

TELEVIDEO
905, 955, and 9220 Terminal
Hardware Maintenance Student Guide

May 20, 1986

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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 _____

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.

905, 955, 9220 PRODUCT OVERVIEW

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 similiar 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 it's own unique characteristics and market that it is being sold in to, but over all ... a terminal is a terminal ... parts is parts !

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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

Bits	7 6 5 4 3 2 1				0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1	
	4	3	2	1	Column ↓ Row	0	1	2	3	4	5	6	7
0	0	0	0	0	0	NUL	DLE	SP	0	@	P	.	p
0	0	0	1	1	1	SOH	DC1	!	1	A	Q	a	q
0	0	1	0	2	2	STX	DC2	"	2	B	R	b	r
0	0	1	1	3	3	ETX	DC3	#	3	C	S	c	s
0	1	0	0	4	4	EOT	DC4	\$	4	D	T	d	t
0	1	0	1	5	5	ENQ	NAK	%	5	E	U	e	u
0	1	1	0	6	6	ACK	SYN!	&	6	F	V	f	v
0	1	1	1	7	7	BEL	ETB	'	7	G	W	g	w
1	0	0	0	8	8	BS←	CAN	(	8	H	X	h	x
1	0	0	1	9	9	SKIP HT	EM	)	9	I	Y	i	y
1	0	1	0	10 (a)	10	LF	SUB	*	:	J	Z	j	z
1	0	1	1	11 (b)	11	VT!	ESC	+	;	K	[	k	{
1	1	0	0	12 (c)	12	FF←	FS	,	<	L	\	l	|
1	1	0	1	13 (d)	13	CR	GS	←	=	M	]	m	}
1	1	1	0	14 (e)	14	SO	HOME RS	.	>	N	^	n	~
1	1	1	1	15 (f)	15	SI	NEW LINE US	/	?	O	_	o	DEL RUB

What is ASCII ?

- o A binary code used in computers for communication
- o A standard used world wide
- o Assigns each character a unique binary code
- o 128 ASCII characters
- o 96 letters, numbers, and symbols
- o 32 special control codes

MODULE 1 - ESCAPE SEQUENCES

THE ASCII CONTROL CODES

ASCII Code Table
Abbreviations For Control Characters

NUL	null	FF	form feed	CAN	cancel
SOH	start of heading	CR	carriage return	EM	end of medium
STX	start of text	SO	shift out	SUB	substitute
ETX	end of text	SI	shift in	ESC	escape
EOT	end of transmission	DLE	data link escape	FS	file separator
ENQ	enquiry	DC1	device control 1	GS	group separator
ACK	acknowledge	DC2	device control 2	RS	record separator
BEL	bell	DC3	device control 3	US	unit separator
BS	backspace	DC4	device control 4	SP	space
HT	horizontal tabulation	NAK	negative acknowledge	DEL	delete
LF	linefeed	SYN	synchronous idle		
VT	vertical tabulation	ETB	end of transmission block		

What are control codes ?

- o The first 32 ASCII characters
- o Used for special purposes - controlling a device separating data
- o Non-displayable characters
- o Uses NOT standardized
- o 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

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

What are escape sequences ?

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

MODULE 1 - ESCAPE SEQUENCES

REVIEW QUESTIONS

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

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

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

<u>Terminal Function</u>	<u>905</u>	<u>955</u>	<u>9220</u>
Set Reverse Video Attribute	_____	_____	_____
Set Normal Video Attribute	_____	_____	_____
Set Smooth Scroll	_____	_____	_____
Cursor Address to Row and Column	_____	_____	_____
Select 132 Column Display	_____	_____	_____

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 : _____

Terminal Function

Brief Description

1. Lock Keyboard	_____
2. Unlock Keyboard	_____
3. Monitor Mode On	_____
4. Monitor Mode Off	_____
5. Keyclick On	_____
6. Keyclick Off	_____
7. Buffered Copy Print On	_____
8. Cursor to Home Position	_____
9. Display Self Test	_____
10. Delete a Character	_____
11. Factory Default Reset	_____

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.

