with the same default SET-UP switch pack settings.

**3.6.3    Line/Local (LL)**
The line/local parameter allows the operator to enter the terminal into either an on-line or a local (off-line) mode. When the terminal is on-line (the ON-LINE indicator lights), all characters typed on the keyboard are sent directly to the computer and messages from the computer appear on the screen. In local mode (the LOCAL indicator lights), the terminal is disconnected from the computer; messages are not sent to or received from the computer. Characters typed on the keyboard are echoed directly to the screen.

NOTE
When the terminal is on-line (LL1), the data terminal ready (DTR) signal on the EIA communications line is asserted. When the terminal enters local mode (LL0), DTR is deasserted and the LOCAL indicator lights.

**3.6.4    BASIC (BA)**
The BASIC mode parameter allows the operator to select the BASIC programming capability of the VK100 terminal. If the BASIC mode is off (BA0), the terminal operates normally. The line/local parameter (LL) determines if the terminal is on-line or local to the host computer.

When the operator selects BASIC local (BA1), the standard BASIC programming capability of the terminal turns on and the terminal keyboard acts as the input device to BASIC. In this mode, to enter a BASIC program into the terminal type it on the keyboard. The BASIC indicator lights when the parameter is set to BA1.

When the operator selects BASIC host (BA2), the BASIC programming capability of the terminal turns on and the host computer acts as the input device to BASIC. In this mode the host computer normally loads a BASIC program in the VK100 terminal through the communications line. The BASIC indicator lights when the parameter is set to BA2.

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### 3.6.5 Parity Enable (PE)

The parity enable parameter defines the type of parity bit that the VK100 terminal generates for transmitted characters and checks for received characters. All characters contain eight bits -- seven data bits and one parity bit. Select the parity bit from one of the three following options.

1. Space parity, which ignores the parity bit for all received characters (PE0)

2. Even parity, with even parity checking for all received characters (PE1)

3. Odd parity, with odd parity checking for all received characters (PE2)

Select the default value of this parameter with the default SET-UP switch pack settings. Section 2.5 provides information on how to set these switches.

### 3.6.6 XON/XOFF (XO)

The VK100 terminal can automatically generate the synchronizing codes XON (DC1) and XOFF (DC3). The synchronizing codes prevent data loss when the host computer sends characters to the terminal faster than the terminal can process them. The XOFF control code stops data transmission from the host computer to the terminal; the XON code signals the host computer to resume transmission.

When the parameter is on, and the receive buffer contains 100 unprocessed characters, the VK100 terminal automatically generates the XOFF code. The receive buffer fills to that point when one of the following events occur.

1. The operator presses **NO SCROLL**.

2. The operator enters the SET-UP mode.

3. The terminal receives characters faster than it can process them.

The buffer empties only after the operator presses **NO SCROLL** again or takes the terminal out of SET-UP mode. The terminal then takes characters out of the buffer and processes them one at a time. When 50 characters remain in the buffer, the terminal transmits the XON code to resume transmission from the computer to the terminal.

If the XON/XOFF parameter is off, **NO SCROLL** is disabled.

If the host computer software does not support the XON/XOFF codes, data sent during buffer-full conditions may be lost.

3.6.7    Scroll Mode (SM)

Scrolling describes the movement of existing lines on the monitor
screen to make room for new lines on the screen. The scroll mode
function has four possible settings: scroll off, jump scroll,
smooth scroll, or wrap scroll.

In scroll off mode (SMØ), the text cursor always remains on the
top or bottom line of the display. The display does not move up or
down. The terminal adds new lines to the screen by writing over
the top or bottom line.

In jump scroll mode (SM1), the text cursor immediately moves to
the next line. In this mode the existing lines on the screen move
up or down to make room for new lines. The new lines appear on the
screen as fast as the computer sends them to the terminal. At the
higher baud rates, the data is very difficult to read  due to the
rapid movement of the lines.

In smooth scroll mode (SM2), the terminal receives new lines of
data at a limited speed. The movement of lines occurs at the
smooth, steady rate of eight lines per second, allowing the
operator to read the data as it appears on the screen.

In wrap scroll mode (SM3), the terminal adds new lines to the
screen by writing over the old lines. When the operator reaches
the end of the screen, (bottom or top) the cursor automatically
moves to the beginning of the screen, and the terminal writes new
lines over the old lines on the screen. Existing data on the
screen does not move.

### 3.6.8   Reverse Video (RV)

The reverse video parameter allows the operator to select the background of the screen. In normal screen mode (RV0), the screen contains light (or colored) characters on a dark background. In reverse screen mode (RV1), the screen contains dark characters on a light (or colored) background.

### 3.6.9   Horizontal Margins (HM)

This parameter allows the operator to tailor the video output of the VK100 terminal to the monitor. If the monitor cannot display 84 characters per line, insert margins on both sides of the screen. The width of each margin is in characters.

If the horizontal margin parameter is set for HM0, the monitor can display 84 characters on a line (42 characters if the expansion mode parameter is set for EM1). If the parameter is set for a one-character margin (HM1), both the left and right margins are one character wide. This setting allows only 82 characters per line (40 characters in EM1).

The maximum margin width is nine characters for both the left and right margins. This setting provides space for 66 characters per line (24 characters in EM1).

### 3.6.10   Vertical Margins (VM)

This parameter allows the operator to tailor the video output of the VK100 terminal to the monitor. If the monitor cannot display 24 lines of data, insert vertical margins at the top and bottom of the screen. The height of each margin is in lines.

If the vertical margin parameter is set for VM0, the terminal sends 24 lines of data to the monitor before scrolling the screen. If the parameter is set for VM1, both the top and bottom margins are set for one line. This setting allows the terminal to send 22 lines of data to the monitor before scrolling the screen.

The maximum margin height is nine lines for both the top and bottom margins. This setting allows the terminal to send six lines of data to the monitor before scrolling the screen.

### 3.6.11   Expansion Mode (EM)

This parameter allows the operator to expand characters on the screen to twice their normal width. In normal mode (EM0), characters are seven pixels wide and are spaced two pixels apart. In expanded mode (EM1), characters are 14 pixels wide and are spaced 4 pixels apart.

The EM1 setting allows a maximum of 42 characters per line.

### 3.6.12   Horizontal Position (HP)

This parameter allows the operator to tailor the video output of the VK100 terminal to the monitor. The horizontal position parameter lets the operator center the entire display on the

screen. The normal setting for this parameter is HP5. If the
display is left of center, increase the value of the parameter
setting. This moves the entire display to the right. If the
display is right of center, decrease the parameter setting value.
This moves the entire display to the left.

### 3.6.13 Overstrike (OS)

This parameter allows the operator to create special graphics on
the screen by typing over characters. If the overstrike parameter
is off (OS0), typing over a character replaces the old character
with the new character. If the parameter is on (OS1), typing over
a character places the new character over the old character
without destroying the old character. For example, this parameter
allows you to create the "not equal to" sign (≠) by pressing the =
key, BACKSPACE key, and / key.

### 3.6.14 Visual Cursor (VC)

This parameter allows the operator to change the visual cursor
displayed. The cursor is the visual indicator that shows the
active position, where the next character will appear on the
screen. The text cursor is a solid block character ( ■ ); it only
appears when the terminal is in text mode. The graphics cursor is
a diamond cross hair (◇) at the current drawing position; it only
appears when the terminal is in graphics mode. Only one cursor
appears on the screen at any one time.

The visual cursor parameter has four settings.

In VC0, neither the text cursor nor the graphics cursor appears on
the screen.

In VC1, the text cursor appears in text mode, and no cursor
appears in graphics mode.

In VC2, no cursor appears in text mode, but the graphics cursor
appears in graphics mode.

In VC3, both the text and graphics cursors appear in their
respective modes.

### 3.6.15 Text Display (TD)

This parameter controls how characters sent to the display are
processed by the terminal.

In TD0, normal processing of both text and ReGIS graphics occurs.

In TD1, all characters appear as graphics text, including all
control and escape sequences. No normal processing of these
characters occurs, except for line feed (LF) which causes a
next-line function. The XON/XOFF codes are still interpreted for
synchronization, but also appear as graphics text. Control codes
appear as the proposed ANSI standard two-character mnemonics.

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In TD2, normal processing occurs; those control codes which are not normally processed appear as graphics text. Unrecognized escape and control sequences do <u>not</u> appear.

### 3.6.16   Graphics Display (GD)

This parameter controls how characters sent to the terminal's ReGIS interpreter are processed.

In GD0, normal ReGIS processing occurs.

In GD1, ReGIS commands appear as text, and no graphics display occurs. When the operator enters ReGIS mode while in GD1, the message "GON" appears on the screen, and "GOFF" appears when the ReGIS string is done.

In GD2 and GD3, normal processing of ReGIS graphics commands occurs. The last line of the ReGIS commands appears as text on the top display line (GD2) or bottom display line (GD3). This line appears only when there are no more ReGIS commands to process, or when you freeze the display by pressing **NO SCROLL**.

### 3.6.17   Graphics Prefix (GP)

This parameter allows the terminal to enter graphics mode by receiving a single unique character from the host computer. When the graphics prefix character parameter is off (GP0), no graphics prefix character operations can occur. When the parameter is on (GP1), the line feed (LF) character followed by the graphics prefix character enters the terminal into graphics mode. The terminal interprets any characters received after the prefix character as graphics data. The next LF character received returns the terminal to normal text mode. If the graphics prefix character follows the second LF character, the terminal remains in graphics mode for the next line. The terminal does not perform a line feed function when it receives the second LF character.

Use the following procedure to set the graphics prefix character.

1.   Enter SET-UP mode and place the graphics prefix character parameter on the screen. If the parameter has not been set, the default character (!) appears as the prefix character.

2.   Press the = key.

3.   Press the key for the prefix character. The prefix character may be any one of 95 graphic text characters (space thru ~).

The graphics prefix character is now set in the terminal.

### 3.6.18    Single Character (SC)

When this parameter is on (SC1), the terminal sends a carriage return (CR) character after each code or set of codes generated by a single keystroke. The CR character is also sent after a terminal report.

### 3.6.19    Local Echo (LE)

When this parameter is on (LE1), every character sent to the host computer is automatically echoed on the screen. The host computer does not have to transmit the character back to the terminal.

If double characters appear on the screen, turn the local echo parameter off, since the host computer is echoing characters back to the terminal.

### 3.6.20    New Line (NL)

This parameter enables the **RETURN** key on the terminal to function like the **RETURN** key on an electric typewriter.  When the new line parameter is on (NL1), pressing **RETURN** generates the carriage return (CR) and line feed (LF) codes. When the terminal receives a LF code, it interprets the code as a carriage return and line feed.

When the parameter is off (NL0), pressing **RETURN** generates only the CR code; a LF code causes the terminal to perform a line feed only.

If double line feeds occur consistently, turn this parameter off since the computer is performing this function.

### 3.6.21    Auto Hardcopy (AH)

This parameter allows the operator to make a continuous hardcopy record of all text that appears on the screen. When the auto hardcopy parameter is on (AH1), the printer copies the screen:

1.    Just before the screen is cleared

2.    Each time an entire display of new lines scrolls onto the screen.

### 3.6.22    Auto Wraparound (AW)

This parameter determines where the next character will appear on the screen after reaching the end of the current line. When the auto wraparound parameter is off (AW0), all characters received after reaching the end of the line appear in the last character position of that line. For example, take an 84-character line. With the parameter off, the eighty-fifth text character received appears at the end of the current line and replaces the character already located there. This continues until the terminal receives a carriage return character.

When the parameter is on (AW1), the eighty-fifth text character received appears in the first character position on the next line.

### 3.6.23  Key Repeat (KR)

This parameter allows a key to automatically repeat when you hold the key down for more than 0.5 seconds. The repeat rate speeds up to about 30 characters per second when you hold the key down for more than 1.5 seconds. The key repeat parameter affects all but the following keyboard keys.

BREAK
ESC
NO SCROLL
SET-UP
RETURN
CTRL and any other key
PF1 to PF4
SHIFT

### 3.6.24  Keyclick (KC)

The keyclick is a tone generated every time the operator presses a key. The keyclick may be turned on or off to suit the operator's needs. However, research and experience have shown that an operator is more accurate when there is an audible feedback from the keyboard.

The keyclick volume is not adjustable.

### 3.6.25  Margin Bell (MB)

This parameter acts like the bell in a typewriter. When the margin bell parameter is on (MB1), the VK100 terminal sounds a tone to alert the operator that the cursor is nine characters from the end of the current line.

### 3.6.26  Terminal Mode (TM)

The VK100 terminal follows two different programming standards -- American National Standards Institute (ANSI) and VT52. In ANSI mode (TM1), the VK100 terminal generates and responds to coded sequences per ANSI standards X3.41-1974 and X3.64-1977. In VT52 mode (TM0), the VK100 terminal is compatible with previous DIGITAL software used on the VT52 video terminal. Chapter 4 summarizes both ANSI and VT52 modes.

### 3.6.27  Keypad Mode (KP)

In normal (numeric) mode (KP0), the auxiliary keypad keys transmit the ASCII codes for the characters engraved on the keycaps, (for example 0 to 9). The ENTER key acts like the RETURN key on the main keyboard. In application mode (KP1), these keys transmit unique escape sequences. Chapter 4 provides the exact escape sequences.

### 3.6.28  Cursor Key Mode (CK)

In normal (cursor) mode (CK0), the four cursor keys send the ANSI cursor movement escape sequences. In application mode (CK1), the cursor keys transmit unique control sequences. Chapter 4 provides the exact escape sequences. In VT52 mode (TM0), this parameter has no effect; the four cursor keys send the codes listed in Table 4-1.

### 3.6.29   Programmed Keypad Mode (PK)

The VK100 terminal can be programmed to send special sequences for any or all of the auxiliary keypad keys. When the programmable keypad parameter is on (PK1), keys that are programmed to send special code sequences send those sequences. Keys not programmed are not affected. If the parameter is off (PK0), all cursor and auxiliary keypad keys transmit their normal sequences as selected by the TM, KP, and CK parameters.

### 3.6.30   Tablet Locator Mode (TL)

This parameter defines how to move the locator mode cross-hair cursor. When the parameter is off (TL0), move the cross-hair cursor by pressing one of the four arrow keys on the keyboard. The cross-hair cursor moves in the direction of the arrow on the key.

When this parameter is on (TL1), an optional tablet pen or cursor positions the cross-hair cursor.

The optional tablet connects to the VK100 terminal at the Hardcopy connector. When the tablet is connected, the terminal cannot be connected to a printer.

### 3.6.31   United Kingdom Character Set (UK)

The VK100 terminal contains two different character sets: the United States ASCII character set and the UK (United Kingdom) character set. The difference between the two sets is one character, the # or ₤ sign. When this parameter is on (UK1), the UK pound sign ₤ appears instead of the # sign.

Setting this parameter does not immediately change the character that appears on the screen. To obtain the desired character set reset the terminal.

The default SET-UP switch pack settings determine the default value of this parameter. Section 2.5 of Chapter 2 provides information on how to set these switches.

### 3.6.32   Communications Interface (CI)

This parameter selects the communications interface (EIA or 20 mA current loop) used to connect the terminal to the host computer. A parameter setting of CI0 selects EIA communications. CI1 selects the 20 mA communications. This parameter must be set correctly for the VK100 terminal to communicate with the host computer.

The default SET-UP switch pack settings determine the default value of this parameter. Section 2.5 of Chapter 2 provides information on how to set these switches.

### 3.6.33   Hardcopy Speed (HS)

Set the hardcopy speed to match the hardcopy printer's transmit and receive speed. The VK100 terminal can transmit data to the hardcopy printer at any one of the following preselected speeds: 110, 300, 600, 1,200, 2,400, 4,800, 9,600 and 19,200 baud.

### 3.6.34    Power Frequency (PF)

This parameter matches the terminal's video output signals to the monitor characteristics affected by the power line frequency. During the terminal installation, set this parameter for the power line frequency, 50 or 60 Hertz. In the US, the correct setting is 60 Hertz (PF0).

The default SET-UP switch pack settings determine the default value of this parameter. Section 2.5 of Chapter 2 provides information on how to set these switches.

### 3.6.35    Interlace (IL)

Interlace describes a method of displaying characters on the screen. When the interlace parameter is on, every other scan line (row of horizontal dots) appears on the screen. After a complete scan of the screen, the terminal returns to start and scans the lines that were skipped. When the parameter is off, every scan line appears on the screen in order.

Using the interlace parameter with a monitor that does not need an interlaced video input causes the screen to flicker. When using the Barco Model GD33 monitor with the VK100 terminal, turn the interlace parameter off (IL0).

### 3.6.36    Self-Test (ST)

This parameter selects the internal test programs the terminal performs. The following programs are available.

Clear all selected test(s) (0)
Power-up test (1)
External communications test (2)
Hardcopy communications test (3)
Display pattern test (4)
Color bar test pattern (5)
Repeat the selected test(s) until failure (9)

The self-test parameter allows the operator to select more than one test program. To do this type the number of each test program to be run. The terminal performs the test(s) after exiting SET-UP mode by pressing **SET-UP**.

## 4.1    INTRODUCTION

This chapter summarizes the programming characteristics of the VK100 terminal. The summary covers the following topics.

Codes generated by the keyboard

Character sets

Terminal actions to control sequences in both ANSI and VT52 modes

ReGIS command structure

BASIC command structure

## 4.2    KEYBOARD CODES

The following paragraphs describe the codes generated by the VK100 terminal keyboard.

### 4.2.1    Standard Key Codes

The VK100 terminal keyboard resembles a standard office typewriter. In addition to the standard typewriter keys, the terminal has keys to generate control functions and cursor control commands. Figure 4-1 shows the VK100 terminal keyboard layout and the ASCII codes generated by each key.

### 4.2.2    Cursor Control Key Codes

The VK100 terminal's main keyboard contains four cursor control keys. Table 4-1 lists all the possible codes generated by these keys. The operator selects the ANSI/VT52 mode with the terminal mode (TM) SET-UP feature, and the cursor key application mode with the set mode (SM) and reset mode (RM) control functions.

| 033 ESC 033 | 041 1! 061 | 100 2@ 062 | 043 3# 063 | 044 4$ 064 | 045 5% 065 | 136 6^ 066 | 046 7& 067 | 052 8* 070 | 050 9( 071 | 051 0) 060 | 137 _— 055 | 153 =+ 075 | 176 \~ 140 | 010 BACK SPACE 010 |
| 011 TAB 011 | | 127 W 167 | 105 E 145 | 122 R 162 | 124 T 164 | 131 Y 171 | 125 U 165 | 111 I 151 | 117 O 157 | 120 P 160 | 173 {[ 133 | 175 }] 135 | | 177 DELETE 177 |
| | | 101 A 141 | 123 S 163 | 104 D 144 | 106 F 146 | 107 G 147 | 110 H 150 | 112 J 152 | 113 K 153 | 114 L 154 | 072 :; 073 | 042 '" 047 | 015 RETURN 015 | 174 \| 134 |
| | | 132 Z 172 | 130 X 170 | 103 C 143 | 126 V 166 | 102 B 142 | 116 N 156 | 115 M 155 | 074 ,< 054 | 076 .> 056 | 077 /? 057 | | | 012 LINE FEED 012 |

040 / 040

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Figure 4-1 Keyboard-Generated ASCII Codes

Table 4-1 Cursor Control Key Codes

| Cursor Key (Arrow) | VT52 Mode | ANSI Mode/Cursor Key Mode Reset | ANSI Mode/Cursor Key Mode Set (Application) |
|---|---|---|---|
| Up | ESC A | ESC [ A | ESC O A |
| Down | ESC B | ESB [ B | ESC O B |
| Right | ESC C | ESC [ C | ESC O C |
| Left | ESC D | ESC [ D | ESC O D |

## 4.2.3   Auxiliary Keypad Codes

The VK100 terminal contains an auxiliary or numeric keypad to the right of the main keyboard. Table 4-2 shows all the possible codes generated by the numeric keys. Table 4-3 shows all the possible codes generated by the program function (PF) keys. The operator selects the ANSI/VT52 mode with the terminal mode (TM) SET-UP feature, and the keypad applications mode with the set mode (SM) and reset mode (RM) control functions.

Table 4-2   Auxiliary Keypad Numeric Key Codes

| Key | Keypad Numeric Mode | Keypad Application Mode ANSI | VT52 |
|-----|-----|-----|-----|
| 0 | 0 | ESC O p | ESC ? p |
| 1 | 1 | ESC O q | ESC ? q |
| 2 | 2 | ESC O r | ESC ? r |
| 3 | 3 | ESC O s | ESC ? s |
| 4 | 4 | ESC O t | ESC ? t |
| 5 | 5 | ESC O u | ESC ? u |
| 6 | 6 | ESC O v | ESC ? v |
| 7 | 7 | ESC O w | ESC ? w |
| 8 | 8 | ESC O x | ESC ? x |
| 9 | 9 | ESC O y | ESC ? y |
| — | — | ESC O m | ESC ? m |
| , | , | ESC O l | ESC ? l |
| . | . | ESC O n | ESC ? n |
| ENTER | Same as RETURN | ESC O M | ESC ? M |

Table 4-3   Auxiliary Keypad PF Key Codes

| Key | Keypad Numeric Mode/ Keypad Application Mode ANSI | VT52 |
|-----|-----|-----|
| PF1/HARDCOPY | ESC O P | ESC ? P |
| PF2/LOCTR | ESC O Q | ESC ? Q |
| PF3/TEXT | ESC O R | ESC ? R |
| PF4/RESET | ESC O S | ESC ? S |

**4.2.4    Control Characters**

The VK100 terminal generates and supports certain control characters. Figure 4-2 shows the control characters generated by the terminal keyboard. Table 4-4 lists the control characters supported by the VK100 terminal, and the action the terminal takes when it receives each control character. The terminal ignores control characters that it does not support.

OCTAL REPRESENTATION OF CODES
GENERATED BY KEYBOARD WITH CTRL
KEY HELD DOWN (MNEMONICS SHOWN
ABOVE LEGENDS; OCTAL CODES SHOWN
BELOW LEGENDS.)

Row 1:
| ESC ESC 033 | | | | | | | | | | | | RS \ ~ 036 | BS BACK SPACE 010 | |

Row 2:
| HT TAB 011 | XON Q 021 | ETB W 027 | ENQ E 005 | DC2 R 022 | DC4 T 024 | EM Y 031 | NAK U 025 | HT I 011 | SI O 017 | DLE P 020 | ESC [ { 033 | GS ] } 035 | | DEL DELETE 177 |

Row 3:
| | | SOH A 001 | XOFF S 023 | EOT D 004 | ACK F 006 | BEL G 007 | BS H 010 | LF J 012 | VT K 013 | FF L 014 | : ; | ' " | CR RETURN 015 | FS \ | 034 |

Row 4:
| | | SUB Z 032 | CAN X 030 | ETX C 003 | SYN V 026 | STX B 002 | SO N 016 | CR M 015 | , < | . > | US / ? 037 | | LF LINE FEED 012 |

Space bar: NUL 000

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Figure 4-2  Keyboard-Generated Control Codes

Table 4-4 Terminal-Supported Control Character Functions

| Control Code | Octal Code | Terminal Action |
|---|---|---|
| BEL | 007 | Ring the terminal bell. |
| BS | 010 | Backspace the cursor by one position; if at left margin, then no operation. |
| HT | 011 | Horizontal tab; move the cursor to next fixed tab position (fixed at eight character intervals). The cursor will not move if at right margin. |
| LF | 012 | Line feed; move cursor to next line down. If at bottom margin, the cursor position remains unchanged. If new line mode is enabled, perform carriage return function. |
| FF | 014 | Form feed; clear screen and move cursor to home position (upper left corner). |
| CR | 015 | Carriage return; move cursor to left margin. |
| SO | 016 | Shift out; invoke G1 character set. |
| SI | 017 | Shift in; invoke G0 character set. |
| DC1(XON) | 021 | Allows terminal to resume transmitting. |
| DC3(XOFF) | 023 | Causes terminal to stop transmitting all characters except XOFF and XON. |
| CAN | 030 | If sent during an escape sequence the sequence is immediately terminated and not executed. Causes the error character ( ≉ ) to be displayed. |
| SUB | 032 | Same effect as CAN. |
| ESC | 033 | Subsequent character(s) are interpreted as part of an escape sequence. |

## 4.3    CHARACTER SETS
The VK1ØØ terminal can contain up to five character sets.

    1.    United Kingdom (UK)
    2.    United States (USASCII)
    3.    Soft character set 1
    4.    Soft character set 2
    5.    Soft character set 3

The soft character sets 1 through 3 are the same character sets referenced in the ReGIS mode of operation. The contents of these character sets can be specified to meet specific requirements. The character sets are loaded by using the ReGIS L command. (See the ReGIS command summary in section 4.4.3.)

Using multiple character sets in the VK1ØØ terminal is a simple, two-step operation. Simply define the active character sets and select one of those sets for use.

From the five character sets select one or two active character sets. This is done with the select character set (SCS) control sequence. The SCS control sequence defines the active character sets as GØ and G1. Table 4-5 summarizes the SCS control sequences. It lists the exact sequence needed to define any character set as GØ or G1.

Table 4-5 Select Character Set Sequences

| Character Set | GØ | G1 |
|---|---|---|
| UK | ESC ( A | ESC ) A |
| US ASCII | ESC ( B | ESC ) B |
| Soft Set 1 | ESC ( Ø | ESC ) Ø |
| Soft Set 2 | ESC ( 1 | ESC ) 1 |
| Soft Set 3 | ESC ( 2 | ESC ) 2 |

The shift in (SI) and shift out (SO) control characters select the actual character set used. When the terminal receives the shift in (SI, $017_8$) control character, the character set defined as G0 by the SCS control sequence becomes the active character set. The shift out (SO, $016_8$) control character activates the character set defined as G1 by the SCS control sequence. The following examples show how the multiple character sets are used.

**Example 1**
You want to use the United States character set and soft character set 3 in the terminal. To select these two character sets as the active character sets, the host computer sends the following control sequences to the terminal.

ESC ( B     To define the United States character set as G0

ESC ) 2     To define soft character set 3 as G1

The shift in and shift out control characters then control the selection of the active character sets. Shift in (SI, $017_8$) selects the US character set and shift out (SO, $016_8$) selects soft character set 3.

**Example 2**
You want to use soft character set 1 and the United States character set in the terminal. To define these two character sets as the active character sets, the host computer sends the following control sequences to the terminal.

ESC ( 0     To define soft character set 1 as G0

ESC ) B     To define the United States character set as G1

The shift in and shift out control characters then control the selection of the active character set. Shift in (SI, $017_8$) selects soft character set 1, and shift out (SO, $016_8$) selects the US character set.

As the two examples show, any character set can be defined as G0 and any other character set as G1. In those cases only one character set is used, it can be defined as both G0 and G1.

At either power-up or master reset, the terminal defines the default character set as both G0 and G1. The default SET-UP switch pack selects the specific default character set. See Chapter 2 section 2.5 for information on changing the default character set.

## 4.4     CONTROL FUNCTIONS

The VK1ØØ terminal is an upward and downward software compatible terminal. Previous DIGITAL terminals have DIGITAL private standards for control sequences. The American National Standards Institute (ANSI) has since standardized control sequences in terminals. The VK1ØØ terminal is compatible with both the previous DIGITAL standards and current ANSI standards.

> **NOTE**
> The ANSI standards allow the manufacturer flexibility in implementing each function. This manual describes how the VK1ØØ terminal responds to the implemented ANSI control functions.

Customers may use existing DIGITAL software designed around the VT52, or new VK1ØØ terminal software designed to meet ANSI standards. The VK1ØØ terminal has a "VT52 compatible" mode in which the VK1ØØ terminal responds to control sequences like a VT52. In this mode, the operator cannot use many VK1ØØ terminal features.

Throughout this chapter references are made to "VT52 mode" or "ANSI mode". These two terms indicate the VK1ØØ terminal's software compatibility. All new software should be designed around the VK1ØØ terminal's ANSI mode. The VT52 mode is included only to provide continuity for existing operating systems support.

The following paragraphs briefly summarize the control sequences implemented by the VK1ØØ terminal. The GIGI ReGIS Handbook, AA-K366A-TK, contains detailed descriptions of the control sequences and the action they perform.

The following ANSI standards were used in implementing the VK1ØØ terminal.

X3.16-1976          Character Structure and Character Parity Sense

X3.4-1977           USA Standard Code for Information Interchange (ASCII)

X3.41-1974          Code Extension Techniques for Use with ASCII

X3.64-1977          Addition Controls for Use with ASCII

The VK1ØØ terminal implements a subset of these standards.

In the list of control functions in this chapter, the characters
are shown using the ASCII character set. The case (upper or lower)
of the characters sent is significant and must be sent exactly as
documented. These characters are spaced apart for clarity only.
The SPACE character ($040_8$) never appears in any of the VK100
terminal's recognizable control or escape sequences. The ESCAPE
character ($033_8$) is defined as ESC. All graphics characters shown
in bold are integral to the control or escape sequence. Characters
not in bold indicate variable parameters (Ps and Pn) or a possible
sequence of parameters (...). Where a variable parameter is
indicated, the possible values appear immediately after the
sequence.

4.4.1    ANSI Control Functions Summary
The following escape and control sequences are transmitted from
the host computer to the VK100 terminal unless otherwise noted.
The control sequences are listed according to the generic function
they perform.

4.4.1.1  Cursor Movement Commands

Sequence                                Function

ESC [ Pn A*                             Cursor up
ESC [ Pn B*                             Cursor down
ESC [ Pn C*                             Cursor forward (right)
ESC [ Pn D*                             Cursor backward (left)
ESC [ Pl ; Pc H+                        Direct cursor addressing
ESC [ Pl ; Pc f
ESC D                                   Index
ESC E                                   New line
ESC M                                   Reverse index
ESC 7                                   Save cursor and attributes
ESC 8                                   Restore cursor and attributes

_____

* Pn is a decimal number expressed as a string of ASCII digits.
  Multiple parameters are separated by the semicolon character
  ($073_8$). If a parameter is omitted or specified as 0, the default
  parameter value is used. For the cursor movement commands, the
  default parameter value is 1.

+ Pl equals the line number; Pc equals the column number.

## 4.4.1.2 Character Attributes
ESC [ Ps ; Ps; Ps ;...; Ps m

Ps is a selective parameter. Multiple parameters are separated by the semicolon character ($073_8$). The parameters execute in order and have the following functions.

| Parameter | Function | |
|---|---|---|
| 0 or none | Exit graphic mode and select writing color (same as SHIFT/PF3) | |
| 2 | Half bright (or green) | |
| 4 | Underscore on | |
| 5 | Blink on | |
| 7 | Reverse video on | |
| 30 | Black | |
| 31 | Red | |
| 32 | Green | |
| 33 | Yellow | writing colors |
| 34 | Blue | |
| 35 | Magenta | |
| 36 | Cyan | |
| 37 | White | |
| 40 | Black | |
| 41 | Red | screen colors |
| 42 | Green | |
| 43 | Yellow | |
| 44 | Blue | |
| 45 | Magenta | |
| 46 | Cyan | |
| 47 | White | |

Any other parameter values are ignored.

## 4.4.1.3 Erasing Commands

| Sequence | Function |
|---|---|
| ESC [ K or | From cursor to end of line |
| ESC [ 0 K | |
| ESC [ 1 K | From beginning of line to cursor |
| ESC [ 2 K | Entire line containing cursor |
| ESC [ J or | From cursor to end of screen |
| ESC [ 0 J | |
| ESC [ 1 J | From beginning of screen to cursor |
| ESC [ 2 J | Entire screen |

## 4.4.1.4 Programmable Indicators
ESC [ Ps ; Ps ;...Ps q

Ps is a selective parameter. Multiple parameters are separated by the semicolon character ($073_8$). The parameters execute in order and have the following functions.

```
Parameter          Function

Ø or none          All indicators off
1                  Indicator 1 on
2                  Indicator 2 on
```

## 4.4.1.5  Select Character Sets (SCS)

```
Character Set      Sequence

                   GØ              G1
UK                 ESC ( A         ESC ) A
US ASCII           ESC ( B         ESC ) B
Soft set 1         ESC ( Ø         ESC ) Ø
Soft set 2         ESC ( 1         ESC ) 1
Soft set 3         ESC ( 2         ESC ) 2
```

## 4.4.1.6  Enter Graphics Mode

| Sequence | Function |
|---|---|
| ESC Pp | Enter and remain in graphics mode until next escape sequence |
| Line Feed (LF)! | Enter and remain in graphics mode until next line feed character if GP1 is selected |

## 4.4.1.7  Modes
SET-UP parameters are affected by these modes.

| SET-UP Para | Mode Name | To Set Mode | Sequence | To Reset Mode | Sequence |
|---|---|---|---|---|---|
| NL | Line Feed/ New Line | New Line | ESC [ 20 h | Line Feed | ESC [ 20 1* |
| CK | Cursor Key | Appl | ESC [ ? 1 h | Cursor | ESC [ ? 1 1* |
| TM | ANSI/VT52 | ANSI | n/a | VT52 | ESC [ ? 2 1* |
| SM | Scrolling | Smooth | ESC [ ? 4 h | JUMP | ESC [ ? 4 1* |
| RV | Screen | Reverse | ESC [ ? 5 h | Normal | ESC [ ? 5 1* |
| AW | Auto Wrap- around | On | ESC [ ? 7 h | Off | ESC [ ? 7 1* |
| AR | Auto Repeat | On | ESC [ ? 8 h | Off | ESC [ ? 8 1* |
| OS | Overstrike | On | ESC [ ? 20 h | Off | ESC [ ? 20 1* |
| BA | Local BASIC | Local | ESC [ ? 21 h | BASIC Off | ESC [ ? 21 1* |
| BA | Host BASIC | Host | ESC [ ? 22 h | BASIC Off | ESC [ ? 22 1* |
| PK | Programmed Keypad | Program-med | ESC [ ? 23 h | Normal | ESC [ ? 23 1* |
| AH | Auto Hardcopy | On | ESC [ ? 24 h | Off | ESC [ ? 24 1* |
| KP | Keypad | Appl | ESC = | Numeric | ESC > |

_____

* The last character of the sequence is a lowercase l ($154_8$).

## 4.4.1.8 Reports

There are three types of reports with the following escape and control sequences.

### Cursor Position Report

    Invoked by:  ESC [ 6 n
    Response is: ESC [ Pl ; Pc R

    Pl equals the line number; Pc equals the column number.

### Status Report

    Invoked by:  ESC [ 5 n
    Response is: ESC [ Ø n   (terminal ok)

### What Are You

    Invoked by:  ESC [ c or ESC [ Ø c
    Response is: ESC [ ? 5 ; Ø c or
                 ESC [ ? 5 c
                 (Meaning:  I am GIGI terminal.)

Alternately invoked by ESC Z (not recommended). Response is the same.

## 4.4.1.9  Reset

ESC c

Reset executes the reset routine. The SET-UP parameters, BASIC program, and soft character sets are not destroyed. This is the same as pressing SHIFT and PF4.

## 4.4.1.1Ø Print Commands

| Sequence | Function |
|---|---|
| ESC # 7 | Print display image (same as pressing SHIFT and PF1.) |
| ESC [ Pn ; Pn !q | Print partial image |

Pn is a numeric parameter; these parameters specify start and stop line numbers inclusive.

## 4.4.1.11 Confidence Tests

| Sequence | Function |
|---|---|
| ESC # 8 | Generate crosshatch pattern on display |
| ESC [ 3 ; Pn ;...y | Perform self-tests |

Pn selects the test to be performed as follows.

```
Pn        Test Selected
1         All power-up tests
2         External communications test
3         Hardcopy communications test
4         Display pattern test
5         Color bar test
9         Repeat selected tests until failure
```

### 4.4.1.12 Device Control Strings

| Sequence | Function |
|---|---|
| ESC P p (host to terminal) | ReGIS data to follow |
| ESC P r (host to terminal) | SET-UP data to follow |
| ESC P key ID code s (host to terminal) | Auxiliary keypad data to follow |
| ESC P q (terminal to printer) | Hardcopy data to follow* |
| ESC \ | String terminator |

---

* This string is generated by the VK100 terminal and sent to the LA34VA graphics printer. The VK100 terminal does not process the string.

All device control strings must be terminated with a string terminator. For example:

ESC P r ... SET-UP data ... ESC \

### 4.4.2    VT52 Control Functions Summary

| Sequence | Function |
|---|---|
| ESC A | Cursor up |
| ESC B | Cursor down |
| ESC C | Cursor right |
| ESC D | Cursor left |
| ESC F | Select soft character set 1 |
| ESC G | Select ASCII character set |
| ESC H | Cursor to home |
| ESC I | Reverse line feed |
| ESC J | Erase to end of screen |
| ESC K | Erase to end of line |
| ESC Ylc* | Direct cursor address |

---

* l equals line number, c equals column number. Line and column numbers for direct cursor address are single character codes whose values equal the desired number plus $37_8$. Line and column numbers start at 1.

| Sequence | Function |
|---|---|
| ESC Z† | Identify |
| ESC = | Enter alternate keypad mode |
| ESC > | Exit alternate keypad mode |
| ESC < | Enter ANSI mode |
| ESC ] | Dump hardcopy |
| ESC Pp | Enter graphics mode (ReGIS) |
| ESC \ | Exit graphics mode |

† Response to ESC Z is ESC / Z. This is not recommended; use What Are You report in ANSI mode.

### 4.4.3 ReGIS Summary

The following summary of ReGIS commands serves as a quick reference guide. Refer to the software documentation for more information on any command or command argument. Chapter 1 provides a complete list of all the documentation available along with ordering information.

