

SY31-0461-0

IBM 5250 Information Display System
IBM 5251 Display Station
Model 11
Maintenance Information Manual

MAINTENANCE INFORMATION



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MAINTENANCE INFORMATION

This maintenance information manual is to be used for servicing the IBM 5251 Model 11 Display Station. Customer engineers using this manual are assumed to have completed the 5251 Model 11 Display Station education course.

The Maintenance Information Manual (MIM) is in two major sections; maintenance and theory. Maintenance includes locations, procedures, and diagnostic aids. Theory includes data flow, functional units, and features.

Definitions of terms and abbreviations that are not common, but are used in the MIM are in *Glossary of Terms and Abbreviations*.

Setup instructions for the 5251 Model 11 Display Station are in *Appendix A*.

Note: MIM pages vi, 1-4, 1-6, 1-10, 1-18, 1-42, 1-43, 1-45, 1-46, 1-53, 1-55, 3-2 and A-1 have DANGER and CAUTION notices. If desired, translate these notices and write your own words on the blank lines provided on these pages.

Related Publications

Related information can be found in the following manuals:

- *IBM 5250 Information Display System Installation Manual – Physical Planning*, GA21 - 9277
- *IBM 5250 Display System Reference Card*, GX21-9249
- *IBM 5251 Display Station Operator's Guide*, GA21-9248
- *IBM 5251 Display Station Setup Procedures*, GA21-9286
- *IBM 5251 Model 11 Display Station Maintenance Analysis Procedures*, SY31-0571
- *IBM 5256 Printer Operator's Guide*, GA21-9260
- *IBM 5256 Printer Maintenance Information Manual*, SY31-0462
- *IBM 5256 Printer Maintenance Analysis Procedures*, SY31-0572

First Edition (December 1977)

The information in this manual is sometimes changed. Any changes will be given in later editions. Requests for copies of IBM publications should be made to your IBM representative or the IBM branch office serving your locality.

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Safety

The 5251 Model 11 has the following specific DANGERS:

- Line voltage is present at the power supply and the display assembly.

- High voltage is present at the cathode-ray tube.

- The cathode-ray tube could implode if it is hit or dropped.

- The green wire in the display assembly is not at ground voltage.

CE SAFETY PRACTICES

All Customer Engineers are expected to take every safety precaution possible and observe the following safety practices while maintaining IBM equipment:

1. You should not work alone under hazardous conditions or around equipment with dangerous voltage. Always advise your manager if you **MUST** work alone.
2. Remove all power, ac and dc, when removing or assembling major components, working in immediate areas of power supplies, performing mechanical inspection of power supplies, or installing changes in machine circuitry.
3. After turning off wall box power switch, lock it in the Off position or tag it with a "Do Not Operate" tag, Form 229-1266. Pull power supply cord whenever possible.
4. When it is absolutely necessary to work on equipment having exposed operating mechanical parts or exposed live electrical circuitry anywhere in the machine, observe the following precautions:
 - a. Another person familiar with power off controls must be in immediate vicinity.
 - b. Do not wear rings, wrist watches, chains, bracelets, or metal cuff links.
 - c. Use only insulated pliers and screwdrivers.
 - d. Keep one hand in pocket.
 - e. When using test instruments, be certain that controls are set correctly and that insulated probes of proper capacity are used.
 - f. Avoid contacting ground potential (metal floor strips, machine frames, etc.). Use suitable rubber mats, purchased locally if necessary.
5. Wear safety glasses when:
 - a. Using a hammer to drive pins, riveting, staking, etc.
 - b. Power or hand drilling, reaming, grinding, etc.
 - c. Using spring hooks, attaching springs.
 - d. Soldering, wire cutting, removing steel bands.
 - e. Cleaning parts with solvents, sprays, cleaners, chemicals, etc.
 - f. Performing any other work that may be hazardous to your eyes. **REMEMBER – THEY ARE YOUR EYES.**
6. Follow special safety instructions when performing specialized tasks, such as handling cathode ray tubes and extremely high voltages. These instructions are outlined in CEMs and the safety portion of the maintenance manuals.
7. Do not use solvents, chemicals, greases, or oils that have not been approved by IBM.
8. Avoid using tools or test equipment that have not been approved by IBM.
9. Replace worn or broken tools and test equipment.
10. Lift by standing or pushing up with stronger leg muscles – this takes strain off back muscles. Do not lift any equipment or parts weighing over 60 pounds.
11. After maintenance, restore all safety devices, such as guards, shields, signs, and grounding wires.
12. Each Customer Engineer is responsible to be certain that no action on his part renders products unsafe or exposes customer personnel to hazards.
13. Place removed machine covers in a safe out-of-the-way place where no one can trip over them.
14. Ensure that all machine covers are in place before returning machine to customer.
15. Always place CE tool kit away from walk areas where no one can trip over it; for example, under desk or table.