INTRODUCTION

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 be 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 ?

- o A series of menus displayed on the terminal
- o 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
- o Values set to match host system
- o 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

MAIN PORT 1	CURSOR keys to move	SPACE BAR to change	SET-UP to exit		

BAUD 9600	WORD 8	PRTY NO	STOP 1	COMM FDX	HAND X-ON

2. 905 Printer Communication Set-up

PRINT	BAUD 1200	WORD 8	PRTY NO	STOP 1		
-------	-----------	--------	---------	--------	--	--

3. 9220 Display Set-up

Display Set-Up				TVS922 R.A.			
TO NEXT SET-UP	TO DIRECTORY	80 COLUMNS	INTERPRET CONTROLS				
NO AUTO WRAP	SMOOTH SCROLL	NORMAL BACKGROUND					
CURSOR	BLINKING	BLOCK					

PC= 01001				NOPR	REPL	DATA	

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

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

UNIT 2

MODULE LEVEL TROUBLESHOOTING

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.

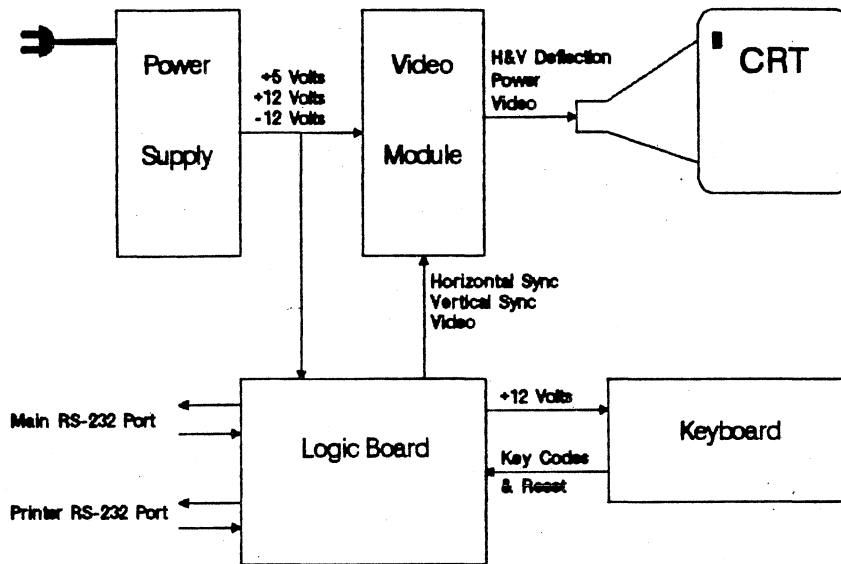
CRITERIA: All questions on lab exercises correct.

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.

MODULE 1 - MODULE LEVEL TROUBLESHOOTING

THE MODULE BLOCK DIAGRAM



MODULE 1 - MODULE LEVEL TROUBLESHOOTING

What are the basic modules ?

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

- o 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

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

- o 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 :

- o Fuse has been checked
- o Unit is plugged in
- o Wall outlet is known good
- o Set-up has been verified to match host

Check list abbreviations :

G/A	-	Gate Array IC
CRTC	-	CRT Controller chip
D-RAM	-	Display RAM
C.G.	-	Character Generator

Symptom: No beep on power up

Suspected Module	Probable Cause	Procedure
Power supply	Power to logic board	Check voltages
Logic board	Not signaling keyboard	Check keyboard I/O
Keyboard	Processor or speaker	Check keyboard

Symptom: No video, no cursor

Suspected Module	Probable Cause	Procedure
Power supply	No power	Check voltages
Logic board	Not providing video	Check video & sync
Video module	Not driving CRT	Check video module
CRT	No good	Replace CRT

MODULE 1 - MODULE LEVEL TROUBLESHOOTING

SYMPTOMS CHECK LIST (cont.)