ReGIS Commands (graphics mode only)

| Command | | Function |
|---|---|---|
| S creen | d | Screen scroll offset, quantified to [12,8]. |
| | [x,y] | Move this address to upper left corner. |
| | [dx,dy] | Scoll screen by this amount. |
| | (W ) | Writing controls. |
| | (E rase) | Clear data and set foreground color. |
| | (A ddressing [x1,y1] [x2,y2]) | Compatibility with other ReGIS devices. |
| | (A ddressing) | Restore native addressing. |
| | (N egate 1) | Reverse video. |
| | (N egate 0) | Restore video to normal mode. |
| | (T ime nnn) | In 60ths (PF0) or 50ths (PF1) of a second. |
| | (H ardcopy [,Y1] [,Y2]) | Print hardcopy between Y coordinates. |
| | (I ntensity | Screen background intensity/color. |
| | 0 to 7) | Dark to bright. |
| | (D)) dark | |
| | (B lue)) | |
| | (R ed)) | |
| | (M agenta)) | Red + blue. |
| | (G reen)) | |
| | (C yan)) | Green + blue. |

| Command | | Function |
|---|---|---|
| | (Y ellow)) | Red + green. |
| | (W hite)) | Red + green + blue. |
| | (H ue | |
| | Ø to 360)) | Angle on color wheel. |
| | (L ightness | |
| | Ø to 100)) | Percentage. |
| | (S aturation | |
| | Ø to 100)) | Percentage. |
| W rite | (I ntensity | Writing intensity/color |
| | ___... | null; change colors. |
| | Ø to 7) | Dark to bright. |
| | (D)) dark | |
| | (B lue)) | |
| | (R ed)) | |
| | (M agenta)) | Red + blue. |
| | (G reen)) | |
| | (C yan)) | Green + blue. |
| | (Y ellow)) | Red + green. |
| | (W hite)) | Red + green + blue. |
| | (H ue | |
| | Ø to 100)) | Angle on color wheel. |
| | (L ightness | |
| | Ø to 100)) | Percentage. |
| | (S aturation | |
| | Ø to 100)) | Percentage. |
| | (A lternate | |
| | 1) | Flashing on. |
| | Ø) | Flashing off. |
| | (S hade from [,Y]) | Set shading axis. |
| | (S hade with "c") | Set shading character. |
| | (S hade | |
| | 1) | Shade on, line pattern shading. |
| | Ø) | Shade off. |
| | (M ultiplier nnn) | Pixels per offset vector. |
| | (N egate | |
| | 1) | Negative writing (invert pattern bits). |
| | Ø) | Positive writing. |
| | (C omplement) | Exclusive OR pattern with bit map. |
| | (oV erlay) | Logical OR pattern with bit map. |
| | (E rase) | Write "negate" setting. |
| | (R eplace) | Replace, ignore bit map data. |

| Command | | Function |
|---|---|---|
| | (P attern | |
| | bbbbbb) | Binary bit pattern, fills to 8 places. |
| | (Md)) | Multiply each bit pattern. |
| | 1) | Solid line. |
| | p) | Digits 2--9 specify standard patterns. |
| | | |
| P osition | [X,Y] | Absolute position. |
| | [dx,dy] | Relative position, |
| | d | d is offset vector, 0--7. |
| | (W   ) | Temporary write controls. |
| | (B egin) | Begin position sequence -- save position (up to 7 levels). |
| | (E nd) | End and restore starting position. |
| | | |
| V ector | [ ] | Write point at current cursor position. |
| | [X,Y] | Absolute position. |
| | [dx,dy] | Relative position, |
| | d | d is offset vector, 0--7. |
| | (W...) | Temporary write controls. |
| | (B egin) | Begin closed polygon sequence. |
| | (E nd) | Draw to starting position. |
| | | |
| C urve | [X,Y] | Absolute coordinates |
| | [dx,dy] | Relative coordinates |
| | d | Offset vectors, 0--7. |
| | (B egin) | Begin closed curve. |
| | (S tart) | Start open curve. |
| | (E nd) | End curve. |
| | (W...  ) | Temporary writing controls. |
| | | |
| C ircle | [X,Y] | Absolute coordinates. |
| | [dx,dy] | Relative coordinates, |
| | d | offset vectors, 0--7. |
| | (C ircumference) | Position is on the circumference. |
| | (A ngle d) | d = degrees resolution, signed. |
| | (W...  ) | Temporary writing controls. |

4-16

| Command | | Function |
|---|---|---|
| T ext | 'string' | Display 'string' (includes BS, CR, LF, TAB). |
| | "string" | Display "string" (includes BS, CR, LF, TAB). |
| | d | Offset text line by 1/2 character, d = 0--7. |
| | [dx,dy] | Set spacing between characters. |
| | (A lphabet 0 to 3) | Select character set 0 to 3. |
| | (B egin) | Begin temporary text attributes (saves 1 level). |
| | (D irection d) | d = 45 degrees resolution, signed. |
| | (E nd) | Restore permanent text attributes. |
| | (H eight 0 to 16) | Height times base character size (affects S[r,c]). |
| | (I talic + degrees) | Right slant, no. of degrees. |
| | - degrees) | Left slant, no. of degrees. |
| | 0) | No slant. |
| | (M ultiplier [r,c]) | No. of times to repeat bits in character. ([1,2] used for standard size.) |
| | (S ize [r,c]) | Dimensions of character area. [9,20] is standard size.) |
| | (S ize 0 to 16) | Select one of 17 predefined character sizes. |
| | (W... ) | Temporary writing controls. |
| L oad | (A lphabet 1 to 3) | Select character set 1 to 3. |
| | 'name') | 1 to 10 character name for character set; see R(L). |
| | "c" <10 hex pairs > | Load specific letter with pattern. |

| Command | | Function |
|---|---|---|
| | 'c' <10 hex pairs > | Load specific letter with pattern. |
| @ | letter | Invoke macrograph "letter". |
| | :l etter  ... @; | Load macrograph "letter". |
| | . | Clear all macrographs. |
| R eport | (L oaded) | Currently loaded character set name. |
| | (M acrographs (letter ,... )) | Report contents of macrograph "letter". |
| | (=)) | Report macrograph space usage. |
| | (P osition) | |
| | | Current position. |
| | (I interactive)) | Enter locator mode. |
| | [+dx,+dy])) | Arrow increments. |
| | (M acrographs (letter)) | Report contents of macrograph l. |
| | (=)) | Report macrograph space usage. |
| ; | | Resynchronization character. |

Offset vectors are:

```
3    2    1
4    *    0
5    6    7
```

To initialize ReGIS:    ;S (I 0 N 0 A) W (V I 7A 0 S 0 M 1 N 0 P 1
                        M 2) T (I 0 A 0 D 0 S 1) P[0,0]

### 4.4.4 BASIC SUMMARY

The following summary of the BASIC commands serves as a quick reference guide. Refer to the software documentation for more information on any command or command argument. Chapter 1 provides a complete list of all the documentation available along with ordering information.

### 4.4.4.1 Commands/Statements

| | | | |
|---|---|---|---|
| AUTO | CLEAR | CONT | CTRLC |
| CTRLO | DATA | DEF FN | DELETE |
| DIM | ECHO | EDIT | END |
| ERASE | ERL | ERR | ERROR |
| FOR...NEXT | GOSUB...RETURN | GOTO | HOST |
| IF...THEN[...ELSE] | IF...GOTO | INPUT | LET |
| LINPUT | LIST | MID | NEW |
| NEXT | NO ECHO | OLD | ON ERROR GO TO |
| ON...GOSUB | ON...GOTO | OPTION BASE | OUT |
| PRINT | RANDOMIZE | RCTRLC | RCTRL |
| READ | REM | RESTORE | RESUME |
| RUN | SAVE | STOP | SWAP |
| TRON/TROFF | WAIT | WHILE...WEND | WIDTH |

### 4.4.4.2 Functions

| | | | |
|---|---|---|---|
| ABS | ASC | ATN | CHR$ |
| COS | EXP | FRE | GOFF$ |
| GON$ | HEX$ | INKEY$ | INP |
| INSTR | INT | LEFT$ | LEN |
| LOG | MID$ | OCT$ | POS |
| RIGHT$ | RND | SGN | SIN |
| SPACE$ | SPC | SQR | STR$ |
| STRING$ | TAB | TAN | |

## 5.1 INTRODUCTION

The VK100 terminal is a graphics terminal which displays information from the keyboard in local mode or displays information from the host computer in on-line mode. The system prints the display data on the Graphic Line Printer (LA34VA). A writing tablet can also be connected to the hardcopy port. Only one type of device may be connected to the hardcopy port, graphics line printer or the writing tablet. Figure 5-1 shows the block diagram of the VK100 system.
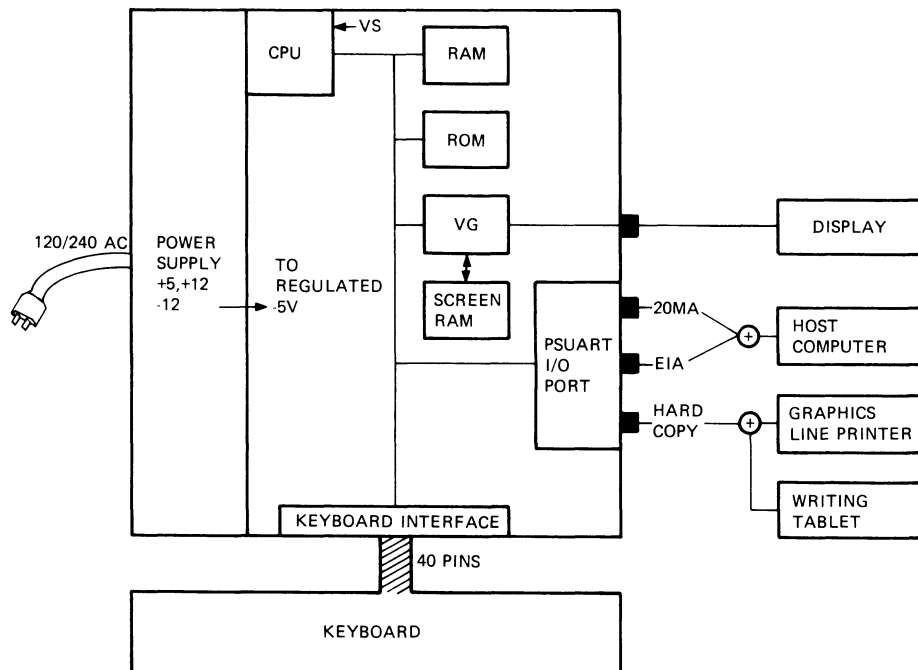


Figure 5-1 VK100 (GIGI) Block Diagram

5-1

5.2     TERMINAL CONTROLLER MODULE

This chapter describes the functional theory of the VK100 (GIGI)
Terminal. The terminal controller module is divided into five
sections (Figure 5-2):

    1.    CPU
    2.    Vector Generator
    3.    I/O Ports
    4.    Keyboard
    5.    Power Supply

5.2.1     Central Processing Unit (CPU)

The CPU is an 8085 chip; 8-bit general purpose microprocessor
capable of accessing up to 64K bytes of memory. Figure 5-3 shows a
functional block diagram of the CPU.

The microprocessor (8085A) performs the following functions.

    Clock generation
    Interrupt priority selection
    System bus control
    Executing the instruction

The CPU transfers data on an 8-bit bidirectional Tri-State Bus
(AD0--AD7) that is time multiplexed to transmit the eight low
ordered address bits. Address bits A8--A15 expand the address
capability to 16 bits, allowing the CPU to directly access 64K
bytes of memory.

The CPU generates signals telling peripheral devices what type of
information is on the multiplexed address/data bus. Figure 5-4
shows the basic CPU blocks. The CPU is a single chip that performs
the following machine cycles.

    Memory write
    Memory read
    I/O write
    I/O read
    Opcode fetch
    INT ACK (interrupt acknowledge)
    Bus idle

Table 5-1 shows the machine cycle status and control signals.

The execution of any CPU program is a sequence of read and write
operations. Each operation transfers a byte of data between the
CPU and a specific memory or I/O address.

Each read or write operation is referred to as a machine cycle.
The execution of each instruction by the CPU includes  a sequence
of from one to five machine cycles. Each machine cycle contains a
minimum of from three to six clock cycles (also referred to as T
states). Figure 5-5 shows an instruction cycle for Store
Accumulator Direct (STA).
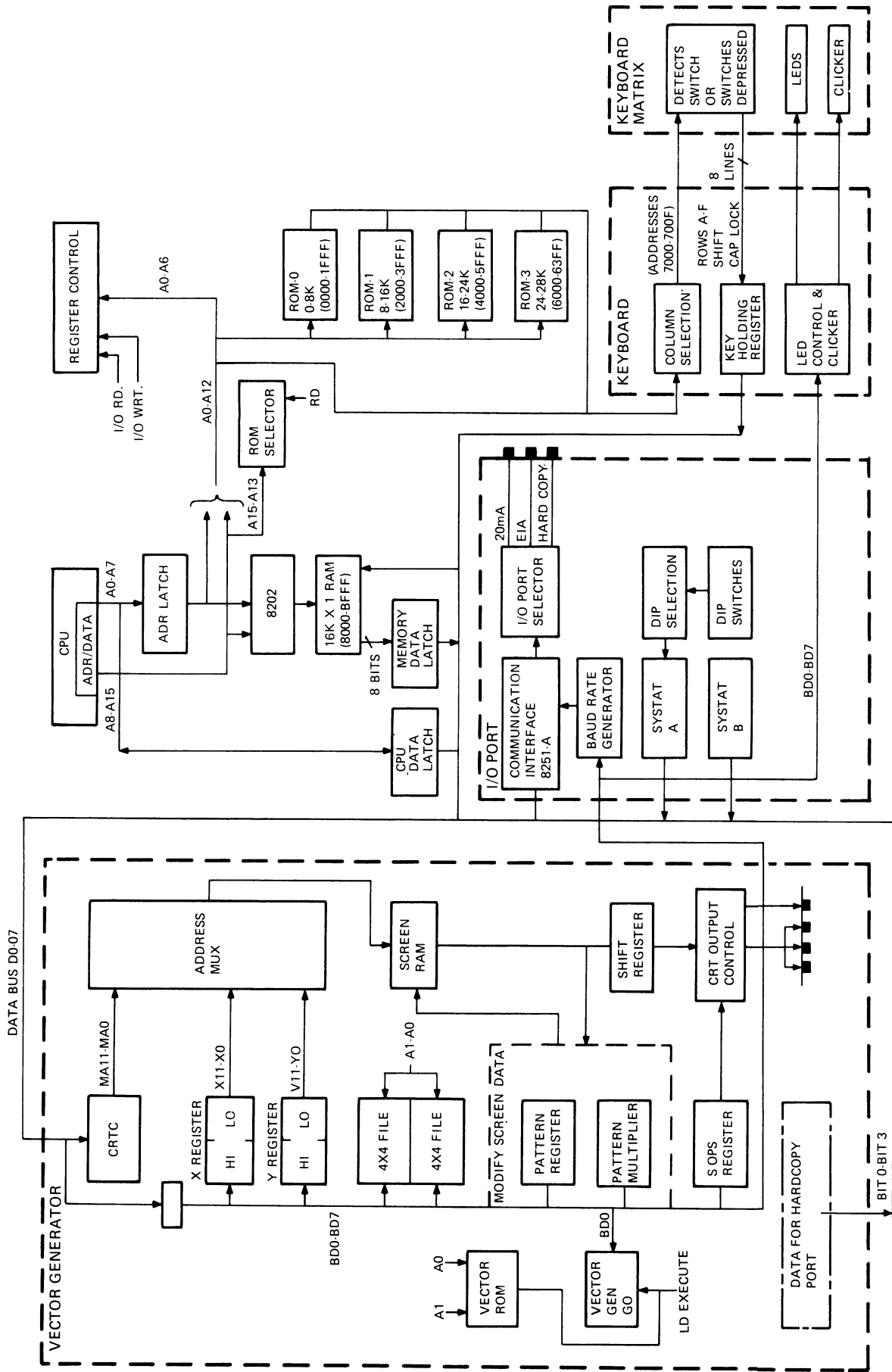
Figure 5-2 System Overview Block Diagram

5-3
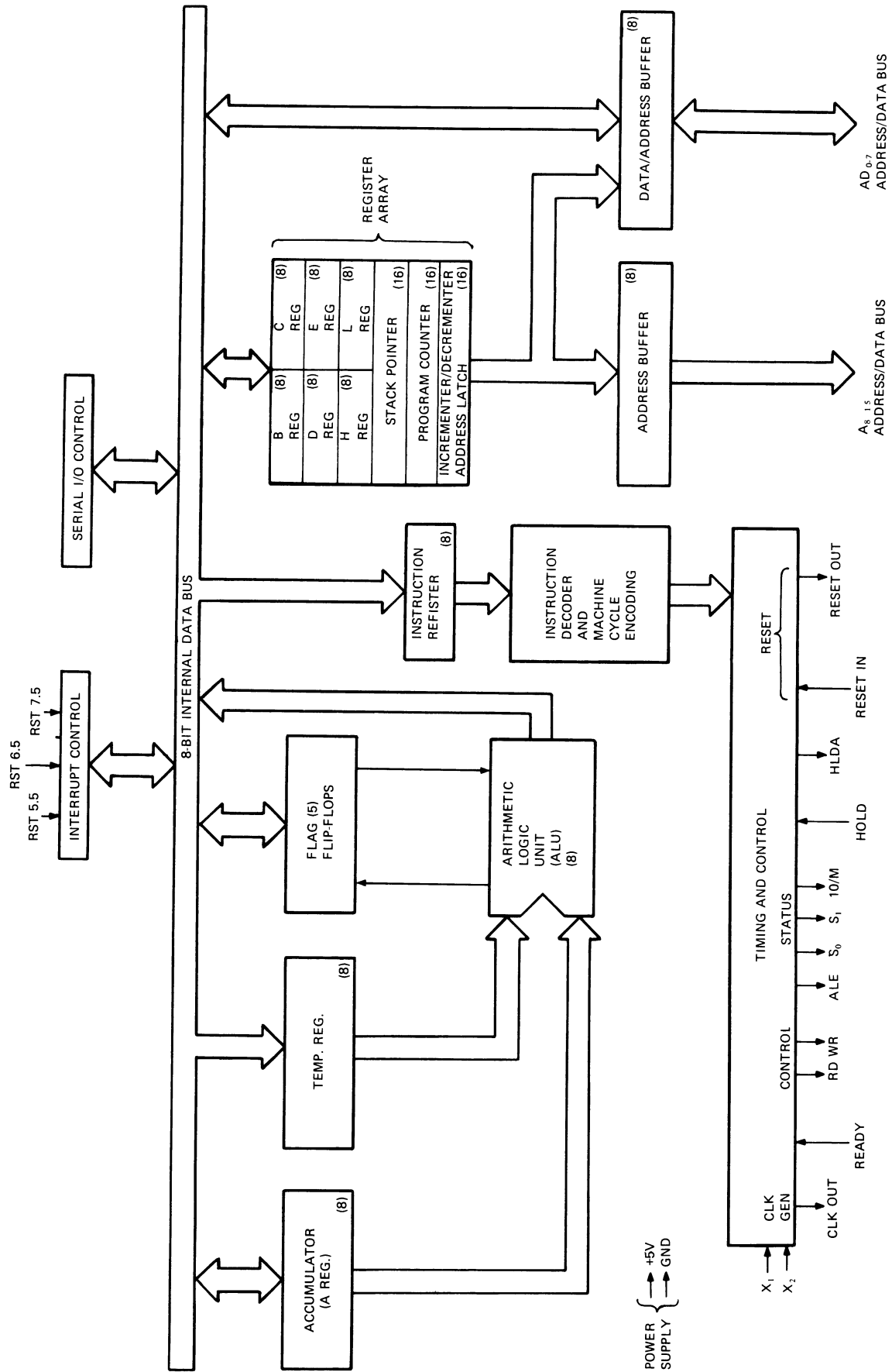
Figure 5-3 CPU Functional Block Diagram

XTAL

CPU
8085

INTR

$\overline{\text{INTA}}$

$\overline{\text{RESET IN}}$

RESET OUT

ADDRESS BUS

ALE

MULTIPLEXED
ADDRESS/DATA BUS

$\overline{\text{RD}}$

$\overline{\text{WR}}$

I/O $\overline{\text{M}}$

S0

S1

MA-8147
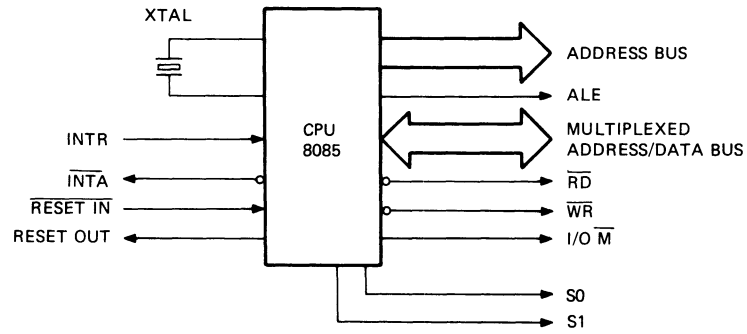
Figure 5-4 Basic CPU Block Diagram

Table 5-1   Machine Cycle Status and Control

| Machine Cycle | | Status I/O M | S1 | SØ | Control RD | WRT | INTA |
|---|---|---|---|---|---|---|---|
| Op Fetch | (OF) | Ø | 1 | 1 | Ø | 1 | 1 |
| Memory Read | (MR) | Ø | 1 | Ø | Ø | 1 | 1 |
| Memory Write | (MW) | Ø | Ø | 1 | 1 | Ø | 1 |
| I/O Read | (IOR) | 1 | 1 | Ø | Ø | 1 | 1 |
| I/O Write | (IOW) | 1 | Ø | 1 | 1 | Ø | 1 |
| INTR Acknowledge | (INA) | 1 | 1 | 1 | 1 | 1 | Ø |
| Bus Idle* | (BI):DAD | Ø | 1 | Ø | 1 | 1 | 1 |
| | INA(RSTS/TRAP) | 1 | 1 | 1 | 1 | 1 | 1 |
| | HALT | TS | Ø | Ø | TS | TS | 1 |

Ø = Logic "Ø", 1 = Logic "1", TS = High Impedance

* Bus idle (BI) only occurs in response to:

1. DAD instructions
2. During an acknowledge of RSTS, TRAP, or HALT instructions.
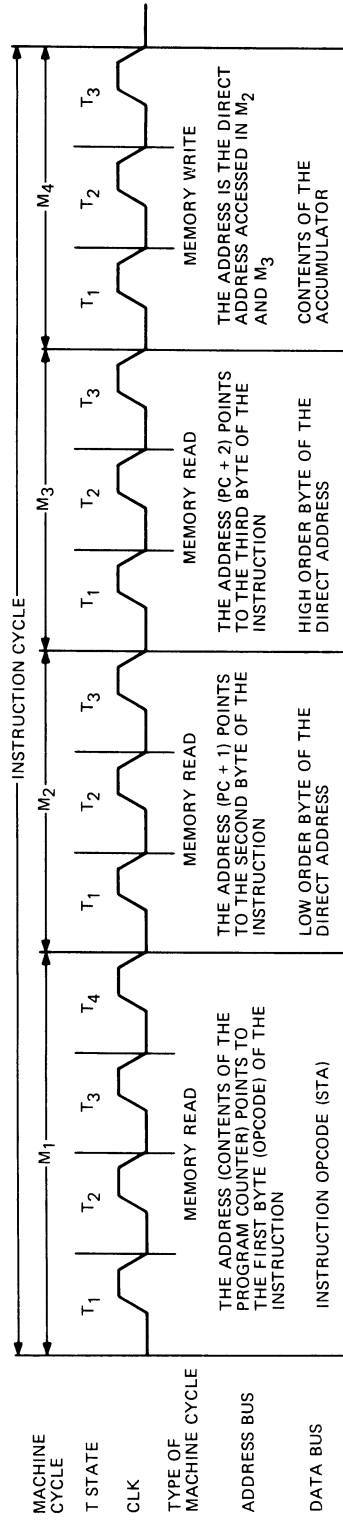
Figure 5-5 Instruction Cycle for Store Accumulator Direct

The CPU can address up to 256 different I/O addresses. These addresses have the same numerical values (00 through FF Hex) as the first 256 memory addresses. The 256 I/O locations are selected by the I/O M output.

The status signals, I/O M, S1, and S0, define what type of machine cycle is about to occur. The I/O M signal identifies the machine cycle as either a memory reference or input/output operation. The S1 status signal identifies whether the cycle is a read or write operation. S0 and S1 can be used together (see Table 5-1) to identify read, write, opcode fetch, or halt machine cycles. Figure 5-6 shows the timing and control for an opcode fetch.

5.2.1.1 Address -- When the CPU generates a 16 bit address, the lower byte is latched and the upper byte is held active by the CPU. Bits A0--A15 address the following:

    RAM Memory
    A0--A7 -- Row address bits
    A8--A15 -- Column address bits

    ROM Memory
    Address bits A13, A14, and A15 generate ENA ROM 0, ENA ROM 1,and ENA ROM 2. Address bits A0--A12 address the selected ROM.

    Register Control
    Address bits A0--A6 address and generate register load pulses.

Table 5-2 shows an address map.
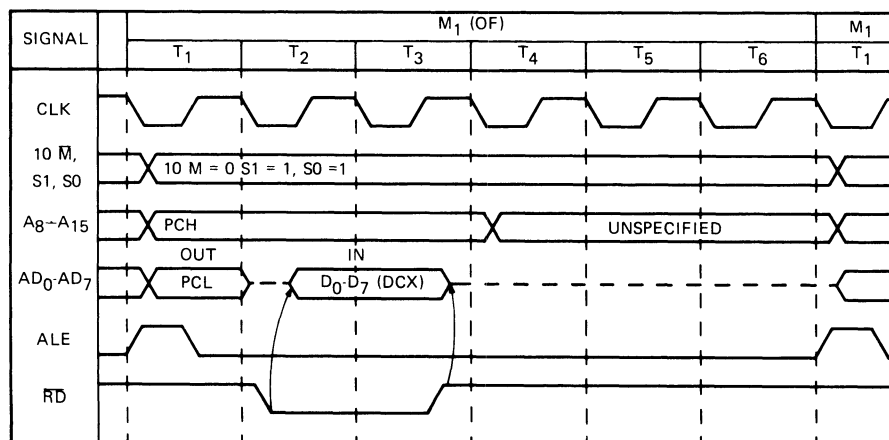


MA-8193

Figure 5-6 Opcode Fetch Machine Cycle

Table 5-2 8202 Pin Description

| Pin Name | No. | I/O | Pin Description |
|---|---|---|---|
| $AL_0$ | 6 | I | Low-Order Address. These Address |
| $AL_1$ | 8 | I | inputs generate the ROW |
| $AL_2$ | 10 | I | Address for the Multiplexer. If |
| $AL_3$ | 12 | I | $AL_6/OP_3$ is pulled to +12V |
| $AL_4$ | 14 | I | through a 5KX resistor, the 8202 |
| $AL_5$ | 16 | I | configures itself for 4K RAMs. If |
| $AL_6/OP_3$ | 18 | I | $AL_6/OP_3$ is driven with TTL levels, the 8202 configures itself for 16K RAMs. |
| $AH_0$ | 5 | I | High-Order Address. These Ad- |
| $AH_1$ | 4 | I | dress inputs generate the |
| $AH_2$ | 3 | I | Column Address for the Multiplexer. |
| $AH_3$ | 2 | I | If the 8202 is configured for 4K |
| $AH_4$ | 1 | I | RAMs, use $AH_6$ as an active high |
| $AH_5$ | 39 | I | chip select for memory controlled |
| $AH_6$ | 38 | I | by 8202. For 16K RAM operation, $AH_6$ becomes the most significant column address bit. |
| $OUT_0$ | 7 | O | Output of the Multiplexer. These |
| $OUT_1$ | 9 | O | outputs drive the addresses |
| $OUT_2$ | 11 | O | of the Dynamic RAM array. |
| $OUT_3$ | 13 | O | For 4K RAM operation, $OUT_6$ |
| $OUT_4$ | 15 | O | drives the 2104A CS input. |
| $OUT_5$ | 17 | O | (Note that the $OUT_{0-6}$ pins do not |
| $OUT_6$ | 19 | O | require inverters or drivers for proper operation. |
| WE | 28 | O | Write Enable. This output drives the Write Enable inputs of the Dynamic RAM array. |
| CAS | 27 | O | Column Address Strobe. This output latches the Column Address into the Dynamic RAM array. |
| $RAS_0$ | 21 | O | Row Address Strobe. These outputs |
| $RAS_1$ | 22 | O | latch the ROW Address |
| $RAS_2$ | 23 | O | into the bank of dynamic RAMs |
| $RAS_3$ | 26 | O | selected by the 8202 Bank Address pins ($B_0$, $B_1/OP_1$). |

Table 5-2 8202 Pin Description (Cont)

| Pin Name | No. | I/O | Pin Description |
|----------|-----|-----|----------------|
| $B_0$ | 24 | I | Bank Address.  These inputs |
| $B_1$/$OP_1$ | 25 | I | select one of four banks of dynamic RAM via the $RAS_{0-3}$ outputs. If the $B_1$/$OP_1$ input is pulled to +12V through a 5K$\Omega$ resistor, the 8202 configures itself to the Advanced Read mode.  This mode changes the function of the 8202 $RD/S_1$ and REFRQ/ALE inputs and disables the $RAS_0$ and $RAS_1$ outputs. |
| $RD/S_1$ | 32 | I | Read/$S_1$ input. This input requests a read cycle. In normal operation, a low on this input informs the arbiter that a read cycle is requested.  In the Advanced Read Mode, this input accepts the $S_1$ status signal from the 8085A (fully decoded for a read). The trailing edge of ALE informs the arbiter that a read cycle is requested by latching $S_1$. |
| WR | 31 | I | Write Input. This input requests a write cycle. A low on this input informs the arbiter that a write cycle is desired. |
| PCS | 33 | I | Protect ed Chip Select. A low on this input enables the WR and $RD/S_1$ inputs. PCS is protected against terminating a cycle in progress. |
| REFRQ/ALE | 34 | I | Refresh Request/Address Latch Enable.  During normal operation, a high on this input indicates to the arbiter that a refresh cycle is being requested. In the Advanced Read Mode, this input latches the state of the 8085 $S_1$ signal into the $RD/S_1$ input.  If $S_1$ is high at this time, a Read Cycle is requested.  In this mode, transparent refresh is not possible. |
| XACK | 29 | O | Transfer Acknowledge.  This output is a strobe indicating valid data during a read cycle or data written during a write cycle.  XACK can latch valid data from the RAM array. |

Table 5-2 8202 Pin Description (Cont)

| Pin Name | No. | I/O | Pin Description |
|---|---|---|---|
| SACK | 30 | O | System Acknowledge. This output indicates the beginning of a memory access cycle. It is also an advanced transfer acknowledge to eliminate wait states. (Note: If a memory access request is made during a refresh cycle, SACK is delayed until XACK occurs in the memory access cycle). |
| $X_0/IO_2$ $X_1/CLK$ | 36 37 | I I | Crystal Inputs. These inputs are designed for a quartz crystal to control the frequency of the oscillator. If $X_0/OP_2$ is pulled to +12V through a 1KΩ resistor, $X_1/CLK$ becomes a TTL input for an external clock. |
| TNK | 35 | | Tank. This pin provides a tank circuit connection. |
| $V_{cc}$ | 40 | | +5V ± 10% |
| $V_{ss}$ | 20 | | Ground |

5.2.1.2 ROMs -- Four ROMs hold the firmware to run the system:

    Three 8K by 8 ROMs
    One 4K by 8 ROMs

This means there are 28K of firmware space, however, the system uses only 26K.

When the CPU reads the ROMs, it sends out an address (A12--A0) to the ROM. Address bits A13 and A14 select one of the four ROMs. A15 is high for all memory addresses. The ROM addresses follow:

    0000--1FFF      (ROM 0)      E53
    2000--3FFF      (ROM 1)      E52
    4000--5FFF      (ROM 2)      E51
    6000--63FF      (ROM 3)      E50

The CPU sends out the control signals RD and I/O M. Both these signals are active low.

The data from the selected ROM is placed on the data bus and sent to the CPU.

**5.2.1.3 RAMs** -- There are two RAMs in the system:

System RAM
Contains the CPU stacks, work areas and User's programs

Screen RAM
Stores the CPU data and attributes to be displayed on the CRT.

The System RAM and the Screen RAM both are 16K by 1 RAMs. The Screen RAM is described in the Vector Generator section. The following paragraphs describe the system RAM.

For any memory operation to occur, the CPU generates the following actions.

Address
Control
Data

Figure 5-7 shows how the CPU controls the System RAM.

**Address** -- The address range of the memory is 8000--BFFF. The address bits, A0--A15 go to the Dynamic RAM Controller (8202). The address bits contain the following information:

1. Row Address (A0--A6)
2. Column Address (A7--A15)
3. Row Address Selection (RAS0--3) (A14, A15).
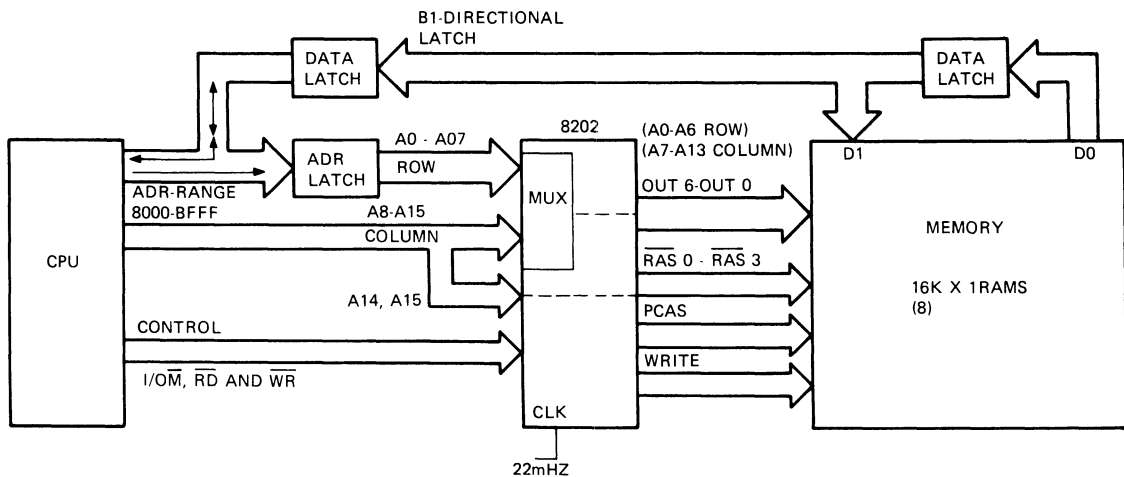


Figure 5-7 CPU to RAM Memory Block Diagram

Memory addresses within the 8000--BFFF range have A15=1, A14=0. This combination selects RAS2.

**Control** -- The control signals are I/O M, RD and WRT. When low the I/O M signal enables the 8202 to receive RD or WRT commands. If high the I/O M signal prevents the 8202 from starting a memory cycle. The address at this time an I/O address.

**Data** -- The data path to and from the memory is shown in Figure 5-6.

Figure 5-8 shows the block diagram of the 8202 and its pin configuration. Refer to Table 5-2 for the 8202 pin description.

**5.2.1.4  Data Bus** -- The data bus is a Tri-State bus that connects the CPU to the following.

    RAM (memory)
    ROM
    I/O Port
    Keyboard

Figure 5-9 shows the data bus.

The CPU time multiplexes the low byte of the Data/Address Buffer. When the CPU reads a valid address, the data is gated onto the Tri-State Data Bus. When active, the direction signal RD allows the data in the data latch. The CPU then loads the data into the Data/Address buffer. When the CPU writes a valid address, WRT determines the data flow direction. This implies RD is high and the data is gated on the Tri-State Data Bus.

**5.2.1.5  Control Functions** -- The CPU control functions are divided into two groups.

    1.   Memory control
    2.   Register control

Memory control generates memory reads, writes and opcode fetches. Table 5-1 shows the memory control for these operations.

The registers that the system uses as control registers are I/O addresses.

This means the CPU generates the following sequence.