16. Avoid touching moving mechanical parts when lubricating, checking for play, etc.
17. When using stroboscope, do not touch **ANYTHING** - it may be moving.
18. Avoid wearing loose clothing that may be caught in machinery. Shirt sleeves must be left buttoned or rolled above the elbow.
19. Ties must be tucked in shirt or have a tie clasp (preferably nonconductive) approximately 3 inches from end. Tie chains are not recommended.
20. Before starting equipment, make certain fellow CEs and customer personnel are not in a hazardous position.
21. Maintain good housekeeping in area of machine while performing and after completing maintenance.

**Knowing safety rules is not enough.
An unsafe act will inevitably lead to an accident.
Use good judgment - eliminate unsafe acts.**

ARTIFICIAL RESPIRATION

General Considerations

1. Start Immediately – Seconds Count
Do not move victim unless absolutely necessary to remove from danger. Do not wait or look for help or stop to loosen clothing, warm the victim, or apply stimulants.
2. Check Mouth for Obstructions
Remove foreign objects. Pull tongue forward.
3. Loosen Clothing – Keep Victim Warm
Take care of these items after victim is breathing by himself or when help is available.
4. Remain in Position
After victim revives, be ready to resume respiration if necessary.
5. Call a Doctor
Have someone summon medical aid.
6. Don't Give Up
Continue without interruption until victim is breathing without help or is certainly dead.

Rescue Breathing for Adults

1. Place victim on his back immediately.
2. Clear throat of water, food, or foreign matter.
3. Tilt head back to open air passage.
4. Lift jaw up to keep tongue out of air passage.
5. Pinch nostrils to prevent air leakage when you blow.
6. Blow until you see chest rise.
7. Remove your lips and allow lungs to empty.
8. Listen for snoring and gurglings – signs of throat obstruction.
9. Repeat mouth to mouth breathing 10-20 times a minute. Continue rescue breathing until victim breathes for himself.



Thumb and
finger positions



Final mouth-to-
mouth position

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Glossary of Terms and Abbreviations

μf: microfarad.

AC: Alternating current.

addr: Address

ALU: Arithmetic and logic unit.

ASCII: American National Standard Code for Information Interchange.

attribute: Controls how data is displayed on the display screen. For example, attributes of a display field include blinking, high intensity, and reverse image.

B-type display assembly: Refer to reference 150.

blink: An attribute of a display field that causes the characters to flash.

brightness limiter: Refer to reference 150.

Cable Thru feature: A special feature that permits multiple display stations or printers to be attached to a system cable.

char: Character.

character matrix: A part of the display screen character window. The character matrix is 16 scans by 8 dots wide.

character window: A part of the display screen 24 scans by 10 dots wide including the character matrix.

clicker: A solenoid in the keyboard that makes a sound after each keyboard character is received by the display station.

Cmd: The command key on the keyboard that is used to select command functions.

column separator: A vertical bar in a field of data that separates all characters in that field.

command function keys: The 14 keys in the top row of the display station keyboard that are used with the Cmd (command) key to request functions.

cont: Controller

contrast control: Refer to reference 100.

controller: A device that controls the operation of one or more input or output devices.

data stream: A continuing flow of data.

dc: Direct current.

diag: Diagnostic.

driver: Refer to reference 212.

Dup: The key on the keyboard that is used to duplicate a field from a preceding field.

E-type display assembly: Refer to reference 150.

end-of-message delimiter: A 111 in the station ID that indicates the last frame of a message block.

ERAP: Error recording analysis procedures

field attribute: The control characters that describe a displayed field. For example, a display field can be intensified, reversed, underscored, or made to blink.

flyplate: Refer to reference 135.

FRU: Field-replaceable unit.

hex: Hexadecimal.

HH:MM:SS: Hours, minutes, and seconds.

I/O: Input/Output.

ID: Identification.

implode: To burst inward.

Ins: The key on the keyboard that is used to select insert mode.

IPL: Initial program load.

KBD: Keyboard.

key stem: Refer to reference 135.

keylock: A device with a lock and key to restrict use of the display station.

keystroke: The action of pressing a key on the keyboard.

