May 20, 1986

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TeleVideo Systems, Inc., 1170 Morse Avenue, P.O. Box 3568, Sunnyvale, CA 94088-3568 408/745-7760
INTRODUCTION

This manual has been prepared as a learning aid to service personnel. This manual assumes the service personnel have a strong digital; electronics background as well as experience with microcomputer systems and in microcomputer service techniques.

The purpose of this manual is to provide service personnel with a working knowledge of the terminals, alignment/test procedures and diagnostic tests.

This manual begins with an explanation of the escape sequences and a hardware overview. Terminal logic flow is examined by studying the block diagrams. The terminal is studied locating each of the sub-systems discussed in the block diagram lecture. The schematics are studied locating key components, signals and circuits. Finally, as each sub-system is explored with a hands-on lab using the analyzing skills learned.

The modules and topics discussed are listed in the Table of Contents.

It should be noted that this manual has been developed as a "getting started" manual. It does not discuss all possible problems that might occur in a particular system.
TeleVideo History

TeleVideo Systems, Inc. was founded in 1976 by Dr. Phil Hwang, president and chief executive officer, with $9,000 from savings. Dr. Hwang is a Korean born, U.S. educated electrical engineer.

The TeleVideo motto "Leadership Earned Thru Quality" reflects the company attitude of a quality company, quality products and quality support.

The TeleVideo "We Care" program strives to show dedication to our customers, to quality, to innovation and to our employees.

TeleVideo has 8 sales offices in the U.S., 3 sales offices in western Europe and manufacturing in Korea. Televideo employs 600 people worldwide, 450 of those locally.

TeleVideo entered the monitor market in 1976 for the video game entertainment industry. In 1978 the game industry was phased out. In 1979 the company entered the terminals market introducing it's first video terminal. In 1981 TeleVideo introduced it's first Multiuser Microcomputer. In 1982 TeleVideo introduced the personal computer designed for business. In 1984 TeleVideo introduced our daisywheel printer.
Student Introductions

I. "WELCOME"

II. Please make your student name plate

III. Please fill out Student Profile

IV. Please review Rules and Conduct
PARTICIPANT PROFILE

The purpose of this Participant Profile is to enable your instructor to become more familiar with your specific needs. Would you kindly take a few minutes and fill in the information. The information will remain strictly confidential.

Thank you

COURSE NAME __________________ LOCATION __________________ PHONE __________________ (area code)

YOUR NAME __________________ COMPANY __________________ TITLE __________________

ADDRESS ___________________________ (city) __________________ (state) __________________ (zip)

1. Describe your past experience in computers (sales, management, program, maintenance, etc.

2. Explain your job responsibilities

3. What are your expectations for this class (please be as specific as possible)?

4. What areas do you believe should receive special attention?

Signature __________________________ Date ____________

Rev 6/86 v Student Information
CLASSROOM RULES

The adherence to the following rules have been implemented for the benefit of participants and instructors alike. Your cooperation and understanding are greatly appreciated.

1. No smoking while in the classroom. Breaks are provided every hour and smoking in the break area is allowed.

2. No incoming or outgoing phone calls are allowed on the classroom phones. Phone calls can be placed in the public telephone located in the lobby during breaks and lunch hour.

3. Class hours are generally from 8:30 AM to 5:00 PM. Promptness both at the 8:30 starting time, after breaks and after lunch is mandatory.

4. Participants are expected to cleanup (papers, coffee cups, etc.) and store all equipment as requested by the instructor.

5. TeleVideo participants who must meet with personnel at Corporate during class hours, must have prior approval. This prior approval must have been coordinated between the training department and the person at Corporate, before the first day of class.

6. The "buddy system" is an OSHA requirement during hardware lab. This means that the instructor or one other student must assist the student working on equipment. This rule is not an inconvenience, but is intended to add a measure of personal safety.

7. A tool kit will be checked out to you. You are expected to keep track of the tools so they will all be in the kit when you check it in.

8. The lab is shared by software and hardware classes. Check with your instructor to be certain you are on the appropriate system.
The 905, 955 and 9220 represent the third generation of terminals made by TeleVideo. The design is almost unchanged in concept from the first terminals ever made by TeleVideo. The only real changes are in implementation and new Integrated Circuits. Each product contains a processor, CRT Controller, Display Memory, and Serial I/O. The differences actually center around what type of system the terminal is to be connected to. Each terminal was intended for a specific purpose and a specific market and its design reflects that, however the designs of the different terminals is kept extremely similar to reduce manufacturing costs.

The 905 terminal is a low priced terminal developed to replace several older terminals, both TeleVideo's and competitor's. It will emulate a TeleVideo 910, 910+, or 925. It also emulates several other competitors machines that have been in the field for 5 to 10 years. The 905 can execute a sub-set of the 950, and 955 escape sequences.

The 955 terminal is a full featured terminal. It can emulate several TeleVideo terminals and contains several advanced features such as 132 column display, smooth scroll, 2 sets of programmable function keys, multiple pages of memory and more. The 955 also has a graphics version available for Tektronix graphics compatibility. It is currently the most advanced general purpose terminal that TeleVideo manufactures.

The 9220 terminal is a terminal designed to be used in a DEC environment. The 9220 will emulate a VT-52, VT-100, or VT-220 terminal. It also has a 9220 emulation which gives you features above and beyond the VT-200 features. The 9220 also has a graphics version available for Tektronix graphics compatibility. It is currently the key DEC compatible terminal sold by TeleVideo.

Each of these terminals has its own unique characteristics and market that it is being sold in to, but over all ... a terminal is a terminal ... parts is parts!
TABLE OF CONTENTS

UNIT 1 - Setting Up and Basic Operation
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- Set terminal operating parameters ............ 1.2

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- Diagnose terminal problems and locate suspect module ............ 2.1

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- Adjust picture controls ............ 3.1
- Locate problem to basic operational block ............ 3.2
- Repair the video module to component level ............ 3.3

UNIT 4 - The Keyboard
- Locate problem to basic operational block ............ 4.1
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UNIT 5 - The Logic Board
- Install terminal options ............ 5.1
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- Repair the logic board to component level ............ 5.3
UNIT 1

SETTING UP & BASIC OPERATION

Setting up & basic operation consists of two modules:

1. **Escape Sequences**

   Module 1 presents to you the necessary information to find, in the manual, and enter, from the keyboard, escape sequences used to control functions and features of the terminal.