    1.   Address (of register)
    2.   Data
    3.   Control
         a)  I/O M H (The address is an I/O Address)
         b)  RD
         c)  WRT

Address bits A0--A6 generate the appropriate register control signals (Tables 5-3, 5-4 and 5-5).
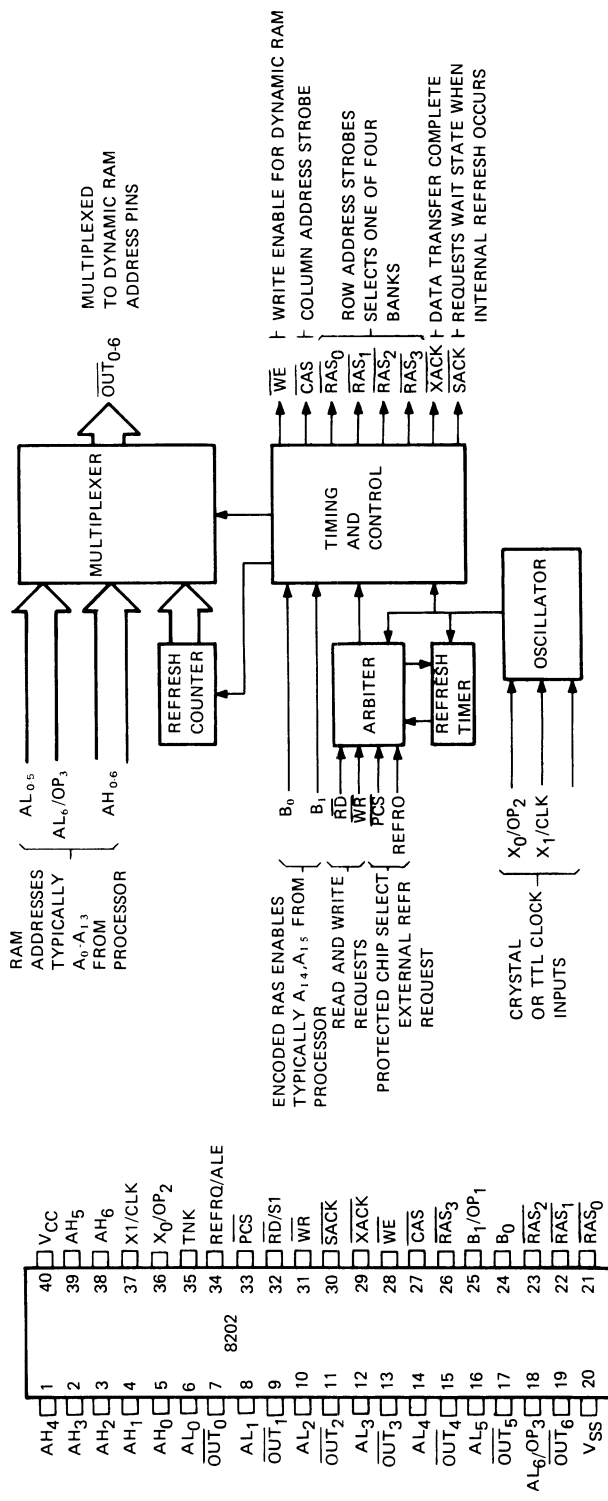
Figure 5-8 8202 Block Diagram and Pin Description

5-13
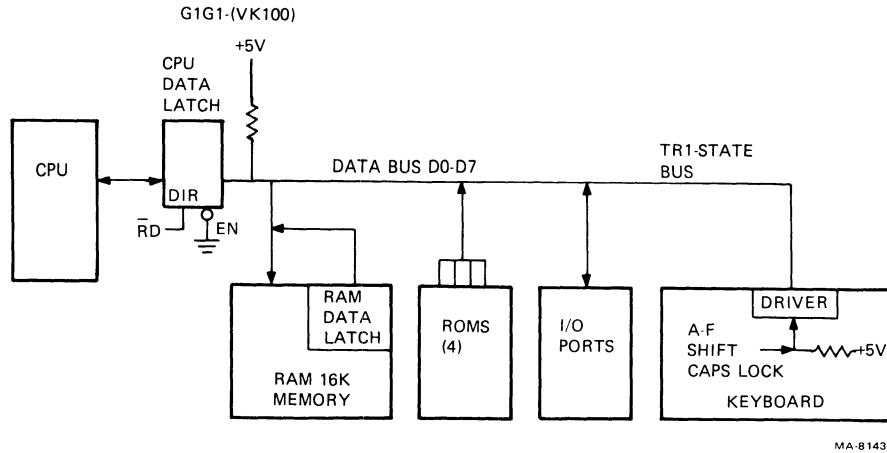
Figure 5-9  DATA Bus

Table 5-3  I/O Register Addresses

| Address Bits 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | Signals I/OM | RD | WT | Address Hex | Function |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 40 | LD X LO |
| 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 41 | LD X HI |
| 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 42 | LD Y LO |
| 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 43 | LD Y HI |
| 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 44 | LD ERR |
| 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 45 | LD SOPS |
| 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 46 | LD PAT |
| 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 47 | LD PMUL |
| 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 60 | LD DU |
| 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 61 | LD DVM |
| 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 62 | LD DIR |
| 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 63 | LD WOPS |
| 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 64 | EX MOV |
| 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 65 | EX DOT |
| 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 66 | EX VEC |
| 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 67 | EX ER |
| 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 68 | |
| 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 6C | LD BAUD |
| 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 70 | LD COMD |
| 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 71 | LD COM |
| 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 74 | |
| ) | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 78 | KYBDW |
| 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 7C | |

I/O WRT

| 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 40 | SYSTAT A |
| 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 48 | SYSTAT B |
| 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 50 | UART O |
| 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 51 | UAR |
| 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 58 | |
| 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 60 | |
| 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 68 | NOT USED |
| 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 70 | |
| 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 78-7F | |

I/O RD

5-14

Table 5-4  Program RAM Addresses

| CPU Address Bits | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8000 Hex | ↑ 16K of Address Space ↓ |
| 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | B FFF Hex | |
| 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | C 000 Hex | ↑ 16K of Address Space ↓ |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | F F F F Hex | |

NOTE
CPU Address Bits 15 and 14 are inputs to the M8202 and are used to generate RAS0 through RAS3

RAS 0 0 0 -- Enables refresh flip-flop to be cleared
RAS 1 0 1 -- Not Used
RAS 2 1 0 -- Used with address range 8000 Hex to BFFF Hex
RAS 3 1 1 -- Used with address range C000 Hex to FFFF Hex

Table 5-5 I/O ROM Microcode Address

| | Address Bits | | | | | | | | | | | | | | | | Address Space | Hex Address Range |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | | |
| ROM 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8K of Address Space | 0000 HEX |
| | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 01FF HEX |
| ROM 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8K of Address Space | 2000 HEX |
| | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 3FFF HEX |
| ROM 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8K of Address Space | 4000 HEX |
| | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 5 FFF HEX |
| ROM 3 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2K of Address Space | 6000 HEX |
| | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 63 FF HEX |
| * | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 700 HEX |
| | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 16 Addresses | |

* ROM 3 and Bit 12 equal to a 1 implies Keyboard address

5.2.1.6  **Memory Refresh Cycle** -- A read cycle causes a refresh to occur. The memory refresh is controlled internally by the dynamic RAM Controller (8202). Figure 5-8 shows the components used for the refresh cycle. 128 memory refresh occurs every 2 ms. The refresh logic has 2 sections.

1.    Internal Counter -- contains the RAS address used during the refresh. The counter is incremented after each refresh resetting to zero after all RAS addresses have been refreshed.

2.    Arbitration -- timing and control logic allows either a read, write or refresh cycle to occur. After any read or write cycle request, SACK (System Acknowledge) goes active if the cycle was not requested during a refresh cycle. If it was requested SACK is delayed until XACK (Transfer Acknowledge) thereby requesting wait states from the cycle requestor.

5.2.1.7  **Interrupts** -- Hardware interrupts are generated from two sources: (the vector generator and I/O port (Figure 5-10).
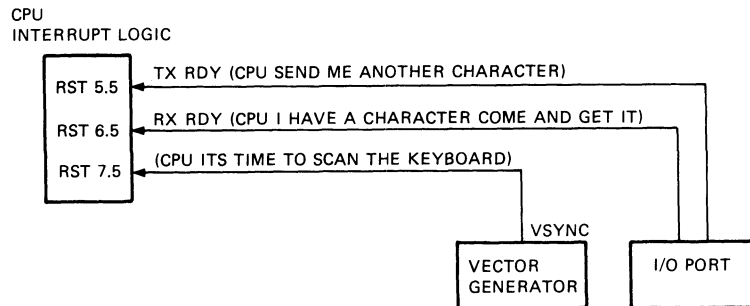
CPU
INTERRUPT LOGIC

| RST 5.5 | TX RDY (CPU SEND ME ANOTHER CHARACTER) |
| RST 6.5 | RX RDY (CPU I HAVE A CHARACTER COME AND GET IT) |
| RST 7.5 | (CPU ITS TIME TO SCAN THE KEYBOARD) |

VSYNC

VECTOR GENERATOR          I/O PORT

| NAME | PRIORITY | ADDRESS BRANCHED TO WHEN INTERRUP OCCURS | TYPE TRIGGER |
|------|----------|------------------------------------------|--------------|
| RST 7.5 | 1 | 3CH | RISING EDGE LATCH |
| RST 6.5 | 2 | 34H | HIGH LEVEL UNTIL SAMPLED |
| RST 5.5 | 3 | 2CH | HIGH LEVEL UNTIL SAMPLED |

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Figure 5-10  Interrupt Block Diagram

These interrupts change the flow of the executing program (ROM control).

The interrupts are sampled on the descending edge of the clock, one cycle before the end of the instruction in which the interrupt input is activated. The CPU saves the contents of the program counter before it branches to the subroutine.

Refer to Table 5-6 for the interrupt priority structure.

The vector generator and I/O port sections describe how the system generates the interrupts. The software controls the interrupt logic by using the RIM (Read Interrupt Masks) and SIM (Set Interrupt Mask) instructions.

### 5.2.1.8 CRT Sweep Overview

The CPU sets the horizontal and vertical timing registers in the CRT controller to control the horizontal and vertical sweep circuits. The horizontal timing registers are R0--R3 and the vertical timing registers are R4--R9. The register functions are as follows.

Horizontal Total Register (R0) -- This 8-bit write-only register determines the horizontal frequency of the horizontal sweep.

Horizontal Displayed Register (R1) -- This 8-bit write-only register determines the number of displayed characters per horizontal line.

Horizontal Sync Position Register (R2) -- This 8-bit write-only register determines the horizontal sync position on the horizontal line.

Horizontal Sync Width Register (R3) -- This 4-bit write-only register determines the width of the horizontal sync pulse.

The horizontal registers are programmed in "character times" units with respect to the reference.

Table 5-6 Interrupt Priority, Restart Address, and Sensitivity

| Name | Priority | Address Branched To When Interrupt Occurs | Type Trigger |
|------|----------|-------------------------------------------|--------------|
| RST 7.5 | 1 | 3CH | Rising edge latch |
| RST 6.5 | 2 | 34H | High level until sampled |
| RST 5.5 | 3 | 2CH | High level until sampled |

Vertical Total Register (R4) and Vertical Total Adjust Register (R5) -- These two registers determine the vertical frequency of vertical sync. The calculated number of character line times is usually an integer plus a fraction to get exactly 50 or 60 Hz vertical refresh rate. The integer number of character line times minus one is programmed in the 7-bit write-only vertical total register; the fraction is programmed in the 5-bit write only vertical scan adjust register as a number of scan lines.

Vertical Displayed Register (R6) -- This 7-bit write-only register determines the number of displayed character rows on the CRT screen and is programmed in character row times.

Vertical Sync Position (R7) -- This 7-bit write-only register determines the vertical sync position with respect to the reference. It is programmed in character row times.

Interlace Mode Register (R8) -- This 2-bit write-only register controls the raster scan mode. These bits are zeros which means non-interlace raster scan mode is selected.

For 60 Hz the CPU initializes the registers in the CRT controller (CRR) as follows.

```
R0 (horizontal total)          = 4F   80-1=79
R1 (horizontal displayed)      = 40   64
R2 (horizontal sync position)  = 44   68
R3 (horizontal sync width)     = 41   65 (value can be 60--69
                                         ticks depending on HP)
R4 (vertical total)            = 41   66-1=65
R5 (vertical total adjust)     = 0    0
R6 (vertical displayed)        = 3D   61
R7 (vertical sync position)    = 3E   62
R8 (interlace mode)            = 0    0
```

5.2.1.8.1  Horizontal Sweep -- The horizontal sweep time is 63.131 ~s. This is the time needed for the beam to move from the left side of the screen to the right side of the screen (display time) and return to the left side (retrace time).

The display time is 50.505 ~s and the retrace time is 12.626 ~s. These times are converted into tick values for the CRTC registers. One tick value is the time needed for the horizontal sweep to pass twelve pixels. One tick occurs every 0.789144 ns.

The horizontal sync pulse triggers the horizontal sweep. The horizontal sync pulse has three components.

    1.   HS pulse width
    2.   HF horizontal front porch
    3.   HB horizontal back porch

The HS pulse width is constant. The HF can be changed by the HP command. If the HF is increased by one tick then the HB is decreased by one tick. This action controls the horizontal sweep start time, which allows for positioning of the display area in the horizontal direction on the face of the CRT.

5.2.1.8.2 Vertical Sweep -- The vertical sweep is 50 or 60 Hz. The total vertical sweep is 16.666 ms. A horizontal sweep rate of 63.131 ~s provides 264 available scan lines of which 244 scan lines are used. The remaining 20 scan lines include retrace time from the last active scan line.

The vertical registers used are

```
R4 (vertical total)           = 41    66-1=65    Character row
R5 (vertical total adjust)    = 0     0          Scan line
R6 (vertical displayed)       = 3D    61         Character row
R7 (vertical sync positive)   = 3E    62         Character row
R8 (interlace mode)           = 0     0
```

The CPU loads the vertical registers with scan line and character row values.

The total sweep time is 66 characters. A character row by definition is four scan lines, which means there are 264 scan lines in a vertical sweep.

The display time is 61 character rows (0--60). The screen remains blank during display time. The screen blank time is five character rows. These rows are divided into:

```
Vertical sync front porch -- one character row
Vertical sync pulse width -- four character rows
Vertical sync back porch -- zero
```

5.2.2     Vector Generator Overview
The vector generator interfaces the VK100 to the CRT display (Figure 5-11). The vector generator performs four functions.

```
1.   Generates a timing chain
2.   Generates display refresh sequence
3.   Generates the hardcopy output
4.   Generates status
```

The vector generator, under ROM control, places characters and vectors on the CRT display. The system, using a crystal control clock (45.692 Hz), synchronizes the display sequence and generates the timing for the vector generator and the CRT monitor (Figure 5-12). Time states control the vector generator, sync ROM and the vector ROM.

The system uses a crystal control clock (45.692 Hz) to synchronize the display sequence and generate the timing for the vector generator and the CRT monitor (Figure 5-12).
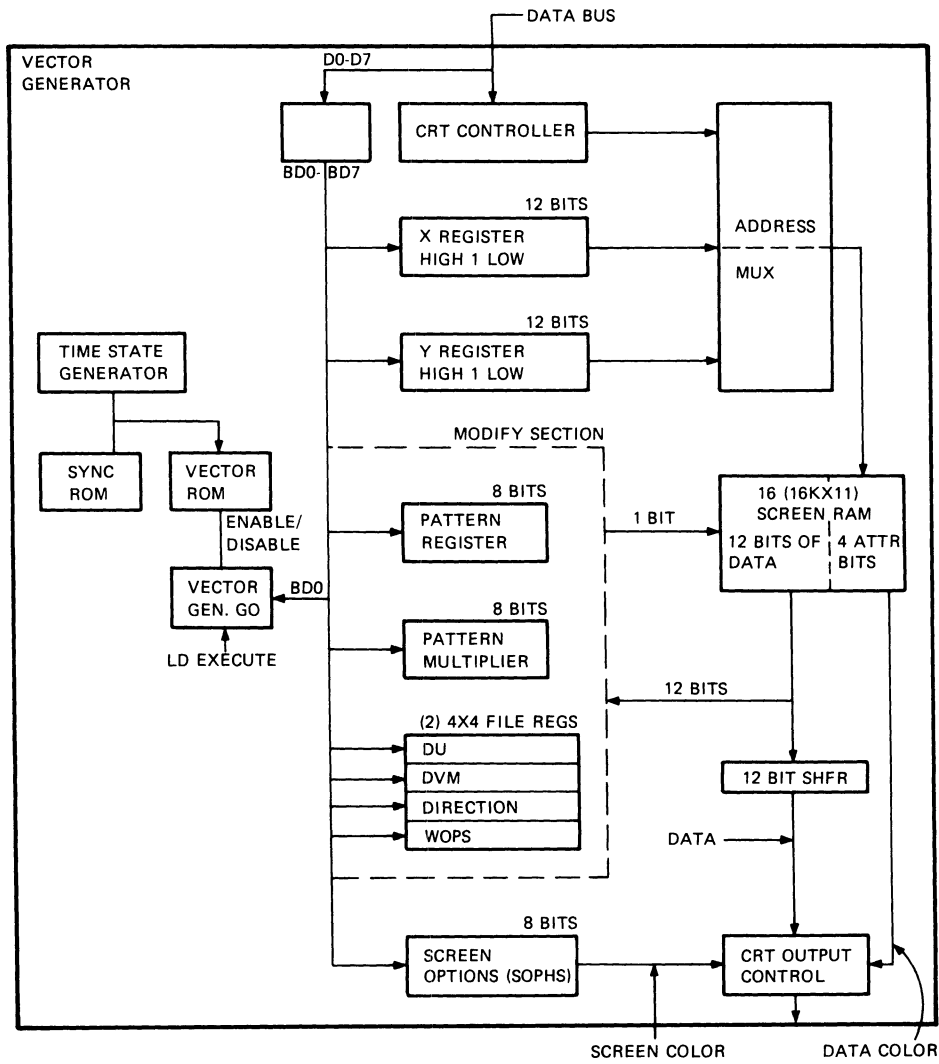
Figure 5-11 Vector Generator Block Diagram
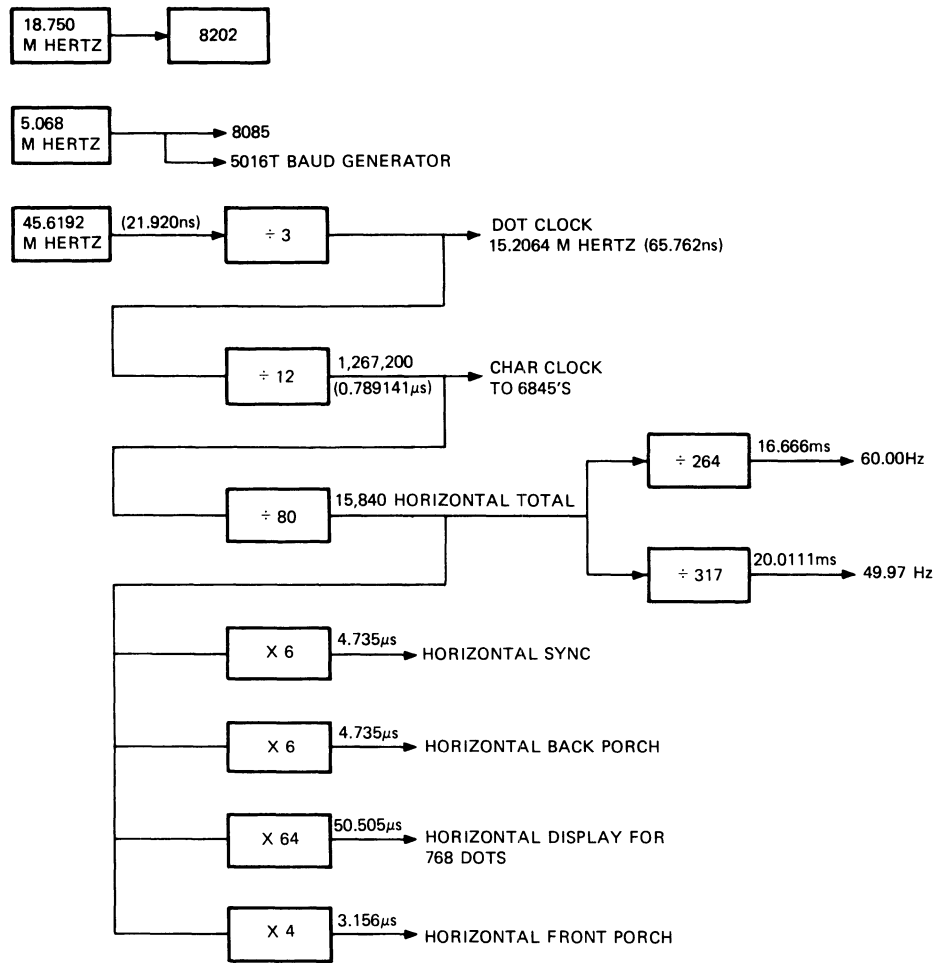
Figure 5-12 System Timing

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The vector generator performs two separate time shared operations.

1.  Modify screen RAM data
2.  CRT display

A read modify write operation modifies the screen RAM. The screen RAM is addressed and 16 bits are read (12 bits of data and 4 attribute bits). Only one of the twelve data bits can be modified at a time. Then the modified data bit is written into the screen RAM.

The CRT refresh holds the display for a limited amount of time. If the CRT is not refreshed the contents of the screen RAM fade and then disappear.

The CRT refresh is a continuous action. The screen RAM is addressed sequentially. For each address twelve bits of data are loaded into the shift register. Then the data is shifted one bit at a time to the CRT display. The data that appears on the CRT is an image of the data in the screen RAM.

5.2.2.1  Addressing the Screen RAM -- The screen RAM is addressed through a two to one multiplexer (Figure 5-16). When the modify screen RAM function is taking place, the address comes from the X and Y register. The WRT/RD signal when high allows the contents of the X and Y register to pass through the multiplexer to address the screen RAM.

When the CRT refresh function is taking place, the address used comes from the sequential counter (MA) of the CRT controller. The low WRT/RD signal when low allows the contents of the MA register to pass through the multiplexer to address the screen RAM.

The address bit breakdown is shown in Figures 5-13 and 5-14. The outputs of the address multiplexer are divided into two groups, the RAS and CAS bits.

The RAS, CAS bits used when modifying the screen RAM are (Figure 5-15):

    RAS -- Y1, X9--X4
    CAS -- Y8--Y2

The RAS, CAS bits used when doing a CRT refresh are:

    RAS -- RA0, MA5--MA0
    CAS -- MA11--MA6, RA1

The address bits X9--X2 go through a translator, which makes sure that the output bits X3 and X2 are never equal to a binary three. Bank three in the screen RAM does not exist (Figure 5-16).
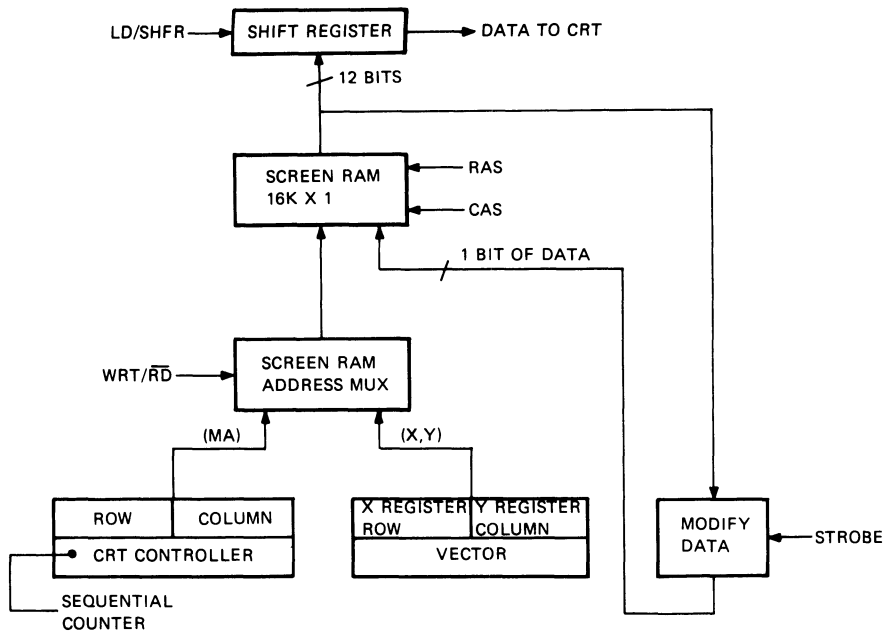
Figure 5-13 Basic Overview of Address and Data Path
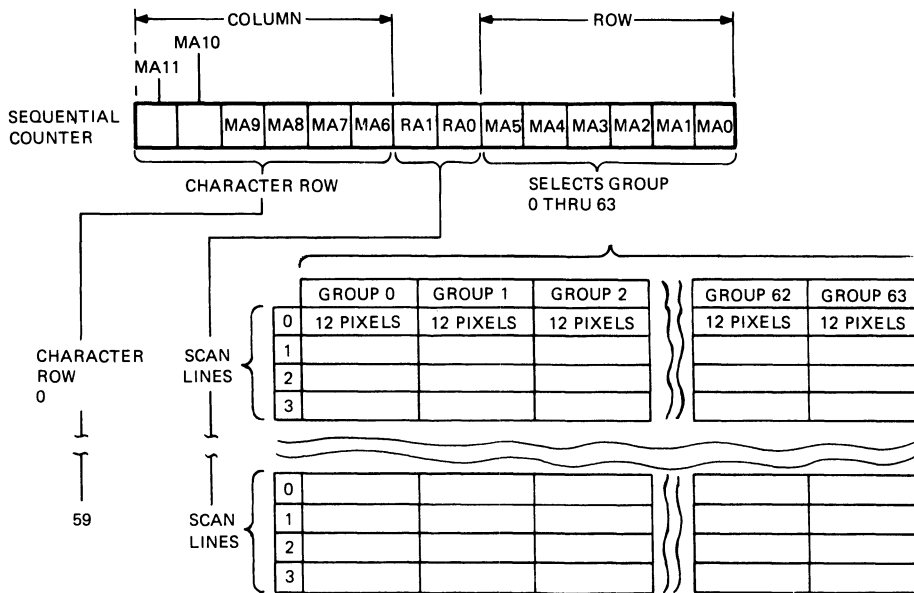


Figure 5-14 Screen Update, Screen RAM Address Breakdown

5-23
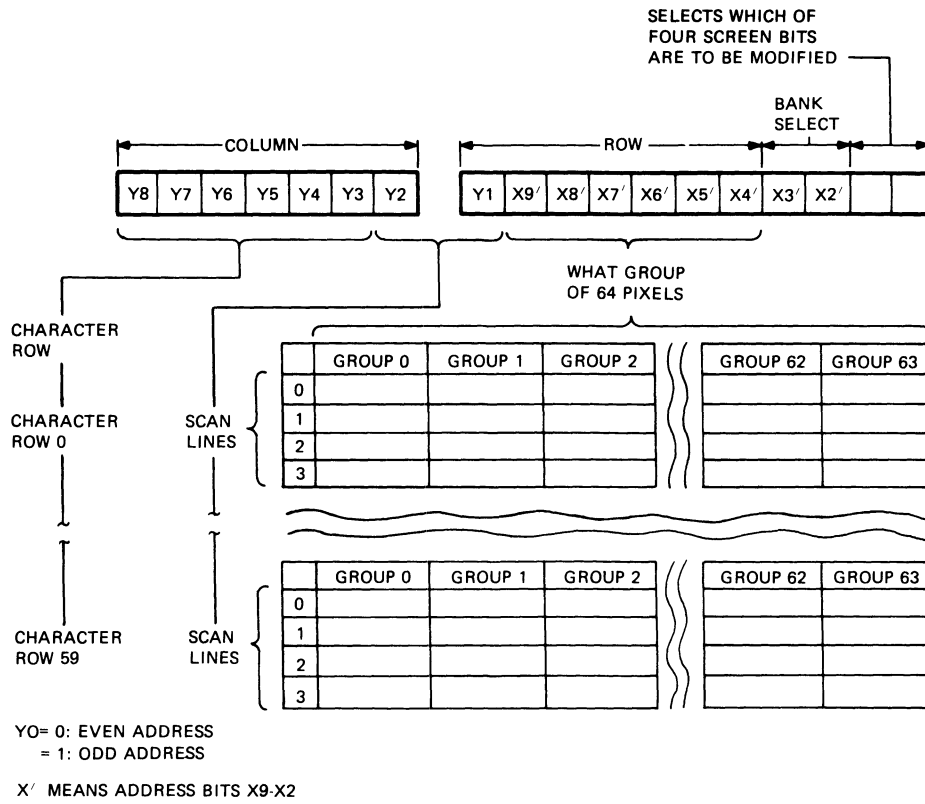
Figure 5-15  Modify Data, Screen RAM Address Breakdown
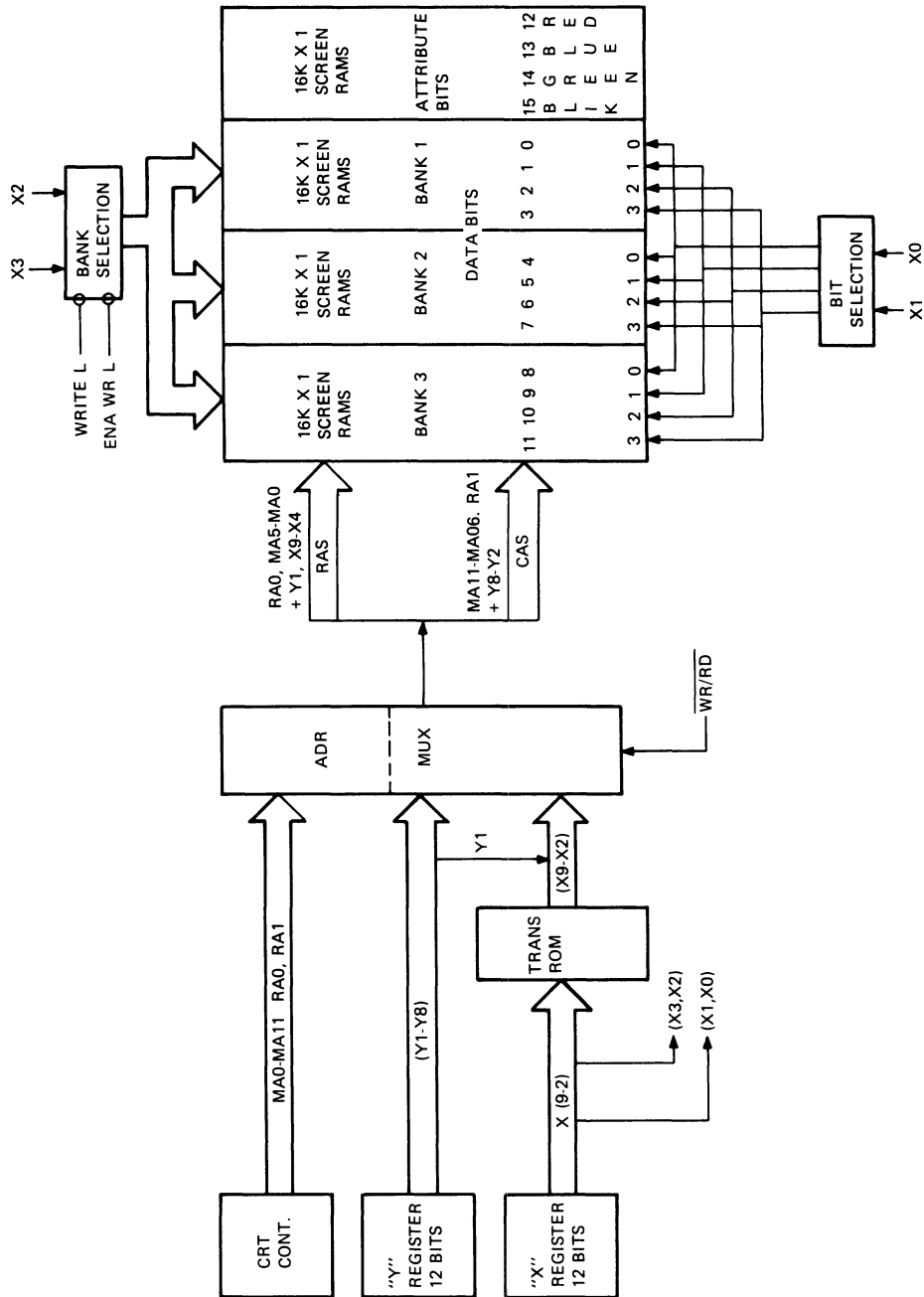
Figure 5-16 Addressing the Screen RAM

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5.2.2.2  Modification of Data in the Screen RAM -- The system sets
up registers in the vector generator to place a character or
vector on the screen. These registers control how the data is
written into the screen RAM. The registers are as follows.

      Pattern register
      Pattern multiplier register
      Write options (WOPS) register

These registers, and the bit selected for update, control how the
data is modified.

The CPU decodes the following write commands and then loads the
commands into the pattern, pattern multiplier and the WOPS
register.

      Write Pattern
      Write Multiplier
      Write Negate
      Write Complement
      Write Intensity

The CPU loads the pattern register with the pattern to be written
into the screen RAM.

The contents of the pattern multiplier register (2's complement of
the value) indicates how many times the pattern register output is
used before allowing the pattern register to be shifted. The
default value of the pattern multiplier is one. If the default
value is loaded into the pattern multiplier, the pattern register
output is used once before shifting. If the pattern multiplier is
two the pattern register output is used twice before shifting.

The CPU loads the Write Negate, Complement and Intensity commands
into the WOPS register.

The CPU loads the x and y registers with an address to modify data
in the screen RAM. This address accesses a location in the screen
RAM. The twelve bits of data are read and bits X3 and X2 select
four of the twelve bits. This is called bank selection. Bits X1
and X0 select which of the four bits is to be modified (bit
selection) (Figure 5-17). At this time the contents of the pattern
register and WOPS determine how the selected data bit will be
modified (Figure 5-18).

The following example shows how the selected bit is modified for a
complement function.

GIVEN:
      The output of screen RAM -- selected bank = 0010 binary
      The output of WOPS register - bits 2--0 = 100 binary
      The output of the pattern register = output bit = 1 binary

TRANSLATOR INPUT (9-2)

TRANSLATOR OUTPUT BITS

| | | 11 10 9 8 7 6 5 4 3 2 1 0 | | | | 11 10 9 8 7 6 5 4 3 2 | 1 0 |
|---|---|---|---|---|---|---|---|
| (000) | TA200 | 1 0 0 0 0 0 0 0 0 0 | | AA | 1 0 1 0 1 0 1 0 | 0 0 | |
| (001) | TA200 | 1 0 0 0 0 0 0 0 1 1 | | AA | 1 0 1 0 1 0 1 0 | 0 1 | |
| (002) | TA200 | 1 0 0 0 0 0 0 1 0 0 | "X" | AA | 1 0 1 0 1 0 1 0 | 1 0 | |
| (003) | TA200 | 1 0 0 0 0 0 0 1 1 1 | | AA | 1 0 1 0 1 0 1 0 | 1 1 | |
| (004) | TA201 | 1 0 0 0 0 0 1 0 0 0 | | AC | 1 0 1 0 1 1 0 0 | 0 0 | |
| (005) | TA201 | 1 0 0 0 0 0 1 0 1 1 | TRASLATOR ROM | AC | 1 0 1 0 1 1 0 0 | 0 1 | |
| (006) | TA201 | 1 0 0 0 0 0 1 1 0 0 | INPUT | AC | 1 0 1 0 1 1 0 0 | 1 0 | |
| (007) | TA201 | 1 0 0 0 0 0 1 1 1 1 | X9-X2 | AC | 1 0 1 0 1 1 0 0 | 1 1 | |
| (010) | TA202 | 1 0 0 0 0 0 1 0 0 0 | | AD | 1 0 1 0 1 1 0 1 | 0 0 | |
| (011) | TA202 | 1 0 0 0 0 0 1 0 0 1 | | AD | 1 0 1 0 1 1 0 1 | 0 1 | |
| (012) | TA202 | 1 0 0 0 0 0 1 0 1 0 | | AD | 1 0 1 0 1 1 0 1 | 1 0 | |
| (013) | TA202 | 1 0 0 0 0 0 1 0 1 1 | | AD | 1 0 1 0 1 1 0 1 | 1 1 | |
| (014) | TA203 | 1 0 0 0 0 0 1 1 0 0 | OUTPUT | AE | 1 0 1 0 1 1 1 0 | 0 0 | |
| (015) | TA203 | 1 0 0 0 0 0 1 1 0 1 | | AE | 1 0 1 0 1 1 1 0 | 0 1 | |
| (016) | TA203 | 1 0 0 0 0 0 1 1 1 0 | | AE | 1 0 1 0 1 1 1 0 | 1 0 | |
| (017) | TA203 | 1 0 0 0 0 0 1 1 1 1 | | AE | 1 0 1 0 1 1 1 0 | 1 1 | |

COLUMN

SELECTS 1 OF 3 BANKS

ROW

| Y8 | Y7 | Y6 | Y5 | Y4 | Y3 | Y2 | | Y1 | X9' | X8' | X7' | X6' | X5' | X4' | X3' | X2' | X1 | X0 |

CHARACTER ROW NUMBER

EQUIVALENT OF WHAT CHARACTER. ROW SCAN (1 OF 4)

WHAT GROUP OF 64 PIXILS

SELECTS WHICH OF 4 SCREEN RAM BITS ARE TO BE MODIFIED.

YO-ODD
   EVEN

(X1000)=TRANSLATION ADR (TA)200

X' MEANS ADDRESS BITS X9-X2 ARE TRANSLATED

MA-8197

Figure 5-17 Translation of X Bits
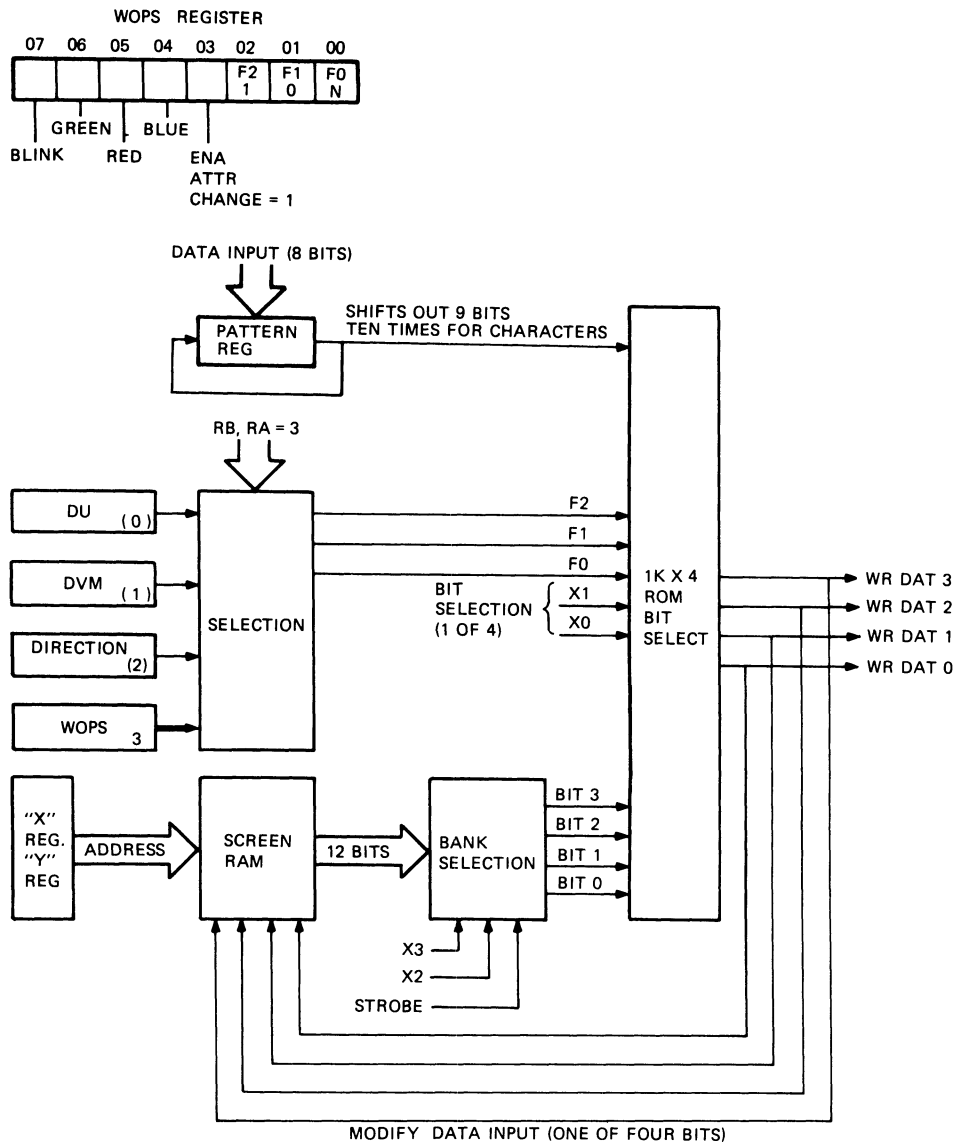
Figure 5-18 Modify Data Bits

The output of the WOPS register equals 4 binary, a complement with no negate function. Refer to the complement equation in Table 5-7.