LED: Light-emitting diode.

linearity: The size of displayed characters being in proportion.

LRC: Longitudinal redundancy check.

M-type display assembly: Refer to reference 150.

main planar: The basic printed circuit electronic board used in the display station.

make/break key: A key that generates a scan code when the key is pressed and when it is released.

MAP: Maintenance analysis procedure.

menu: A list of options that can be selected to request display station tests.

microprocessing: An operation of the MPU.

microprocessing unit (MPU): A processing unit that is microprogram controlled and performs internal machine operations. The MPU receives data, controls the display of data, and controls the flow of information to and from the controller.

microprogram: A program that uses microinstructions to carry out system operations.

MIM: Maintenance information manual.

mini-MAP: A maintenance analysis procedure that is located in the maintenance information manual. A mini-MAP continues the failure analysis after one of the other MAPs has located the area that is failing.

MPU: Microprocessing unit.

mm: Millimeter.

ms: Millisecond.

msg: Message.

MSIPL: Main storage initial program load.

multiframe response: More than one frame or multiple frames of data that are sent.

N/C: Pertains to a switch setting; normally closed.

N/O: Pertains to a switch setting; normally open.

null: A character of all zeros that occupies a position in the buffer and is displayed as a blank.

Online tests: A series of online tests that can be requested from the controller after power on and before sign-on. They are requested and displayed by primary and secondary menus. Refer to 206.

option: The selection listed on a display screen menu for test requests.

P-P: Peak-to-peak.

PC: Printed circuit.

planar: See *main planar*.

PM: Preventive maintenance.

poll: A technique the controller uses to determine if a display station is ready to send or receive data.

POR: Power on reset.

POT: Power on transition.

R/D: Receiver/driver.

raster: A condition of the display screen in which the display screen is lighted but contains no data. Refer to reference 156.

read-only storage (ROS): A device in the MPU that reads data and does not change the data.

read/write storage: A device in the MPU that stores information for later use and can be changed by an MPU.

refresh: Pertains to the repeated actions of the display adapter when data is displayed.

regen: An area in read/write storage where data is stored before it is displayed.

register: A storage device or circuit that stores those limited parts of data needed for executing input/output, storage, processing, and control operations.

resolution: The visual quality of display screen data.

retaining ears: Refer to reference 133.

retrace lines: Refer to reference 156.

retry: Sending frames of information a number of times by the controller until received by the display station without an error.

ripple level: A voltage measurement.

rolling: Pertains to movement of a display screen; either horizontally, vertically, or a combination of both.

ROS: Read only storage.

rt adj: Right adjust.

serdes: Serializer/deserializer.

serializer/deserializer (serdes): A register that is used to send data from the display station to the controller, one bit at a time.

setup: Preparing a device for operation.

sign-on: The procedure performed at a display station that can include entering the sign-on command, a password, or other user specified security information.

stabilizer: Refer to reference 134.

stat addr: Station address.

stem: See *key stem*.

synchronization: Two or more events occurring at the same time.

SVCS: Services.

Sys Req: The Sys Req key is used to enter a request directly to the system.

TB: Terminal block.

template: Refer to reference 143.

Terminator switch: A switch used to terminate the twinaxial cable at the last display station or printer in a series. This switch is a part of the Cable Thru feature on a display station.

theory: A section of this manual that includes data flow, functional units, and features.

twinaxial cable: A twisted-pair shielded cable that connects a display station or printer to a controller.

typamatic key: A repeat-action key on the keyboard.

underscore: An attribute of a display field that places a line under all positions of the field.

US: United States.

V-type display assembly: Refer to reference 150.

Vac: Volts alternating current.

Vdc: Volts direct current.

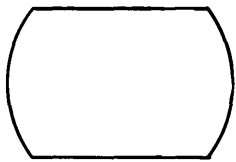
video: Pertains to the display screen image.

yoke: Refer to reference 150.

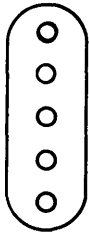
YY/MM/DD: Year, month, and day.