2. **Terminal Parameters**

   Module 2 presents information on how to set the various terminal operating parameters such as baud rate, parity, and word length.
UNIT 1
SETTING UP & BASIC OPERATION

MODULE 1 - ESCAPE SEQUENCES

OBJECTIVE 1 - REVIEW QUESTIONS

GIVEN: An incomplete chart listing terminal functions
       An operators manual for all terminals being covered
       A pencil or Pen

OBJECTIVE: Locate the correct escape sequence for each function

CRITERIA: All Correct within 15 minutes

OBJECTIVE 2 - LAB EXERCISES

GIVEN: Completed chart of terminal functions
       A working terminal
       The Lab Exercise worksheet
       A Pencil or Pen

OBJECTIVE: Enter escape sequences from the keyboard

CRITERIA: Your instructor will ask you to enter two escape sequences from the Review Questions on page 1.1.7
INTRODUCTION

Module 1 presents information about ASCII, control codes, and escape sequences. It will explain what each is used for, and allow you to become familiar with the correct operation of a terminal. This can be used for diagnosing terminal related problems.
MODULE 1 - ESCAPE SEQUENCES

THE ASCII CODE CHART

<table>
<thead>
<tr>
<th>Bits</th>
<th>7 6 5</th>
<th>Column</th>
<th>0 0 0</th>
<th>0 0 1</th>
<th>0 1 0</th>
<th>0 1 1</th>
<th>1 0 0</th>
<th>1 0 1</th>
<th>1 1 0</th>
<th>1 1 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 3 2 1</td>
<td></td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>0 0 0 0 0 0</td>
<td></td>
<td>NUL</td>
<td>DLE</td>
<td>SP</td>
<td>0</td>
<td>@</td>
<td>P</td>
<td></td>
<td>p</td>
<td></td>
</tr>
<tr>
<td>0 0 0 0 1 1</td>
<td></td>
<td>SOH</td>
<td>DC1</td>
<td>!</td>
<td>1</td>
<td>A</td>
<td>Q</td>
<td>a</td>
<td>q</td>
<td></td>
</tr>
<tr>
<td>0 0 1 0 0 2</td>
<td></td>
<td>STX</td>
<td>DC2</td>
<td>-</td>
<td>2</td>
<td>B</td>
<td>R</td>
<td>b</td>
<td>r</td>
<td></td>
</tr>
<tr>
<td>0 0 1 0 1 3</td>
<td></td>
<td>ETX</td>
<td>DC3</td>
<td>#</td>
<td>3</td>
<td>C</td>
<td>S</td>
<td>c</td>
<td>s</td>
<td></td>
</tr>
<tr>
<td>0 1 0 0 0 4</td>
<td></td>
<td>EOT</td>
<td>DC4</td>
<td>$</td>
<td>4</td>
<td>D</td>
<td>T</td>
<td>d</td>
<td>t</td>
<td></td>
</tr>
<tr>
<td>0 1 0 1 0 5</td>
<td></td>
<td>ENQ</td>
<td>NAK</td>
<td>%</td>
<td>5</td>
<td>E</td>
<td>U</td>
<td>e</td>
<td>u</td>
<td></td>
</tr>
<tr>
<td>0 1 1 0 0 6</td>
<td></td>
<td>ACK</td>
<td>SYN;</td>
<td>&amp;</td>
<td>6</td>
<td>F</td>
<td>V</td>
<td>f</td>
<td>v</td>
<td></td>
</tr>
<tr>
<td>0 1 1 1 1 7</td>
<td></td>
<td>BEL</td>
<td>ETB</td>
<td>'</td>
<td>7</td>
<td>G</td>
<td>W</td>
<td>g</td>
<td>w</td>
<td></td>
</tr>
<tr>
<td>1 0 0 0 0 8</td>
<td></td>
<td>BS;</td>
<td>CAN</td>
<td>(</td>
<td>8</td>
<td>H</td>
<td>X</td>
<td>h</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>1 0 0 1 0 9</td>
<td></td>
<td>SKIP HT</td>
<td>EM</td>
<td>)</td>
<td>9</td>
<td>I</td>
<td>Y</td>
<td>i</td>
<td>y</td>
<td></td>
</tr>
<tr>
<td>1 0 1 0 1 10 (a)</td>
<td></td>
<td>LF</td>
<td>SUB</td>
<td>*</td>
<td>:</td>
<td>J</td>
<td>Z</td>
<td>j</td>
<td>z</td>
<td></td>
</tr>
<tr>
<td>1 0 1 1 11 (b)</td>
<td></td>
<td>VT:</td>
<td>ESC</td>
<td>+</td>
<td>;</td>
<td>K</td>
<td>[</td>
<td>k</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 1 0 0 0 12 (c)</td>
<td></td>
<td>FF ^</td>
<td>FS</td>
<td>.</td>
<td>&lt;</td>
<td>L</td>
<td>\</td>
<td>l</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 1 0 1 13 (d)</td>
<td></td>
<td>CR</td>
<td>GS</td>
<td>-</td>
<td>=</td>
<td>M</td>
<td>]</td>
<td>m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 1 1 0 14 (e)</td>
<td></td>
<td>SO</td>
<td>HOME RS</td>
<td>.</td>
<td>&gt;</td>
<td>N</td>
<td>^</td>
<td>n</td>
<td>~</td>
<td></td>
</tr>
<tr>
<td>1 1 1 1 5 (f)</td>
<td></td>
<td>SI</td>
<td>NEW LINE US</td>
<td>/</td>
<td>?</td>
<td>O</td>
<td>—</td>
<td>o</td>
<td>DEL RUB</td>
<td></td>
</tr>
</tbody>
</table>

What is ASCII?

- A binary code used in computers for communication
- A standard used worldwide
- Assigns each character a unique binary code
- 128 ASCII characters
- 96 letters, numbers, and symbols
- 32 special control codes
MODULE 1 - ESCAPE SEQUENCES

THE ASCII CONTROL CODES

<table>
<thead>
<tr>
<th>Character</th>
<th>ASCII Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NUL</td>
<td>null</td>
<td>FF</td>
</tr>
<tr>
<td>SOH</td>
<td>start of heading</td>
<td>CR</td>
</tr>
<tr>
<td>STX</td>
<td>start of text</td>
<td>SO</td>
</tr>
<tr>
<td>ETX</td>
<td>end of text</td>
<td>SI</td>
</tr>
<tr>
<td>EOT</td>
<td>end of transmission</td>
<td>DLE</td>
</tr>
<tr>
<td>ENQ</td>
<td>enquiry</td>
<td>DC1</td>
</tr>
<tr>
<td>ACK</td>
<td>acknowledge</td>
<td>DC2</td>
</tr>
<tr>
<td>BEL</td>
<td>bell</td>
<td>DC3</td>
</tr>
<tr>
<td>BS</td>
<td>backspace</td>
<td>DC4</td>
</tr>
<tr>
<td>HT</td>
<td>horizontal tabulation</td>
<td>NAK</td>
</tr>
<tr>
<td>LF</td>
<td>linefeed</td>
<td>SYN</td>
</tr>
<tr>
<td>VT</td>
<td>vertical tabulation</td>
<td>ETB</td>
</tr>
</tbody>
</table>

What are control codes?