        Complement M = A + (P + N)
        Complement = 0010 + (1 + 0)        (0010 is selected bank)
        Complement = 1 + 1                 (1 is selected bit)
        Complement = 0

The complement bit zero is written into the selected bank of the screen RAM. Initially, the value of the selected bank was 0010 binary. After modification the value changes to 0000 binary.

5.2.2.3 Refresh the CRT -- The display area of the video monitor contains 240 scan lines (horizontal sweeps) with each sweep having 768 picture elements called pixels. A pixel is the smallest picture element that can display data. The display area contains a total of 184,320 pixels. The color of the characters or vectors represents foreground information. The color of the screen represents background information.

The characters, vectors and screen can be different shades of black and white or color. Two separate control circuits are used for CRT color control.

    1.   Foreground control
    2.   Background control

Table 5-7 Screen RAM Write Control

WOPS BITS
2 1 0

| F2 | F1 | F0 | Function | Equation |
|----|----|----|----------|----------|
| O | O | N | Overlay | M=A+(P+N) |
| O | I | N | Replace | M=P+N |
| I | O | N | Complement | M=A+(P+N) |
| I | I | N | Erase | M=N |

Legend for Equations
M = Data to be written into memory
A = Data now in memory
P = Output of pattern register
N = Negate bit
T = OR
+ = XOR

Foreground Control -- The CPU loads the WOPS register with a value that defines the color of the character or vector. The output of the WOPS register bits F7 (blink), F6 (green), F5 (red), and F4 (blue) are inputs to the screen RAM attribute section. Every time the screen RAM is modified, the contents of bits F7--F4 if enabled are written into the screen RAM attribute section.

When the screen RAM is addressed, sixteen bits are read from memory. Twelve bits of data are loaded into the shift register and the four attribute bits are loaded into the S163 latch (Figure 5-19). The data output of the shift register is exclusively ORed with bit 0 of the screen option register (SOPS).

The exclusive OR selects the foreground or background colors. When the video control bit is zero (normal video) and the shifted data bit is a one, the attribute bits from the latch determine the video data color (foreground).
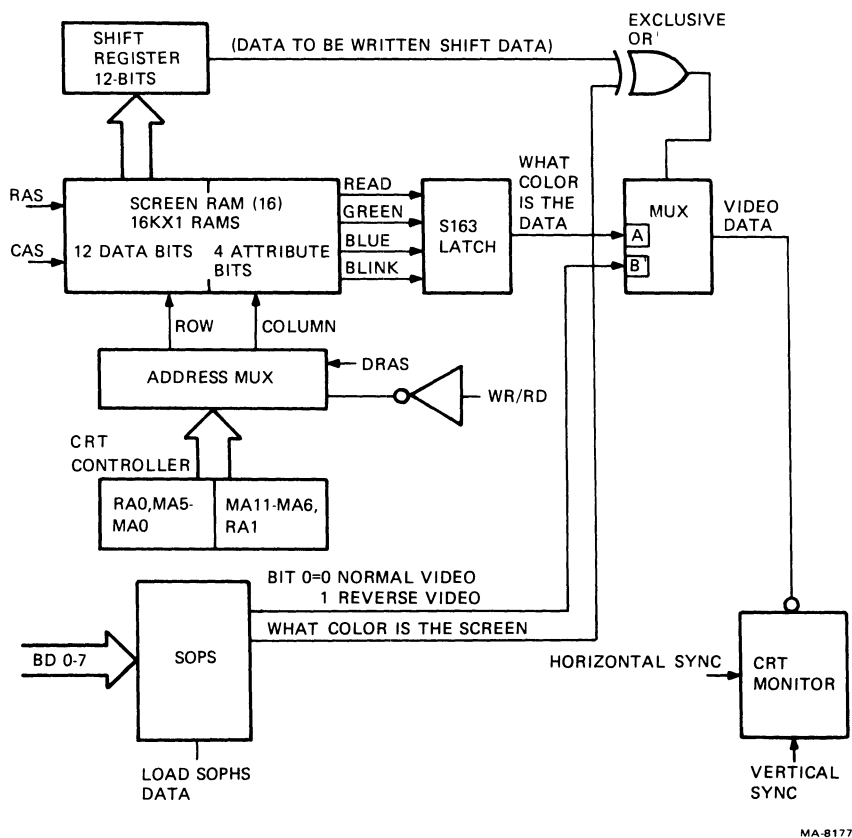


Figure 5-19 Color Control

When the output of the shift register is zero and the video
control bit is zero (normal video), the attribute bits from the
SOPS register determine the video data color (background).

When the SOPS register bit is a one (reverse video), the SOPS
register attribute bits are used for the foreground color and the
latch attribute bits are used for the background color.

Background Control -- The ReGIS screen command, through the CPU,
loads the SOPS register with a value that determines the
background color. The SOPS register holds the background attribute
bits. The SOPS register attribute bits are; bit 6 (green), bit 5
(blue), and bit 4 (red). These bits are inputs to the multiplexer
that in a normal video condition furnishes the background color.
The background color is displayed when the output of the shift
register is zero and bit 0 of the SOPS register is 0.

5.2.2.4 Modify Screen RAM and CRT Refresh Timing -- The sync ROM
in the vector generator runs continuously. Figure 5-20 shows the
sync ROM addresses which are a function of the Time State
Generator (Figure 5-21) and other bits. Twelve addresses are used
before repeating the sequence again. The WRT/RD signal controls
the screen RAM address multiplexer. If the WRT/RD signal is low,
the address from the mA sequential counter passes through the
screen RAM address multiplexer.

If the WRT/RD signal is high, the address from the x and y
register passes through the screen RAM address multiplexer.

The WRT/RD signal changes levels every third sync ROM address. For
every WRT/RD time frame a RAS and CAS signal are generated.
Depending on the sync ROM address, a load shift register or strobe
pulse occurs (Figure 5-19). Strobe pulse loads the four-bit
holding register with data from memory (X3, X2). The following
sequence of events occur.

    1.    Data is loaded into the shift register.

    2.    While the data is shifted is out, the x,y address reads
        the data to be modified. In another read cycle, X3 and X2
        selects the data to be modified and strobes the fours
        bits into the holding register. Only one bit is modified.

    3.    While the data is shifted to the CRT, another RAS, CAS,
        LOAD function is performed. At the proper time another
        twelve bits are loaded in the shift register and shifted
        to the CRT.

    4.    During the continuous shifting of data from the shift
        register to the CRT, the modified data is written into
        the screen RAM. The screen RAM data is modified by the
        execute point, erace and the execute vector commands.
        During sync ROM address 32, the execute vector command
        turns on the vector ROM. This activates the write signal.
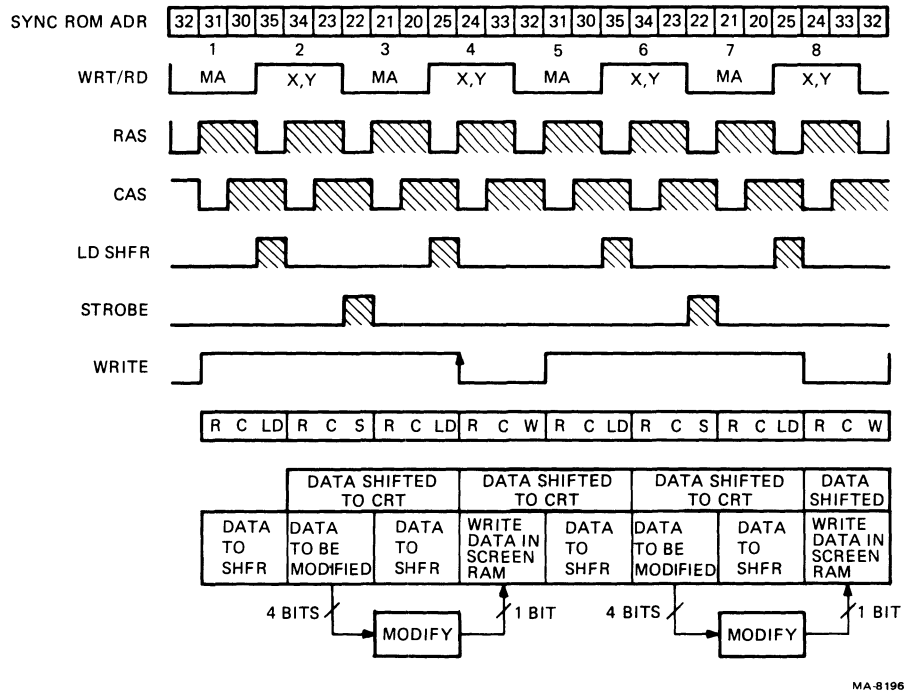
Figure 5-20 Screen RAM Data Timing
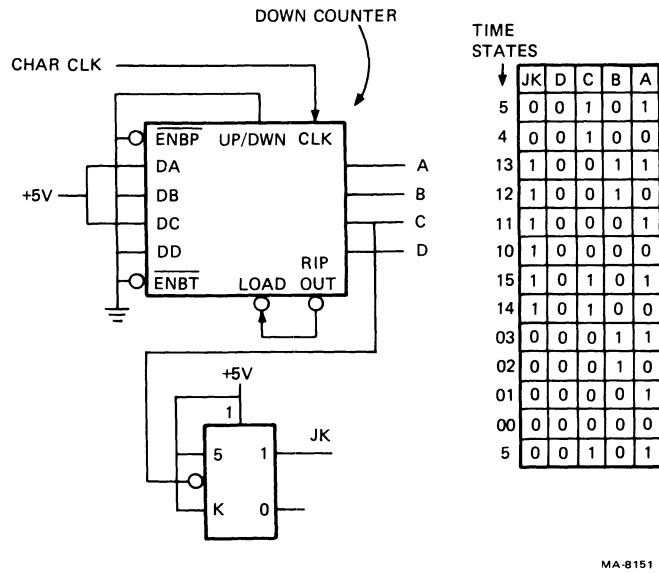


Figure 5-21 Time State Generator

5.2.2.5 Generation of Vectors -- The VK100 system can draw both characters and vectors. Section 5.2.2.5 describes characters. The following paragraphs describe vectors. There are two kinds of vectors.

1.    Basic vectors
2.    Arbitrary vectors

Basic vectors fall under the following conditions:

1.    If coordinates X=0 and/or Y=0
2.    If the absolute value of x = absolute value of y [X]=[Y]

There are eight basic directions for vectors (Figure 5-22). All other conditions are arbitrary vectors.

The terminal operator can type a character and rotate it in any of the basic directions (Figure 5-22). For example the operator types in:

"FORMAT" TEXT (DIRECTION) "Character to Print"
"EXAMPLE" T(D45) "A"

NOTE
The above must be in ReGIS command mode
to work.

The T(D45) command displays the A character along the one basic direction, or 45` direction. This character is a basic vector.
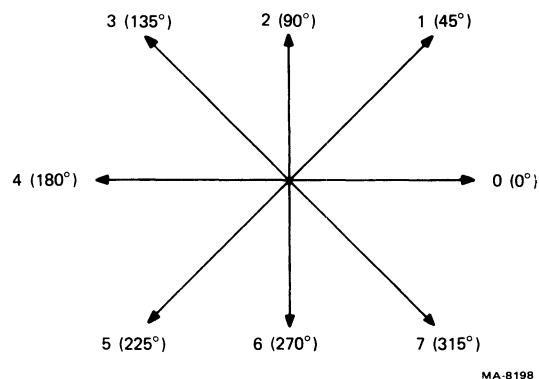


Figure 5-22 Basic Vectors

The CPU has to set up registers in the vector generator to display characters or vectors on the CRT. The following are the registers that are loaded.

    X and Y
    DU-Length of major axis
    DVM-Length of minor axis
    Pattern
    Pattern multiplier
    Direction
    Write options (WOPS)
    Screen options (SOPS)
    Execute vector
    Error register (only used with arbitrary vectors)

The function of these registers follows.

X and Y -- These registers are loaded with the starting address of the character or vector. The X and Y register contents address the screen RAM when modifying data. The address control increments or decrements the x and Y individually or both at the same time.

The X coordinate is X0 through X767. If the direction of the character or vector is ROM coordinate X0 through X767, X is positive. If the direction is from X767 to X0, X is negative.

The Y coordinate is Y0 through Y240. If the direction of the character or vector is from coordinate Y0 to Y240, Y is positive. If the direction is Y240 to Y0, Y is negative.

If both X and Y = 0 during a screen RAM modify, the CRT displays the data in the top left corner of the screen. This corner is the first pixel of the CRT during display time.

DU -- The length of the major axis is loaded into this register. For character displays, the width of a character is loaded into the DU.

For vectors, the firmware knows the vector starting point and how far the vector moves in the X and Y position. The larger of the two values is placed in the DU register.

DVM -- The length of the minor axis is loaded into this register. For character displays, the width of a character is loaded into the DVM.

For vectors, the DVM receives the smaller of the X and Y values.

Pattern -- The pattern register is an eight-bit shift register that is parallel loaded and shifted out one bit at a time to a 1K by 4 PROM. This register controls the pattern of the data written into the screen RAM.

If the pattern = 1, a modify function is performed. If the pattern = 0, the pass data is modified. This does not apply in replace mode.

Pattern Multiplier -- The contents of this four bit register can increase the width of a character or vector by a factor of one to sixteen. If the pattern multiplier register is loaded with all binary ones, the pattern register shifts every write time. If the pattern multiplier is loaded with 1110 binary, the pattern register shifts every two write times.

Direction -- The direction register is an eight bit register. Only four bits are used. Bits 0--2 tell the vector direction and bit 3 tells if the vector is a basic or arbitrary vector. If bit 3 equals zero, the vector is a basic vector. If bit 3 equals one, the vector is an arbitrary vector.

Write Options (WOPS) -- WOPS is an eight-bit register. Bit 7 is blink control. Bits 6--4 tells the color of data (12 pixels) when in normal video mode. Bit 3 (equal to a one) enables attributes. Enable attributes is an address bit to the WRT ROM. This allows the contents of WOPS register bits 7--4 to be written into the screen RAM.

Bits 1 and 2 describe how the data being modified is controlled; If it is overlayed, replaced, complemented or erased. Bit 0, the negate bit, controls the output of the pattern register. If bit 0 equals a one, the pattern register output is complemented.

Screen Options (SOPS) -- The SOPS register is an eight-bit register which controls the following three functions.

1. Blink
2. Background color
3. I/O port control (EIA, 20 mA, hardcopy and self-test)

LD Execute -- The execute instructions set the Go flip flop (GO$_{FF}$) which enables the vector ROM to run. This is necessary for writing the modified data in the screen RAM and reading the file register contents (DU, DVM, DIR, and WOPS).

5.2.2.6 Writing a Character on the Screen -- Writing a character on the CRT is the same as writing a vector. The main difference is that a character is a series of parallel vectors. When you press a key the following events occur:

1. At the next occurrence of VSYNC the CPU recognizes the keyboard interrupt.

2. In response to the interrupt, the CPU enters the keyboard scan routine, reads the keyboard and determines which key was pressed. The processor then translates the key location code into an ASCII code and stores it in the keyboard line.

3.  The processor reads the ASCII character in the keyboard line to determine what character to place on the CRT.

4.  The processor translates the ASCII character code into a dot pattern. To do this, the processor reads a character look-up table located in RAM. The look-up table consists of a series of character cells, one cell for each ASCII code. Each character cell contains 10 patterns to be written as vectors on the screen. These pattern vectors compose the character on the CRT screen.

NOTE
The look-up table is filled with the dot patterns for each displayable character during the ROM power-up sequence. The look-up table can also be filled from the host computer using the Load Character Cell command in the graphics mode.

There are 10 pattern vectors for each character. To write a character into the screen RAM, the DU, DVM, WOPS, and direction registers are initially loaded. The following sequence of events must occur 10 times.

1.  The X and Y registers are loaded. The pattern of the character is loaded into the 8-bit pattern shift register.

2.  The CPU issues the Execute Vector command. The Execute Vector command sets the GO bit enabling the vector ROM to output. The address for Execute vector is 66. This means address bits A1 and A0 are equal to a binary two. These address bits, A1 and A0, are part of the vector ROM address bits which allows the vector ROM sequence for the Execute Vector command.

3.  It takes three cycles (or nine time states) to modify the data in the screen RAM.

    a.  Read cycle -- The X and Y register contents read a location of the screen RAM. The twelve bits of data that are read from the screen RAM go to the bank select logic. Bits X3 and X2 select which four bits will be strobed into the holding register.

    b.  Modify cycle -- The logic uses the pattern output WOPS, X and holding register to determine which bit will be modified by addressing a 1K by 4 ROM. The address of the 1K by 4 ROM is determined by the following.

```
                    Pattern register output bit -- (A9)
                    WOPS register output bits (F2,F1,F0) -- (A8--A6)
                    X register output bit (X1,X0) -- (A5--A4)
                    Holding register output bits (3,2,1,0) -- (A3--A0)
```

      c.   Write cycle -- When the write pulse occurs the output of the bit select ROM (WR DAT 3--WR DAT 0) is written into the same bank in the screen RAM.

4.   The down counter whose value is initially nine bits gets decremented every time a write takes place. The logic checks to see if the down counter equals zero. This indicates a pattern or vector has been stored in the screen RAM.

5.   The X register is incremented or decremented according to the contents of the direction register.

6.   If the down counter is not equal to zero, steps three through five are repeated.

      If the down counter is equal to zero a pattern (vector) with nine bits is stored in the screen RAM. This resets the Go flip-flop and disables the vector ROM outputs.

Steps one through six are performed for each pattern. The character appears on the CRT after the ten patterns are written into the screen RAM and those locations addressed by the CRT Controller (CRR).

5.2.2.7 Arbitrary Vectors -- The vector generator produces basic and arbitrary vectors in the VK100 system. The basic vectors are shown in Figure 5-23. There are eight basic vector directions $45^{\circ}$ apart. Vectors drawn in between the eight basic vectors are called arbitrary vectors.

The Breshinham algorithm is a series of calculations (Appendix B) that allows an arbitrary vector to light a pixel close to the ideal vector path. A staircase effect takes place when arbitrary vectors are drawn. This staircase effect can be seen by looking closely at the screen when it is displaying arbitrary vectors.

A calculation requires twelve time states (Figure 5-24). These twelve time states are divided into four groups. The four groups are repeated until the vector is drawn. The four sequential groups are:

    1.   DVM time (length of minor access)
    2.   DU time (length of major access)
    3.   WOPS time
    4.   Direction time

VECTOR ROM ADDRESS: 34 | 33 | 22 | 21 | 20 | 25 | 24 | 33 | 32 | 31 | 30 | 35 — TWELVE TIME STATES

34 | 35 | 34 | 33 | 22 | 21 | 20 | 25 | 24 | 33 | 32 | 31 | 30 | 35 — TWELVE TIME STATES

OUTPUT OF FILE REGISTER: DVM | DU | WOPS | DIRECTION | DVM | DU | WOPS | DIRECTION

CO (VECTOR ROM)

CALCULATION ER+DVM→(ER) | CALCULATION BR+DU→ER | MODIFY SCREEN RDM | EFFECT X ARRAY MAJOR & MINOR AXIS | CALCULATION ER + DVM + 1→ER | CALCULATION ER+DU→ER | MODIFY SCREEN RAM | EFFECT X ARRAY MAJOR AXIS

LD ERROR

STROBE L

CARRY (1) H

PIXEL WRT

WRT L

V CLK

CLKS X & Y REGISTER CLKS DOWNCOUNTER

CLK MAJOR AXIS

MA-8331

Figure 5-23 Arbitrary Vector Timing

5-38
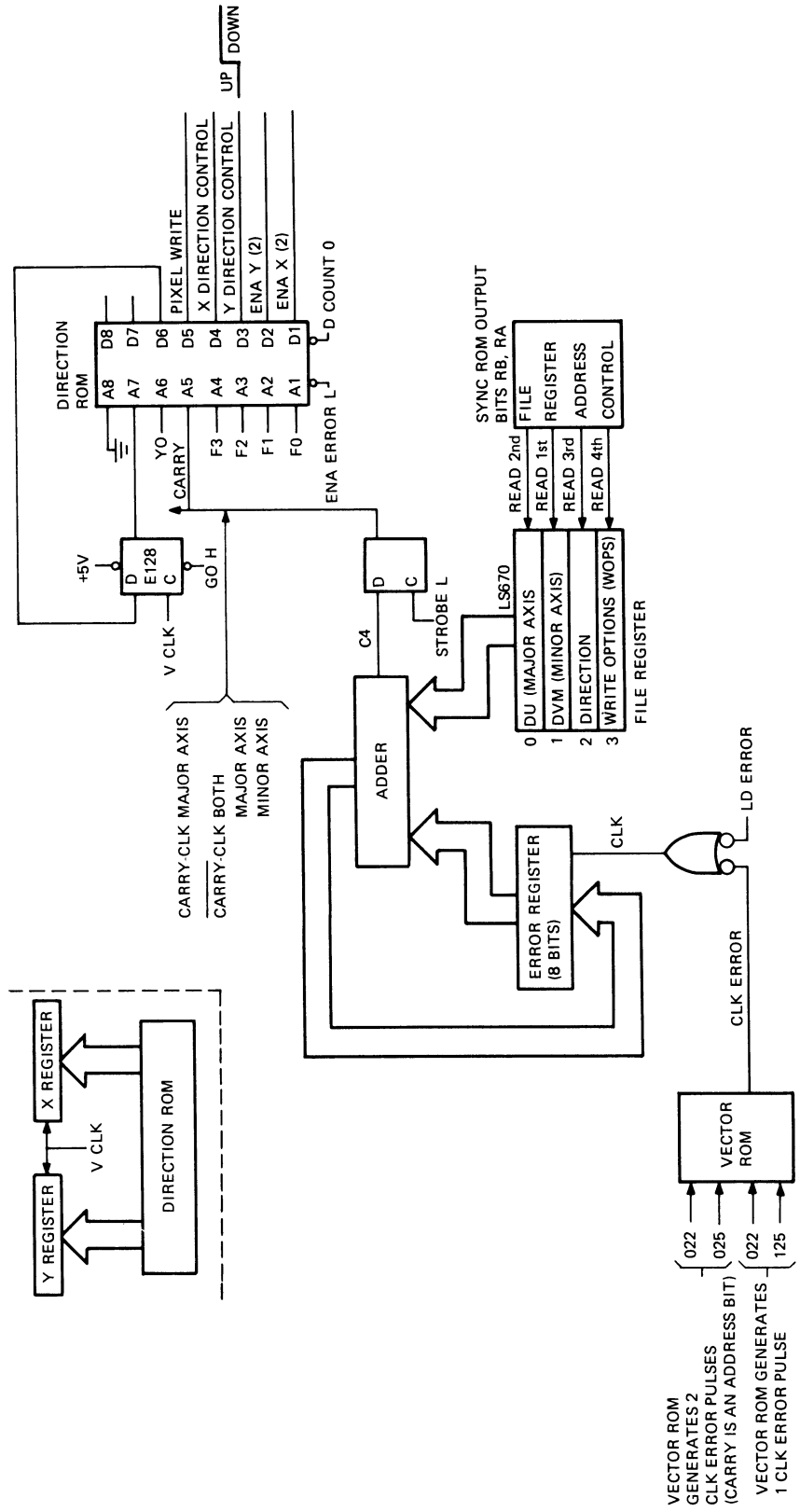
Figure 5-24 Carry Control

When writing a vector, the firmware loads the following registers:

DVM -- with the length of the minor access. For an example use the value of 3 (Appendix B).

DU -- with the length of the major access. For an example use the value of 5 (Appendix B).

Error Rec -- is loaded with a value that the firmware obtains by dividing 2 into the largest value. For an example the value 5 divided by 2 equals 2 with a remainder of 1 (Appendix B).

The following are the functions that occur in each group.

DVM Time -- The error register is added to the DVM register plus carry in. The error clock loads the sum into the error. The carry output of the add is strobed into the carry flip-flop.

DU Time -- The contents of the error register are added to the DU register. If the carry flip-flop is reset, the vector ROM allows an error clock pulse which loads the result of the add into the error register. If the carry flip-flop is set, the vector ROM does not allow an error clock pulse to occur. The contents of the error register remain unchanged.

WOPS Time -- The modified data bits are selected and written into the screen RAM location specified by the X and Y registers.

Direction Time -- The outputs of the direction register, bits F3--F0, are inputs to the direction ROM (Figure 5-25). An arbitrary vector is drawn in direction three when the input bits of the direction ROM equal "B" hex. The carry bit equal to a one indicates that the major axis register is only affected. The direction affected is determined by the direction ROM input bits F0--F2. Direction three is a negative direction. Therefore, the major access register decrements.

If the carry bit equals zero, the major and minor axis registers are effected. The direction effected is determined by the ROM input bits F0--F2. Direction three is a negative direction. Both the major and minor axis registers are decremented.

The vector sequence terminates when the V clock signal clocks the downcounter to zero. This resets the Go flip-flop.

The direction ROM produces the signal pixel write. The pixel write must be active to write data into the screen RAM. There are three conditions that prevent a write operation from occurring.

1. Do not write in direction: 2 from an odd line.
6 from an even line.

2. Do not write if the direction is 5 or 7. The scan line is even (Y0) and the last direction was 6.

3. Do not write if the direction is 1 or 3. The scan line is odd and the last direction was 2.
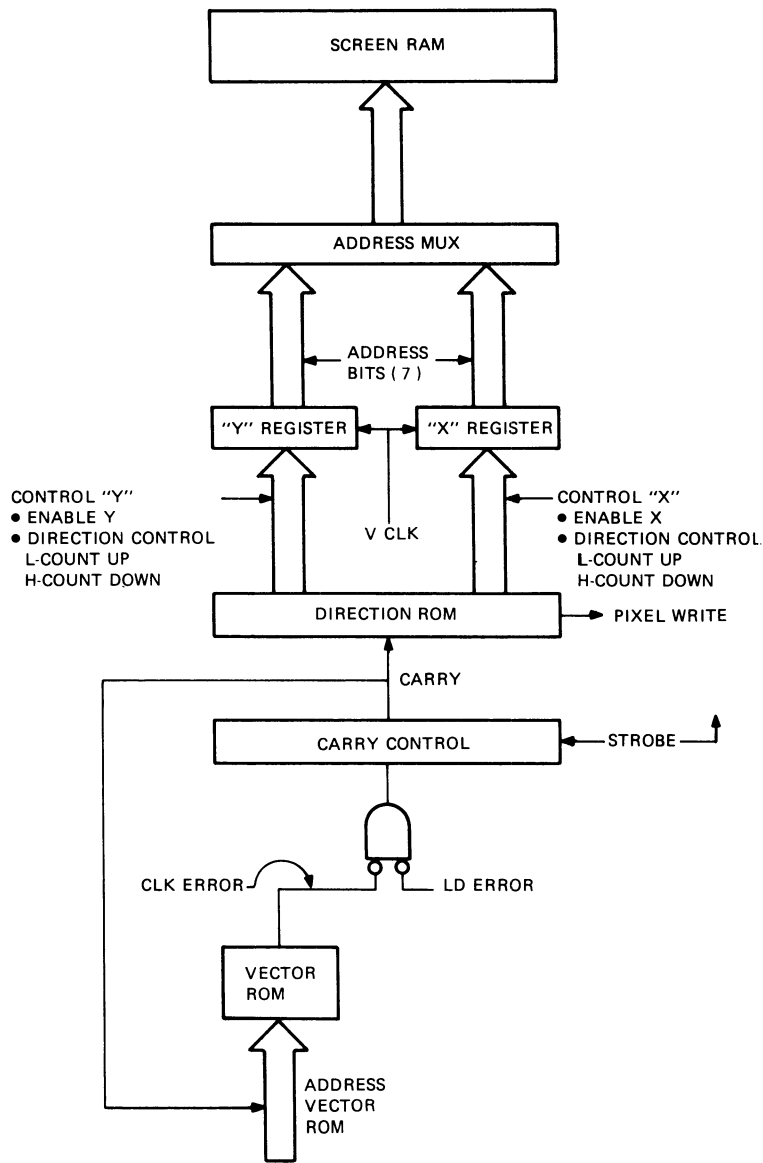


Figure 5-25 Direction Control

## 5.2.3    I/O Port Overview

The VK100 interfaces to the host system through a serial data port. An 8251 programmable universal synchronous or asynchronous receiver-transmitter drives the port. This device translates between parallel and serial character formats. The 8251 adds or removes start and stops bits as needed. The data used are ASCII characters. Character parity may be enabled or disabled. The parity bit, if selected, takes the most significant bit position. The VK100 I/O system can connect the three CPU ports.

EIA
20 mA
Hardcopy

Figure 5-26 shows the Basic I/O Port block diagram.

The communication interface (8251A) is the main control of the I/O section. The baud rate generator allows firmware control of the baud rates to transfer data through the 8251A module.

The I/O port selection logic is controlled by the SL1 and SL0 bits of the screen option register (SOPS). Different combinations of SL1 and SL0 select the desired port or the self-test feature.

The self-test diagnostic feature is firmware controlled. A known value is sent to the I/O interface. The value goes through the 8251A chip as serial transmit data, to the I/O port selection (self-test). Then the data is serially routed to the RXD input of the 8251A chip. The chip assembles a data byte and sends the byte in parallel form to the CPU. The CPU compares the transmitted value to the received value.
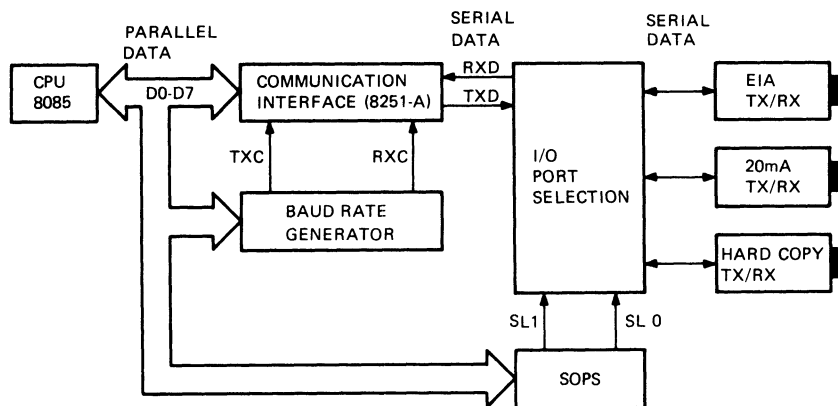
Figure 5-26 Basic I/O Port Block Diagram

5.2.3.1 Communication Interface (8251A) -- This interface (Figure 5-27) performs the following three functions.

 Modem Control
 Data Control
 Error Reporting

**Mode Instruction Register** -- After an internal reset, the CPU loads the mode instruction register. Then any control register writes will load the data into the command instruction register. To return the 8251A from command to mode instruction, the CPU sets the internal reset bit of the command register.

The mode instruction register defines the general operating characteristics of the 8251A (Figure 5-28). The following paragraphs describe these characteristics.

 Baud rate factor
 Character length
 Number of stop bits
 Parity control

**The Baud Rate Factor (X16)** -- The baud rate selected is times 16 (X16) because the TCLK and RCLK frequencies are 16 times the selected baud rates. To obtain the selected baud rate, divide the TCLK and RCLK frequencies by 16.

**Character Length** -- The length of a character transmission may be 5, 6, 7 or 8 bits. The unused bits are zeros **(Figure 5-29)**.

**Number of Stop Bits (1, 1-1/2, 2)** -- If the baud rate is 310 or above, the CPU selects one stop bit. If the baud rate is under 310, the CPU selects two stop bits.

**Parity Enable** -- When set this bit enables parity generation and parity detection.

**Parity Generation Bit** -- When set this bit generates even parity for data transmission. Even parity means the character bits plus the parity bit have an even number of one bits. After receiving a data character the 8251A parity check logic counts the number of one bits in the character plus the parity bit. An odd number of one bits raises the parity error flag.

When clear this bit generates odd parity for data transmission. Odd parity means the character bits plus the parity bit have an odd number of one bits. After receiving a data character, the 8251A parity check logic counts the number of one bits in the character plus the parity bit. An odd number of one bits raises the parity error flag.

DATA BUS BUFFER

$D_7$-$D_0$

TRANSMIT BUFFER (P-S)

TxD

RESET
CLK
C/$\overline{D}$
$\overline{RD}$
$\overline{WR}$

READ/WRITE CONTROL LOGIC

$\overline{CS}$

TRANSMIT CONTROL

TxRDY
TxE
$\overline{TxC}$

$\overline{DSR}$
$\overline{DTR}$
$\overline{CTS}$
$\overline{RTS}$

MODEM CONTROL

RECEIVE BUFFER (S-P)

RxD

INTERNAL DATA BUS

RECEIVE CONTROL

RxRDY
$\overline{RxC}$
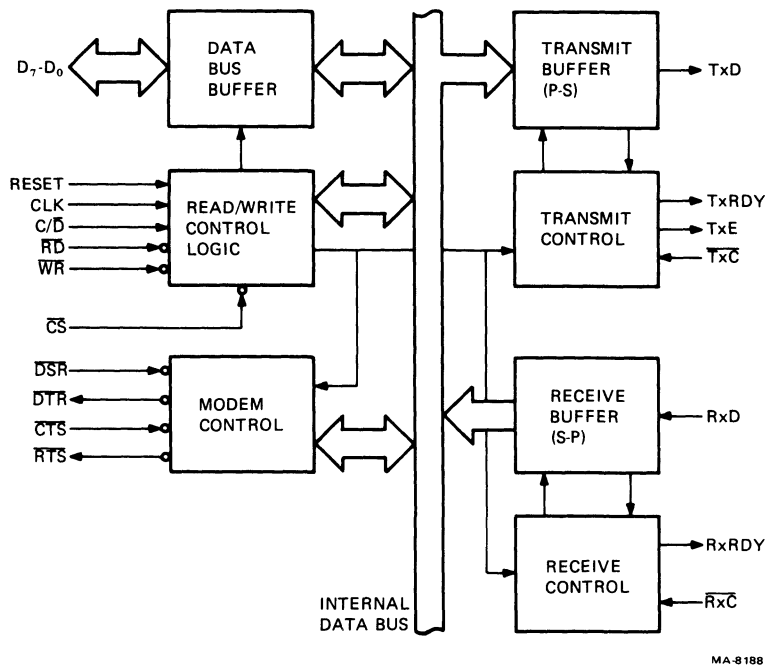
MA-8188

Figure 5-27 8251-A Block Diagram

MODE INSTRUCTION FORMAT
ASYNCHRONOUS MODE

| $D_7$ | $D_6$ | $D_5$ | $D_4$ | $D_3$ | $D_2$ | $D_1$ | $D_0$ |
|-------|-------|-------|-------|-------|-------|-------|-------|
| $S_2$ | $S_1$ | EP | PEN | $L_2$ | $L_1$ | $B_2$ | $B_1$ |

BAUD RATE FACTOR

| 0 | 1 | 0 | 1 |
|---|---|---|---|
| 0 | 0 | 1 | 1 |
| SYNC MODE | (1X) | (16X) | (64X) |

CHARACTER LENGTH

| 0 | 1 | 0 | 1 |
|---|---|---|---|
| 0 | 0 | 1 | 1 |
| 5 BITS | 6 BITS | 7 BITS | 8 BITS |

PARITY ENABLE
1=ENABLE   0=DISABLE

EVEN PARITY GENERATION
1=EVEN   0=ODD

NUMBER OF STOP BITS

| 0 | 1 | 0 | 1 |
|---|---|---|---|
| 0 | 0 | 1 | 1 |
| INVALID | 1 BIT | 1½ BITS | 2 BITS |
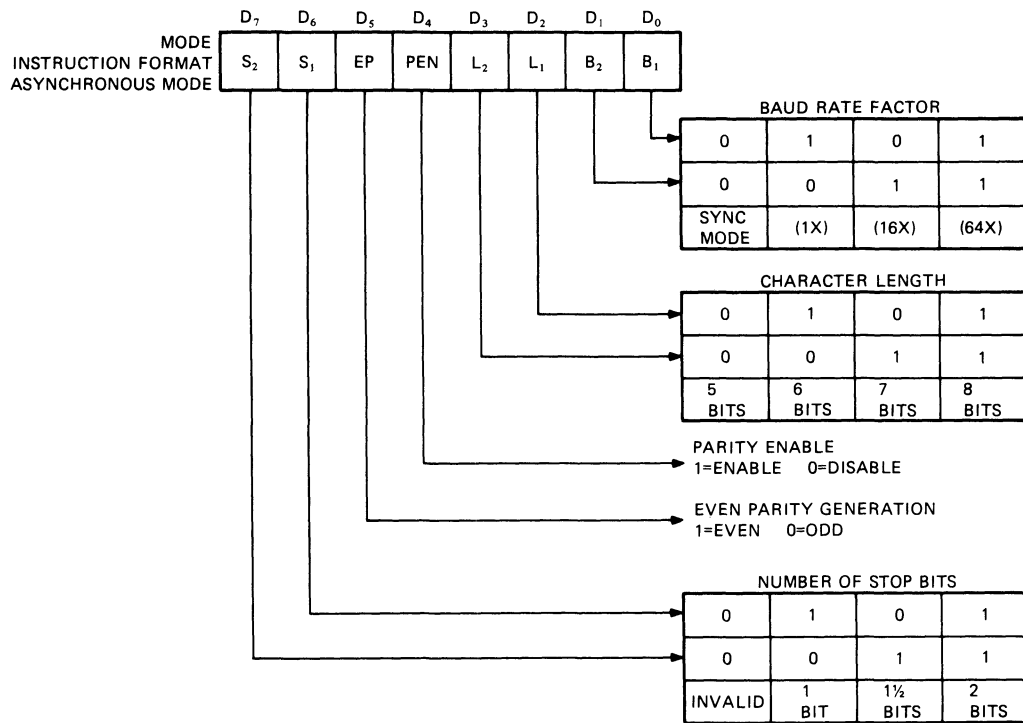
MA-8187

Figure 5-28 Mode Register
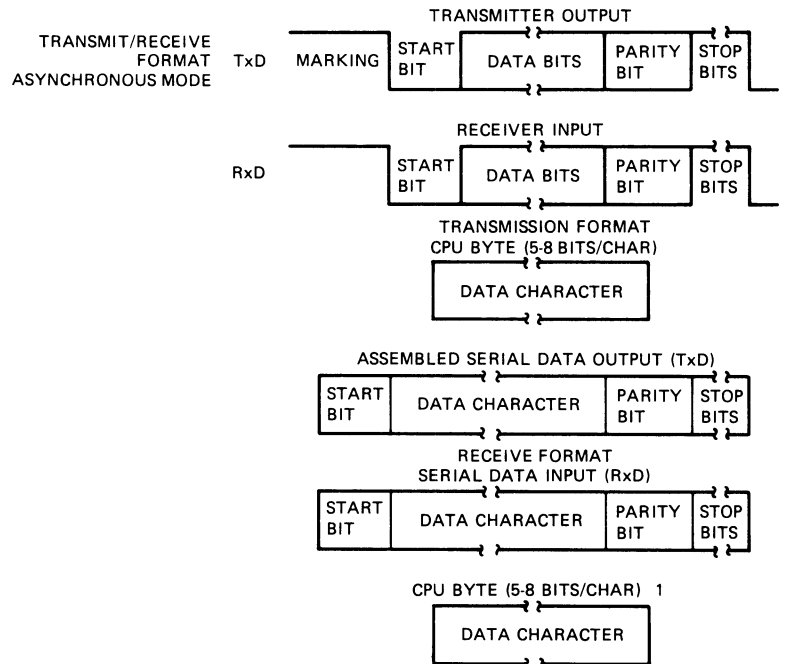
5-44

Figure 5-29 Transmit/Receive Format
Asynchronous Mode

Command Instruction Register (Figure 5-30) -- The command instruction register defines the controls used in the operation of the 8251A. The following are the signals that control this operation.