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Legend



Display Screen



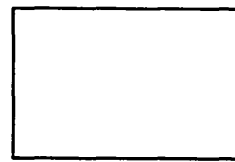
Control Panel
Lights



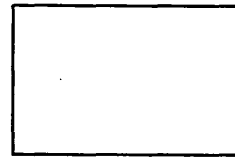
Start and End
of Flowchart



Off-Page
Connector



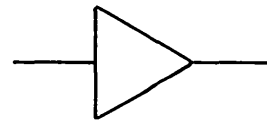
Note Block



Information
Block

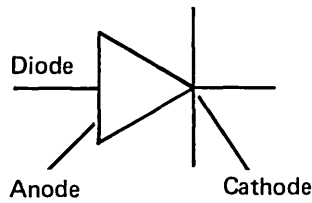


On-Page
Connector



Driver

Logic (indicates
signal direction)



Diode

Anode

Cathode

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Using the IBM 5251 Model 11 Display Station Maintenance Information Manual

The information in this MIM is to be used as reference material when diagnosing machine failures. This MIM contains maintenance procedures, diagnostic aids, preventive maintenance information, tools and test equipment information, theory and features. Appendixes give general information that is not directly related with the maintenance of the 5251 Model 11 Display Station (information such as setup procedures).

The format for page numbering is XXX-YYY.Z. Where XXX is the section number, YYY is the page number, and Z (although not normally used) is for expansion when it is not practical to give new numbers to all pages.

Three-digit reference numbers are assigned to location drawings and maintenance procedures to reference from the MAPs. For example, 130 indicates the keyboard locations of the display station.

MAINTENANCE PROCEDURES

This section contains location drawings, maintenance procedures, mini-MAPs, and diagnostic aids for repairing, installing, or diagnosing the failing field-replaceable units.

Location drawings show the position of the parts in the display station.

Maintenance procedures contain removals, replacements, and adjustment procedures. All procedures and drawings have the three-digit reference number assigned to reference from the MAPs.

Diagnostic Aids

Diagnostic program descriptions, how to use them, and what is available when they are in control are found in this section. To aid in diagnosing machine failures in more detail, a list of error conditions is included.

Mini-MAPs

You are sent to mini-MAPs after one of the other MAPs has located the area that is failing. The mini-MAPs continue the failure analysis to locate a failing field-replaceable unit.

In general, mini-MAPs provide you with three levels of information. These levels are:

1. A figure showing the circuit line names and pin numbers.
2. A description of the circuit and how it can be tested.
3. A detailed guide that uses the yes and no path of questions that you can follow to isolate the failure.

You can select the level of information you need and ignore the remainder in order to locate a failing field-replaceable unit.

PREVENTIVE MAINTENANCE

Any preventive maintenance required by the display station is described in this section.

TOOLS AND TEST EQUIPMENT

The tools needed to service the display station are described in this section.

THEORY

This section contains descriptions of the functional units and features. These descriptions are preceded by a view of the system that gives you a general idea of the complete operation and where each function or feature fits in.

FEATURES

The features that are available with the 5251 Model 11 Display Station are described in this section.