Symptom: No external communication

Suspected Module	Probable Cause	Procedure
Cable to host	Bad cable	Test cable
Power Supply	No +/- 12V	Check voltages
Logic board	No serial I/O	Check serial I/O

Symptom: Incorrect characters - In Local or Block modes

Suspected Module	Probable Cause	Procedure
Logic board	Many things	Check keyboard I/O, G/A, CRTC, D-RAM, C.G.
Keyboard	Improper scan results	Check keyboard

Symptom: Incorrect attributes

Suspected Module	Probable Cause	Procedure
Logic board	Bad RAM or video G/A	Check G/A, CRTC, D-RAM

Symptom: No keyboard communication

Suspected Module	Probable Cause	Procedure
Logic board	Keyboard interface	Check keyboard I/O
Keyboard cable	Bad cable	Test cable
Keyboard	Many things	Check keyboard

MODULE 1 - MODULE LEVEL TROUBLESHOOTING

SYMPTOMS CHECK LIST (cont.)

Symptom: Improper baud-rate selection

Suspected Module	Probable Cause	Procedure
Logic board	Many things	Check baud clock, G/A

Symptom: Power supply fuses blowing

Suspected Module	Probable Cause	Procedure
Video module	Short	Check for short
Power supply	Short	Check for short
Logic Board	Short	Check for short

Symptom: High-pitched whine

Suspected Module	Probable Cause	Procedure
Video module	Coils or Flyback	Check for vibration

Symptom: Distorted video

Suspected Module	Probable Cause	Procedure
Video module	Bad deflection	Check video amps
Power supply	Voltage fluctuations	Check voltages
Logic board	Bad RAM or video G/A	Check G/A, CRTIC, D-RAM

Symptom: Characters missing dots

Suspected Module	Probable Cause	Procedure
Logic board	Bad RAM or video G/A	Check C.G., G/A, CRTIC
Defective CRT	Bad phosphor	Replace CRT

MODULE 1 - MODULE LEVEL TROUBLESHOOTING

SYMPTOMS CHECK LIST (cont.)

Symptom: Display too dim / can't adjust

Suspected Module	Probable Cause	Procedure
Video module	Bad amplification	Check video amps
Power supply	Low voltage	Check voltages
CRT	Bad phosphor	Replace CRT

Symptom: Online communication problem

Suspected Module	Probable Cause	Procedure
Logic board	Serial problems	Check serial I/O
Power Supply	No power	Check voltages
Cable to host	Bad cable	Test cable
Host	Not configured correctly	Check host settings

Symptom: Jittery screen

Suspected Module	Probable Cause	Procedure
Logic board	Bad video	Check video & sync
Video module	Bad capacitor	Check video module
50/60 Hertz	Doesn't match line	Check settings
Power Supply	Voltage fluctuations	Check voltages

Symptom: Wavy screen

Suspected Module	Probable Cause	Procedure
Video module	Intermittent component	Check video module
Power Supply	Voltage fluctuations	Check voltages
External interference	Induced fields	Try new location

MODULE 1 - MODULE LEVEL TROUBLESHOOTING

SYMPTOMS CHECK LIST (cont.)

Symptom: Incorrect voltages

Suspected Module	Probable Cause	Procedure
Power supply	Poor regulation	Check voltages

Symptom: No light at heater filament

Suspected Module	Probable Cause	Procedure
Video module	Bad trace or connection	Check video module
Power supply	No +12 volts	Check voltages
Defective CRT	Bad heater filament	Replace CRT

Symptom: Display not equal to key entry

Suspected Module	Probable Cause	Procedure
Logic board	Serial problems	Check serial I/O
Keyboard cable	Bad cable	Test cable
Cable to host	Bad cable	Test cable
Host	Not echoing correctly	Check host
Keyboard	Improper scan results	Check keyboard

Symptom: Visible retrace scanlines

Suspected Module	Probable Cause	Procedure
Brightness control	Out of adjustment	Adjust brightness
Video module	Bad blanking	Check video module
Logic board	Bad video or G/A	Check G/A, CRTIC, driver
Defective CRT	Bad cathode	Replace CRT

MODULE 1 - MODULE LEVEL TROUBLESHOOTING

SYMPTOMS CHECK LIST (cont.)