     Transmit Enable
     Receive Enable
     Data Terminal Ready
     Request to Send
     Error Reset
     Internal Reset
     Send Break Character
     Enter Hunt Mode

Transmit Enable -- When the CPU sets this bit the 8251A can transmit data. Resetting this bit inhibits data transmission.

Receive Enable -- When the CPU sets this bit the 8251A can receive data. Resetting this bit prevents data reception.

The Transmit Enable and Receive Enable are both set in the VK100 system. This allows the 8251A to operate in full duplex mode.

Data Terminal Ready (DTR) -- The CPU sets this bit for loopback test.

Request to Send -- The request to send signal is normally used for modem control.

Error Reset -- When the CPU sets this bit all error flags are reset. Parity Error (PE), Overrun Error (OE), and Framing Error (FE) are reset in the status register.

Internal Reset -- When set this bit returns the 8251A from Command instruction to Mode instruction.

Send Break Character -- When set this bit forces TxD to a low.

Enter Hunt Mode -- This bit is a zero. The VK100 system does not use the Hunt mode.

COMMAND INSTRUCTION FORMAT

| D$_7$ | D$_6$ | D$_5$ | D$_4$ | D$_3$ | D$_2$ | D$_1$ | D$_0$ |
|-----|-----|-----|-----|------|-----|-----|------|
| EH | IR | RTS | ER | SBRK | RxE | DTR | TxEN |

μPD

TRANSMIT ENABLE
1=ENABLE
0=DISABLE

DATA TERMINAL
READY
"HIGH" WILL FORCE $\overline{DTR}$
OUTPUT TO ZERO

RECEIVE ENABLE
1=ENABLE
0=DISABLE

SEND BREAK
CHARACTER
1=FORCES TxD "LOW"
0=NORMAL OPERATION

ERROR RESET
1=RESET ALL ERROR FLAGS
PE,OE, FE

REQUEST TO SEND
"HIGH" WILL FORCE $\overline{RTS}$
OUTPUT TO ZERO

INTERNAL RESET
"HIGH" RETURNS 8251 TO
MODE INSTRUCTION FORMAT

ENTER HUNT MODE
1=ENABLE SEARCH FOR SYNC
CHARACTERS

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Figure 5-30 Command Instruction Format

Status Register -- Data Communication Systems require the status of the active device. To obtain the status, the CPU reads the status register. The following are the status register bits (Figure 5-31).

Transmitter Ready (TxRDY)
Receiver Ready (RxRDY)
Transmitter Empty (TxE)
Parity Error (PE)
Overrun Error (OE)
Framing Error (FE)
SYNDET
DSR

TxRDY -- This bit signals the CPU that the transmitter is ready to accept a data character. The CPU can use TxRDY for interrupt or polled operations. In polled operations the CPU checks TxRDY using a status read operation. TxRDY automatically resets when the CPU loads a character.

RxRDY -- This bit indicates that the 8251A contains a character ready to input to the CPU. RxRDY connects to the interrupt structure of the CPU or for polled operation. The CPU can check the condition of RxRDY using a status read operation. RxRDY is automatically reset when the CPU reads the character.

TxE -- When the 8251 has no characters to transmit, the TxE output goes high. TxE automatically resets after receiving a character.

The error conditions (PE, OE and FE) are covered in the asynchronous data transfer section.

DSR -- The CPU uses this bit to monitor the hardcopy port. The usage of this bit is covered in the Hardcopy section (Paragraph 5.2.3.3).

Asynchronous Data Transfers -- In the VK100 system there are two modes of data transfers:

1. Data transmissions (TxD)
2. Data receptions (RxD)

Asynchronous Mode Transmissions -- Whenever the CPU sends a character the 8251 does the following.

Adds a start bit (low level)
Adds the required number of stop bits
Adds the correct parity bit if parity is enabled

STATUS READ FORMAT

| D₇ | D₆ | D₅ | D₄ | D₃ | D₂ | D₁ | D₀ |
|---|---|---|---|---|---|---|---|
| DSR | SYN-DET /8D | FE | OE | PE | TxE | Rx RDY | Tx RDY |

1

SAME DEFINITIONS AS I/O PINS

PARITY ERROR
THE PE FLAG IS SET WHEN A PARITY ERROR IS DETECTED. IT IS RESET BY THE ER BIT OF THE COMMAND INSTRUCTION. PE DOES NOT INHIBIT OPERATION OF THE 8251A.

OVERRUN ERROR
THE OE FLAG IS SET WHEN THE CPU DOES NOT READ A CHARACTER BEFORE THE NEXT ONE BECOMES AVAILABLE. IT IS RESET BY THE ER BIT OF THE COMMAND INSTRUCTION. OE DOES NOT INHIBIT OPERATION OF THE 8251A; HOWEVER, THE PREVIOUSLY OVERRUN CHARACTER IS LOST:

FRAMING ERROR (ASYNC ONLY)
THE FE FLAG IS SET WHEN A VALID STOP BIT IS NOT DETECTED AT THE END OF EVERY CHARACTER. IT IS RESET BY THE ER BIT OF THE COMMAND INSTRUCTION. FE DOES NOT INHIBIT THE OPERATION OF THE μPD8251 AND μPD8251A.

NOTE: 1 TxRDY STATUS BIT IS NOT TOTALLY EQUIVALENT TO THE TxRDY OUTPUT PIN, THE RELATIONSHIP IS AS FOLLOWS:

TxRDY STATUS BIT    BUFFER EMPTY
TxRDY (PIN 15)    BUFFER EMPTY •CTS • TxEn

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Figure 5-31 Status Register

The character is then transmitted as a serial data stream on the TxD output (Figure 5-28). The serial data is shifted out on the trailing edge of TxC at a rate equal to 1/16 of the TxC as defined by the Mode Instruction. Break characters can be continuously sent to TxD if commanded to do so. If no data characters are loaded into the 8251A the TxD output remains high (marking) unless a break (continuously low) has been programmed.

Asynchronous Mode Reception -- The RxD line is normally high. When the line goes low this triggers the beginning of the start bit. The validity of the start bit is checked by strobing at the start bits nominal center. If a low is detected at the nominal center a valid start bit has been found. The bit counter then starts counting. The bit counter locates the center of the received bits, parity bits (if it exists) and the stop bits. The stop bits signal the end of a received character. The character is then loaded into the I/O buffer of the 8251A and the logic (RxRDY) signals the CPU that data is available. The 8251A checks each character for errors. There are three types of errors.

    1.   Parity Error
    2.   Framing Error
    3.   Overrun Error

Parity Error -- The rising edge of RxC samples the receive inputs data and parity. If a parity error occurs, the parity error flag is set.

Framing Error -- Occurs if a low level is detected at the stop bit.

Overrun Error -- If a previous character has not been fetched by the CPU, the present character replaces it in the I/O buffer and the overrun flag is raised (the previous character is lost).

The occurrence of any of these errors will not stop the operation of the 8251A.

Table 5-8 shows the addressing of the 8251A.

Table 5-8 Addressing the 8251-A

| Address Bits | | | | Selection and Directive |
|---|---|---|---|---|
| CD | RD | WR | CS | |
| 0 | 0 | 1 | 0 | 8251A > Data Bus |
| 0 | 1 | 0 | 0 | Data Bus > 8251A |
| 1 | 0 | 1 | 0 | Status > Data Bus |
| 1 | 1 | 0 | 0 | Data Bus > Control |
| X | X | X | 1 | |
| X | 1 | 1 | 0 | Data Bus > 3 State |

**5.2.3.2  Baud Rate Generator** -- The baud rate for a VK100 system is controlled by:

> Default set up switch pack (switches S6--S8)
> SET-UP mode (Refer to Chapter 4)
> ReGIS command (Refer to Chapter 4).

On power up, or reset, the firmware uses default set-up switch pack (S6--S8) to load the baud rate generator with a byte value. This value selects the Tx clock and Rx clock frequency. The low four bits of the byte value select the baud rate for the Rx clock pulses and the high four bits select the baud rate of the Tx clock. Both the Tx clock and Rx clock frequencies are 16 times the selected baud rate. If the selected baud rate is 300 bits per second the clock frequencies are 4.8 kHz.

The baud rate generator sends the Tx clock or Rx clock frequency to the 8251A chip which divides the frequency by 16. The result is the device baud rate. Figure 5-32 shows the baud rate generator block diagram.

Table 5-9 shows how the CPU selects one of the eight possible baud rates used for the receive and transmit frequencies.
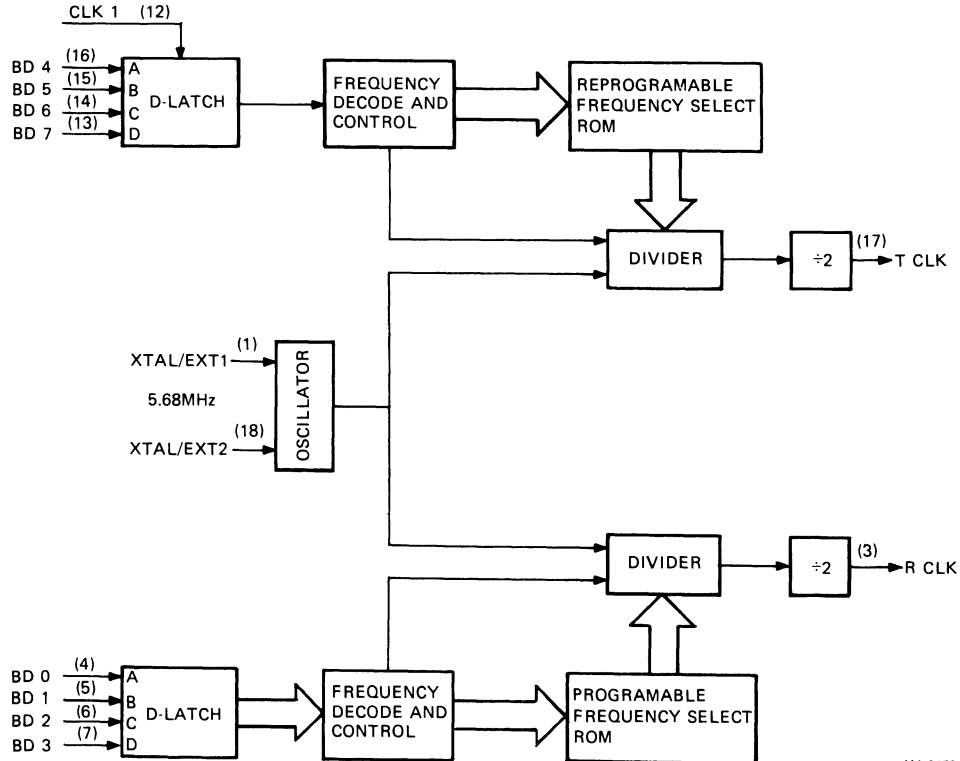


Figure 5-32 Baud Rate Generator

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Table 5-9 Baud Rate Selection Crystal Frequency = 5.0688 M Hertz

| Transmit/Receive Address D C B A | Baud Rate | Theoretical Frequency 16 X CLOCK | Actual Frequency 16 X CLOCK | Divisor |
|---|---|---|---|---|
| 0 0 1 0 | 110 | 1.76 Hz | 1.76 K Hz | 2880 |
| 0 1 0 1 | 300 | 4.8 | 4.8 | 1056 |
| 0 1 1 0 | 600 | 9.6 | 9.6 | 528 |
| 0 1 1 1 | 1200 | 19.2 | 19.2 | 264 |
| 1 0 1 0 | 2400 | 38.4 | 38.4 | 132 |
| 1 1 0 0 | 4800 | 76.8 | 76.8 | 66 |
| 1 1 1 0 | 9600 | 153.6 | 153.6 | 33 |
| 1 1 1 1 | 19,200 | 307.2 | 316.8 | 16 |

5.2.3.3   Selection of I/O Port -- The I/O ports are selected by:

    Default SET-UP switch pack
    SET-UP mode (Refer to Chapter 4)
    ReGIS commands (Refer to Chapter 4).

When a power up or reset operation is performed, the CPU reads the default SET-UP switch pack.  The condition of switch two (S2) determines if the CPU is connected to the 20 mA or EIA port. If S2 is open, the 20 mA port is used. If S2 is closed, the EIA port is used.

When an I/O port is selected the CPU modifies bits SL1 and SL0 of the screen option register (SOPS). The condition of these two bits connect the CPU to the selected port (5-33). Table 5-10 also shows this condition.

5.2.3.4  Transferring Data Through the I/O Port  --  The VK100 system uses the following three ports to connect the CPU to other devices.

    20 mA
    EIA
    Hardcopy

20 mA Port -- The VK100 system has full-duplex capabilities. This includes a transmit and receiver channel (J1).

5-52
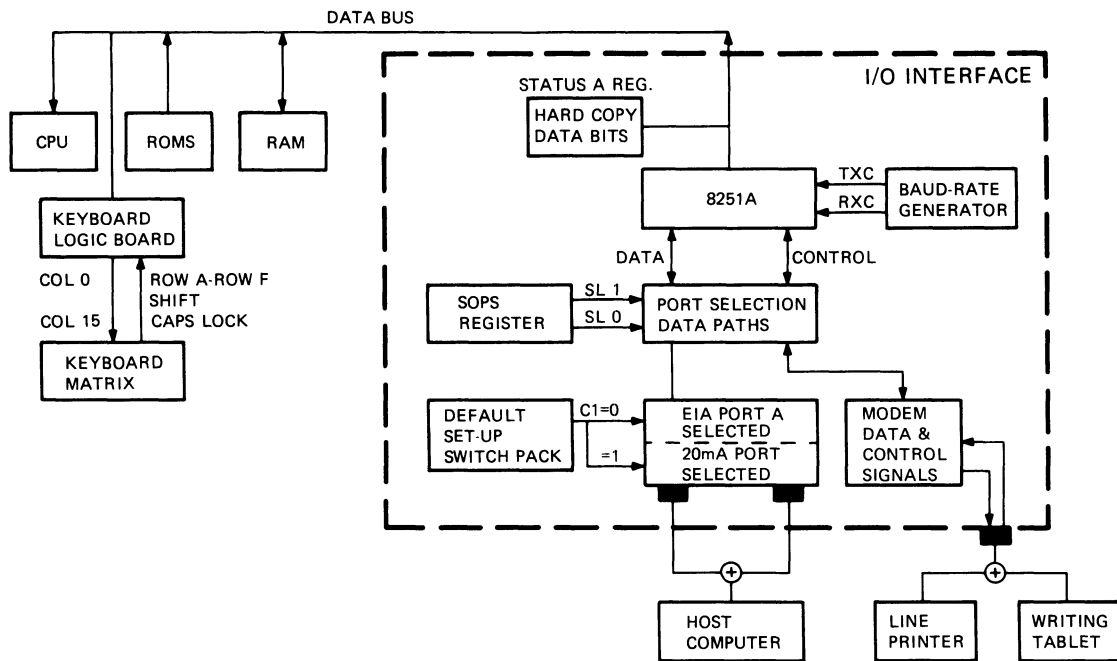
Figure 5-33 Port Selection Block Diagram

Table 5-10 I/O Port Selection

| MUX Inputs | SL1 | SL0 | Port Selection |
|---|---|---|---|
| A | 0 | 0 | EIA |
| B | 0 | 1 | 20 mA |
| C | 1 | 0 | Hardcopy |
| D | 1 | 1 | Self-test |

Note -- 0  Level = L
        1  Level = H

Transmit Channel -- The CPU sends the data to the 8251A. This is where the transmission format is put together according to the mode instruction register. The data stream is shifted out of the 8251A serially on the TxD line. The data goes through the I/O port selected logic. The SOPS register bits SL1 and SL0 (L,H) selects the 20 mA drive circuitry to transmit the data to host computer **(Figure 5-34).**

The data that is transferred out to the 20 mA line goes through a photo transistor. When the photo transistor circuit receives the mark bit, the photo cell transistor is cut off. This allows Q7 to conduct which in turn causes Q8 to conduct. When Q7 and Q8 transistors are turned on the source current (18--50 mA) flows from pin 2, through Q7 and Q8, out to pin 5.

When the photo transistor circuit receives a space (start bit), the photo transistor turns on. This action cuts off Q7, which then cuts off Q8. The current that flows from pin 2 goes through the constant current diode. This keeps a constant current of 2 mA that goes through the photo transistor out to pin 5.

Receiver Channel -- The receiver channel monitors the current loop. If a mark is detected, the receiver channel changes the mark to a binary one. If a space is detected, the receiver channel changes the space to a binary zero.

The receiver channel detects a mark and space in the following manner (Figure 5-35). The marking state is the initial condition.

The marking current causes the photo diode to conduct. When the photo diode passes 18 to 50 mA of current, the photo transistor turns on. The conduction of the photo transistor causes a positive voltage drop that turns on Q6. When Q6 conducts, a mark condition exists. The output of Q6 is inverted. The mark bit goes through the receiver multiplexer to the RxD input of the 8251A.

When a start bit is detected (space) the received current drops from (18 to 50 mA) to (0 to 2 mA). The space condition cuts off the photo transistor which cuts off Q6. The output of Q6 is inverted (0). The space signal goes through the receiver multiplexer to the RxD input of the 8251A.

Table 5-11 shows the transmitter and receives interface specifications.

EIA Port -- The data transfer is the same as the 20 mA port except the EIA drivers or receivers are selected. Figures 5-36 and 5-37 show the block diagrams.

SERIAL
DATA
INPUT

+5V

CUT OFF FOR
A MARK
CONDUCTING
FOR A SPACE

Q7

Q8

J1

5

2

HOST
COMPUTER

SOURCE

≅2mA

CONSTANT
CURRENT
DIODE

─── = MARK CONDITION

CURRENT
0-2mA = OFF = 0
10 mA
18-50mA = ON = MARK = 1

* =   H: MARK
      L: SPACE
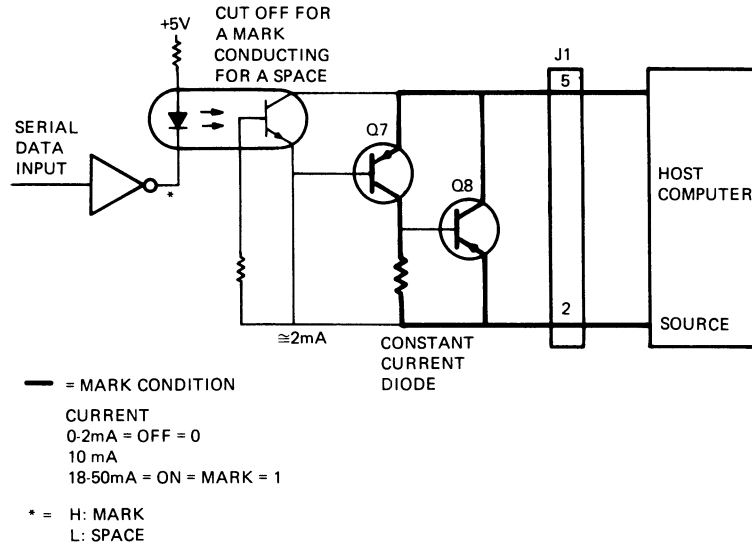
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Figure 5-34 20 mA Transmit Loop



+5V

J1

7

R+

Q5

SPIKE
PROTECTION

HOST
COMPUTER

SERIAL
DATA

R x D

Q6

3

R─

8

MA-8195
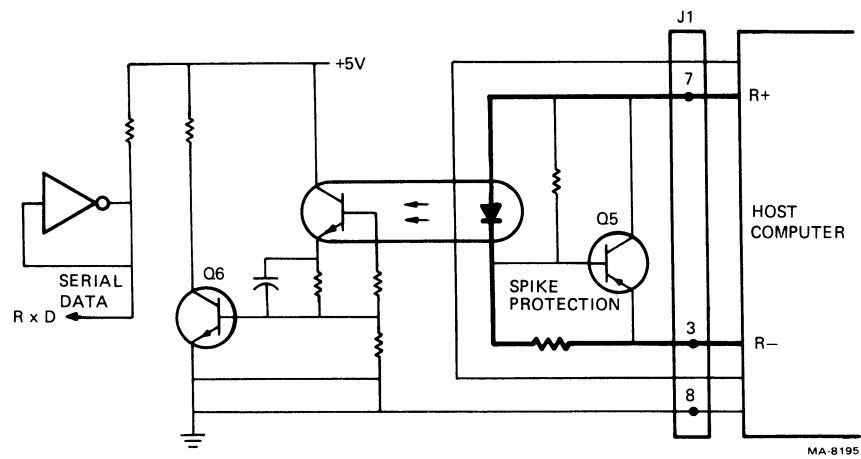
Figure 5-35 20 mA Receive Loop

5-55

## Table 5-11 Interface Specifications

| Transmitter | Min | Max | Units |
|---|---|---|---|
| Open circuit voltage | 5.0 | 50 | Volts |
| Voltage drop marking | 0.0 | 2.0 | Volts |
| Spacing current | -- | 2.0 | MA |
| Marking current | 20 | 50 | MA |

| Receiver | Min | Max | Units |
|---|---|---|---|
| Voltage drop marking | -- | 2.3 | Volts |
| Spacing current | -- | 3.0 | MA |
| Marking current | 15 | 50 | MA |
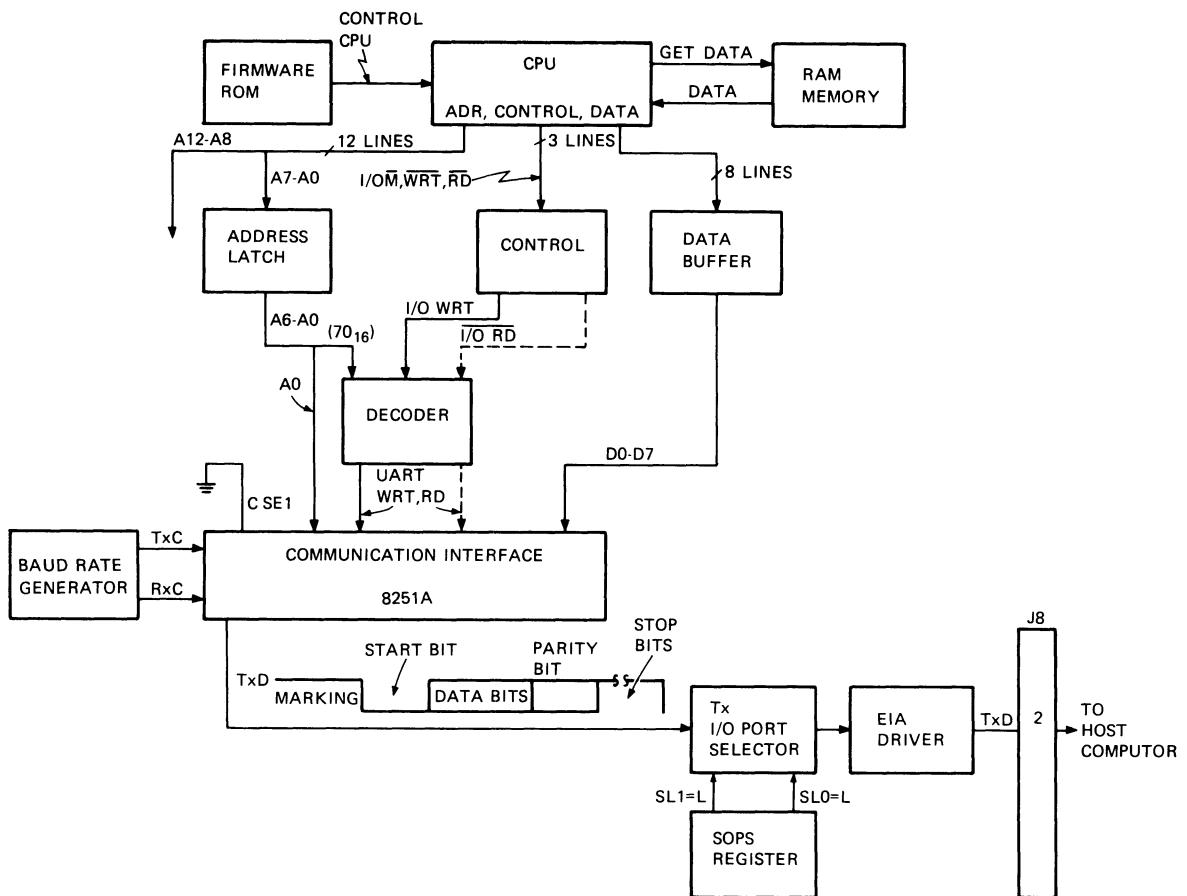


Figure 5-36 EIA Transmit
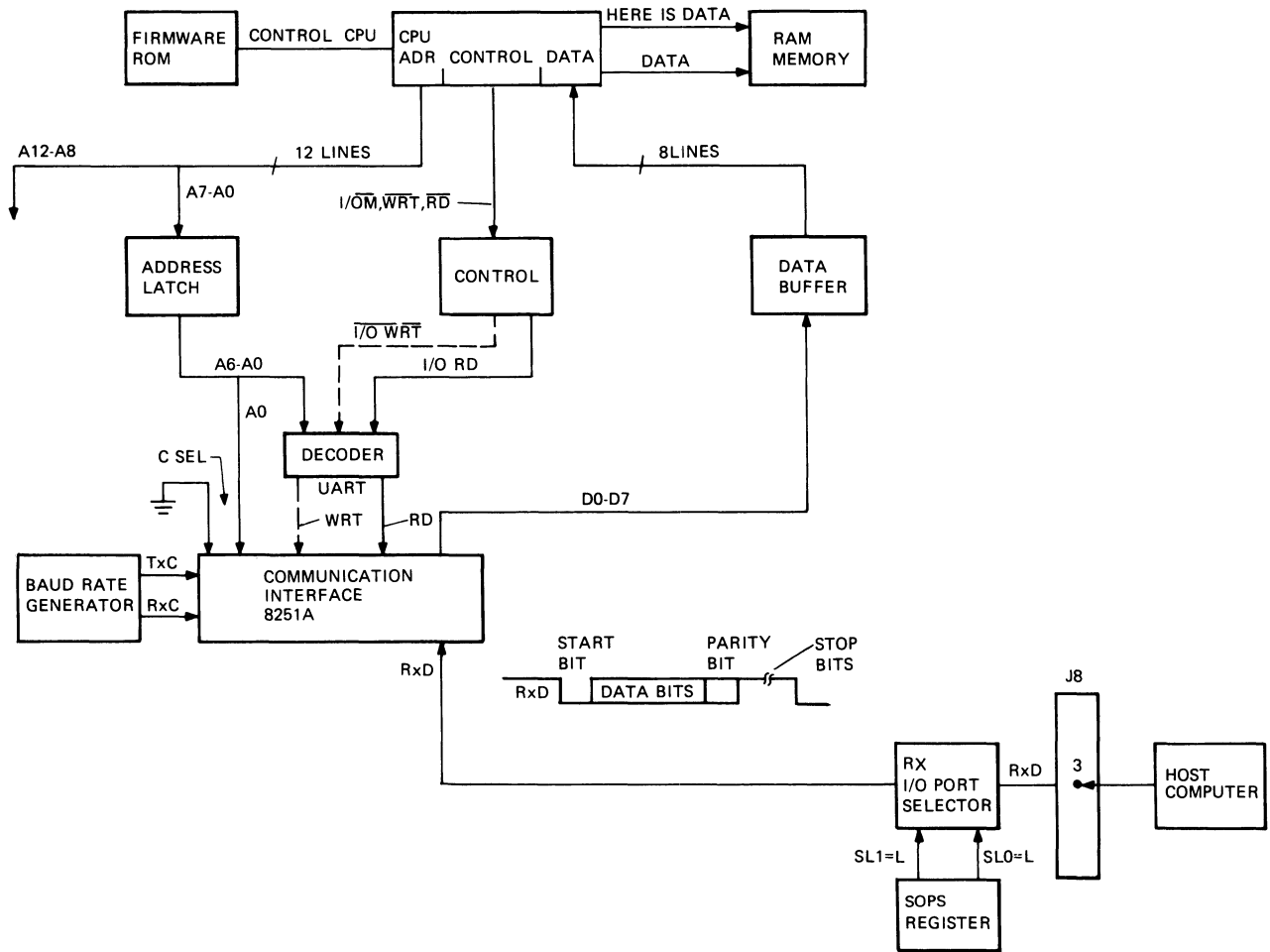
Figure 5-37 EIA Receive

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5.2.3.5  Hardcopy Overview -- The hardcopy mode outputs screen image information to a hardcopy device (LA34-VA or another future compatible device) to obtain a permanent record on paper. Only the information in the bit map memory is sent to the device. The video attribute information is ignored. The four ways of entering hardcopy mode are:

1.    Normal Screen Dump
2.    Auto-Hardcopy
3.    Partial-Hardcopy
4.    Hardcopy Dump in Graphics Mode.

**Normal Screen Dump** -- Once initiated the screen is frozen and the entire image prints. Use SHIFT/PF1 keys or DECHP escape sequence (ESC #7) to enter this mode.

**Auto Hardcopy** -- This is similar to the normal screen dump but it is initiated automatically before the screen clears or scrolls an entire display of new text lines onto the display.

Auto Hardcopy is enabled using Set-Up (AH1) or SM escape sequence (ESC [ ? 24 h ] ), and disabled by AH0 or ESC [ ? 24 l ]. To abort hardcopy before completion, use the SHIFT/PF1 keys.

* The last letter of the sequence is a lowercase l ($154_8$).

**Partial Hardcopy** -- This prints the number of lines specified by the parameters in the following DEC PDH escape sequence

    ESC [ Pn; Pn ! 8]

This escape sequence freezes the display and prints from the text line specified by the first parameter to the line specified by the second parameter.

**Hardcopy Dump in Graphics Mode** -- Hardcopy can be initiated using ReGIS screen command with hardcopy option:

    S (H [, Y1] [, Y2])

If only one Y parameter is specified, the other Y parameter defaults to the current graphics cursor Y position. If neither Y parameter is specified, the whole screen is copied.

**Graphics Data Stream Format** -- The LA34-VA graphic printer accepts the hardcopy data from the VK100 in the following format:

    CR SP SP SP SP
    DCS Pn F . . . SD . . . ST PLO
    DCS Pn F . . . SD . . . ST PLO

Where:
    CR   =   Carriage Return
    SP   =   SPACE (ASCII 2/0)
    DCS  =   Device Control String: ESC P
    Pn   =   Parameter value for horizontal resolution selection:

          Pn   =   1 for horizontal resolution
          F    =   q This final character donates the subsequent
                   characters are encoded raster data to be
                   printed.
          SD   =   String Data
          ST   =   String Terminator: ESC\. Character processing
                   returns to the method prior to the DCS.

          PLO  =   Partial Line Down: ESC K moves to next line of
                   graphic data.

The line printer connects to VK100 terminals in two ways.

    1.   Line printer connected only to a single terminal (Figure
         5-38)
         (Line printer dedicated to one terminal)

    2.   Line printer connected to multi-terminals (Figure 5-39)
         (Line printer is shared by many terminals)

Figure 5-38 shows the cables used with both systems.
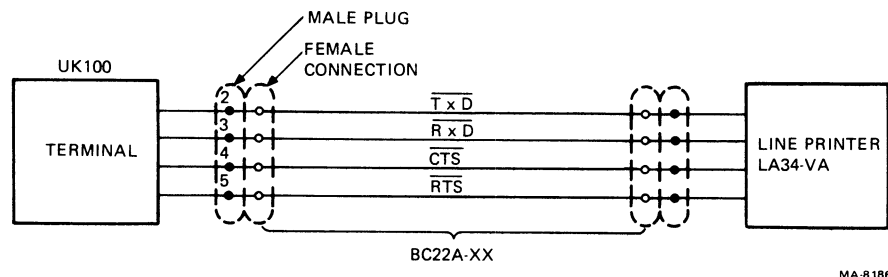


Figure 5-38 Line Printer Connected to Single
Terminal

>———< BC22A-XX OR EQUIVALENT CABLE

>———> BC22B-XX OR EQUIVALENT CABLE

>———> BC22B-01 (Y-CABLE)

———> MALE EIA CONNECTOR

———< FEMALE EIA CONNECTOR

MA-8203
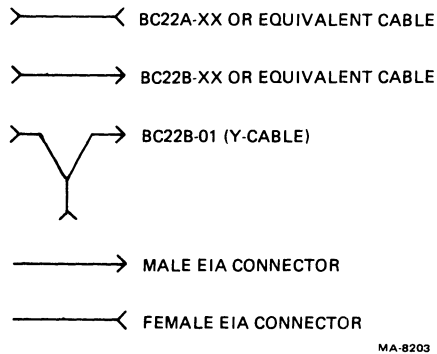
Figure 5-39 Printer Connection to Multiple
Terminals and Connector Names


Line Printer -- Connected to Multi-terminals -- The VK100 has
the ability to organize multi-terminal demands for the hardcopy
device. When the terminal outputs to the hardcopy device, all
other terminals in the chain are locked out. The next terminal to
be served depends on: the position of the currently printing
terminal, its relation to other terminals in the chain, and the
entering order of the hardcopy requests.

In general, the terminal farthest away from the printer has the
higher priority and prints next. There is no limitation on the
number of VK100 terminals that can connect to the line printer as
long as the maximum distance between terminals is 50 feet. The
number of VK100s serviced is limited by the users response time.

When a VK100 is powered off, all upstream terminals (farthest away
from the hardcopy device) are broken off the chain. The upstream
terminals are reconnected to the printer by bypassing the Y cable
on the powered off terminal.

5.2.3.5.1 VK100 Daisy Chain Bus Control -- The daisy-chain bus
connecting the VK100s to the LA34-VA Graphic Line Printer is
divided into data and control lines.

    Data Lines
        1.  Transmit (TxD)
        2.  Receive (RxD)

    Control Lines
        1.  Request to Send (RTS)
        2.  Clear to Send (CTS)

Figure 5-40 shows how each terminal interactively controls which
terminal uses the VK100 daisy-chain bus.
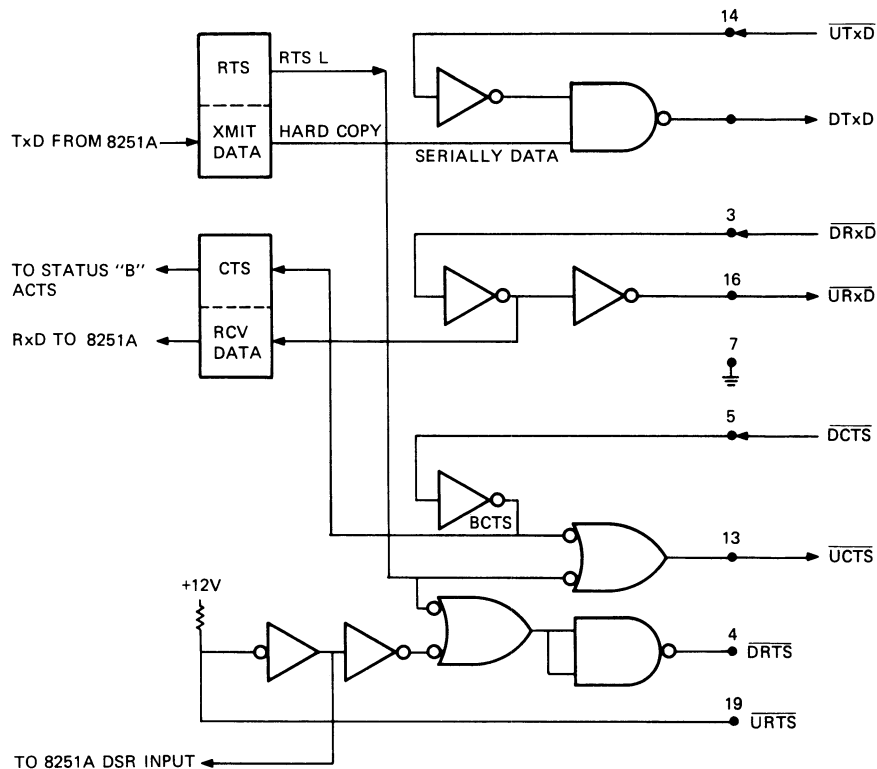
Figure 5-40 Logic for Hardcopy Bus Control

The signals that use the hardcopy daisy chain are:

    Upstream transmit data (UTxD)
    Downstream transmit data (DTxD)
    Upstream receive data (UPxD)
    Downstream receive data (DRxD)
    Upstream clear to send (UCTS)
    Downstream clear to send (DCTS)
    Upstream request to send (URTS)
    Downstream request to send (DRTS)

Terminals in the daisy-chain bus use an interconnecting dialogue that allows only one terminal at a time to use the bus. The following paragraphs describe this dialogue.