APPENDIXES

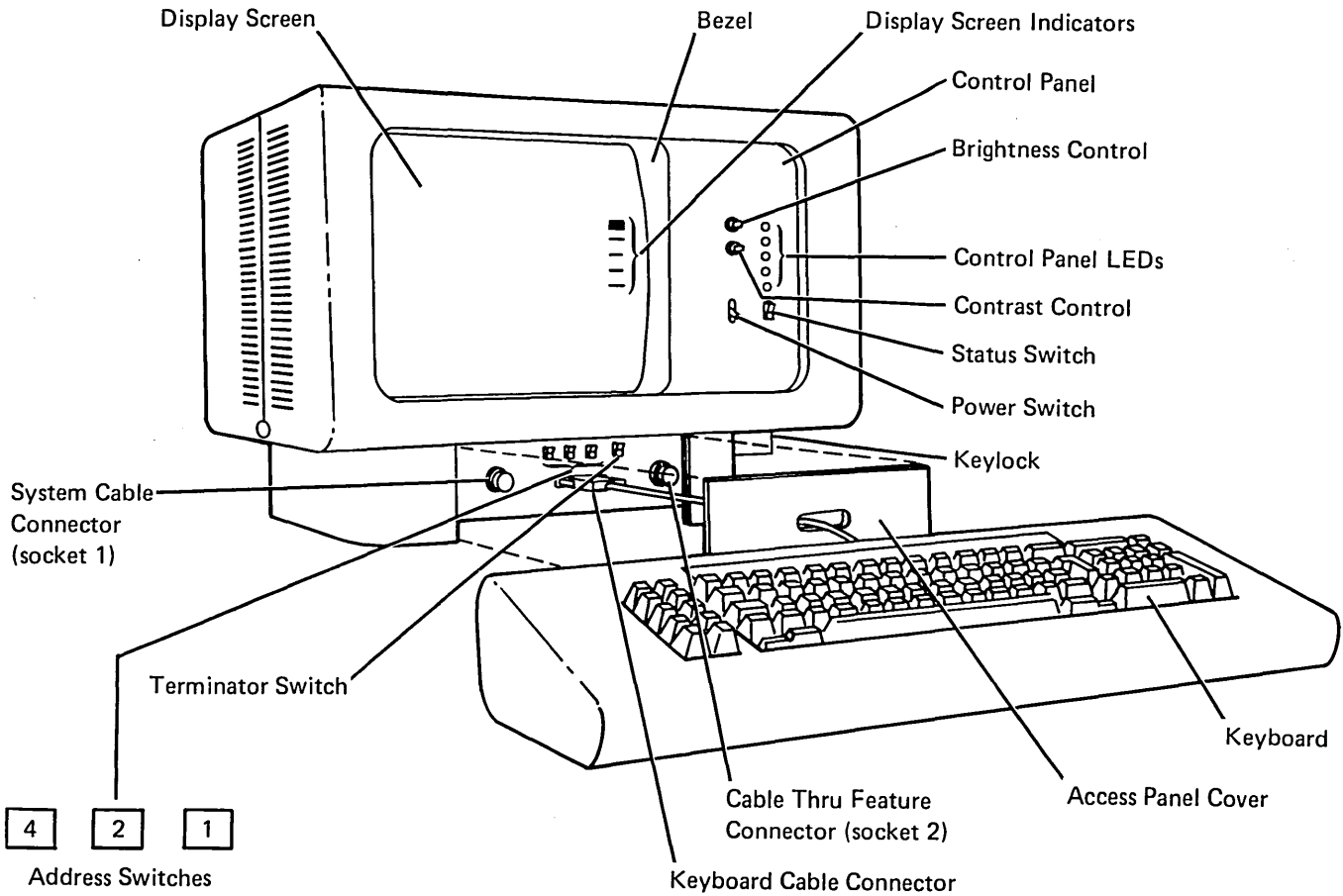
Appendix A contains the setup procedures required to make a new display station operational. Appendix B explains the purpose of special keys on the keyboard.

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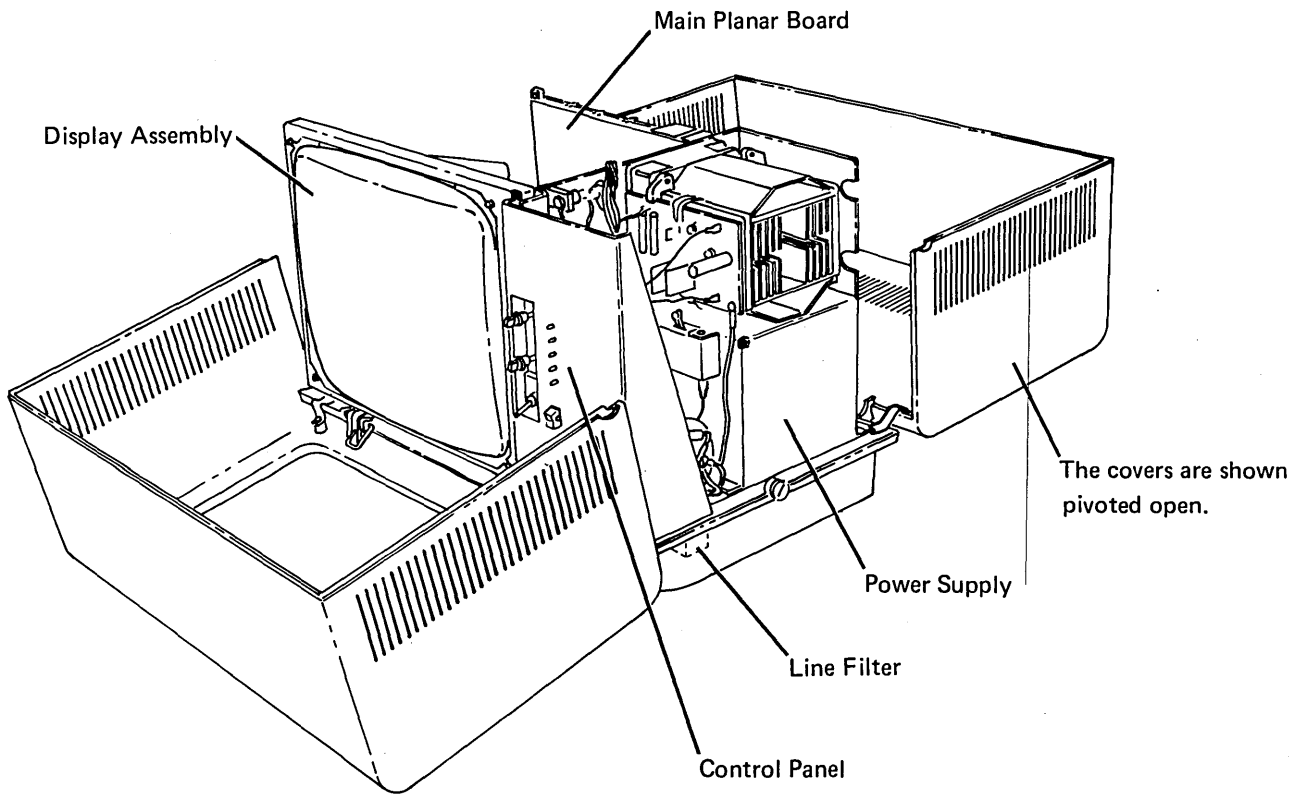
The index is a detailed list of all material in the MIM.