Symptom: Keyboard locked up

Suspected Module	Probable Cause	Procedure
Keyboard cable	Bad cable	Test cable
Logic board	No keyboard I/O	Check keyboard I/O
Software command	Escape sequence	Reset terminal
Keyboard	Many things	Check keyboard

Symptom: Fails self test

Suspected Module	Probable Cause	Procedure
Logic board	Many things	Check C.G., CRTIC, G/A, D-RAM

Symptom: Some keys inoperative

Suspected Module	Probable Cause	Procedure
Keyboard	Improper scan results	Check keyboard
Logic board	Bad keyboard I/O	Check keyboard I/O

Symptom: Horizontal bar across screen

Suspected Module	Probable Cause	Procedure
Logic board	No vertical sync	Check video & sync
Video module	No vertical deflection	Check vertical amp
Yoke	Coil open	Check coil resistance

Symptom: Poor linearity

Suspected Module	Probable Cause	Procedure
Linearity adjust	Control adjustment	Adjust control
Video module	Shorted deflection coil	Check coil resistance

MODULE 1 - MODULE LEVEL TROUBLESHOOTING

SYMPTOMS CHECK LIST (cont.)

Symptom: Cursor moves, no characters

Suspected Module	Probable Cause	Procedure
Logic board	Bad RAM	Check D-RAM, C.G., CRTC
Keyboard	Improper scan results	Check keyboard

Symptom: Vertical line across screen

Suspected Module	Probable Cause	Procedure
Logic board	No horizontal sync	Check video & sync
Video module	No horizontal deflection	Check horizontal amp
Yoke	Open coil	Check coil resistance

Symptom: Crackling sound with distorted video

Suspected Module	Probable Cause	Procedure
Video module	High-voltage arcing	Check video module / CRT Anode Wire

MODULE 1 - MODULE LEVEL TROUBLESHOOTING

LAB EXERCISES

- PROCEDURE:
1. Go to any of the available terminals
 2. Perform what ever 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.