- The first 32 ASCII characters
- Used for special purposes - controlling a device separating data
- Non-displayable characters
- Uses NOT standardized
- When entered from the keyboard, use CTRL key and the character four columns to the right in chart.
MODULE 1 - ESCAPE SEQUENCES

EXAMPLES OF ESCAPE SEQUENCES

<table>
<thead>
<tr>
<th>Terminal Function</th>
<th>905</th>
<th>955</th>
<th>9220</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear Screen</td>
<td>Esc *</td>
<td>Esc *</td>
<td>Esc [ 2 J</td>
</tr>
<tr>
<td>Black characters on light background</td>
<td>Esc b</td>
<td>Esc b</td>
<td>Esc [7 5 h</td>
</tr>
<tr>
<td>Light characters on black background</td>
<td>Esc d</td>
<td>Esc d</td>
<td>Esc [7 5 l</td>
</tr>
<tr>
<td>Cursor Up</td>
<td>Vt</td>
<td>Vt</td>
<td>Esc [ A</td>
</tr>
<tr>
<td>Cursor Down</td>
<td>Lf</td>
<td>Lf</td>
<td>Esc [ B</td>
</tr>
<tr>
<td>Erase current line</td>
<td>Esc R</td>
<td>Esc R</td>
<td>Esc [2 K</td>
</tr>
<tr>
<td>Clear all tab stops</td>
<td>Esc 3</td>
<td>Esc 3</td>
<td>Esc [3 g</td>
</tr>
<tr>
<td>Set a tab stop</td>
<td>Esc 1</td>
<td>Esc 1</td>
<td>Esc H</td>
</tr>
</tbody>
</table>

What are escape sequences?

- Combinations of ASCII characters beginning with ESCAPE
- Sequences which are acted on, rather than displayed
- Consist of two or more ASCII characters
- ASCII characters used as commands to the terminal
- Used to control complex features of the terminal
- When entering a sequence from the keyboard, use Shift-ESCAPE. (Local Escape)
MODULE 1 - ESCAPE SEQUENCES

REVIEW QUESTIONS

PROCEDURE: 
1. Using the operators manuals, find the ASCII characters required to perform the listed escape sequences for each terminal.
2. Enter each sequence on each respective line.
3. Notify your instructor when you are finished.
4. After your instructor has verified these questions, begin the Lab Exercises on the next page.

<table>
<thead>
<tr>
<th>Terminal Function</th>
<th>905</th>
<th>955</th>
<th>9220</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Lock Keyboard</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Unlock Keyboard</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Monitor Mode On</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Monitor Mode Off</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Keyclick On</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Keyclick Off</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Buffered Copy Print On</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Cursor to Home Position</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Display Self Test</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Delete a Character</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Factory Default Reset</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

FINISHED ??? IF YOU HAVE SOME MORE TIME, TRY THE SEQUENCES ON THE NEXT PAGE ...
MODULE 1 - ESCAPE SEQUENCES

REVIEW QUESTIONS (cont.)

EXTRA EXAMPLE ESCAPE SEQUENCES

<table>
<thead>
<tr>
<th>Terminal Function</th>
<th>905</th>
<th>955</th>
<th>9220</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set Reverse Video Attribute</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set Normal Video Attribute</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set Smooth Scroll</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cursor Address to Row and Column</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Select 132 Column Display</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NOTES:
MODULE 1 - ESCAPE SEQUENCES

LAB EXERCISES

PROCEDURE:

. Go to any of the available terminals

. Enter each escape sequence from the appropriate column of the Review Questions.

. As each sequence is entered, watch carefully how it effects the terminal display and write down a brief description.

MODEL OF TERMINAL USED FOR LAB EXERCISES:

<table>
<thead>
<tr>
<th>Terminal Function</th>
<th>Brief Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Lock Keyboard</td>
<td></td>
</tr>
<tr>
<td>2. Unlock Keyboard</td>
<td></td>
</tr>
<tr>
<td>3. Monitor Mode On</td>
<td></td>
</tr>
<tr>
<td>4. Monitor Mode Off</td>
<td></td>
</tr>
<tr>
<td>5. Keyclick On</td>
<td></td>
</tr>
<tr>
<td>6. Keyclick Off</td>
<td></td>
</tr>
<tr>
<td>7. Buffered Copy Print On</td>
<td></td>
</tr>
<tr>
<td>8. Cursor to Home Position</td>
<td></td>
</tr>
<tr>
<td>9. Display Self Test</td>
<td></td>
</tr>
<tr>
<td>10. Delete a Character</td>
<td></td>
</tr>
<tr>
<td>11. Factory Default Reset</td>
<td></td>
</tr>
</tbody>
</table>

Write below, any problems entering the sequences, or questions you would like to ask after the lab?
UNIT 1
SETTING UP & BASIC OPERATION

MODULE 2 - SETTING TERMINAL PARAMETERS

OBJECTIVE - LAB EXERCISES

GIVEN: A working terminal
An Operators Manual
The lab exercise worksheet
A Pencil or Pen

OBJECTIVE: Set the terminal operating parameters such as the baud rate, word structure, and display parameters.

CRITERIA: Your instructor will check the terminal set up against the Lab Exercise worksheet.
Module 2 presents information about how to set the various communication and display parameters required for connection to a computer system. This information is necessary to able to properly configure the terminal, conduct tests, and install the terminal at a job site.
MODULE 2 - SETTING TERMINAL PARAMETERS

What is Set-Up?

- A series of menus displayed on the terminal
- Defines the power-up values for certain parameters
  - Main Communication speed and word structure
  - Printer Communication speed and word structure
  - Display characteristics
  - Keyboard characteristics
  - Emulations
- Values set to match host system
- Saved in Non-Volatile Memory in terminal
  
  905/955 - When exiting setup you are prompted to SAVE? (Y/N).
  
  9220 - In set-up you can select a block labeled SAVE or type ^S at any time in set-up.
MODULE 2 - SETTING TERMINAL PARAMETERS

EXAMPLES OF SET-UP MENUS

1. 955 Main Communication Set-up

<table>
<thead>
<tr>
<th>MAIN PORT 1</th>
<th>CURSOR keys to move</th>
<th>SPACE BAR to change</th>
<th>SET-UP to exit</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>BAUD 9600</th>
<th>WORD 8</th>
<th>PRTY NO</th>
<th>STOP 1</th>
<th>COMM FIX</th>
<th>HAND X-ON</th>
</tr>
</thead>
</table>

2. 905 Printer Communication Set-up

<table>
<thead>
<tr>
<th>PRINT</th>
<th>BAUD 1200</th>
<th>WORD 8</th>
<th>PRTY NO</th>
<th>STOP 1</th>
</tr>
</thead>
</table>

3. 9220 Display Set-up

![Display Set-Up Diagram]

6/86 1.2.4 Set-up and Basic Operation
MODULE 2 - SETTING TERMINAL PARAMETERS

LAB EXERCISES

PROCEDURE:

1. Go to any of the available terminals

2. Perform a factory default reset
   (If needed, check the Module 1 Review Questions)

3. Configure the terminal according to the chart below

4. Let the instructor know when you are done.

---

LAB EXERCISE SYSTEM OPERATING PARAMETERS

<table>
<thead>
<tr>
<th>Setting</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main Communications:</strong></td>
<td></td>
</tr>
<tr>
<td>Baud Rate</td>
<td>7200</td>
</tr>
<tr>
<td>Parity</td>
<td>EVEN</td>
</tr>
<tr>
<td>Data Bits</td>
<td>7</td>
</tr>
<tr>
<td>Stop Bits</td>
<td>1</td>
</tr>
<tr>
<td>Protocol</td>
<td>DTR</td>
</tr>
<tr>
<td><strong>Printer Communications:</strong></td>
<td></td>
</tr>
<tr>
<td>Baud Rate</td>
<td>1800</td>
</tr>
<tr>
<td>Parity</td>
<td>ODD</td>
</tr>
<tr>
<td>Data Bits</td>
<td>8</td>
</tr>
<tr>
<td>Stop Bits</td>
<td>2</td>
</tr>
<tr>
<td><strong>Keyboard Configuration:</strong></td>
<td></td>
</tr>
<tr>
<td>Keyclick</td>
<td>Off</td>
</tr>
<tr>
<td>Edit Keys</td>
<td>Local</td>
</tr>
<tr>
<td>Character Set</td>
<td>German</td>
</tr>
<tr>
<td><strong>Display Configuration:</strong></td>
<td></td>
</tr>
<tr>
<td>Autowrap</td>
<td>On</td>
</tr>
<tr>
<td>Cursor</td>
<td>Blinking Underline</td>
</tr>
<tr>
<td>Time out blank</td>
<td>On</td>
</tr>
<tr>
<td>Status Line</td>
<td>On</td>
</tr>
<tr>
<td><strong>Miscellaneous:</strong></td>
<td></td>
</tr>
<tr>
<td>Emulation (905)</td>
<td>Hazeltine 1500</td>
</tr>
<tr>
<td>(955)</td>
<td>TeleVideo 950</td>
</tr>
<tr>
<td>(9220)</td>
<td>DEC VT-100</td>
</tr>
</tbody>
</table>
Module level troubleshooting consists of 1 module:

1. **Module level troubleshooting**

This module will give you the necessary information to locate problems in the terminal to one of the four basic sub-assemblies of the terminal - The power supply, the video module, the keyboard, or the logic board.
UNIT 2

MODULE 1 - MODULE LEVEL TROUBLESHOOTING

OBJECTIVE - LAB EXERCISES

GIVEN: At least three bugged terminals
Symptoms check list
DVM
Pin-out diagram for power and video connectors
The lab exercise worksheet
A Pencil/Pen

OBJECTIVE: To Diagnose terminal problems to find the suspect module.

CRITERIA: All questions on lab exercises correct.
INTRODUCTION

This module is to set down the basis for repairing any terminal. You will learn to diagnose terminal problems down to the suspect sub-assembly.
What are the basic modules?

- **Power Supply**
  - Switching type
  - Produces three voltages: +12, -12, and +5
  - 115 or 230 Volt - Changed with jumper and fuses
  - Powers the other modules

- **Video Module**
  - Gets TTL level video, and video sync from logic board
  - Controls yoke for beam deflection
  - Controls beam intensity for generation of characters
  - Generates high voltage for anode

- **Keyboard**
  - Matrix scanned key switches
  - Microprocessor used for scanning
  - Transmits serial information to logic board
  - Powered from logic board

- **Logic Board**
  - Contains all intelligence of terminal
  - Microcomputer/Controller
  - Generates video and video sync
  - Two RS-232c interfaces
  - Keyboard interface
  - Non-Volatile RAM
  - Display RAM
MODULE 1 - MODULE LEVEL TROUBLESHOOTING

SYMPTOMS CHECK LIST

TeleVideo's modular terminal design makes isolating a problem to the suspect module easy. You can either follow the symptoms check list below, or, if you have a golden unit, replace each module in turn until the fault is corrected.

Check List Assumptions:
- Fuse has been checked
- Unit is plugged in
- Wall outlet is known good
- Set-up has been verified to match host

Check list abbreviations:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>G/A</td>
<td>Gate Array IC</td>
</tr>
<tr>
<td>CRTC</td>
<td>CRT Controller chip</td>
</tr>
<tr>
<td>D-RAM</td>
<td>Display RAM</td>
</tr>
<tr>
<td>C.G.</td>
<td>Character Generator</td>
</tr>
</tbody>
</table>

Symptom: No beep on power up

<table>
<thead>
<tr>
<th>Suspected Module</th>
<th>Probable Cause</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply</td>
<td>Power to logic board</td>
<td>Check voltages</td>
</tr>
<tr>
<td>Logic board</td>
<td>Not signaling keyboard</td>
<td>Check keyboard I/O</td>
</tr>
<tr>
<td>Keyboard</td>
<td>Processor or speaker</td>
<td>Check keyboard</td>
</tr>
</tbody>
</table>

Symptom: No video, no cursor

<table>
<thead>
<tr>
<th>Suspected Module</th>
<th>Probable Cause</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply</td>
<td>No power</td>
<td>Check voltages</td>
</tr>
<tr>
<td>Logic board</td>
<td>Not providing video</td>
<td>Check video &amp; sync</td>
</tr>
<tr>
<td>Video module</td>
<td>Not driving CRT</td>
<td>Check video module</td>
</tr>
<tr>
<td>CRT</td>
<td>No good</td>
<td>Replace CRT</td>
</tr>
</tbody>
</table>

6/86 2.1.6 Module Level Troubleshooting
### Symptom: No external communication

<table>
<thead>
<tr>
<th>Suspected Module</th>
<th>Probable Cause</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable to host</td>
<td>Bad cable</td>
<td>Test cable</td>
</tr>
<tr>
<td>Power Supply</td>
<td>No +/- 12V</td>
<td>Check voltages</td>
</tr>
<tr>
<td>Logic board</td>
<td>No serial I/O</td>
<td>Check serial I/O</td>
</tr>
</tbody>
</table>

### Symptom: Incorrect characters - In Local or Block modes

<table>
<thead>
<tr>
<th>Suspected Module</th>
<th>Probable Cause</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logic board</td>
<td>Many things</td>
<td>Check keyboard I/O, G/A, CRTC, D-RAM, C.G.</td>
</tr>
<tr>
<td>Keyboard</td>
<td>Improper scan results</td>
<td>Check keyboard</td>
</tr>
</tbody>
</table>

### Symptom: Incorrect attributes

<table>
<thead>
<tr>
<th>Suspected Module</th>
<th>Probable Cause</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logic board</td>
<td>Bad RAM or video G/A</td>
<td>Check G/A, CRTC, D-RAM</td>
</tr>
</tbody>
</table>

### Symptom: No keyboard communication

<table>
<thead>
<tr>
<th>Suspected Module</th>
<th>Probable Cause</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logic board</td>
<td>Keyboard interface</td>
<td>Check keyboard I/O</td>
</tr>
<tr>
<td>Keyboard cable</td>
<td>Bad cable</td>
<td>Test cable</td>
</tr>
<tr>
<td>Keyboard</td>
<td>Many things</td>
<td>Check keyboard</td>
</tr>
</tbody>
</table>
**Symptoms Check List (cont.)**

**Symptom: Improper baud-rate selection**

<table>
<thead>
<tr>
<th>Suspected Module</th>
<th>Probable Cause</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logic board</td>
<td>Many things</td>
<td>Check baud clock, G/A</td>
</tr>
</tbody>
</table>