Locations

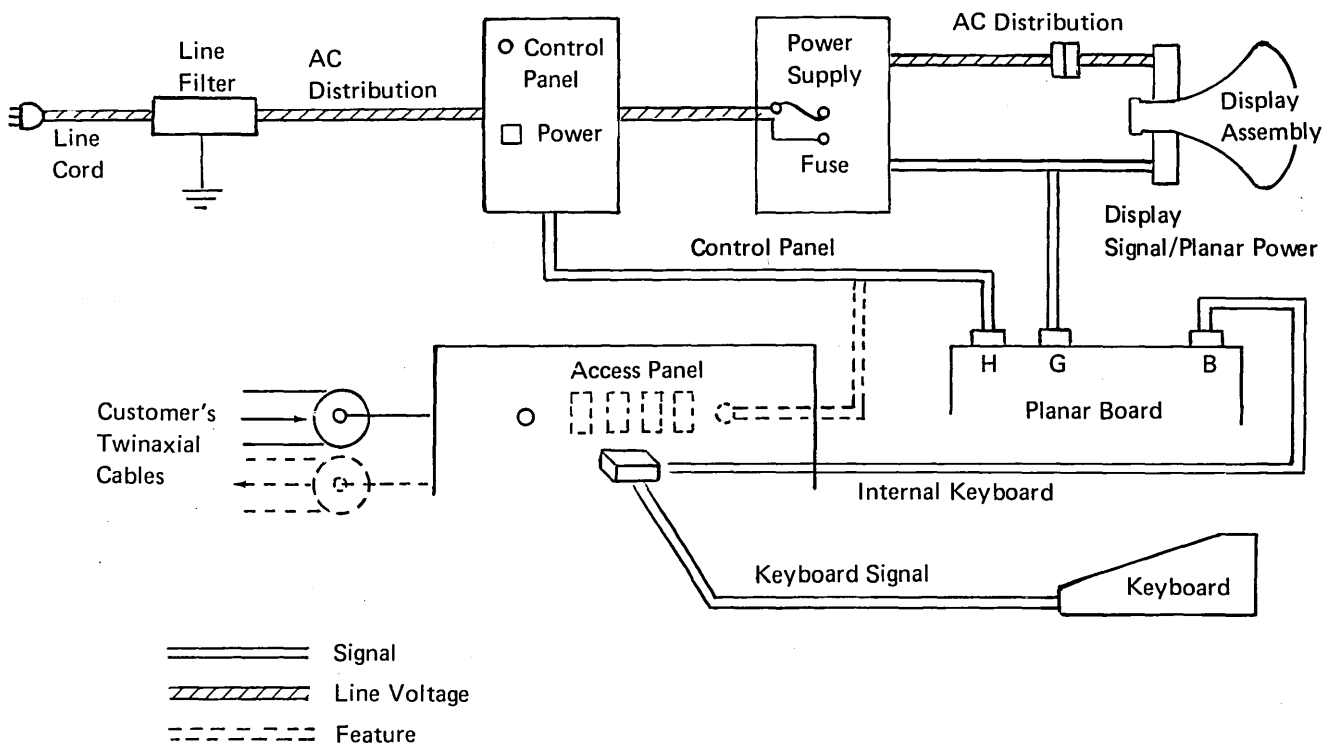
100 FRONT VIEW



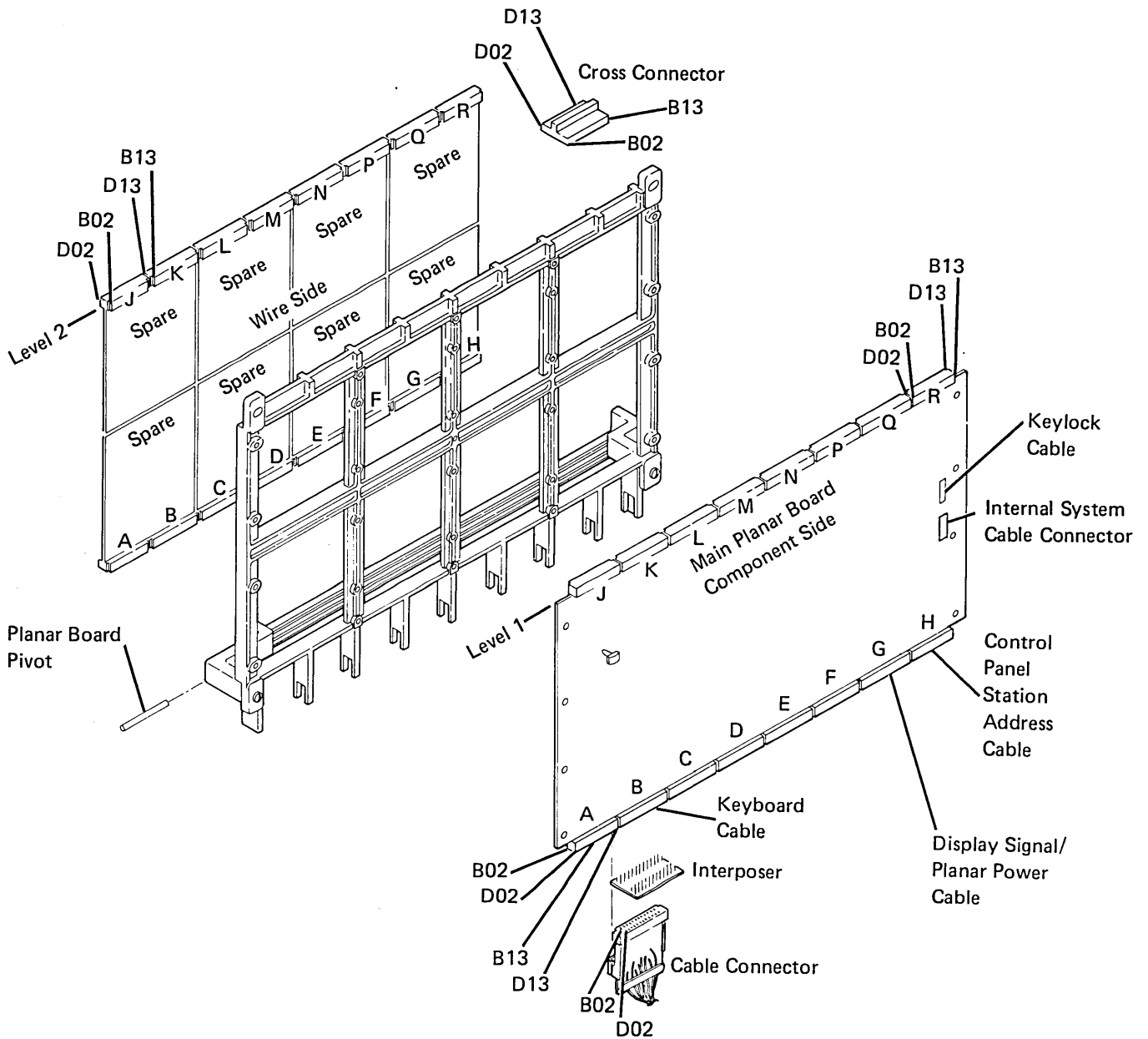
101 COVERS OPEN



102 CABLE CHART



103 MAIN PLANAR BOARD AND CARD LOCATIONS



104 MAIN PLANAR BOARD PART NUMBERS

Country	Main Planar Board Part Numbers
U.S. and Canada	7362528
ASCII	7362529
Japan (English)	7362530
Japan (Katakana)	7362531
Austria/Germany	7362532
Belgium	7362533
Brazil	7362534
Canada (French)	7362535
Denmark/Norway	7362536
Finland/Sweden	7362537
France	7362538
Italy	7362539
Portugal	7362540
Spain	7362541
Spanish-Speaking	7362542
United Kingdom	7362543

CAUTION

The logic used on planar boards is susceptible to electrostatic discharge damage. Avoid contact with any conductive parts. Handle the planar by the plastic frame only.