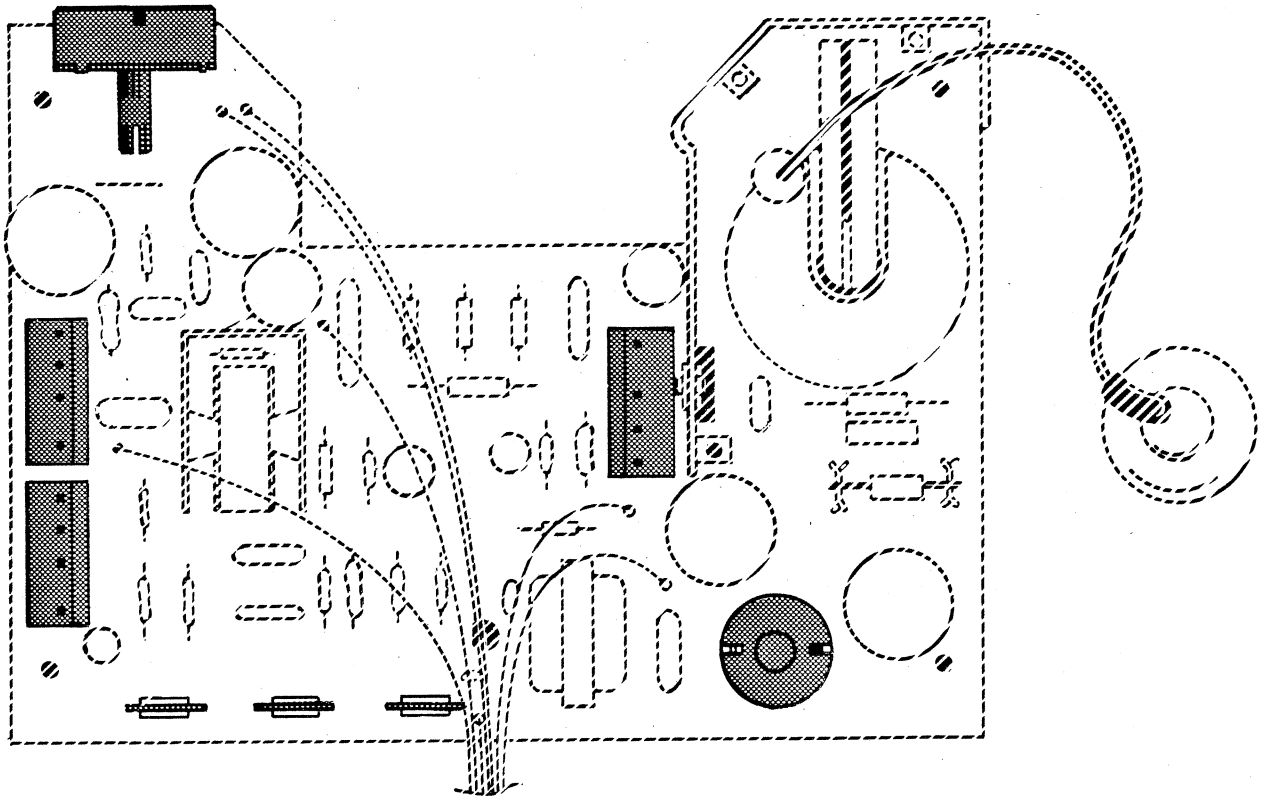
INTRODUCTION

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.

MODULE 1 - PICTURE CONTROLS

THE PICTURE CONTROLS

What are the picture controls ?



- o All picture controls are located on the video module except Contrast
- o All adjustments should be done with a non-conductive tool
- o All adjustments are similiar to a TV set
- o Yoke is preset at the manufacturer
- o All adjustments should be done with the Contrast control turned to it's maximum setting and the video self test being displayed.

MODULE 1 - PICTURE CONTROLS

THE PICTURE CONTROLS

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

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

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

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

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

- o 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 the 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 Miantenance Manual
This Student Guide
A Pencil or Pen

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

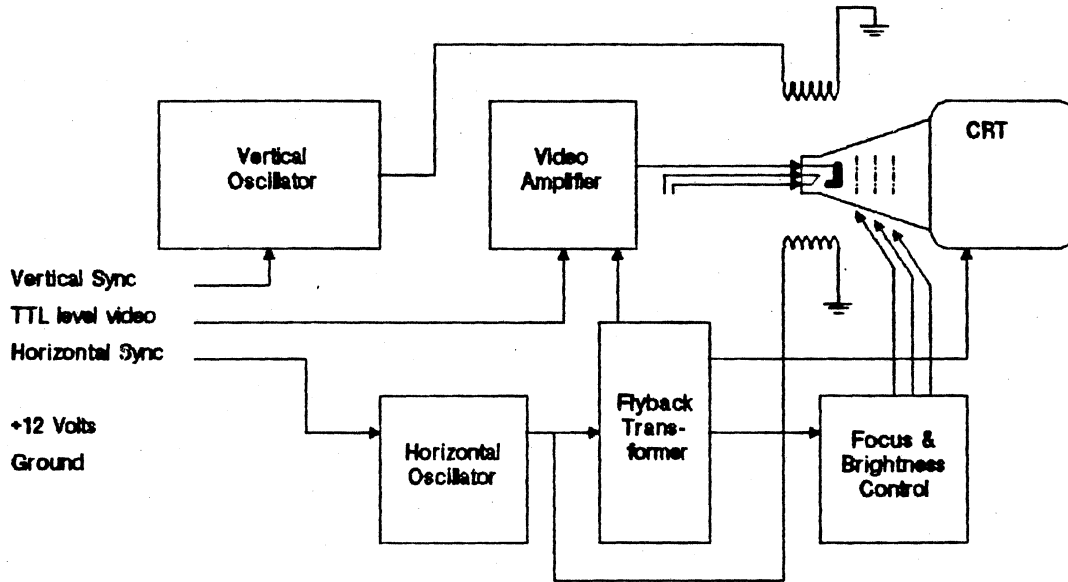
CRITERIA: All review questions correct.