**Symptom: Power supply fuses blowing**

<table>
<thead>
<tr>
<th>Suspected Module</th>
<th>Probable Cause</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Video module</td>
<td>Short</td>
<td>Check for short</td>
</tr>
<tr>
<td>Power supply</td>
<td>Short</td>
<td>Check for short</td>
</tr>
<tr>
<td>Logic Board</td>
<td>Short</td>
<td>Check for short</td>
</tr>
</tbody>
</table>

**Symptom: High-pitched whine**

<table>
<thead>
<tr>
<th>Suspected Module</th>
<th>Probable Cause</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Video module</td>
<td>Coils or Flyback</td>
<td>Check for vibration</td>
</tr>
</tbody>
</table>

**Symptom: Distorted video**

<table>
<thead>
<tr>
<th>Suspected Module</th>
<th>Probable Cause</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Video module</td>
<td>Bad deflection</td>
<td>Check video amps</td>
</tr>
<tr>
<td>Power supply</td>
<td>Voltage fluctuations</td>
<td>Check voltages</td>
</tr>
<tr>
<td>Logic board</td>
<td>Bad RAM or video G/A</td>
<td>Check G/A, CRTC, D-ROM</td>
</tr>
</tbody>
</table>

**Symptom: Characters missing dots**

<table>
<thead>
<tr>
<th>Suspected Module</th>
<th>Probable Cause</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logic board</td>
<td>Bad RAM or video G/A</td>
<td>Check C.G., G/A, CRTC</td>
</tr>
<tr>
<td>Defective CRT</td>
<td>Bad phosphor</td>
<td>Replace CRT</td>
</tr>
</tbody>
</table>
SYMPTOMS CHECK LIST (cont.)

**Symptom: Display too dim / can't adjust**

<table>
<thead>
<tr>
<th>Suspected Module</th>
<th>Probable Cause</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Video module</td>
<td>Bad amplification</td>
<td>Check video amps</td>
</tr>
<tr>
<td>Power supply</td>
<td>Low voltage</td>
<td>Check voltages</td>
</tr>
<tr>
<td>CRT</td>
<td>Bad phosphor</td>
<td>Replace CRT</td>
</tr>
</tbody>
</table>

**Symptom: Online communication problem**

<table>
<thead>
<tr>
<th>Suspected Module</th>
<th>Probable Cause</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logic board</td>
<td>Serial problems</td>
<td>Check serial I/O</td>
</tr>
<tr>
<td>Power Supply</td>
<td>No power</td>
<td>Check voltages</td>
</tr>
<tr>
<td>Cable to host</td>
<td>Bad cable</td>
<td>Test cable</td>
</tr>
<tr>
<td>Host</td>
<td>Not configured correctly</td>
<td>Check host settings</td>
</tr>
</tbody>
</table>

**Symptom: Jittery screen**

<table>
<thead>
<tr>
<th>Suspected Module</th>
<th>Probable Cause</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logic board</td>
<td>Bad video</td>
<td>Check video &amp; sync</td>
</tr>
<tr>
<td>Video module</td>
<td>Bad capacitor</td>
<td>Check video module</td>
</tr>
<tr>
<td>50/60 Hertz</td>
<td>Doesn't match line</td>
<td>Check settings</td>
</tr>
<tr>
<td>Power Supply</td>
<td>Voltage fluctuations</td>
<td>Check voltages</td>
</tr>
</tbody>
</table>

**Symptom: Wavy screen**

<table>
<thead>
<tr>
<th>Suspected Module</th>
<th>Probable Cause</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Video module</td>
<td>Intermittent component</td>
<td>Check video module</td>
</tr>
<tr>
<td>Power Supply</td>
<td>Voltage fluctuations</td>
<td>Check voltages</td>
</tr>
<tr>
<td>External interference</td>
<td>Induced fields</td>
<td>Try new location</td>
</tr>
</tbody>
</table>
### MODULE 1 - MODULE LEVEL TROUBLESHOOTING

### SYMPTOMS CHECK LIST (cont.)

#### Symptom: Incorrect voltages

<table>
<thead>
<tr>
<th>Suspected Module</th>
<th>Probable Cause</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply</td>
<td>Poor regulation</td>
<td>Check voltages</td>
</tr>
</tbody>
</table>

#### Symptom: No light at heater filament

<table>
<thead>
<tr>
<th>Suspected Module</th>
<th>Probable Cause</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Video module</td>
<td>Bad trace or connection</td>
<td>Check video module</td>
</tr>
<tr>
<td>Power supply</td>
<td>No +12 volts</td>
<td>Check voltages</td>
</tr>
<tr>
<td>Defective CRT</td>
<td>Bad heater filament</td>
<td>Replace CRT</td>
</tr>
</tbody>
</table>

#### Symptom: Display not equal to key entry

<table>
<thead>
<tr>
<th>Suspected Module</th>
<th>Probable Cause</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logic board</td>
<td>Serial problems</td>
<td>Check serial I/O</td>
</tr>
<tr>
<td>Keyboard cable</td>
<td>Bad cable</td>
<td>Test cable</td>
</tr>
<tr>
<td>Cable to host</td>
<td>Bad cable</td>
<td>Test cable</td>
</tr>
<tr>
<td>Host</td>
<td>Not echoing correctly</td>
<td>Check host</td>
</tr>
<tr>
<td>Keyboard</td>
<td>Improper scan results</td>
<td>Check keyboard</td>
</tr>
</tbody>
</table>

#### Symptom: Visible retrace scanlines

<table>
<thead>
<tr>
<th>Suspected Module</th>
<th>Probable Cause</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brightness control</td>
<td>Out of adjustment</td>
<td>Adjust brightness</td>
</tr>
<tr>
<td>Video module</td>
<td>Bad blanking</td>
<td>Check video module</td>
</tr>
<tr>
<td>Logic board</td>
<td>Bad video or G/A</td>
<td>Check G/A, CRTC, driver</td>
</tr>
<tr>
<td>Defective CRT</td>
<td>Bad cathode</td>
<td>Replace CRT</td>
</tr>
</tbody>
</table>
### Module Level Troubleshooting

#### Symptoms Check List (cont.)

**Symptom: Keyboard locked up**

<table>
<thead>
<tr>
<th>Suspected Module</th>
<th>Probable Cause</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keyboard cable</td>
<td>Bad cable</td>
<td>Test cable</td>
</tr>
<tr>
<td>Logic board</td>
<td>No keyboard I/O</td>
<td>Check keyboard I/O</td>
</tr>
<tr>
<td>Software command</td>
<td>Escape sequence</td>
<td>Reset terminal</td>
</tr>
<tr>
<td>Keyboard</td>
<td>Many things</td>
<td>Check keyboard</td>
</tr>
</tbody>
</table>

**Symptom: Fails self test**

<table>
<thead>
<tr>
<th>Suspected Module</th>
<th>Probable Cause</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logic board</td>
<td>Many things</td>
<td>Check C.G., CRTC, G/A, D-RAM</td>
</tr>
</tbody>
</table>