BUS NOT BUSY
When the bus is not busy each VK100 has as inputs, DCTS low and URTS high. The logic in each VK100 passes on the output signals, UCTS low and DRTS high. All VK100 are enabled to transfer data.

CPU WANTS TO USE BUS
A CPU that wants to transfer data reads two status registers.

    1.    Status Register B (checks ACTS bit)
    2.    Status Register 8251A (checks DSR bit)

        The ACTS bit reflects the inverted condition of DCTS low (ACTS bit=1). The DSR bit reflects the condition of URTS high (DSR bit=0). The only time a VK100 can use the bus is when ACTS bit=1 and DSR bit=0.

When the CPU finds the ACTS bit=1 and DSR bit=0, it then clears the RTS bit in the command register in the 8251A. RTS switches the following signals.

    1.    UCTS goes high -- in the upstream terminal this signal name becomes DCTS high and is inverted changing the ACTS from a one to a zero. The upstream terminals have ACTS bits equal to zero to prevent the terminals from using the bus.

    2.    DRTS goes low -- in the downstream terminal this signal name becomes URTS low and is inverted changing the DSR bit from a zero to a one. The downstream terminals have DSR bits equal to one to prevent the terminals from using the bus.

CPU USING BUS
The terminal after gaining control of the bus transfers the data to the line printer (TxD).

BUS NOT BUSY
When the CPU finishes the data transfer the CPU sets RTS. RTS switches the UCTS and DRTS and the bus is no longer busy.

5.2.3.5.2  **Hardcopy Data Transfer** -- To transfer data to the line printer the following sequence takes place.

    1.    SET-UP
    2.    The DVM register is loaded. Direction equals 2.
    3.    The direction register is loaded. Direction equals 6.
    4.    The X and Y register is loaded.
    5.    The Baud Rate Generator is loaded.
    6.    The instruction format register is loaded.

For the following sequence of events refer to Figure 5-41.

        SYSTAT A (X0, Y0) -- Firmware reads 4 bits from the screen RAM, (bits 0, 1, 2 and 3 of scan line zero) by issuing the instruction SYSTAT A. When the CPU receives the 4 bits it masks out bits 1, 2 and 3 and saves bit zero in a register X LSB in the CPU.

SYSTAT A (X0, Y2) -- Firmware reads 4 bits from the
screen RAM, (bits 0, 1, 2 and 3 of scan line two) by
issuing the instruction SYSTAT A. When the CPU receives
the four bits it masks out bits 1, 2, and 3 and saves bit
zero in a register X LSB + 1 position.

The above sequence continues until six reads are done
(X0, Y12). At this time six-bit position zeros are stored
in a register in the CPU.

The firmware makes an ASCII character by adding 077 octal
to the contents of register X and sends the new value to
the 8251A transmit buffer.

The 8251A assembles the data into the correct format, and
transfers the data to the line printer.

The line printer receives and assembles the transmission,
subtracts 077 octal from it and stores the result in a
256 byte buffer.

When its buffer is filled, the line printer transmits
XOFF to the Receive Data buffer in the 8251A. This
interrupts the CPU, signalling it to stop sending
characters. When the buffer is able to receive more data
it transmits XON to the CPU.

Starting at bit zero position the data is transferred as
follows.

SCAN LINE 0--12 six bit zeros, six bit ones . . . . . . .
six bit 767

SCAN LINE 12--26 six bit zeros, six bit ones . . . . . .
six bit 767

SCAN LINE 226--240 six bit zeros, six bit ones . . . . .
six bit 767
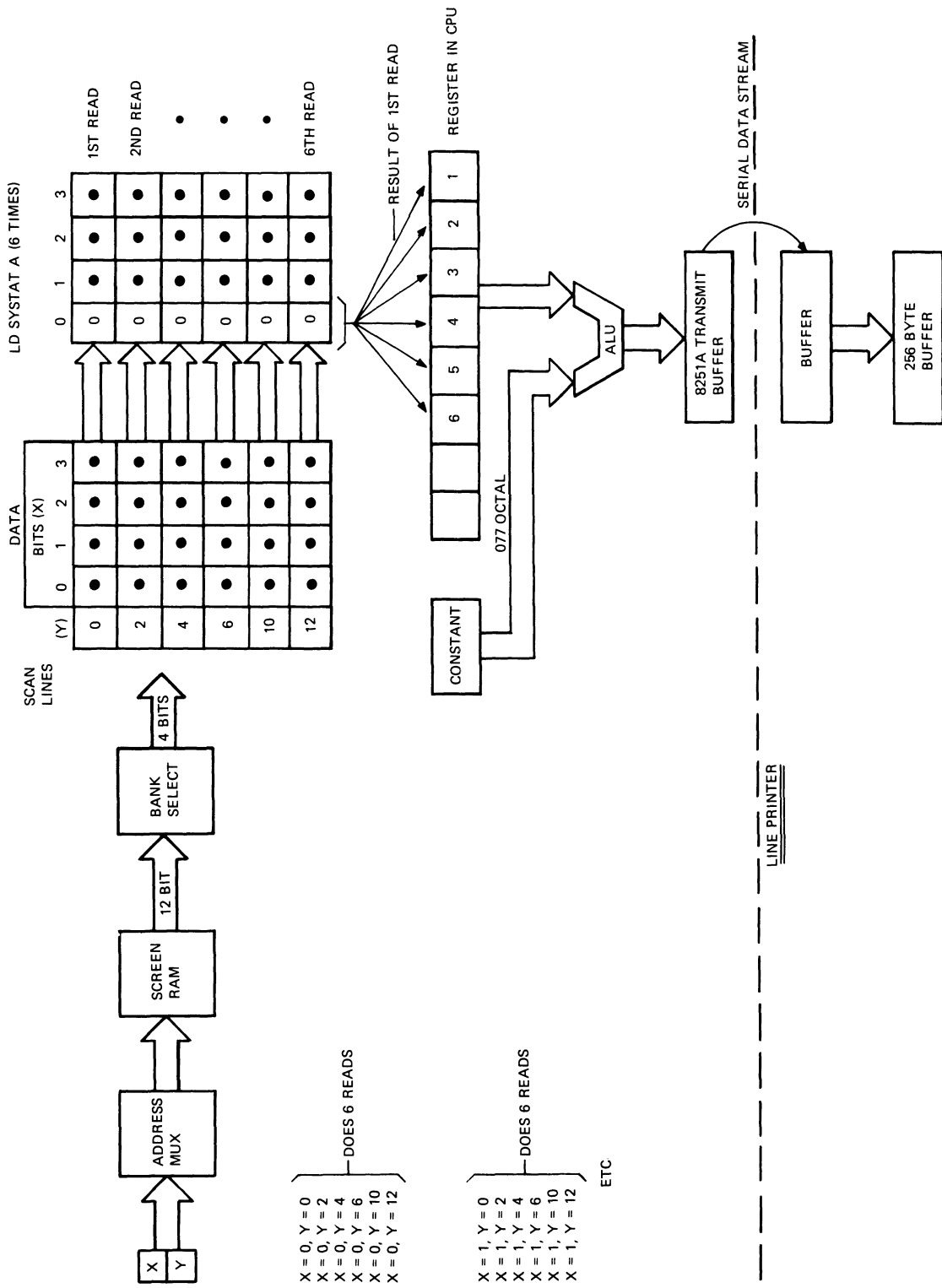
Figure 5-41 Hardcopy Data Transfer

## 5.2.4    Keyboard

The keyboard is the user's input device to the terminal. The keyboard logic is divided into two sections.

1.    Keyboard Matric
      The keyboard switches are arranged like a typewriter with a numerical keypad. The keyboard matrix also provides light indicators.

2.    Keyboard Interface
      The keyboard interface is on the terminal controller module and determines which keys have been pressed.

The keyboard is a firmware scanned key array, mapped into memory space (RAM). The CPU reads the keyboard array 16 times every 60th of a second to find out if any keys have been pressed. The keyboard logic consists of:

    Keyboard array
    Array column selector
    Indicators
    Audible section

The keyboard array consists of switches arranged in a column, row matrix. There are 15 columns (1--15) and 6 rows (A--F). Each switch has its own column and row position (Figure 5-42).

The CPU selects the column to read by using address bits A∅--A3. When column one is selected, a ground (low) is present on one side of the following switches: SET-UP, ESC, TAB, ENTER and PF1. If one or more of the switches is pressed, the lows will be felt on the corresponding row bits. Then the CPU does a keyboard read (KBRD). Figure 5-43 shows column two addressed with the A switch pressed. The A switch pressed means the row C output is low and when the KBRD is active D2 goes low. All other bits are high. The code sent to RAM memory for an A is 11111∅11.

The keyboard write register controls the audible and indicator logic. Bits 1--6 control the indicators. Bit six output has two destinations:

1.    ON-LINE LGD
2.    Inverted bit six - LOCAL indicator

The following are the indicators.

    L2
    L1
    HARDCOPY
    BASIC
    NO SCROLL
    ON-LINE
    LOCAL

Bit six controls the ON-LINE/LOCAL signal.
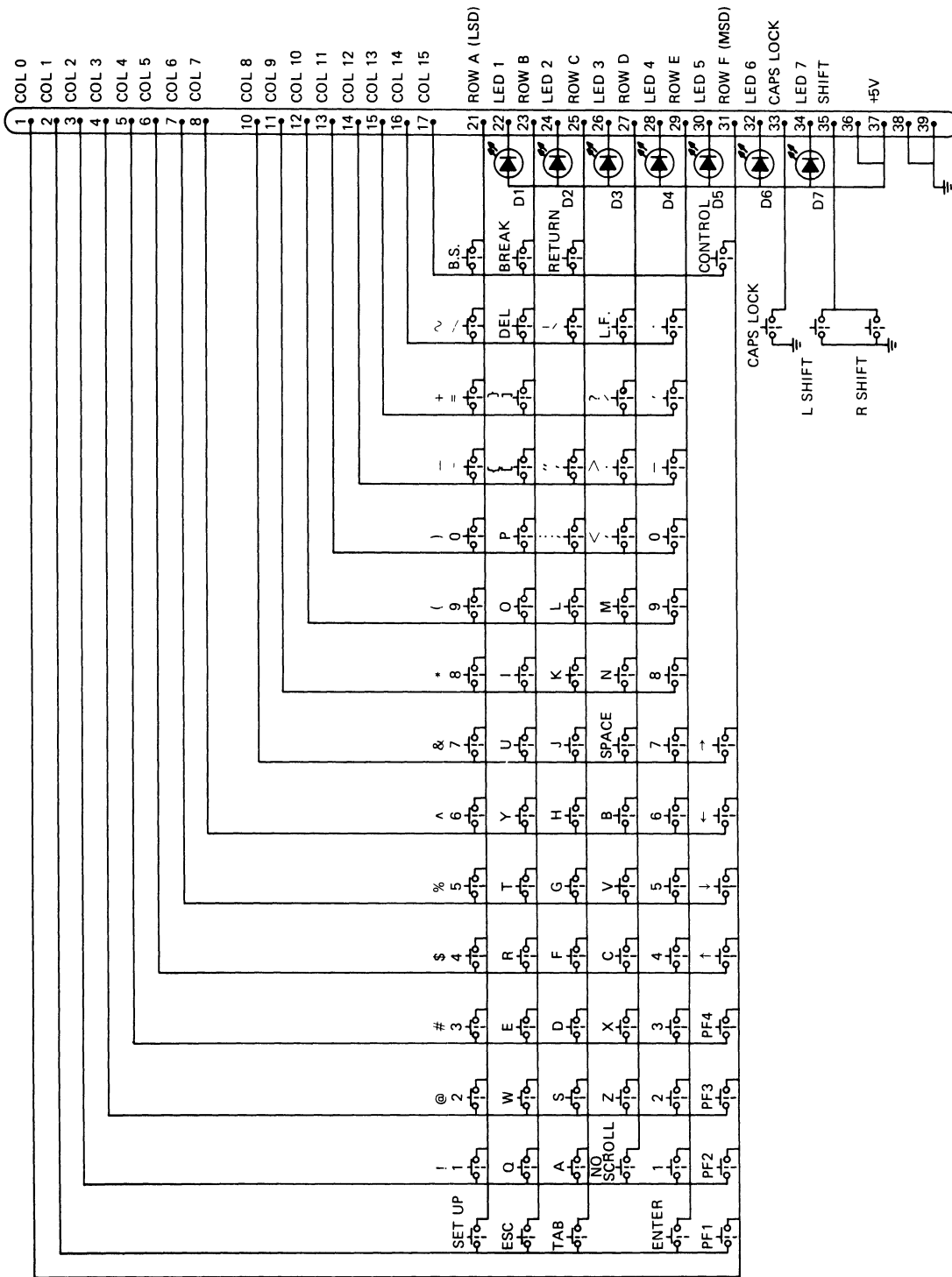
Figure 5-42 Keyboard Matrix

5-66
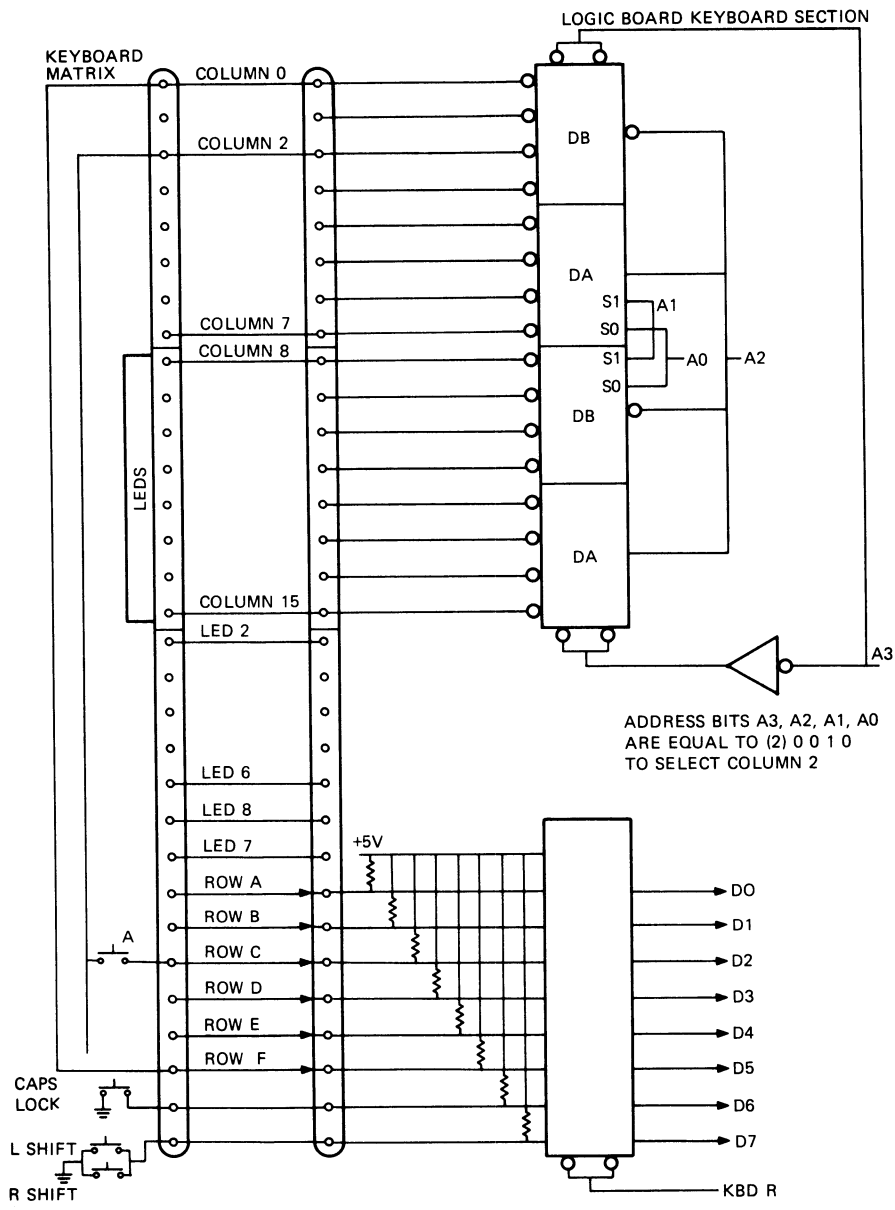
Figure 5-43 Keyboard Road with "A" Switch Pressed

Write register bits 77 and 8 control the two audible sounds emitted from the loudspeaker: the keyclick and beeper (Figure 5-44).

A one-shot multivibrator determines the keyclick signal. the output is high for 1.5 ms and low for 30.2 ms.

The beeper signal is high for 17.2 ms and low for 16.5 ms.

## 5.2.5    Power Supply

The VK100 is driven by a free running, flyback mode, off-line switching power supply. It accepts either 115 or 230 Vac input and delivers three regulated dc outputs: +5 V, +12 V -5 V.
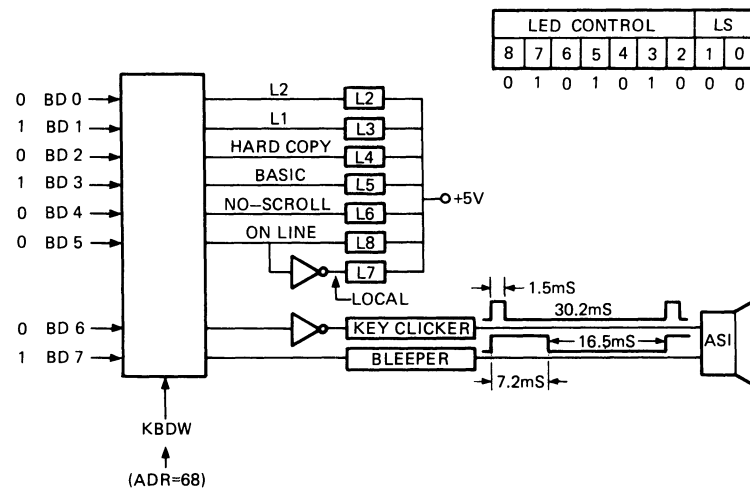


Figure 5-44 LED (Indicator) Keyclicks and
Bleeper Block Diagram

The power supply has the following protection.

> Overcurrent Protection -- No damage to the power supply
> result from a short circuit of any duration across the
> output terminals. Normal operation resumes upon removal
> of the short circuit.
>
> Overvoltage protection -- A crowbar circuit is provided
> to protect the load from damage. The crowbar activates if
> the +12 V output voltage range is between 13.0 V and 15.0
> Vdc. No damage to the power supply results from
> activation of the crowbar for any duration and at any
> ambient temperature within specification limits.
>
> Tolerance Band = +12 V: 11.4 to 12.6 dc
>                  -12 V: -11.4 to -12.6 dc
>
> Output Current = +12 V: 0.2 to 0.9A dc
>                  -12 V: 0.2 to 0.075A dc
>
> Voltage adjustments = none.

Figure 5-45 shows the power supply schematic. The explanation
follows.

The mains are brought in through an EMI filter, (T1, C1, C2, and
C3) rectified by BD1 and deliver approximately 300 Vdc across
capacitive input filter C6, C7, C8, and C9. Current surge is
limited by R1 and R2 and transient voltages are suppressed by VD1
and VD2. By turning on power transistor Q2, this voltage is
applied across the primary of T2, charging its inductance with a
linear current ramp. When Q2 is turned off, the energy stored in
T2 is delivered from the secondary windings through rectifiers,
capacitive input filters and smoothing filters to the outputs.

Initial turn-on Q2 is done by R1. Thereafter this task is
performed by the feedback winding on T2 driving through R4 and
C10. This winding initiates turn-on during the ring down following
flyback. The operating frequency varies with line and load.

IC3 compares the output voltage level at the base of Q3. When the
voltage created by L4 and R15 combination is sufficient to turn on
Q3, T3 terminates Q2's drive..

Q2 can also be turned off when sufficient voltage is developed
across R12 causing Q1 to turn on.

SCRI is used as a crowbar designed to protect against output
overvoltage.
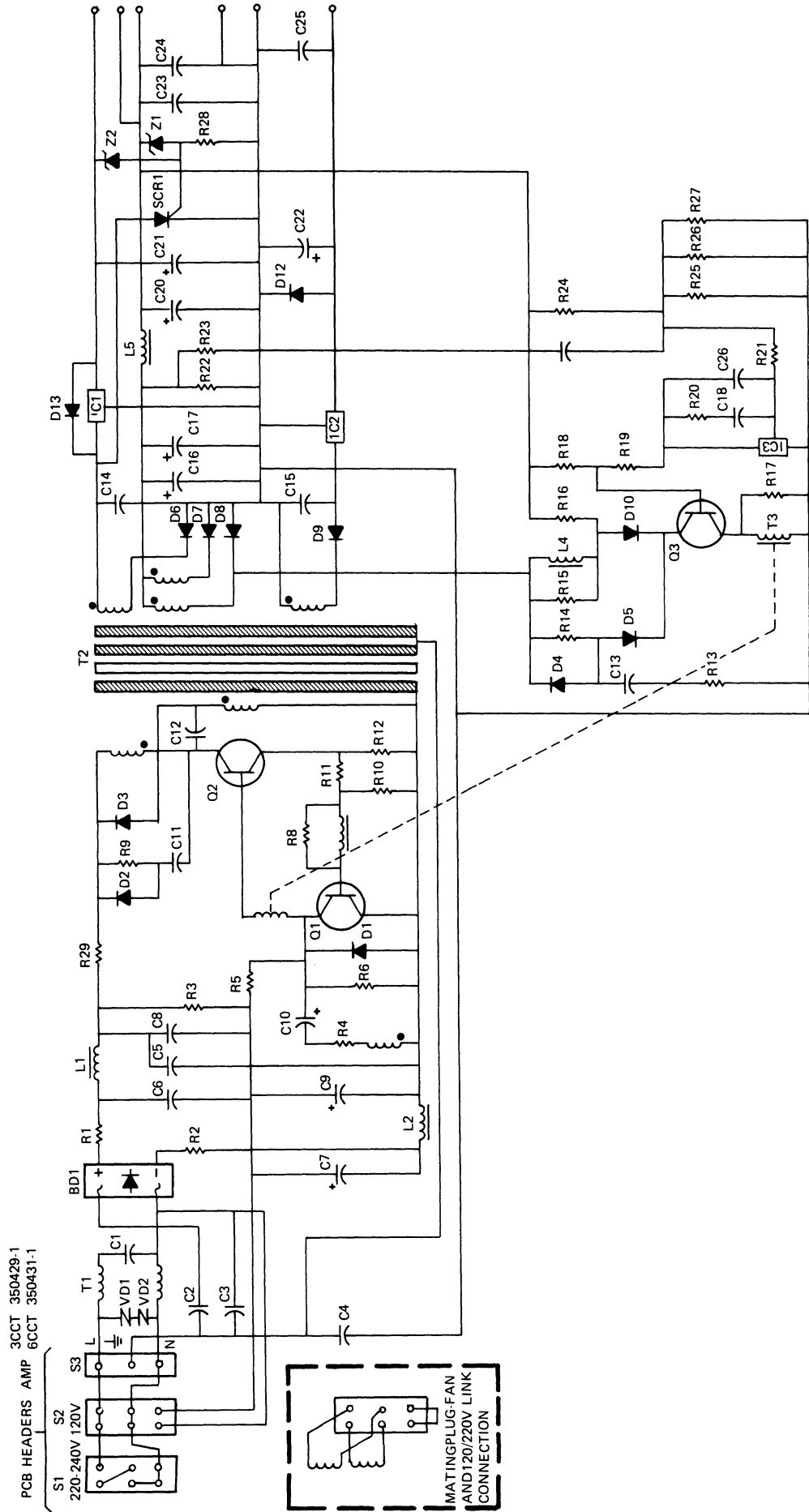
Figure 5-45 Power Supply Schematic

MA-8241

## 6.1     INTRODUCTION

The VK100 terminal contains a complete set of hardware self-test programs that check all of the major terminal functions. The self-test indicates that a problem exists and where the problem is.

Self-test mode has two tests power-up and diagnostic. Power-up tests automatically check the condition of the terminal every time terminal power is turned on. Diagnostic tests check the terminal outputs. Diagnostic tests require optional test connectors.

The self-test functions of the VK100 are invoked in one of three ways:

     1.     Automatic Tests (PUPTST)
     2.     Escape Sequences (CSITST)
     3.     SET-UP Mode (SETST)

**6.1.1     Automatic Tests (PUPTST)** -- The user has no control of the automatic confidence tests invoked when the terminal is powered on. The same tests may be invoked by doing a terminal reset (using SHIFT "-" key). These tests may also be called as a group through the various methods listed below.

**6.1.2     Escape Sequences (CSITST)** -- All tests are invoked by the escape sequence: ESC [3;Pn;Pn;...y] where Pn selects the test to be performed as follows:

     Pn     Test Selected

     1      All power-up tests
     2.     External communication test
     3      Hardcopy communication test
     4.     Display pattern test
     5.     Color bar test
     6.     Repeat selected tests until failure

Any set of these tests may be selected in any order; however, they are always executed in numerical order.

The test select data is stored in a single byte (TSTSEL), with one bit for each test/option selected. While the CPU, ROM and RAM tests are running, these select bits are stored in register E, preserving this register.

6.1.3    SET-UP Mode (SETST) -- When the terminal is in SET-UP mode, setting the ST mode to any number has exactly the same effect as specifying the same parameter in the above escape sequence. The selected tests are executed when ST0 is set. Thus typing ST190 selects all the power-up tests and repeats these tests until failure. Every time the ST parameter set routine (STPPST) is called, it accumulates the test select data (TSTSEL).

**6.1.4    Error Reporting** -- Errors occurring during any test are reported in one of two ways:

1.    Fatal errors
2.    Non-fatal errors

6.1.4.1 Fatal Errors (TSTERROR) -- A fatal error (which causes the terminal to be useless) displays an error code in the indicators with the LOCAL indicator, alternating with a possible data item with the Line indicator, each for about 1/2 second. Table 6-1 shows the possible error codes.

Table 6-1 Possible Error Codes

| Error Codes | | | | Data | |
|---|---|---|---|---|---|
| Basic | Hard Copy | L1 | L2 | | |
| 0 | 0 | 0 | 0 | CPU Register Error | Data=1111 |
| 0 | 0 | 0 | 1 | ROM Error | Data=Bits 14,13,12 of ROM Address in Error |
| 0 | 0 | 1 | 0 | RAM Error | Data=Bit Number of RAM Error |
| 0 | 0 | 1 | 1 | Video Bit Map Error | Data=Bit Number of Screen RAM Error |
| 0 | 1 | 0 | 0 | Vector Generator Error | Data=1111 |
| 0 | 1 | 0 | 1 | CRT Controller Register Error | Data=1111 |

**6.1.4.2 Non-Fatal Errors** -- Errors which allow some portion of the terminal to be useful display an error code in the center of the screen. The following are the possible error codes.

1.  KB ERR -- Keyboard error
2.  IC ERR -- Internal communication test error
3.  EC ERR -- External communication test error
4.  HC ERR -- Hardcopy test error

The two-byte mnemonic for the error is stored (TSTERM) and upon completion of terminal initialization is displayed in the center of the screen. The terminal always comes up in the local mode if any non-fatal errors are detected (only LOCAL indicator is lit).

**6.2       POWER-UP SELF-TEST**
Power-up self-tests check the following terminal circuits.

Microprocessor
Visual and audible indicators
Read only memory (ROM)
Random access memory (RAM)
CRT controller
CRT timing
Vector timing
Video bit map
Vector generator
Keyboard
Communications (internal)

The power-up self-test can be started in four different ways.

1.  Turn the terminal power switch to the on position.

2.  Reset the terminal by pressing the shift and auxiliary keypad **PF4** keys together in SET-UP mode.

3.  Select the set-up self-test feature (ST1).

4.  Receive a command from the host computer.

The power-up self-test takes about 15 seconds. While the test is running, the monitor displays various patterns that do not make sense. This is normal. Once the test is complete the cursor appears in the upper left corner of the monitor and only the ON-LINE indicator is turned on. If the self-test finds an error, it shows on either the keyboard or the monitor.

### 6.2.1   8085 CPU Test (CPUTST)

The microprocessor test checks the following registers: A, B, C, D, E, H, L, and SP by writing two patterns in the registers. The two patterns are:

1.   0 1 0 1 0 1 0 1
2.   1 0 1 0 1 0 1 0

The test is as follows:

PATTERN ➤ A ➤ B ➤ C ➤ D ➤ E ➤ H ➤ L ➤ SP

The pattern is loaded in the accumulator (A register) which is shifted to the B register ... shifted to the SP.

Firmware clears H L and then does a double add with the SP. The H L registers end up with the following.

```
H                   L
0 1 0 1 0 1 0 1   0 1 0 1 0 1 0 1
```

The firmware compares the contents of the H and L register with the contents of the A register. If either test finds a difference, an error code is generated.

```
The error code = 0000
The data code = 1111
```

After the first pattern is checked, the second pattern is loaded and tested in the same manner.

### 6.2.2   Visual and Audible Indicators

The firmware when testing the indicators and bleeper circuits loads the accumulator with a value (0101010). This turns on the ON-LINE, NO SCROLL, HARDCOPY and L2 indicators and the bleeper for approximately 1/4 second (Figure 5-4).

### 6.2.3   ROM Test (ROM TST)

The ROM test verifies the addressability, order and data of all the ROMs present in the VK100. Only the CPU (8085A) and the ROMs are used in this test. There are four ROMs that are tested. If there is an error, the indicators blink.

|  | Basic | Hard copy | L1 | L2 |  |
|---|---|---|---|---|---|
| with code equal to | 0 | 0 | 0 | 1 | = ROM failure |
| with data equal to |  |  |  |  | = address of ROM in error |

To start the ROM test the following steps.

1.    Each ROM has a check byte stored somewhere in each ROM
      and is a function of the ROM address.

2.    Set initial value to high byte of ROM address + 1.

3.    Rotate current check value left one bit.

4.    Exclusive-OR current value with this ROM byte.

5.    If value is zero, ROM is correct. Any other value
      indicates an error.

6.2.4    Program RAM Test (RAM TST)
The program RAM checks to see if every bit can be written with
ones and zeros and that every address is correct. This test uses
only the 8085 CPU and the RAMs. The following patterns are written
into the RAMs.

    11111111
    01010101
    10101010
    00000000

The ROM firmware writes the all ones pattern into the RAM memory.
To start the RAM test perform the following steps for each RAM
byte.

1.    Read the first byte and compare with the old pattern (all
      ones). If the pattern is different, an error occurs.

2.    If no error is found, write new pattern into the first
      byte location and continue this sequence until done.

3.    If the error indicators blink with code = 0010, the data
      = the bit number of RAM bits in error.

6.2.5    Video Bit Map RAM Test (VBMTST)
This test checks the entire video bit map for read/write of 0 and
1. A simple vector pattern is written throughout the entire memory
(including the attribute memory) and then read back. The test uses
CPU, ROM, Program RAM and the vector generator. To start the video
bit map RAM test perform the following algorithm:

1.    Set pattern = $01010101_{2}$, blink = off, color = green
      blue.

2.    Set vertical position to zero.

3.  Do 256 times:

    a.  Set horizontal position to zero.

    b.  Write 128 dot vector horizontal to the right. Repeat six times.

    c.  Increment vertical position by 2.

4.  For pattern = $10101010_{(2)}$, blink = on, color = red; pattern = $00000000_{(2)}$, blink = off, color = dark; perform the following.

    a.  Set vertical position to zero.

    b.  Do 256 times:

        1.  Set horizontal position to zero.

        2.  Do 64 times:

            a.  Do 3 times
                Read 4 horizontal at current position

                Advance horizontal position by 4.

                Compare 4 bits just read with last pattern written. If pattern is different, an error is indicated.

            3.  Read 4 attribute bits (blink, green, red, blue) at current position.

            4.  Compare 4 bits just read with last pattern. If pattern is different an error is indicated.

            5.  Decrement horizontal position by 12.

            6.  Write a 12 dot vector to the right.

    c.  Increment vertical position by 2.

If error indicators blink with code = 0011, then the data = the bit number of data in error (bits 0--11 are bit map bits, 13--16 are attribute bits).


## 6.2.6   Vector Generator Test (VGNTST)

The vector generator test writes a series of vectors from a single point and comparises a small portion of the resultant bit map with an expected result. This test uses the 8085, ROM, Program RAM, and video bit map RAM.

To start the vector generator test perform the following steps:

1. Clear video bit map

2. Write the following sequence of vectors (**Figure 6-1**) starting at (-1,0)

3. Read and compare the 8 by 8 dot sample from (0,0),(7,0) to (0,7),(7,7) with the following pattern:

       (0,0) 00100000 (7,0)
             00100000
             00100001
             10100000
             00100000
             00100000
             00100000
       (0,7) 00010000 (7,7)

   If pattern is not identical an error occurs.

4. If an error occurs the indicators will blink the following patterns.

       Code=0101
       Data=1111

Vector Generator Test (to write sequence of vector)

Sequence of Vector Test (8)

| DU | DVM | DIR | PMUL | PAT | WOPS |
|----|-----|-----|------|-----|------|
| 7 6 5 4 3 2 1 0 | 7 6 5 4 3 2 1 0 | 7 6 5 4 3 2 1 0 | 3 2 1 0 | 7 6 5 4 3 2 1 0 | 7 6 5 4 3 2 1 0 |
| 0 0 0 0 1 0 0 0 | 1 1 1 1 1 0 1 0 | 0 0 0 0 1 1 1 1 | 1 1 1 1 | 1 0 0 1 1 1 0 0 | 0 1 1 1 1 0 0 0 |
| 0 0 0 0 1 0 0 1 | 1 1 1 1 1 0 1 1 | 0 0 0 0 1 1 0 1 | 1 1 1 0 | 1 0 1 0 1 0 0 0 | 0 1 1 1 1 0 0 1 |
| 0 0 0 0 0 1 1 1 | 1 1 1 1 1 1 0 0 | 0 0 0 0 1 0 1 0 | 1 1 0 1 | 1 1 1 0 0 0 0 0 | 0 1 1 1 1 0 1 0 |
| 0 0 0 0 0 1 0 1 | 1 1 1 1 1 0 1 0 | 0 0 0 0 1 0 0 0 | 1 1 0 0 | 1 1 0 0 0 0 0 0 | 0 1 1 1 1 0 1 1 |
| 0 0 0 0 1 0 0 1 | 1 1 1 1 1 1 0 1 | 0 0 0 0 1 1 1 0 | 1 0 1 1 | 1 1 0 0 0 0 0 0 | 0 1 1 1 1 1 0 0 |
| 0 0 0 0 0 1 0 0 | 1 1 1 1 1 1 0 1 | 0 0 0 0 1 1 0 0 | 1 0 1 0 | 1 1 0 0 0 0 0 0 | 0 1 1 1 1 1 0 1 |
| 0 0 0 0 0 0 0 1 | 1 1 1 1 1 1 1 0 | 0 0 0 0 1 0 1 1 | 1 0 0 1 | 1 0 0 0 0 0 0 0 | 0 1 1 1 1 1 1 0 |
| 0 0 0 0 1 1 0 0 | 1 1 1 1 1 1 1 1 | 0 0 0 0 1 0 0 1 | 1 0 0 0 | 0 0 0 0 0 0 0 0 | 0 1 1 1 1 1 1 1 |

Figure 6-1  Vector Generator Sequence

6.2.7    CRT Controller Test (CRTST)
This test makes sure that the CRT controller registers can be read
and written. Only one register of the CRT controller, the cursor
register, is read/write. This test uses the CPU and ROM. Two
patterns are used in this test.

$$01010101(_2), \ 10101010(_2)$$

1.    Write the cursor low register (register 15) and compare
      it with the pattern.

2.    Read the cursor low register and compare with pattern. If
      the pattern is different or an error occurs.

3.    If an error occurs    the indicators will blink the
      following patterns.

      Code=0101
      Data=1111

6.2.8    CRT Timing
Firmware routine checks for the V SYNC signal from the CRT
controller. If V SYNC is not received within 20 ms, a CRT timing
error is generated.

      Code 0100100 (Local and Hardcopy)
      Data 1001111 (On-Line, Basic, Hardcopy, L1, L2)

6.3      DIAGNOSTIC TESTS
These tests are not normally executed by the terminal. They can be
initiated via setup or escape sequences. They exist for diagnostic
purposes and for error isolation in repair operations. The VK100
terminal contains five diagnostic tests.

      External communications test
      Hardcopy communications test
      Display test
      Color bar test
      Screen alignment pattern

The following paragraphs describe Each test.

6.3.1    External Communications Test
This test is an extension of the internal communications test in
the power-up test. In the external communications test the
transmit and receive lines are connected through a special
loopback connector. A predefined set of characters are then
transmitted. The terminal receives the characters and compares
them to the characters transmitted. If the characters do not match
an error is indicated. This test is performed for all
communications speeds.

This test requires an optional loopback connector.

To start the external communications test perform the following steps:

    1.    Turn terminal power off.

    2.    Disconnect the communications cable from the rear of the terminal.

    3.    Install the optional loopback connector on the terminal communications output connector. Loopback connector part number 12-13336-00 is for EIA communications; part number 70-13503-00 is for 20 mA current loop communications.

    4.    Turn terminal power on.

    5.    Place the terminal in SET-UP mode.

    6.    Verify CI SET-UP feature (CI0=EIA; CI1=20 mA).

    7.    Set the self-test SET-UP feature for selection 2 (ST2).

    8.    Exit SET-UP mode by pressing the **SET-UP** key. This starts the test.

If no error is found by the test the cursor is displayed on the monitor. Paragraph 6.4 lists the displayed error codes and their meanings.

## 6.3.2 Hardcopy Communications Test

This test is similar to the external communications test described above. In the hardcopy communications test, the transmit and receive hardcopy output lines are connected through an EIA loopback connector. A predefined set of characters is then transmitted. The terminal receives the characters and compares them to the characters transmitted. If the characters do not match an error is indicated.

This test requires an optional loopback connector.

To start the hardcopy communications test perform the following steps:

    1.    Turn terminal power off.

    2.    Disconnect the hardcopy printer cable from the rear of the terminal.

    3.    Install the optional loopback connector on the terminal hardcopy connector. The loopback connector is part number 12-13336-00.