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 ?



- o The power supply provides +12 volts and ground
- o 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

- o 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.

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

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

- o 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

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

- o 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 visable on the screen ?

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

4. If there is a single verticle 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

- o 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
- o 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 an input signal to the flyback transformer.
- KEY COMPONENTS -
 - Q301, Q302
 - T301
 - L301
 - Width Coil
- o Video Amplifier
 - . Amplifies TTL level video to levels capable of driving the CRT.
- KEY COMPONENTS -
 - Q502, Q501
 - R511 (known to fail)
- o 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

- o 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

- o 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 what ever 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.

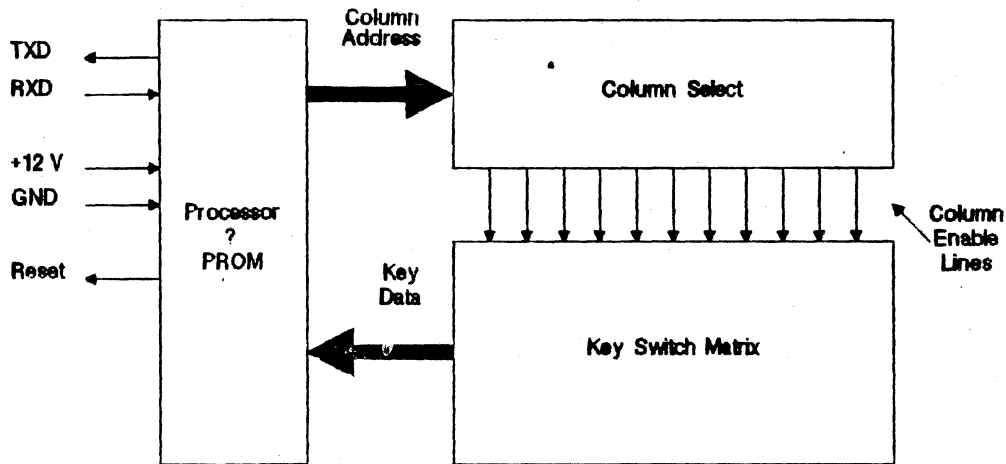
CRITERIA: All Review Questions correct.

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 ?



- o 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

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

- o 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 doesn't 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 |

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

- o 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

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

- o 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 what ever 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.

INTRODUCTION

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:

- o Current Loop
- o 7 foreign keycap sets w/ 7 Character Generators

955 Options:

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

9220 Options:

- o 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 ?

- o CPU
 - . 65C02
 - . Controls all terminal operations
- o System EPROM
 - . 2764 or 27128
 - . Contains the terminal control program
- o Non-volatile / System RAM
 - . 2K x 8
 - . Saves terminal configuration
 - . Used as scratch-pad RAM
- o UARTs
 - . Used for serial communication to host, printer, and keyboard
 - . Variable baud rate
 - . Each port has its own UART
- o CRT Controller
 - . Generates sync signals and character timing
 - . Latches characters from display RAM into the character generator.
 - . Produces all video related timing
- o Address Mux
 - . Allows both the CPU and CRTC to access the same RAM
 - . Controls which device has access and when
- o 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

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

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

- o Gate Array
 - . Usually contains circuitry necessary to mix the video and attribute data for correct appearance.
 - . Also mixes other signals such as Display Enable.

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 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 ?

Gate Array	CRTC	Display RAM	Shift Register
Character Latch	Character Generator	Clock Circuit	

UNIT 5

THE LOGIC BOARD

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 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 what ever tests necessary to determine the problem to the component level.
 3. Write your lab results on the Lab Exercise worksheet.
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-

Which terminal was used ?

What were the terminal symptoms ?

What tests did you perform ?