**Symptom: Some keys inoperative**

<table>
<thead>
<tr>
<th>Suspected Module</th>
<th>Probable Cause</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keyboard</td>
<td>Improper scan results</td>
<td>Check keyboard</td>
</tr>
<tr>
<td>Logic board</td>
<td>Bad keyboard I/O</td>
<td>Check keyboard I/O</td>
</tr>
</tbody>
</table>

**Symptom: Horizontal bar across screen**

<table>
<thead>
<tr>
<th>Suspected Module</th>
<th>Probable Cause</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logic board</td>
<td>No vertical sync</td>
<td>Check video &amp; sync</td>
</tr>
<tr>
<td>Video module</td>
<td>No vertical deflection</td>
<td>Check vertical amp</td>
</tr>
<tr>
<td>Yoke</td>
<td>Coil open</td>
<td>Check coil resistance</td>
</tr>
</tbody>
</table>

**Symptom: Poor linearity**

<table>
<thead>
<tr>
<th>Suspected Module</th>
<th>Probable Cause</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linearity adjust</td>
<td>Control adjustment</td>
<td>Adjust control</td>
</tr>
<tr>
<td>Video module</td>
<td>Shorted deflection coil</td>
<td>Check coil resistance</td>
</tr>
</tbody>
</table>
MODULE 1 - MODULE LEVEL TROUBLESHOOTING

SYMPTOMS CHECK LIST (cont.)

Symptom: Cursor moves, no characters

<table>
<thead>
<tr>
<th>Suspected Module</th>
<th>Probable Cause</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logic board</td>
<td>Bad RAM</td>
<td>Check D-RAM, C.G., CRTC</td>
</tr>
<tr>
<td>Keyboard</td>
<td>Improper scan results</td>
<td>Check keyboard</td>
</tr>
</tbody>
</table>

Symptom: Vertical line across screen

<table>
<thead>
<tr>
<th>Suspected Module</th>
<th>Probable Cause</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logic board</td>
<td>No horizontal sync</td>
<td>Check video &amp; sync</td>
</tr>
<tr>
<td>Video module</td>
<td>No horizontal deflection</td>
<td>Check horizontal amp</td>
</tr>
<tr>
<td>Yoke</td>
<td>Open coil</td>
<td>Check coil resistance</td>
</tr>
</tbody>
</table>

Symptom: Crackling sound with distorted video

<table>
<thead>
<tr>
<th>Suspected Module</th>
<th>Probable Cause</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Video module</td>
<td>High-voltage arcing</td>
<td>Check video module / CRT Anode Wire</td>
</tr>
</tbody>
</table>
PROCEDURE:  

1. Go to any of the available terminals
2. Perform whatever tests necessary to determine the problem to module level.
3. Write your Lab results on the Lab Exercise worksheet.
4. Let the instructor know when you are done.

Which terminal was used? ____________________________

What were the terminal symptoms? 
__________________________
__________________________
__________________________

What tests did you perform? ____________________________
__________________________
__________________________

What is needed to repair this unit? 
__________________________
__________________________
__________________________
UNIT 3
THE VIDEO MODULE

This unit on the video module consists of three modules:

1. Adjusting the Picture Controls

Module 1, as the title suggests, will explain the use and proper procedures for adjusting the picture controls. Examples of these controls are the focus, brightness, linearity, and height.

2. Sub-module Level Troubleshooting

This module will give you the necessary information to locate problems in the video module to one of the basic operational blocks.

3. Component Level Troubleshooting

This module will explain what each component should be doing and how to isolate problems to the component level.
UNIT 3

THE VIDEO MODULE

MODULE 1 - PICTURE CONTROLS

OBJECTIVE 1 - REVIEW QUESTIONS

GIVEN: Several fill in the blank review questions
       905/955/9220 Maintenance Manual
       This Student Guide
       A pencil or Pen

OBJECTIVE: Correct picture alignment and/or screen
detail problems.

CRITERIA: All Review Questions correct.
INTRODUCTION

Module 1 will cover the picture controls and adjustments. This information will be used to properly align the picture on the screen, making sure that the best possible picture is being displayed. The effects of adjusting each of the video controls will be covered along with the location of the control and proper adjusting techniques.
THE PICTURE CONTROLS

What are the picture controls?

- All picture controls are located on the video module except Contrast.
- All adjustments should be done with a non-conductive tool.
- All adjustments are similar to a TV set.
- Yoke is preset at the manufacturer.
- All adjustments should be done with the Contrast control turned to its maximum setting and the video self test being displayed.
MODULE 1 - PICTURE CONTROLS

THE PICTURE CONTROLS

- **Focus**
  - Adjusts the focus of the individual pixels
  - Normally the last adjustment to be done

- **Vertical Height**
  - Adjusts overall height of the visible picture
  - Must be adjusted in unison with Vertical Linearity

- **Vertical Linearity**
  - Balances the spacing of scan lines between the top and bottom of the picture
  - Must be adjusted in unison with Vertical Height

- **Brightness**
  - Adjusts the 'beam on' threshold
  - Used to set the maximum intensity without displaying raster.

- **Horizontal Width**
  - Adjusts the width of the display picture
  - Should be preset from the factory

- **Contrast**
  - Adjusts the viewing intensity of the picture
  - Only user adjustable control
MODULE 1 - PICTURE CONTROLS

THE PICTURE CONTROLS

Symptom: Characters at top of screen are bigger than characters at the bottom.
Cause: Vertical Linearity
Procedure: Adjust Vertical Height and Linearity to get even spacing between lines and even top and bottom margins

Symptom: Blurred characters
Cause: Focus
Procedure: Adjust focus just outside the center of the picture

Symptom: Faint lines covering screen
Cause: Brightness
Procedure: Making sure the contrast control is at its maximum, adjust brightness control so that the lines disappear.

Symptom: Picture expanded past sides of case
Cause: Width
Procedure: Adjust width control to bring the picture back into perspective with even side margins.
MODULE 1 - PICTURE CONTROLS

REVIEW QUESTIONS

PROCEDURE:  
1. Using the information in this guide, answer the questions below.
2. Notify your instructor when you are finished.

1. If the picture is too dim to see, even with the contrast control adjusted all the way up, what procedure might be necessary?

2. To correct a picture which has larger characters at the top of the screen than the bottom, which controls should be adjusted and in what order?

3. When adjusting Focus, what part of the screen should be used for reference?
UNIT 3

MODULE 2 - BASIC OPERATIONAL BLOCKS

OBJECTIVE - REVIEW QUESTIONS

GIVEN: Several fill in the blank review questions
905/955/9220 Maintenance Manual
This Student Guide
A Pencil or Pen

OBJECTIVE: To diagnose any video module problems to the suspect operational block.

CRITERIA: All review questions correct.
INTRODUCTION

This module will break down the video module into basic operational blocks and explain what each block does. This information will enable you to quickly isolate problems to a group of suspect components.
MODULE 2 - BASIC OPERATIONAL BLOCKS

What are the basic operational blocks?