    4.    Turn terminal power on.

    5.    Place the terminal in SET-UP mode.

6.    Set the self-test set-up feature for selection 3 (ST3).

7.    Exit SET-UP mode by pressing the **SET-UP** key. This starts the test.

If no error is found by the test the cursor is displayed on the monitor. Paragraph 6.4 lists the displayed error codes and their meanings.

6.3.3    Display Test
This test displays a full screen of blue, red, green, white, black, and a crosshatch pattern. Each display screen lasts for approximately one-half second and the crosshatch pattern remains on the screen at the end of the test. On a black and white monitor the test displays full screens of increasing intensity.

To start the display test perform the following steps.

1.    Place the terminal in SET-UP mode.

2.    Set the self-test set-up feature for selection 4 (ST4).

3.    Exit SET-UP mode by pressing the **SET-UP** key. This starts the test.

An error in this test occurs if one of the display screens is not shown. If this happens the monitor attached to the VK100 terminal may have failed. Proceed with the color bar test.

To clear the monitor screen reset the terminal by pressing the **SHIFT** and **PF4/RESET** keys together.

6.3.4    Color Bar Test
This test displays a color bar/grey scale pattern on the monitor. The color bar/grey scale pattern consists of eight equally spaced vertical bars. On a color monitor the bars are in the following order from left to right:

    Black      Green
    Blue       Cyan
    Red        Yellow
    Magenta    White

On a monochrome (black and white) monitor the bars show as different shades of grey. The bars start as black on the left and increase in intensity to a white bar on the right of the display.

To start the color bar test perform the following steps:

1.    Place the terminal in SET-UP mode.

2.    Set the self-test set-up feature for selection 5 (ST5).

3.    Exit SET-UP mode by pressing the **SET-UP** key. This starts the test.

An error in this test occurs if the color bar/grey scale pattern is not displayed or a portion of the pattern is missing. Either error condition indicates that the attached monitor has failed, the video cable is not connected properly, or the VK100 terminal has failed. If you suspect that the terminal has failed, connect it to a different monitor and perform both the display and color bar/grey scale tests. If the same symptoms are present the second time the terminal has probably failed.

To clear the monitor screen reset the terminal by pressing the SHIFT and PF4/RESET keys together.

6.3.5    Screen Alignment Pattern
This test fills the screen with a crosshatch pattern. The crosshatch pattern adjusts the display monitor connected to the VK100 terminal.

To place the screen alignment pattern on the monitor screen perform the following steps:

1.    Place the terminal in SET-UP mode.

2.    Set the self-test set-up feature for selection 4 (ST4).

3.    Exit SET-UP mode by pressing the SET-UP key. This starts the display test. At the end of the display test the screen alignment pattern remains on the screen.

To clear the monitor screen reset the terminal by pressing the SHIFT and PF4/RESET keys together.

6.4    ERROR CODES
There are two categories of errors: fatal and nonfatal. Fatal errors cause the terminal to immediately stop all operations. The monitor screen displays random patterns that do not make sense. In addition to the random pattern an error code is displayed on the keyboard indicators. Table 6-2 shows the possible error codes.

The fatal error code displayed on the keyboard light indicators contains two different messages: an error code and a data code. The error code lights the LOCAL indicator and displays a code in the BASIC, HARDCOPY, L1, and L2 indicators. The data code lights the ON-LINE indicator and is displayed in the BASIC, HARDCOPY, L1, and L2 indicators. The VK100 terminal alternates between each message about every one-quarter second.

Table 6-2  Possible Fatal Error Codes

Error Code Displayed

| On Line | Local | No Scroll | Basic | Hard Copy | L 1 | L 2 | Meaning |
|---------|-------|-----------|-------|-----------|-----|-----|---------|
| X | Ø | Ø | Ø | Ø | Ø | Ø | Microprocessor error |
| Ø | X | Ø | X | X | X | X | Data code |
| X | Ø | Ø | Ø | Ø | Ø | X | ROM error |
| Ø | X | Ø | Ø | ? | ? | ? | Data code |
| X | Ø | Ø | Ø | Ø | X | Ø | RAM error |
| Ø | X | Ø | Ø | ? | ? | ? | Data code |
| X | Ø | Ø | Ø | Ø | X | X | CRT controller error |
| Ø | X | Ø | X | X | X | X | Data code |
| X | Ø | Ø | Ø | X | Ø | Ø | CRT controller timeout |
| Ø | X | Ø | X | X | X | X | Data code |
| X | Ø | Ø | Ø | X | Ø | X | Vector timeout error |
| Ø | X | Ø | X | X | X | X | Data code |

X = ON
Ø = OFF
? = variable condition

Nonfatal errors do not halt the terminal processor. Instead, the terminal displays an error code on the keyboard indicators and in the center of the monitor screen. The terminal may still be used if a nonfatal error occurs. In this case, the terminal remains in on-line or local mode with the appropriate indicator lit. The error is indicated by any of the BASIC, HARDCOPY, L1 or L2 indicators blinking. An example of this type of occurrence is a keyboard error. If the self-test detects a keyboard error, the L2 indicator blinks, and the message KB ERR is shown on the monitor screen.

Table 6-3 lists all of the nonfatal error codes the terminal displays and what they mean to the terminal.

Table 6-3   Possible Nonfatal Error Codes

Indicator Error Code

| No Scroll | Basic | Hard Copy | L 1 | L 2 | Screen Code | Meaning |
|---|---|---|---|---|---|---|
| Ø | Ø | B | B | Ø | ID Err | Vector generator and internal communications data loopback error |
| Ø | Ø | B | B | Ø | IT Err | Vector generator and internal communications timeout error |
| Ø | Ø | B | B | B | KC Err | Vector generator, keyboard and communications control signal error |
| Ø | Ø | B | B | B | KD Err | Vector generator, keyboard and internal communications data loopback error |
| Ø | Ø | B | B | B | KT Err | Vector generator, keyboard and internal communications timeout error |

0 = Indicator FF
B = Indicator blinking

6-13

Table 6-3  Possible Nonfatal Error Codes (Cont)

Indicator Error Code

| No Scroll | Basic | Hard Copy | L 1 | L 2 | Screen Code | Meaning |
|---|---|---|---|---|---|---|
| Ø | B | Ø | Ø | Ø | None | Video RAM error |
| Ø | B | Ø | Ø | B | KB Err | Video RAM and keyboard error |
| Ø | B | Ø | B | Ø | IC Err | Video RAM and internal communications control signal error |
| Ø | B | Ø | B | Ø | ID Err | Video RAM and internal communications data loopback error |
| Ø | B | Ø | B | Ø | IT Err | Video RAM and internal communications timeout error |
| Ø | B | Ø | B | B | KC Err | Video RAM, keyboard and internal communications control signal error |
| Ø | B | Ø | B | B | KD Err | Video RAM, keyboard and internal communications data loopback error |
| Ø | B | Ø | B | B | KT Err | Video RAM, keyboard and internal communications timeout error |
| Ø | B | B | Ø | Ø | None | Video RAM and vector generator error |
| Ø | B | B | Ø | B | KB Err | Video RAM, vector generator and keyboard error |

Table 6-3  Possible Nonfatal Error Codes (Cont)

| No Scroll | Basic | Hard Copy | L 1 | L 2 | Screen Code | Meaning |
|---|---|---|---|---|---|---|
| Ø | B | B | B | Ø | IC Err | Video RAM, vector generator and internal communications control signal error |
| Ø | B | B | B | Ø | ID Err | Video RAM, vector generator and internal communications data loopback error |
| Ø | B | B | B | Ø | IT Err | Video RAM, vector generator and internal communications timeout error |
| Ø | B | B | B | B | KC Err | Video RAM, vector generator, keyboard and communications control signal error |
| Ø | B | B | B | B | KD Err | Video RAM, vector generator, keyboard and internal communications data loopback error |
| Ø | B | B | B | B | KT Err | Video RAM, vector generator, keyboard and internal communications timeout error |

Ø = Indicator FF
B = Indicator blinking

## 6.5    TROUBLESHOOTING

The troubleshooting section consists of Tables 6-4 through 6-6. These tables show the indicators error code, screen code and the module to replace.

Table 6-7 shows the on-site recommended spares and their part numbers.

Table 6-8 lists the DIGITAL Servicenter Recommended Spares and their part numbers.

Table 6-4   Fatal Error Codes

Indicator Error Code

| On Line | Local | No Scroll | Basic | Hard Copy | L 1 | L 2 | Meaning | Module to Replace |
|---------|-------|-----------|-------|-----------|-----|-----|---------|-------------------|
| X | Ø | Ø | Ø | Ø | Ø | Ø | Microprocessor error | Logic |
| Ø | X | Ø | X | X | X | X | Data code | |
| X | Ø | Ø | Ø | Ø | Ø | X | ROM error | Logic |
| Ø | X | Ø | Ø | ? | ? | ? | Data code | |
| X | Ø | Ø | Ø | Ø | X | Ø | RAM Error | Logic |
| Ø | X | Ø | Ø | ? | ? | ? | Data code | |
| X | Ø | Ø | Ø | Ø | X | X | CRT controller error | Logic |
| Ø | X | Ø | X | X | X | X | Data code | |
| X | Ø | Ø | Ø | X | Ø | Ø | CRT controller timeout | Logic |
| Ø | X | Ø | X | X | X | X | Data code | |
| X | Ø | Ø | Ø | X | Ø | X | Vector timeout error | Logic |
| Ø | X | Ø | X | X | X | X | Data code | |

X = ON
Ø = OFF
? = Variable condition

## Table 6-5  Nonfatal Error Codes

Indicator Error Code

| No Scroll | Basic | Hard Copy | L 1 | L 2 | Screen Code | Module to Replace |
|-----------|-------|-----------|-----|-----|-------------|-------------------|
| Ø | Ø | Ø | Ø | B | KB Err | Keyboard |
| Ø | Ø | Ø | B | Ø | IC Err | Logic |
| Ø | Ø | Ø | B | Ø | ID Err | Logic |
| Ø | Ø | Ø | B | Ø | IT Err | Logic |
| Ø | Ø | Ø | B | Ø | EC Err | Logic |
| Ø | Ø | Ø | B | Ø | ED Err | Logic |
| Ø | Ø | Ø | B | Ø | ET Err | Logic |
| Ø | Ø | Ø | B | Ø | EM Err | Logic |
| Ø | Ø | Ø | B | Ø | HC Err | Logic |
| Ø | Ø | Ø | B | Ø | HD Err | Logic |
| Ø | Ø | Ø | B | Ø | HT Err | Logic |
| Ø | Ø | Ø | B | B | KC Err | Keyboard and Logic |
| Ø | Ø | Ø | B | B | KD Err | Keyboard and Logic |
| Ø | Ø | Ø | B | B | KT Err | Keyboard and Logic |
| Ø | Ø | B | Ø | Ø | None | Logic |
| Ø | Ø | B | Ø | B | KB Err | Keyboard and Logic |
| Ø | Ø | B | B | Ø | IC Err | Logic |
| Ø | Ø | B | B | Ø | ID Err | Logic |
| Ø | Ø | B | B | Ø | IT Err | Logic |
| Ø | Ø | B | B | B | KC Err | Keyboard and Logic |
| Ø | Ø | B | B | B | KD Err | Keyboard and Logic |
| Ø | Ø | B | B | B | KT Err | Keyboard and Logic |
| Ø | B | Ø | Ø | Ø | None | Logic |
| Ø | B | Ø | Ø | B | KB Err | Keyboard and Logic |
| Ø | B | Ø | B | Ø | IC Err | Logic |
| Ø | B | Ø | B | Ø | ID Err | Logic |
| Ø | B | Ø | B | Ø | IT Err | Logic |
| Ø | B | Ø | B | B | KC Err | Keyboard and Logic |
| Ø | B | Ø | B | B | KD Err | Keyboard and Logic |
| Ø | B | Ø | B | B | KT Err | Keyboard and Logic |
| Ø | B | B | Ø | Ø | None | Logic |
| Ø | B | B | Ø | B | KB Err | Keyboard and Logic |
| Ø | B | B | B | Ø | IC Err | Logic |
| Ø | B | B | B | Ø | ID Err | Logic |
| Ø | B | B | B | Ø | IT Err | Logic |
| Ø | B | B | B | B | KC Err | Keyboard and Logic |
| Ø | B | B | B | B | KD Err | Keyboard and Logic |
| Ø | B | B | B | B | KT Err | Keyboard and Logic |

Ø = Indicator off
B = Indicator blinking

Table 6-6  VK100 Troubleshooting

| Type of Problem | Symptom | Check | Corrective Action |
|---|---|---|---|
| Power | No indicators, no video on monitor, no SET-UP key response, no fan | Line fuse | Replace if open. |
| | | Power cord | Reconnect at both ends. |
| | | | Replace power cord if open. |
| | | Power supply connections J2 and J3 | Reconnect power supply. |
| | | | Replace power supply. |
| | No indicators, no video on monitor, no SET-UP key response. Fan is on. | Check power supply voltages: +12, +5, -12, (Fig. 6-1) | If voltages are wrong replace power supply. If voltages are ok: |
| | | | Replace keyboard. |
| | | | Replace logic board. |
| | No indicators, no SET-UP key response. Fan is on and video present on monitor. | | Replace keyboard. Replace logic module. |
| | No fan, SET-UP key responds, Indicators are on and video is present on monitor. | Fan is obstructed. | Clear obstruction. |
| | | Fan cable. | Replace power supply. |
| | Error code displayed in indicator (self-test error). | | See Tables 6-4 and 6-5. |

Table 6-6  VK100 Troubleshooting (Cont)

| Type of Problem | Symptom | Check | Corrective Action |
|---|---|---|---|
| Video with a color monitor. | No cursor displayed. | HP, HM, or VM SET-UP features are set wrong. | Change SET-UP feature settings. |
| | | Monitor brightness | Increase monitor brightness. |
| | | Monitor power on | Turn monitor power on. |
| | | Have customer check monitor fuse. | Have customer replace monitor fuse. |
| | | Run color bar and screen alignment self-tests. | Replace logic board. |
| | | | Replace video cable. |
| | | Have customer swap monitor with another monitor. | If problem is solved the monitor is bad. Monitor repair is the customer's responsibility. |
| | Wrong color displayed. | Check video connections. | Reconnect video cable. |
| | | | Replace video cable. |
| | | | Have customer adjust monitor. |
| | Incorrect data displayed or sync is lost. | | Replace video cable. |
| | | | Replace logic module. |

Table 6-6   VK100 Troubleshooting (Cont)

| Type of Problem | Symptom | Check | Corrective Action |
|---|---|---|---|
| | | Monitor is bad. | Monitor repair is the customer's responsibility. |
| | No color is displayed. The monitor display is always white. | | Replace logic module. |
| Video with black and white (monochrome) monitor. | No cursor displayed. | HP, HM or VM SET-UP features are set wrong. | Change SET-UP feature settings. |
| | | Monitor brightness. | Increase monitor brightness. |
| | | Monitor power on. | Turn monitor power on. |
| | | Have customer check monitor fuse. | Have customer replace monitor fuse. |
| | | Run color bar and screen alignment self-test. | Replace video cable.<br><br>Replace logic module. |
| | | Have customer swap monitor with another. | If problem is solved, the monitor is bad.<br><br>Monitor repair is the customer's responsibility. |
| | Incorrect data is displayed or sync is lost. | | Replace video cable.<br><br>Replace logic module. |

Table 6-6  VK100 Troubleshooting (Cont)

| Type of Problem | Symptom | Check | Corrective Action |
|---|---|---|---|
| | | Monitor is bad. | Monitor repair is the customer's responsibility. |
| Hardcopy | No hardcopy output (1 or more terminals) | Make sure all VK100 and LA34VA terminals are turned on. | |
| | | Make sure correct I/O cables are used and connected. | |
| | | Perform the hardcopy self-test on all VK100 terminals in the string. | Replace logic module on failing unit. Replace hardcopy cable. |
| | | Perform the LA34VA self-test. | The problem is in the LA34VA. |
| | Wrong data is printed. | Check the SET-UP parameters at VK100 and LA34VA terminals. | Change the SET-UP parameters. |
| | | Perform the hardcopy self-test. | Replace logic module. |
| | | | The problem is in the LA34VA. |

Table 6-6  VK100 Troubleshooting (Cont)

| Type of Problem | Symptom | Check | Corrective Action |
|---|---|---|---|
| Communica-tion | VK100 does not communicate with the host system. | Check the SET-UP parameter settings in the terminal and make sure that they agree with the host system. | Change the SET-UP parameters. |
| | | Perform the external communications self-tests. | Replace logic module. |
| | | | Replace communications cable. |
| | | | The problem is in either the modem (if one is used) or the system. |

Table 6-7  On-Site Recommended Spares

| Qty | Description | Part Number |
|---|---|---|
| 1 | Logic module | 54-14230-00 |
| 1 | Power supply assembly | 70-17387-00 |
| 1 | Keyboard assembly | 70-17397-FS |
| 1 | Y type cable | 17-00197-00 |
| 1 | Video cable, coaxial | 17-00223-00 |
| 1 | Loopback connector (EIA) | 12-15336-00 |
| 1 | Loopback connector (20 mA) | 70-15503-00 |
| 1 | Power cord (115 V) | 17-00083-09 |
| 1 | Power cord (230 V) | 17-00083-10 |
| 1 | Power cable (dc) | 70-17389-00 |
| 10 | Plunger, 5/16 dia. | 90-09964-00 |
| 10 | Grommet, snap-in, 5/16 dia. | 90-09966-01 |
| 4 | Screw, sems, slotted head, 4-40 X 3/8 | 90-09702-00 |
| 1 | Fuse, 2 A, 250 V box of 5 | 90-07215-00 |
| 4 | Screw, sems, slotted head, 10-32 X 3/8 | 90-06444-00 |
| 1 | Keycap removal tool | 74-16355 |

Table 6-8   DIGITAL Servicenter Recommended Spares

| Qty | Description | Part Number |
|-----|-------------|-------------|
| 1 | Logic module | 54-14230-00 |
| 1 | Power supply assembly | 70-17387-00 |
| 1 | Power supply module (PCB only) | 12-16987-00 |
| 1 | Power cable (dc) | 70-17389-00 |
| 1 | Receptacle assembly (ac) | 70-17411-00 |
| 1 | Power cord (115 V) | 17-00083-09 |
| 1 | Power cord (230 V) | 17-00083-10 |
| 1 | Power switch, 2-pole, 16 A | 12-17051-00 |
| 1 | Fan assembly | 12-16488-00 |
| 1 | Fuseholder | 12-16931-00 |
| 1 | Keyboard assembly | 70-17397-FS |
| 1 | Keyboard distribution cable | 70-17390-00 |
| 10 | Indicator, ANCD @ 10 mA | 11-10864-00 |
| 10 | Keyboard plunger | 12-11862-00 |
| 10 | Keyboard spring | 12-11863-00 |
| 20 | Keyboard contact, quadfurcated | 12-11865-00 |
| 20 | Keyboard contact | 12-11866-00 |
| 1 | Switch, array cap. solid adapter | 12-14332-00 |
| 1 | Fuse, reg. blow, 2 A 250 V (box of 5) | 90-07215-00 |
| 2 | Screw, Sems, slotted head, 10-32 X 3/8 | 90-06444-00 |
| 10 | Support, C Bd. standoffs | 90-09313-00 |
| 10 | Screw, Sems, slotted head, 4-40 X 3/8 | 90-06444-00 |
| 10 | Plunger, 5/16 dia. | 90-09964-00 |
| 10 | Grommet, snap-in, 5/16 dia. | 90-09966-01 |
| 10 | Screw, captive, hex slotted | 12-16682-00 |
| 10 | Bumper, round | 90-09538-00 |
| 10 | Bumper, square | 90-09624-00 |
| 10 | Fastener, pinch-on | 90-09601-00 |
| 10 | Screw, hex head, slotted, 6-32 X 5/16 | 90-09967-00 |
| 2 | Case, bottom | 70-17394-00 |
| 2 | Case, top | 70-17395-00 |
| 1 | Y type cable | 17-00197-00 |
| 1 | Video cable, coax | 17-00223-00 |
| 1 | Loopback connector (EIA) | 12-15336-00 |
| 1 | Loopback connector (20 mA) | 70-15503-00 |
| 2 | Foam insert, top | 99-06742-00 |
| 2 | Foam insert, bottom | 99-06742-01 |
| 2 | Carton, die-cut | 99-06793-00 |
| 2 | Polybag | 99-05128-17 |
| 2 | Tape | 99-06486-00 |

## 6.6    ADJUSTMENTS

The VK100 is <u>not</u> adjustable. All power supply and video outputs are constant. The appropriate module must be replaced if an output is low or not present.

The video monitor <u>is</u> adjustable. The monitor is provided by the customer and is the responsibility of the customer. Adjustments to the monitor must be made by the customer or a service technician who has been qualified by the monitor manufacturer. DIGITAL does not supply any monitor for use with the VK100 terminal.

The best way to determine if the monitor requires adjustment is to swap the suspected bad monitor with one that is working correctly. If the problem disappears the monitor is bad. If the problem remains the VK100 terminal contains a problem. Use the procedures in Chapters 2 and 3 to test the terminal and locate the problem.

## 6.7    REMOVAL AND REPLACEMENT

To remove or replace a subassembly, the only tools necessary are:

    Common blade screwdriver or
    1/4 inch nutdriver

**Figure** 6-2 lists all removal procedures in this chapter and the sequence in which they are performed. As an example, Figure 6-2 shows that to remove the terminal logic board the top cover, keyboard assembly, and power supply assembly removal procedures must be performed first.
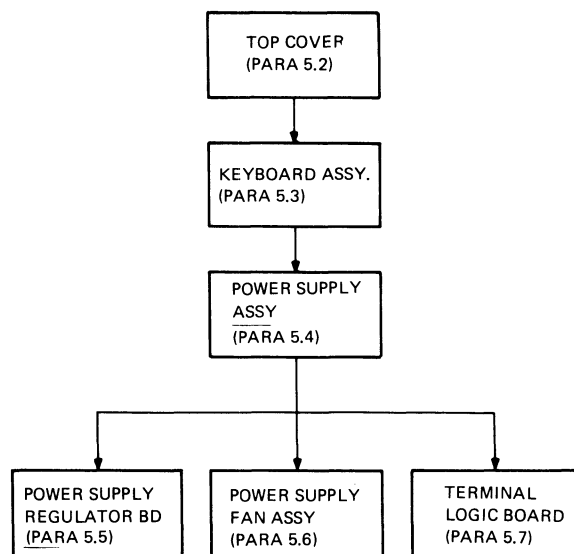


Figure 6-2   Module Removal Sequence

### 6.7.1 Top Cover Removal

To remove the top cover perform the following steps.

1. Remove power from the terminal by disconnecting the ac plug.

2. Turn the terminal over so that the bottom of the terminal is accessible.

3. Loosen the four (4) captive screws at the corners of the terminal (Figure 6-3). The screws may be loosened with either a nutdriver or a blade-type screwdriver.

4. Grasp the top and bottom halves of the terminal and turn the terminal over so that the keyboard is face up.

5. Grasp the top cover by its sides and lift the cover up and off the terminal.

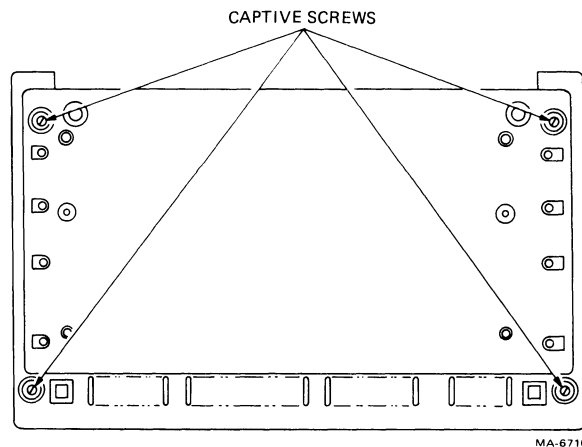6. Install the top cover by performing steps 1 through 5 in reverse.

CAPTIVE SCREWS

MA-6710

Figure 6-3   VK100 Terminal (Bottom View)

## 6.7.2 Keyboard Assembly Removal
To remove the keyboard assembly perform the following steps.

1. Remove the terminal top cover (Paragraph 6.7.1).

2. Release the four (4) pop fasteners securing the keyboard assembly to the terminal (Figure 6-4). To release the pop fasteners pull up on the plungers.

3. Gently remove the keyboard assembly from the terminal and place it in front of the terminal.

4. Disconnect the keyboard ribbon cable from the logic board.

> ### CAUTION
> Do not disconnect the keyboard ribbon cable from the keyboard. Any attempts to do so will damage the connector and force replacement of the entire keyboard assembly.

5. Remove the keyboard assembly.

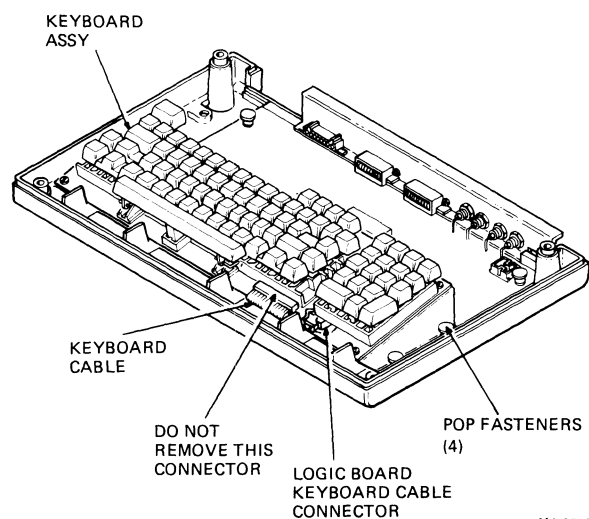6. Install the keyboard assembly by performing steps 1 through 5 in reverse.

Figure 6-4  Keyboard Assembly Removal

### 6.7.3    Power Supply Assembly Removal

To remove the power supply assembly perform the following steps.

1.    Remove the terminal top cover (Paragraph 6.7.1).

2.    Remove the keyboard assembly (Paragraph 6.7.2).

3.    From the rear of the terminal, remove the grounding screw securing the connector bracket to the power supply chassis (Figure 6-5). The screw may be removed with either a nutdriver or a blade-type screwdriver.

4.    Release the four (4) pop fasteners securing the power supply assembly to the terminal (**Figure 6-6**). To release the pop fasteners pull up on the plungers.
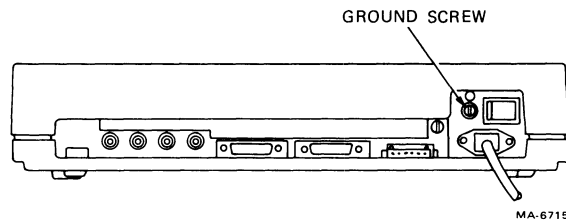


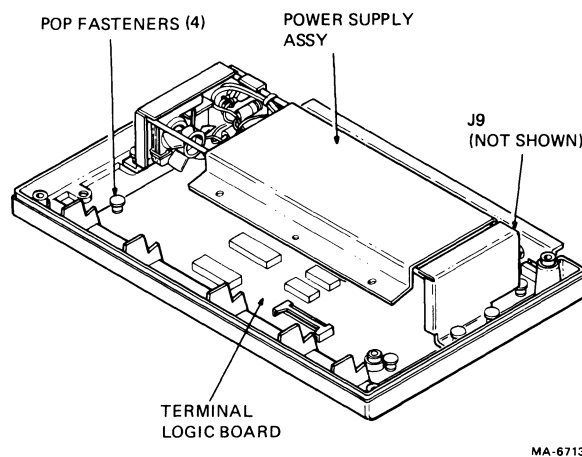Figure 6-5   VK100 Terminal (Rear View)



Figure 6-6   Power Supply Assembly Removal

5.  Gently remove the power supply assembly from the terminal and place it next to the rear edge of the terminal.

6.  Disconnect the 6-wire power output cable from J9 on the terminal logic board.

7.  Remove the power supply assembly.

                              NOTE
            P14 connects to J14 for 115 V operation,
            or P14 connects to J13 for 230 V
            operation.

8.  Install the power supply assembly by performing steps 1 through 6 in reverse.

6.7.4    Power Supply Regulator Board Removal
To remove the power supply regulator perform the following steps.

1.  Remove the terminal top cover (Paragraph 6.7.1).

2.  Remove the keyboard assembly (Paragraph 6.7.2).

3.  Remove the power supply assembly (Paragraph 6.7.3).

4.  Disconnect the 3-wire connector from J11 on the regulator board.

5.  Disconnect the 6-wire connector from J14 (115 V) or J13 (230 V) on the regulator board.

6.  Remove the power output cable from J10 on the regulator board.

7.  Remove the four (4) screws securing the regulator board to the power supply chassis. Remove the regulator board. The screws may be removed with either a nutdriver or a blade-type screwdriver.

8.  Install the power supply assembly by performing steps 1 through 6 in reverse.

## 6.7.5    Power Supply Fan Assembly Removal
To remove the power supply assembly perform the following steps.

1.    Remove the terminal top cover (Paragraph 6.7.1).

2.    Remove the keyboard assembly (Paragraph 6.7.2).

3.    Remove the power supply assembly (Paragraph 6.7.3).

4.    Disconnect the 6-wire connector from J14 (115 V) or J13 (230 V) on the power supply regulator board.

5.    Remove the two (2) screws securing the fan assembly to the power supply chassis **(Figure 6-7)**. The screws may be removed with either a nutdriver or a blade-type screwdriver.

6.    Install the power supply assembly by performing steps 1 through 4 in reverse.
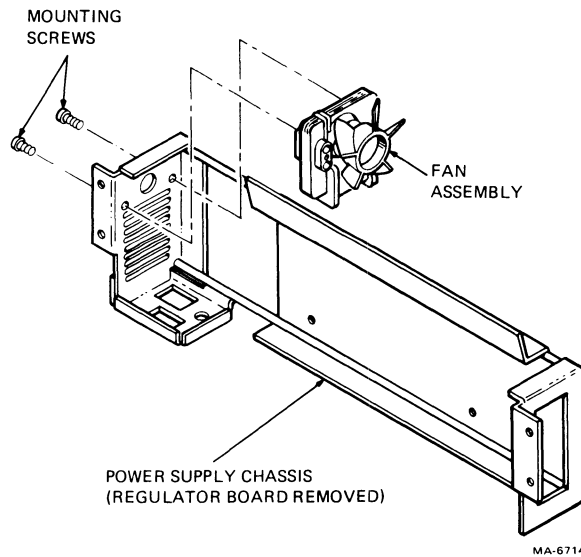


Figure 6-7   Power Supply Fan Assembly Removal

## 6.7.6 Terminal Logic Board Removal
Perform the following steps to remove the terminal logic board.

1.  Remove the terminal top cover (Paragraph 6.7.1).

2.  Remove the keyboard assembly (Paragraph 6.7.2).

3.  Remove the power supply assembly (Paragraph 6.7.3).

4.  Release the four (4) pop fasteners securing the logic board to the bottom cover (**Figure 6-8**). To release the pop fasteners pull up on **the** plungers.

5.  Remove the terminal logic board.

6.  Install the terminal logic board by performing steps 1 through 5 in reverse.

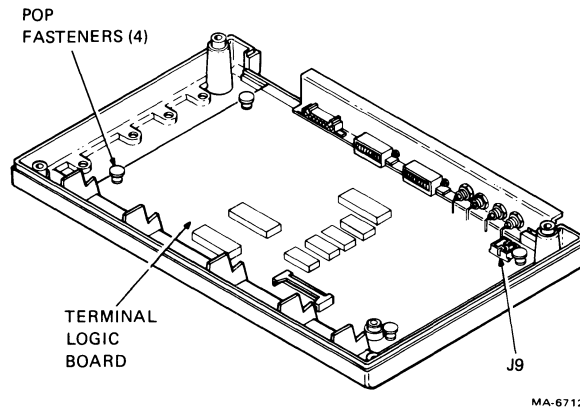7.  Be sure to set the default SET-UP switches to the customer settings.

Figure 6-8   Terminal Logic Board Removal

VK100 TERMINAL SPECIFICATIONS

Dimensions

| | |
|---|---|
| Height | 9.88 cm (3.89 in) |
| Width | 49.30 cm (19.40 in) |
| Depth | 31.10 cm (12.25 in) |

Weight

| | |
|---|---|
| Shipping weight | 5.7 kg (12.5 lbs) |

Environment

Operating

| | |
|---|---|
| Temperature | 10` to 40` C (50` to 104` F) |
| Relative humidity | 10% to 90% |
| Max wet bulb | 28` (82` F) |
| Min dew point | 2` C (36` F) |
| Altitude | 2.4 km (8,000 ft) |

Nonoperating

| | |
|---|---|
| Temperature | -40` to 66` C (-40` to 151` F) |
| Relative humidity | 5% to 95% |
| Altitude | 9.1 km (30,000 ft) |

Power

| | |
|---|---|
| Line voltage | 90--128 V RMS single phase, 2 wire with ground wire 180--256 V RMS single phase, 2 wire with ground wire (internally selectable) |
| Line frequency | 46 Hz to 61 Hz |
| Current | 1.3 Arms max at 115 Vrms 0.7 Arms max at 230 V |

**Power**

| | |
|---|---|
| Input power | 120 VA apparent, 60 W max |
| Current limiting | 2 A/250 V normal blow fuse |
| Power cord | 2.0 m (6.5 ft), 3 prong |

**Product Safety**  
UL: Listing per UL 478  
CSA: certification per CSA  
C22.2. No. 154  
IEC 435 and VDE 0804  
compliance

**Program Memory**  
13K bytes available to the user  
and down-line loadable:  
7.8K for BASIC programs  
2+K for ReGIS macrographs and  
keypad key definitions  
three soft character sets each  
95 X 10 X 8 bytes

**Display Outputs**

**Text mode**  
24 lines X 84 characters max  
or 24 lines X 42 double-width  
characters

| | |
|---|---|
| Character | 8 X 10 dot matrix with descenders |
| Character set | 95-character displayable ASCII subset (upper and lowercase, numeric and punctuation) |
| Text cursor type | Blinking block character; can be disabled in SET-UP |

**Graphics mode**  
768 pixels horizontal  
240 pixels vertical

| | |
|---|---|
| Graphic cursor type | Diamond shape with cross hair in the center; can be disabled in SET-UP |
| Locator cursor type | Large cross hair |

| | |
|---|---|
| Graphic pattern memories | Permanent UK/US ASCII character set: 128 characters, 8 X 10 dot matrix |
| | Three user programmable and down-line loadable soft alphabet character sets: 95 characters each, 8 X 10 dot matrix |
| Visual attributes | Four bits per segment of 12 horizontal pixels<br>Eight levels of grey for black and white monitors<br>Eight colors for color monitor: black, blue, red, magenta, green, cyan, yellow, and white<br>Blink |
| **Video outputs** | Output to drive one black and white (composite video) and one color (RGB) monitor (with composite green video) simultaneously |
| | Adjustable horizontal and vertical margins to accommodate monitor overscan |
| | Adjustable horizontal centering 50/60 Hz refresh, noninterlaced or interlaced |

**Keyboard**

| | |
|---|---|
| General | 83-key unit |
| Key layout | 65-key arrangement and sculpturing similar to standard typewriter keyboard, with an 18-key auxiliary keypad |
| Auxiliary keyboard | 18-key numeric pad with period, comma, minus, ENTER, and four function keys |
| Visual indicators | Seven indicators: five indicators dedicated to ON-LINE, LOCAL, NO SCROLL, BASIC and HARD COPY; two indicators user-programmable |

## Keyboard

Audible signals | Keyclock: sound simulates typewriter
Bell: sounds upon receipt of BEL code, or
sounds nine characters from right margin (keyboard selectable)

## Communication

Type | EIA RS-232-C/CCITT V 24 or 20 mA passive current loop (keyboard selectable)

Speeds | Full-duplex: 110 (two stop bits), 300, 600, 1,200, 2,400 4,800, 9,600 and 19,200 baud; transmit and receive speeds are independent of each other

Code | ASCII

Character format | Asynchronous serial

Character size | Eight bits including parity bit

Parity | Even, odd, or none (keyboard selectable)

Synchronization | Keyboard selectable via automatic generation of XON/XOFF control codes

Modes | Normal line, single character, local echo (keyboard selectable)

Hardcopy Interface | Drive an LA34VA graphics printer with daisy-chaining capability

Auto hardcopy

CALCULATION #1
Error Register =    2
DVM Register   = 374 (1's complement of 3)
Carry In       =    1
Error Register = $\overline{377}_8$
                No Carry   Decrement
Strobe                     Major and Minor Axis

Error Register = $377_8$
DU Register    = $\underline{005}_8$
Error Register = $\overline{004}_8$
                Carry

Strobe

Direction -- Decrement X and Y
Do a Pixel Write
Decrement Down Counter
     5 - 1 = 4
Downcounter = 4

   RULES AND DRAW VECTOR

1.  Do not write in direction if
    2 from an odd line or
    6 from an even line.

2.  Do not write if the direction is
    5 or 7, the scan line is even
    (Y0) and the last direction was 6.

3.  Do not write if the direction is
    1 or 3, the scan line is odd and
    the last direction was 2.
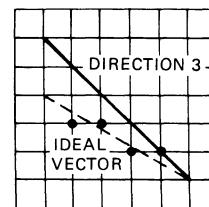


MA-9756

**CALCULATION #2**

$$\text{Error Register} = 004_8$$
$$\text{DVM Register} = 374_8$$
$$\text{Carry In} = \underline{\phantom{00}1}$$
$$\text{Error Register} = \overline{001}$$

                 Carry     <u>Decrement</u>
                            <u>Major Axis</u>

Strobe $\rightarrow$ Set Carry$_{FF}$

$$\text{Error Register} = 001_8$$
$$\text{DU Register} = \underline{005_8}$$
$$\overline{006}_8$$

$$\text{Error Register} = 001_8 \qquad \text{(No Error CLK)}$$

Strobe

Direction -- Decrement X
Do a Pixel Write
Decrement Down Counter
     4 - 1 = 3

   **DRAW VECTOR**
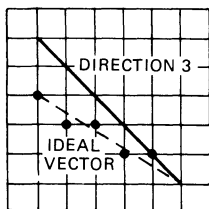


MA-9757

**CALCULATION #3**

```
Error Register =    1
DVM Register   = 374
Carry In       =    1
Error Register = 376
                No Carry   Decrement
Strobe                     Major and Minor Axis

Error Register = 376
DU Register    = 005
Error Register = 003
                Carry
Strobe
```
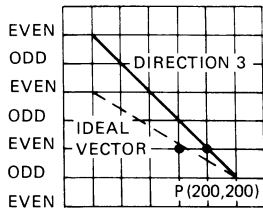
Direction -- Decrement X and Y.
Do a Pixel Write
Decrement Down Counter
     3 - 1 = 2

**DRAW VECTOR**



MA-9758

CALCULATION #4

```
Error Register = 003
DVM Register   = 374
Carry In       =   1
Error Register = 000
                 Carry   Decrement
Strobe                   Major Axis


Error Register = 000
DU Register    = 005
                 005
Error Register = 000

Strobe

Direction -- Decrement X
Do a Pixel Write
Decrement Down Counter
      2 - 1 = 1
```

**DRAW VECTOR**



```
ODD    Y=1
EVEN   Y=0    DIRECTION 3
ODD    Y=1
EVEN   Y=0   IDEAL
ODD    Y=1   VECTOR
EVEN   Y=0
                 P (200,200)
             MA-9759
```

```
CALCULATION #5
Error Register  = 000
DVM Register    = 374
Carry In        = 001
Error Register  = 375
                      No Carry  Decrement
Strobe                          Major and Minor Axis

Error Register  = 375
DU Register     = 005
Error Register  = 002
                      Carry
Strobe

Direction -- Decrement X and Y
Do a Pixel Write
Decrement Down Counter
     1 - 1 = 0

    DRAW VECTOR

VECTOR COMPLETE
```

**digital**

EK-VK100-IP-001

# ILLUSTRATED PARTS BREAKDOWN

# VK100
# GIGI TERMINAL

## HOW TO USE THE IPB

### GENERAL
This IPB is compiled following the organization and nomenclature of the engineering drawing structure.

### MAJOR ASSEMBLY LOCATOR
The Major Assembly Locator (first illustration) is an index that provides a description and a figure reference for all illustrations used in this manual.