- The power supply provides +12 volts and ground
- The signals coming from the logic board are:
  - Video Information
    - TTL level pulses
    - Max Frequency = 1/2 Dot Clock Frequency
    - TTL High turns on beam (>2.7 Volts)
    - TTL Low turns off beam (<.5 Volts)
  - Vertical Sync
    - TTL level pulses
    - Frequency = 50/60 Hz.
    - TTL High level for approx 16.4 ms.
    - TTL Low level for approx 200 us.
  - Horizontal Sync
    - TTL level pulses
    - Frequency = 16667 Hz.
    - TTL High level for approx 10 us.
    - TTL Low level for approx 50 us.
MODULE 2 - BASIC OPERATIONAL BLOCKS

THE VIDEO MODULE

THE BASIC BLOCKS

- Vertical Oscillator (Waveform generator)
  - Triggered by leading edge of sync pulse.
  - Generates saw-tooth current through vertical yoke windings.
  - Contains most of the components on the module.

- Horizontal Oscillator (Waveform generator)
  - Triggered by leading edge of sync pulse.
  - Generates saw-tooth current through horizontal yoke windings.
  - Drives the flyback transformer

- Video Amplifier
  - Amplifies TTL level video to 0-50V signal
  - Drives CRT cathode to generate display.

- Flyback Transformer
  - Generates high voltage for: The Anode, The Video Amplifier, The CRT Grids
MODULE 2 - BASIC OPERATIONAL BLOCKS

THE VIDEO MODULE

THE BASIC BLOCKS

- Focus and Brightness Control
  - Controls voltages on focus and brightness grids

- Yoke and CRT
  - CRT produces image on screen
  - Contains the electron gun
  - Yoke bends electron beam to create scanning
MODULE 2 - BASIC OPERATIONAL BLOCKS

REVIEW QUESTIONS

PROCEDURE: Using the block diagrams in this guide, and the schematics, answer the questions listed below.

- Notify your instructor when you are finished

1. If the video and sync is properly going from the logic board to the video module, but there is NO video at all on the tube, what would be the suspect sub-modules?

2. If horizontal sync is not present from the logic board, what will be visible on the screen?

3. The flyback transformer provides power to what three sub-modules?

4. If there is a single vertical line on the screen, what would be suspected?
UNIT 3
THE VIDEO MODULE

MODULE 3 - COMPONENT LEVEL TROUBLESHOOTING

OBJECTIVE - LAB EXERCISES

GIVEN: A 'bugged' terminal
        A DVM
        This Student Guide
        The Lab Exercise worksheet
        A Pencil or Pen

OBJECTIVE: Locate the video module problem to the component level and fill in the information on the Lab Exercise worksheet.

CRITERIA: Correct diagnosis within 30 minutes.
INTRODUCTION

Module 3 presents information on the video module components and how each component operates. The function of the components will be discussed and you will get hands-on experience in diagnosing a video module problem to the component level.
MODULE 3 - COMPONENT LEVEL TROUBLESHOOTING

THE BASIC BLOCKS

- Vertical Oscillator (Waveform generator)
  - Sync is coupled through C601
  - IC1 generates waveform based on settings of SFR1, SFR2, and the various biasing components.
  - Output of IC1 goes to vertical section of yoke

KEY COMPONENTS -
  Vertical Oscillator IC
  Height Potentiometer
  Linearity Potentiometer

- Horizontal Oscillator (Waveform generator)
  - Sync is coupled through C301
  - Transistors Q301 and Q302 along with transformer T301 create Horizontal Saw-tooth.
  - The output of Q302 is used to drive the Horizontal section of yoke.
  - The output of Q302 also provides and input signal to the flyback transformer.

KEY COMPONENTS -
  Q301, Q302
  T301
  L301
  Width Coil

- Video Amplifier
  - Amplifies TTL level video to levels capable of driving the CRT.

KEY COMPONENTS -
  Q502, Q501
  R511 (known to fail)

- Flyback Transformer
  - Generates high-voltage for the anode and video amplifier.
  - Provides voltages for grids

KEY COMPONENTS -
  Flyback Transformer
MODULE 3 - COMPONENT LEVEL TROUBLESHOOTING

THE BASIC BLOCKS

- Focus and Brightness Control
  - VR2 forms a voltage divider to supply power to the focus grid.
  - SFR4 sets the 'beam on' threshold

KEY COMPONENTS -
  SFR4
  VR2

- Yoke and CRT
  - CRT produces image on screen
  - Contains the electron gun

KEY COMPONENTS -
  Yoke
  CRT
MODULE 3 - COMPONENT LEVEL TROUBLESHOOTING

LAB EXERCISES

PROCEDURE:

1. Go to any of the available terminals

2. Perform whatever tests necessary to determine the problem to the component level.

3. Write your lab results on the Lab Exercise worksheet.

4. Let the instructor know when you are done.

Which terminal was used?

What were the terminal symptoms?

What tests did you perform?
UNIT 4
THE KEYBOARD

This unit on the keyboard consists of two modules:

1. Sub-module level troubleshooting

Module 1 presents to you the necessary information to locate problems in the video module to one of the basic operational blocks.

2. Component level troubleshooting

Module 2 will explain the purpose of each component and how to isolate problems to the component level.
UNIT 4

MODULE 1 - BASIC OPERATIONAL BLOCKS

OBJECTIVE - REVIEW QUESTIONS

GIVEN: Several fill in the blank review questions
905/955/9220 keyboard schematics
This Student Guide
A pencil or Pen

OBJECTIVE: Diagnose any keyboard problem to the suspect
operational block.

CRITERIA: All Review Questions correct.
INTRODUCTION

This module will break down the power supply into basic operational blocks and explain what each block does. This information will enable you to quickly isolate problems to a group of suspect components.
MODULE 1 - BASIC OPERATIONAL BLOCKS

What are the basic operational blocks of the keyboard?

- Processor - Prom
  - Contains program to scan keys and transmit key code
  - Monitors receive data for commands
  - Generates key click and bell
  - Resets terminal when control reset is pressed

- Column select
  - Selects which key column is active
  - Should generate only one low line at a time

- Key matrix
  - Each key is attached to one row and one column
  - As a single column is selected, all keys in that column are read.
MODULE 1 - BASIC OPERATIONAL BLOCKS

REVIEW QUESTIONS

PROCEDURE: Using the block diagrams in this guide, and the schematics, answer the questions listed below.

. Notify your instructor when you are finished

1. If the keyboard doen's beep, what sub-module should be suspected?

2. If a single character is not working, which sub-module would you suspect?

3. The keyboard transmits the key code to the logic board by what transmission technique?

4. Which terminals use the same keyboard as the 955 terminal? (Circle the correct choices)

   910   910+   912   920   914   924
   905   922   925e   9220   955   921

6/86   4.1.5   Keyboard
UNIT 4
THE KEYBOARD

MODULE 2 - COMPONENT LEVEL TROUBLESHOOTING

OBJECTIVE 1 - LAB EXERCISES

GIVEN: A 'bugged' terminal
A DVM
This Student Guide
The Lab Exercise worksheet
A Pencil or Pen

OBJECTIVE: Locate the keyboard problem to the component level and fill in the information on the Lab Exercise worksheet.

CRITERIA: Correct diagnosis within 30 minutes.
INTRODUCTION

Module 2 presents information on the keyboard components and how each component operates. The function of the components will be discussed and you will get hands-on experience in diagnosing a keyboard problem to the component level.
MODULE 2 - COMPONENT LEVEL TROUBLESHOOTING

The Basic Blocks

- Processor - Prom
  - IC2 - 8049 Processor containing ROM
  - Handles all serial I/O through buffer U1
  - Same processor and internal ROM as most other products, i.e. 970, 921, 924, 925e
  - Uses special input port for special keys, i.e. Shift, CTRL, RESET, Alpha Lock, FUNCT

- Column select
  - Two 74LS145 4 to 10 line decoder
  - Takes parallel output of 8049 and converts to single active column select line.

- Key matrix
  - 16 x 8 key matrix
  - Hi-Tek sealed keyswitches
  - 9220 has extra keys that are not used on the 905 or 955.
MODULE 2 - COMPONENT LEVEL TROUBLESHOOTING

LAB EXERCISES

PROCEDURE:
1. Go to any of the available terminals
2. Perform whatever tests necessary to determine the problem to the component level.
3. Write your lab results on the Lab Exercise worksheet.
4. Let the instructor know when you are done.

Which terminal was used? ____________________________

What were the terminal symptoms? ____________________________

What tests did you perform? ____________________________
UNIT 5

THE LOGIC BOARD

Unit 5, The Logic Board, consists of three modules:

1. Installing Terminal Options

Module 1 will explain the installation and uses of any options the terminals might have. Some of the options that will be covered are current loop and RS-422 interfaces, extra pages of memory, and any others available.

2. Sub-module Level Troubleshooting

This module will give you the necessary information to locate problems in the logic board to one of the basic operational blocks.

3. Component Level Troubleshooting

This module will explain what each component should be doing and how to isolate problems to the component level.
UNIT 5
THE LOGIC BOARD

MODULE 1 - TERMINAL OPTIONS

OBJECTIVE - REVIEW QUESTIONS

GIVEN: Several Review Questions
This Student Guide
A pencil or Pen

OBJECTIVE: Identify the various available options

CRITERIA: All review question correct.
Module 1 is designed to make you familiar with the various TeleVideo options. Since most of these options can be ordered installed from the factory or can be purchased in kit form, equipment coming in for repair could have a wide variety of options installed.
MODULE 1 - TERMINAL OPTIONS

THE TERMINAL OPTIONS

What terminal options are available?

905 Options:
- Current Loop
- 7 foreign keycap sets w/ 7 Character Generators

955 Options:
- Current Loop
- RS-422
- Extra Pages of Memory
- 7 foreign keycap sets w/ 1 Character Generator
- Graphics Board

9220 Options:
- Graphics Board
MODULE 1 - TERMINAL OPTIONS

REVIEW QUESTIONS

PROCEDURE: Using the block diagrams in this guide, and the schematics, answer the questions listed below.

. Notify your instructor when you are finished

1. What optional BOARDS might be found in a 955 terminal?

2. To add extra pages of memory to a 955 terminal, what must be purchased from TeleVideo?

3. How is current loop added to a 9220 terminal?

4. Would you ever see a 905 problems involving the graphics board?
UNIT 5

MODULE 2 - BASIC OPERATIONAL BLOCKS

OBJECTIVE - REVIEW QUESTIONS

GIVEN: Several fill in the blank review questions
905/955/9220 logic board schematics
This Student Guide
A Pencil or Pen

OBJECTIVE: To diagnose any logic board problems to the
suspect operational block.

CRITERIA: All review questions correct.
INTRODUCTION

This module will break down the logic board into basic operational blocks and explain what each block does. This information will enable you to quickly isolate problems to a group of suspect components.
MODULE 2 - BASIC OPERATIONAL BLOCKS

What are the basic operational blocks?

- CPU
  - 65C02
  - Controls all terminal operations

- System EPROM
  - 2764 or 27128
  - Contains the terminal control program

- Non-volatile / System RAM
  - 2K x 8
  - Saves terminal configuration
  - Used as scratch-pad RAM

- UARTs
  - Used for serial communication to host, printer, and keyboard
  - Variable baud rate
  - Each port has its own UART

- CRT Controller
  - Generates sync signals and character timing
  - Latches characters from display RAM into the character generator.
  - Produces all video related timing

- Address Mux
  - Allows both the CPU and CRTC to access the same RAM
  - Controls which device has access and when

- Display RAM
  - Contains a memory location for each screen position
  - Each memory location contains the ASCII value of the character at that screen location
  - Both the CPU and CRTC have access to this RAM
MODULE 2 - BASIC OPERATIONAL BLOCKS

- Character Generator
  - Converts the ASCII code and Row Address into the correct bit pattern for that character
  - Usually a 2732 EPROM or ROM equivalent

- Shift Register
  - Takes the Character Row Data and shifts it out at the video frequency.

- Gate Array
  - Usually contains circuitry necessary to mix the video and attribute data for correct appearance.
  - Also mixes other signals such as Display Enable.
PROCEDURE: Using the block diagrams in this guide, and the schematics, answer the questions listed below.

. Notify your instructor when you are finished

1. If a terminal continues to lose set-up values, what sub-module would you look at?


2. If the video is correct, but missing attributes, what areas would you investigate?


3. If the keyboard is working correctly, but the logic board does not seem to recognize characters typed, what sub-module would be suspect?


4. If there was no video coming from the logic board, in what order would you check the sub-module listed below?

<table>
<thead>
<tr>
<th>Gate Array</th>
<th>CRTC</th>
<th>Display RAM</th>
<th>Shift Register</th>
</tr>
</thead>
<tbody>
<tr>
<td>Character Latch</td>
<td>Character Generator</td>
<td>Clock Circuit</td>
<td></td>
</tr>
</tbody>
</table>
UNIT 5
THE LOGIC BOARD

MODULE 3 - COMPONENT LEVEL TROUBLESHOOTING

OBJECTIVE - LAB EXERCISES

GIVEN: A 'bugged' terminal
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OBJECTIVE: Locate the logic board problem to the component level and fill in the information on the Lab Exercise worksheet.

CRITERIA: Correct diagnosis within 30 minutes.
INTRODUCTION

Module 3 presents information on the logic board components and how each component operates. The function of the components will be discussed and you will get hands-on experience in diagnosing a logic board problem to the component level.
MODULE 3 - COMPONENT LEVEL TROUBLESHOOTING

This module will be covering specific information about the terminals being discussed and so all discussion will reference the following sections in the maintenance manual ...

The Schematics - Section 2
The Theory of Operation - Section 4
MODULE 3 - COMPONENT LEVEL TROUBLESHOOTING

LAB EXERCISES

PROCEDURE:
1. Go to any of the available terminals
2. Perform whatever tests necessary to determine the problem to the component level.
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Which terminal was used?

What were the terminal symptoms?

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