### INDENTED PARTS LIST
This manual identifies each assembly being broken down (figure reference callout), and all parts of that assembly. Further breakdown of an assembly is shown by an asterisk (*) preceding the item callouts in the Description Column. The number of asterisks preceding an item is used to denote the subordination of that item with respect to the Major Assembly. A single asterisk preceding an item description indicates that the item is part of the major assembly being illustrated. Items that are subordinate to single asterisks items, are denoted by two asterisks (**) and immediately follow the related single asterisk item. Additional asterisks are used, as required, to denote further subordination. This system of part identification, provides a means for the user to identify the next higher assembly item and make alternate selections for parts when the required replacement part or assembly is not immediately available.

### COLUMN CALLOUT DESCRIPTION
**Figure & Item** — Indicates the figure number and item number of each part.

**Description** — Lists the name of the part and pertinent specifications (when required). Asterisks preceding the description denote the subordination of the part to the next higher assembly.

**DEC Part No.** — Lists the DEC part ordering number. A blank in this column indicates a DEC part number was not assigned at the time of publication.

**ECO Cut-In** — The notation at the top of this column indicates the ECO level of the system (option), at which the IPB was initially prepared. Subsequent ECO level designations, that modify existing parts or add new parts to the device, are inserted in the ECO Cut-In column next to the part that is added or modified. A bracket ([) preceding the item description is used to indicate the parts affected by ECO's.

**Vendor Code/Part No.** — Indicates vendor parts that are not stocked by DEC. Refer to the Field Service Spares Catalog (vendor part number to DEC part number) for the vendor code cross-reference.

**Used On Code** — Letters in this column correspond to the variation codes assigned in Figure 1. Parts with an Alpha notation(s) are used only in those option variations. A blank indicates that the part is used on all option variations.

**Ref Fig No.** — A cross reference between illustrations. For each Major Assembly, the number in this column denotes the figure of the next higher assembly. For all subassemblies, the number in this column denotes the figure showing additional detailed breakdown.

### SYMBOL USAGE
**Hardware Designators** — Alpha designators for screws (S), washers (W), nuts (N), and retaining rings (R) are inserted after the item number callouts on the illustration when stacked item numbers are used.

**Attaching Hardware** — The @ symbol is inserted before any part that is used as attaching hardware. Attaching hardware is denoted as those parts that are not an integral part of the referenced assembly.

**(NFR) Not Field Repairable** — The (NFR) symbol is inserted after any assembly that is not to be field dismantled.

**Other Symbols** — Any other symbols that are required for kits, accessories, etc., will be explained and appear as part of the item description.
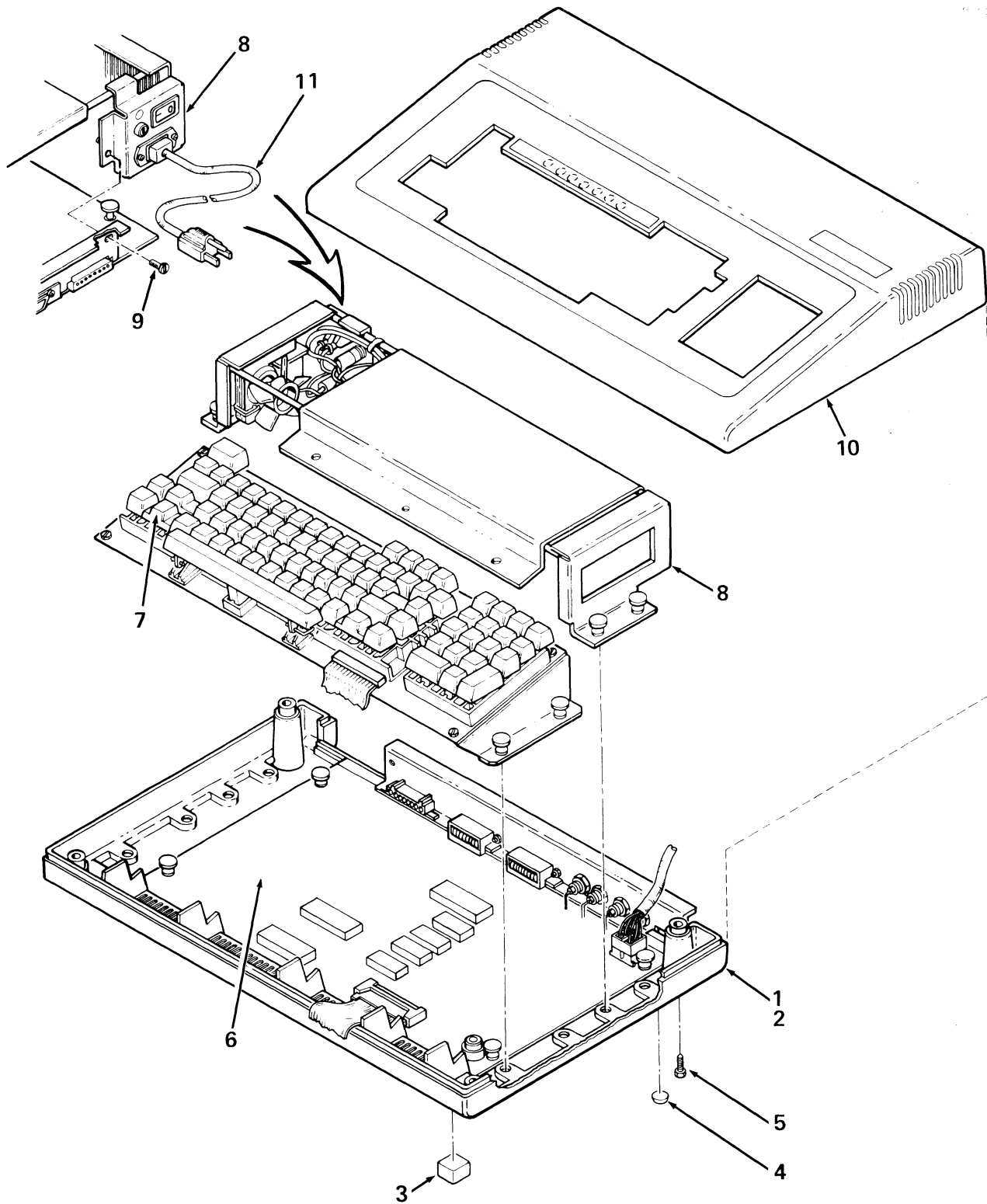
| REVISION HISTORY | | | | OTHER IPB MANUALS REQUIRED TO SUPPORT THIS OPTION........ |
|---|---|---|---|---|
| PRINTING | ECO LEVEL | DATE | PAGES AFFECTED | |
| 1st Printing | VK100 00000-00000<br>70-17387 00000-00000<br>70-17397 00000-00000<br>70-17484 00000-00000<br>54-14228 00000-00000<br>70-17388 00000-00000<br>70-17389 00000-00000<br>70-17411 00000-00000 | 9-29-81 | N/A | N/A |

VK100-01

*Figure 1. VK100 GIGI Terminal*

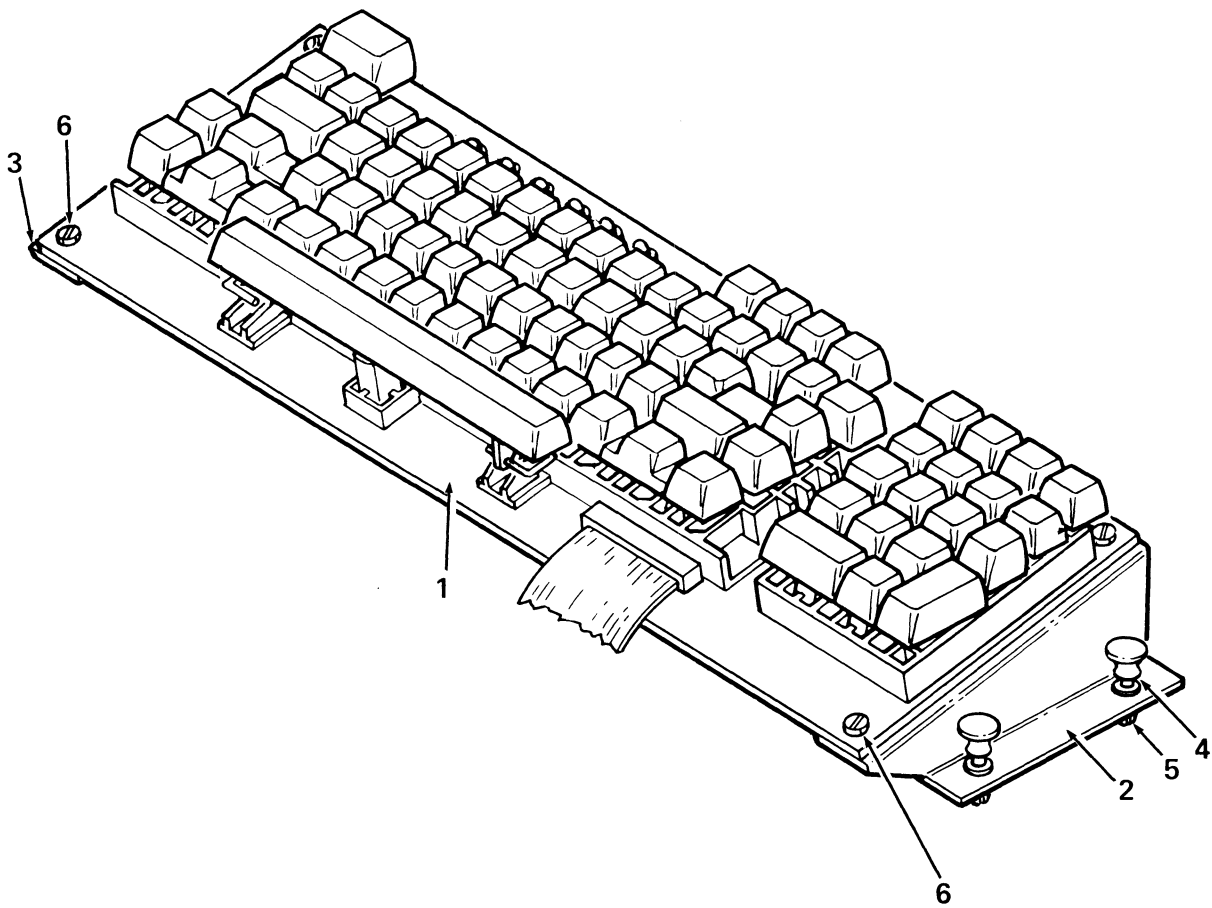| FIG. & ITEM NO. | DESCRIPTION | DEC PART NO. | ECO CUT-IN VK100 00000 | USED ON CODE | REF FIG NO. |
|---|---|---|---|---|---|
| 1— | VK100 GIGI TERMINAL | | | | |
| | Code A — Used on Model VK100-AA 115V | VK100-AA | | A | |
| | Code B — Used on Model VK100-AB 230V | VK100-AB | | B | |
| | | | | | |
| 1 | *KEYBOARD BASE ASSEMBLY | 70-17394-00 | | | |
| 2 | **Enclosure, Bottom Keyboard | 74-23626-00 | | | |
| 3 | **Bumper, Square (Adhesive Backed) | 90-09624-00 | | | |
| 4 | **Bumper, Self Stick | 90-09538-00 | | | |
| 5 | **Screw, Slotted Hex Hd No. 6-32 x 3/4 | 12-16682-00 | | | |
| 6 | *VK100 Logic Board | 54-14230-00 | | | |
| 7 | *KEYBOARD/KEYCAP ASSEMBLY | 70-17397-00 | | | 3 |
| 8 | *POWER SUPPLY ASSEMBLY 115V | 70-17387-00 | | A | 2 |
| | *POWER SUPPLY ASSEMBLY 230V | 70-17387-01 | | B | 2 |
| 9 | *Screw, Slotted Hex Hd No. 6-32 x 5/16 | 90-09967-00 | | | |
| 10 | *Keyboard Top Assembly | 70-17409-00 | | | |
| 11 | *Power Cord 115V | 17-00083-09 | | A | |
| | *Power Cord 230V | 17-00083-10 | | B | |
| | | | | | |
| | Labels (Not Shown) | | | | |
| | *Label, "Electrical Data" Rear Panel | 36-17318-00 | | | |
| | *Label, "Electrical Data" | 36-13209-00 | | | |
| | *Label, "FCC Class A Processor" | 36-17880-02 | | A | |

16 → Part of Item 11
16 → Part of Item 8
1

A

3
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17
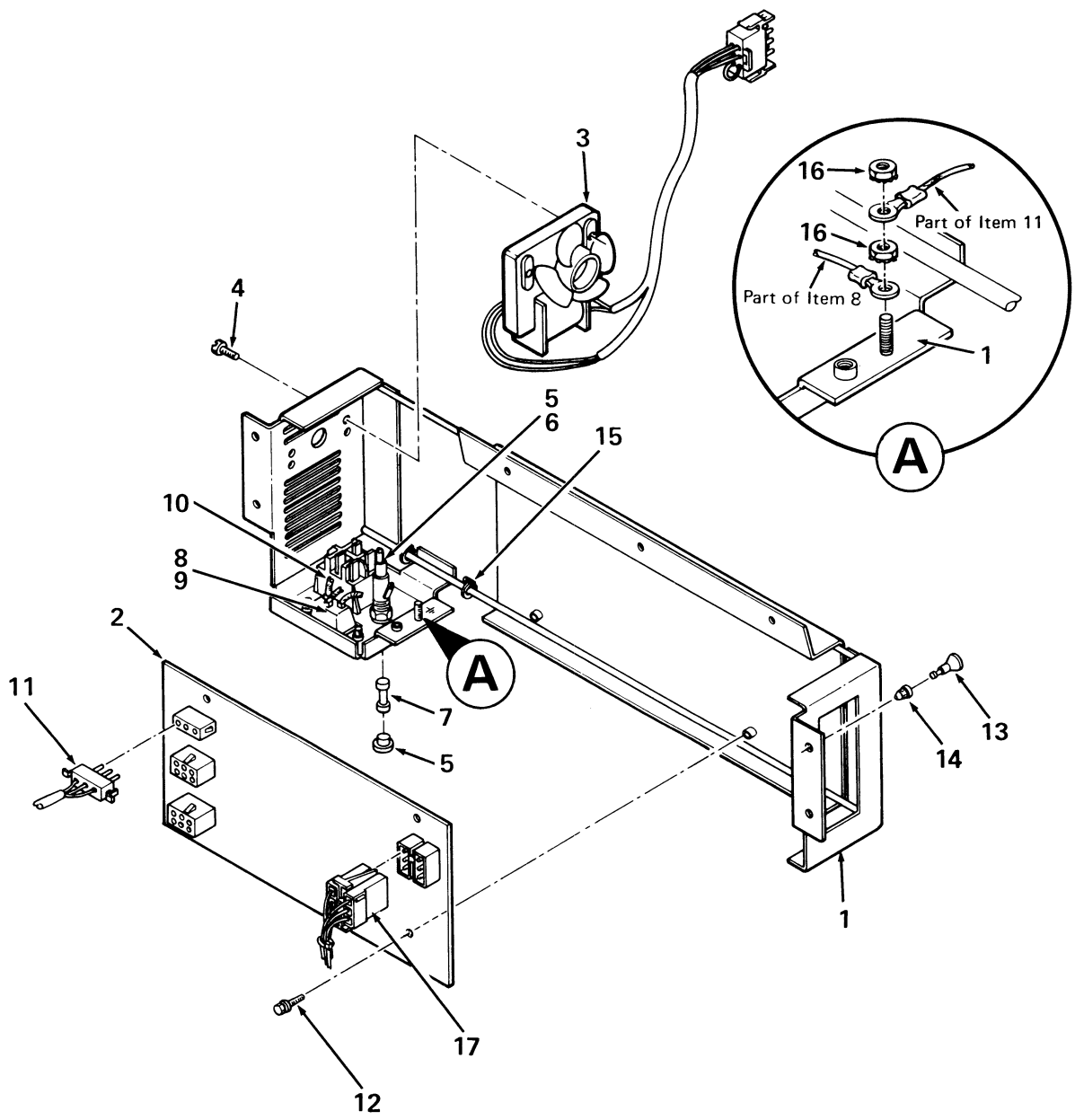
VK100-02

*Figure 2. Power Supply Assembly*

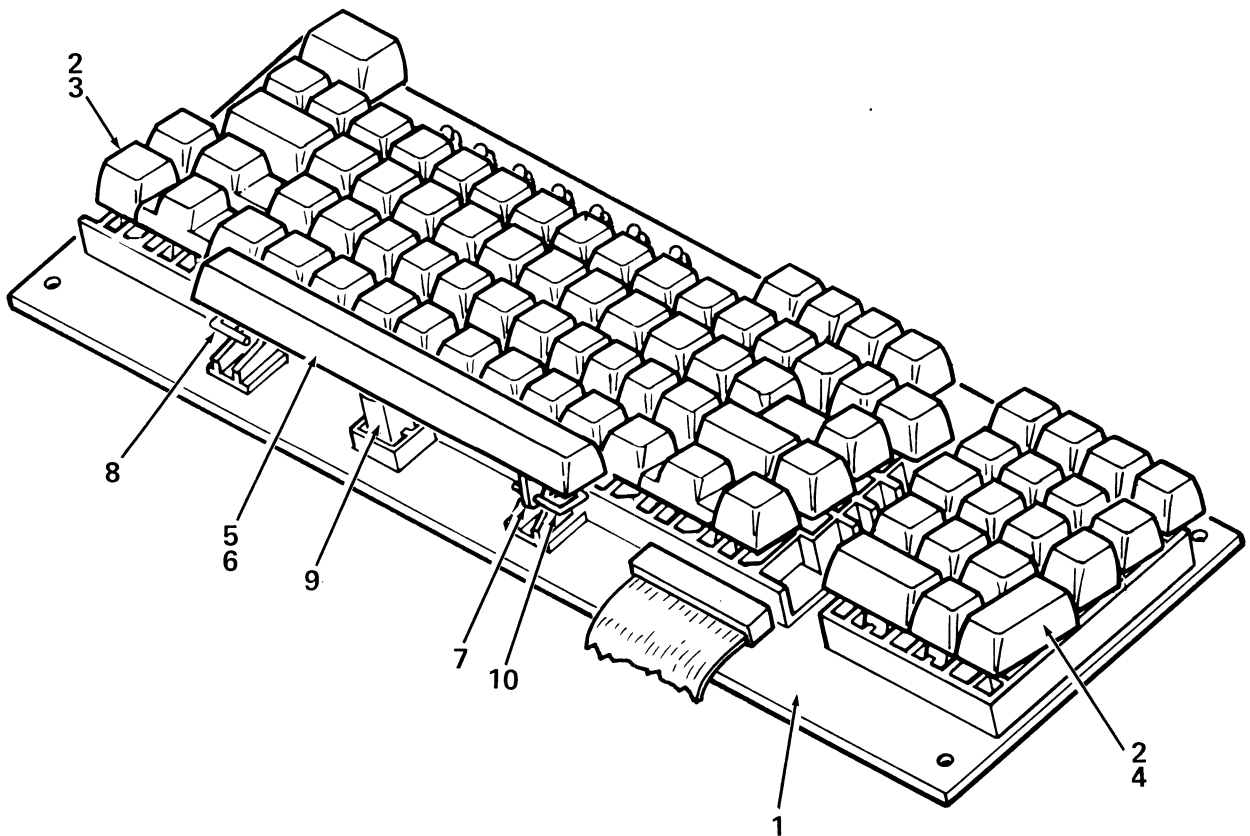| FIG. & ITEM NO. | DESCRIPTION | DEC PART NO. | ECO CUT-IN 70-17387 00000 | USED ON CODE | REF FIG NO. |
|---|---|---|---|---|---|
| 2— | POWER SUPPLY ASSEMBLY 115V | 70-17387-00 | | A | 1 |
| | POWER SUPPLY ASSEMBLY 230V | 70-17387-01 | | B | 1 |
| | | | | | |
| 1 | *Power Supply Chassis Assembly | 70-17483-00 | | | |
| 2 | *Power Supply, Switching | 12-16987-00 | | | |
| 3 | *Fan Assembly 115/230V 50-60 HZ | 12-16488-01 | | | |
| 4 | *Screw, Slotted Hex Hd No. 10-32 x 3/8 | 90-06444-00 | | | |
| 5 | *Fuseholder, (F1) 12A 250V | 12-16391-00 | | | |
| 6 | *Tubing, Shrink | 91-07685-00 | | | |
| 7 | *Fuse, 2A 250V | 90-07215-00 | | | |
| 8 | *A.C. RECEPTACLE ASSEMBLY | 70-17411-00 | | | 8 |
| 9 | *Screw, Slotted Pan Hd No. 4-40 x 3/8 | 90-09702-00 | | | |
| 10 | *Switch Rocker (2 Position) | 12-17051-00 | | | |
| 11 | *A.C. WIRING HARNESS ASSEMBLY | 70-17388-00 | | | 6 |
| 12 | *Screw, Slotted Hex Hd No. 6-32 x 5/16 | 90-09967-00 | | | |
| 13 | *Plunger | 90-09964-00 | | | |
| 14 | *Grommet, Snap-In | 90-09966-01 | | | |
| 15 | *Cable Tie (Bundle) | 90-07031-00 | | | |
| 16 | *Nut, Kep No. 10-32 | 90-06565-01 | | | |
| 17 | *D.C. POWER CABLE ASSEMBLY | 70-17389-0J | | | 7 |
| | | | | | |
| | Decals/Labels (Not Shown) | | | | |
| | *Label, "Danger Stored High Voltage" | 36-16930-00 | | | |
| | *Label, "2 A 250V" | 36-17165-00 | | | |
| | *Label, "Power Supply" | 90-09255-00 | | | |
| | *Decal, "Ground" | 36-12680-00 | | | |

| FIG. & ITEM NO. | DESCRIPTION | DEC PART NO. A | ECO CUT-IN 70-17397 00000 | USED ON CODE | REF FIG NO. |
|---|---|---|---|---|---|
| 3– | KEYBOARD/KEYCAP ASSEMBLY | 70-17397-00 | | | 1 |
| 1 | *VK100 KEYBOARD/KEYCAP ASSEMBLY | 70-17484-00 | | | 4 |
| 2 | *Bracket, Key Array Support (R.H.) | 74-23702-00 | | | |
| 3 | *Bracket, Key Array Support (L.H.) | 74-23702-01 | | | |
| 4 | *Plunger | 90-09964-00 | | | |
| 5 | *Grommet, Snap-In | 90-09966-01 | | | |
| 6 | *Screw, Slotted Hex Hd No. 6-32 x 5/16 | 90-09967-00 | | | |



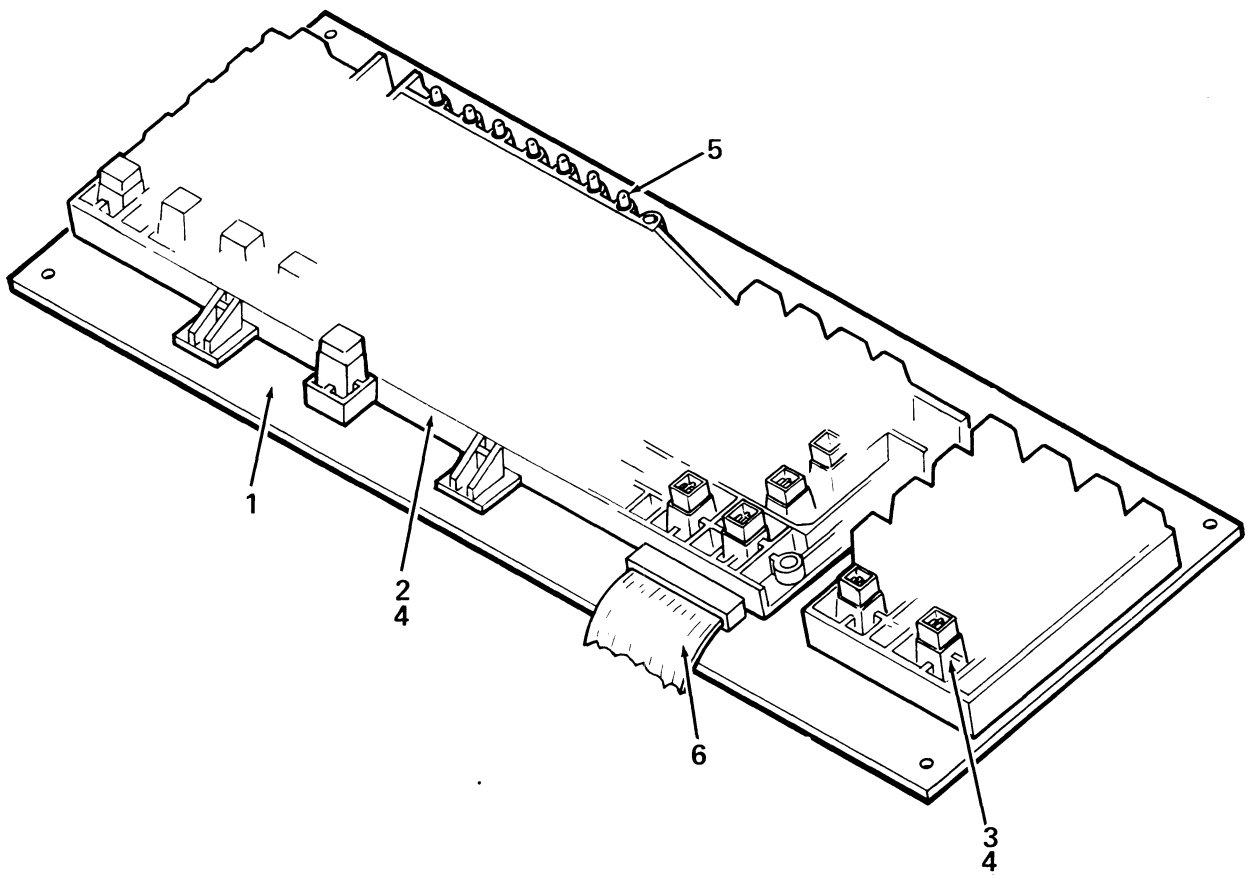VK100-03

Figure 3.  Keyboard/Keycap Assembly

| FIG. & ITEM NO. | DESCRIPTION | DEC PART NO. | ECO CUT-IN 70-17484 00000 | USED ON CODE | REF FIG NO. |
|---|---|---|---|---|---|
| 4— | VK100 KEYBOARD/KEYCAP ASSEMBLY | 70-17484-00 | | | 3 |
| 1 | *VK100 KEYBOARD MODULE ASSEMBLY | 54-14228-00 | | | 5 |
| 2 | *Adapter, Keycap | 12-14332-00 | | | |
| 3 | *Keycap Set (Basic Set) | 12-14333-72 | | | |
| 4 | *Keycap Set (Basic Numeric Pad) | 12-14333-LA | | | |
| 5 | *SPACE BAR ASSEMBLY | 70-15050-00 | | | |
| 6 | **Bar, Space | 12-11857-02 | | | |
| 7 | **Bracket, Space Bar | 74-24159-00 | | | |
| 8 | **Bar, Equalizer | 12-11858-00 | | | |
| 9 | **Switch, Keyboard Cap Tilted | 12-11860-00 | | | |
| 10 | *Clip, Space Bar Equalizer | 74-24160-00 | | | |



VK100-04

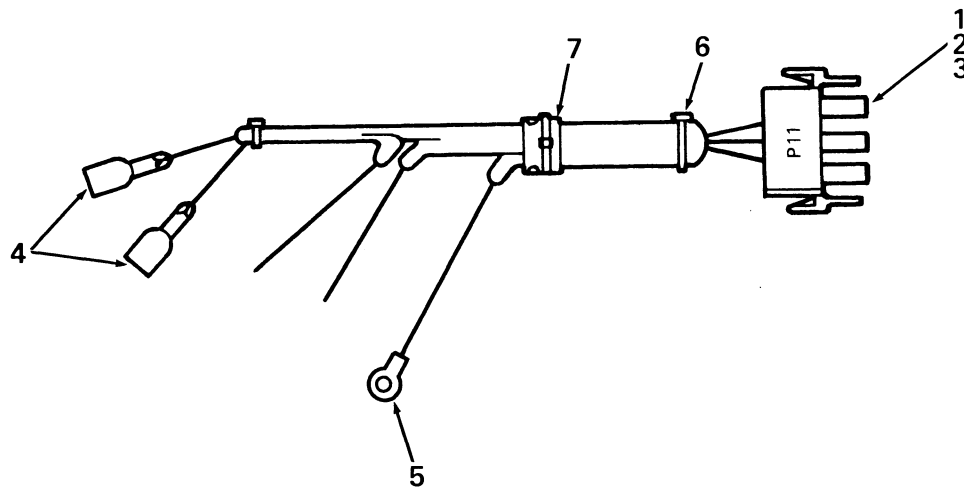*Figure 4.   VK100 Keyboard/Keycap Assembly*

| FIG. & ITEM NO. | DESCRIPTION | DEC PART NO. | ECO CUT-IN 54-14228 00000 | USED ON CODE | REF FIG NO. |
|---|---|---|---|---|---|
| 5— | VK100 KEYBOARD MODULE ASSEMBLY | 54-14228-00 | | | 4 |
| 1 | *Board, Etch (Rev. C) | 50-14227-00 | | | |
| 2 | *Keyboard Array Assembly | 70-13910-00 | | | |
| 3 | *18 Key Numeric Pad Assembly | 70-14561-00 | | | |
| 4 | *Screw, Phl Pan Hd No. 4-24 x 3/8 | 90-10033-00 | | | |
| 5 | *LED 2MCD 10MA | 11-10864-00 | | | |
| 6 | *Keyboard Distribution Cable Assembly | 70-17390-0J | | | |



VK100-05

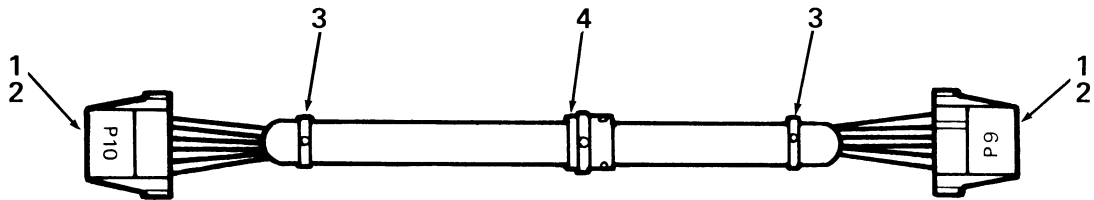Figure 5.   VK100 Keyboard Module Assembly

| FIG. & ITEM NO. | DESCRIPTION | DEC PART NO. | ECO CUT-IN 70-17388 00000 | USED ON CODE | REF FIG NO. |
|---|---|---|---|---|---|
| 6– | A.C. WIRING HARNESS ASSEMBLY | 70-17388-00 | | | 2 |
| 1 | *Connector (P11), Universal (Socket Housing) 3-Pin Mate-N-Lok | 12-12167-00 | | | |
| 2 | *Terminal (P11), Universal Socket Contact | 12-12169-01 | | | |
| 3 | *Terminal (P11), Universal Ground Socket Contact | 12-17519-00 | | | |
| 4 | *Terminal, Quick Connect | 12-17000-00 | | | |
| 5 | *Terminal, Ring | 90-07930-00 | | | |
| 6 | *Cable Tie (Bundle) | 90-07031-00 | | | |
| 7 | *Label, "Cable Identification" | 90-09532-00 | | | |
| | *Wire, Strand, 18 AWG (Brown) | 91-07786-11 | | | |
| | *Wire, Strand, 18 AWG (Blue) | 91-07786-66 | | | |
| | *Wire, Strand, 18 AWG (Green/Yellow) | 91-07410-54 | | | |



VK100-06

*Figure 6. A.C. Wiring Harness Assembly*

| FIG. & ITEM NO. | DESCRIPTION | DEC PART NO. | ECO CUT-IN 70-17389 00000 | USED ON CODE | REF FIG NO. |
|---|---|---|---|---|---|
| 7— | D.C. POWER CABLE ASSEMBLY | 70-17389-00 | | | 2 |
| 1 | *Connector (P9, P10), Socket Housing 6 Pin Mate-N-Lok | 12-10821-06 | | | |
| 2 | *Terminal (P9, P10), Socket Contact | 12-09379-00 | | | |
| 3 | *Cable Tie (Bundle) | 90-07031-00 | | | |
| 4 | *Label, "Cable Identification" | 90-09532-00 | | | |
| | *Wire, Strand, 18 AWG (Red) | 91-07786-22 | | | |
| | *Wire, Strand, 18 AWG (Orange) | 91-07786-33 | | | |
| | *Wire, Strand, 18 AWG (Blue) | 91-07786-66 | | | |
| | *Wire, Strand, 18 AWG (Black) | 91-07786-00 | | | |

VK100-07

Figure 7.  D.C. Power Cable Assembly

| FIG. & ITEM NO. | DESCRIPTION | DEC PART NO. | ECO CUT-IN 70-17411 00000 | USED ON CODE | REF FIG NO. |
|---|---|---|---|---|---|
| 8– | A.C. RECEPTACLE ASSEMBLY | 70-17411-00 | | | 2 |
| 1 | *Connector (J12), 3 Pin Power Plug | 12-17046-00 | | | |
| 2 | *Terminal, Ring | 90-07930-00 | | | |
| 3 | *Terminal, Quick Connect | 12-17000-00 | | | |
| 4 | *Terminal, Spade | 12-17045-00 | | | |
| 5 | *Cable Tie (Bundle) | 90-07031-00 | | | |
| 6 | *Label, "Cable Identification" | 90-09532-00 | | | |
| | *Wire, Strand 18 AWG (Green/Yellow) | 91-07410-54 | | | |
| | *Wire, Strand 18 AWG (Blue) | 91-07786-66 | | | |
| | *Wire, Strand 18 AWG (Brown) | 91-07786-11 | | | |
| | | | | | DEC |
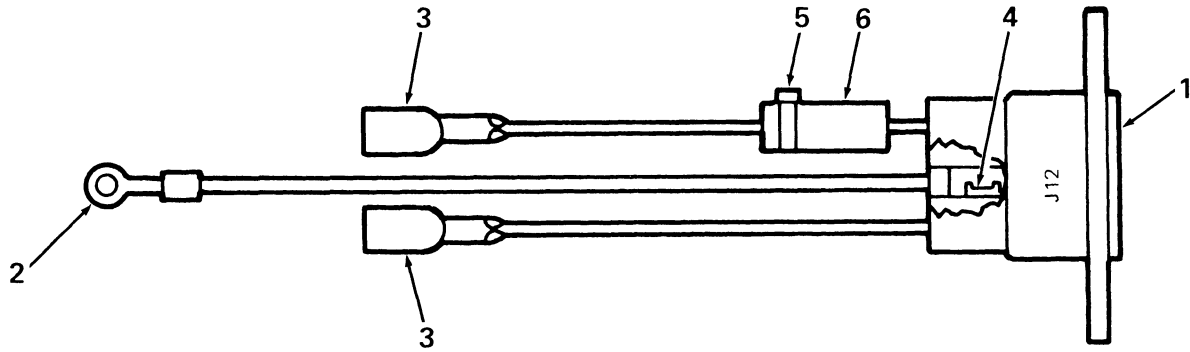


VK100-08

Figure 8.   A.C. Receptacle Assembly

# ILLUSTRATED PARTS BREAKDOWN
# COMMENT SHEET

Any and all comments and suggestions for correcting errors and/or additional information to improve this manual will be reviewed and researched for possible use when this manual is revised and/or reprinted. Enter your comments and suggestions in the form provided below and return to Technical Documentation.

**MODEL** _____ VK100 GIGI TERMINAL _____     **PUBLICATION NO.** _____ EK-VK100-IP-001 _____

FIGURE NO. _____ ITEM NO. _____     FIGURE NO. _____ ITEM NO. _____

CHANGE FROM _____     CHANGE FROM _____

CHANGE TO _____     CHANGE TO _____


FIGURE NO. _____ ITEM NO. _____     FIGURE NO. _____ ITEM NO. _____

CHANGE FROM _____     CHANGE FROM _____

CHANGE TO _____     CHANGE TO _____


FIGURE NO. _____ ITEM NO. _____     FIGURE NO. _____ ITEM NO. _____

CHANGE FROM _____     CHANGE FROM _____

CHANGE TO _____     CHANGE TO _____


ADDITIONAL COMMENT(S)


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Street _____ Department _____

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