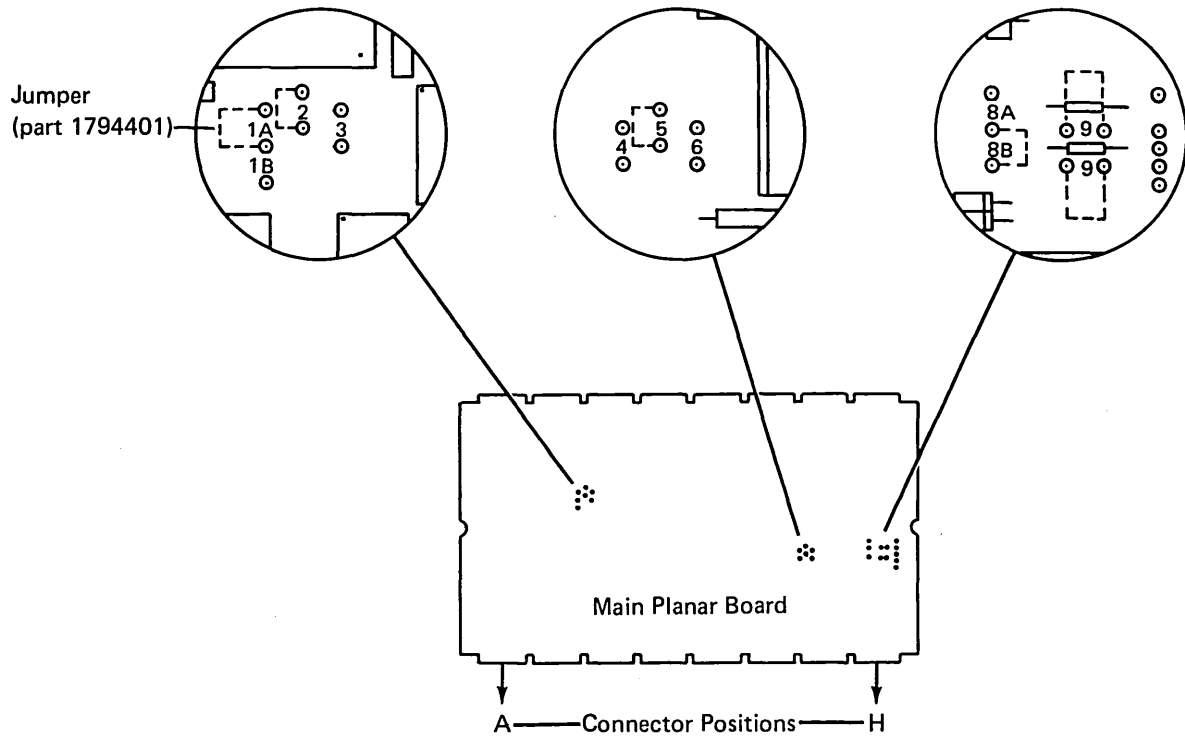
Ground yourself and the conductive plastic bag containing the new planar by holding the bag and momentarily touching the machine frame.

Ensure that the component side is face up when placing a planar on any surface.

105 MAIN PLANAR BOARD JUMPERS

The jumper part number is 1794401.

Jumper Position	Description
1A	Installed for 5251 Model 11
1B	(not used)
2	Installed for 5251 Model 11
3	(not used)
4	(not used)
5	Installed for 5251 Model 11
6	Installed when needed for raster check (156)
7	(not used)
8A	(not used)
8B	Installed for twinaxial cable
9	Installed (both jumpers) when the Cable Thru feature is NOT installed

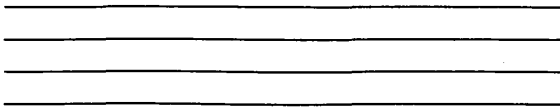


Covers

108 DISPLAY STATION COVERS

CAUTION

Place the display station away from the edge of the table to prevent damage to the covers.



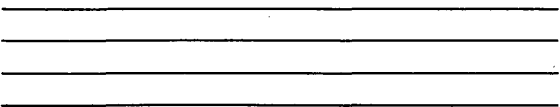
To open the covers:

1. Loosen the cup screw **1** on the left side of the display station.
2. Loosen the cup screw **2** on the right side of the display station.
3. Hold the front half of the cover and pivot it toward the front of the display station.
4. Hold the back half of the cover and pivot it toward the rear of the display station.

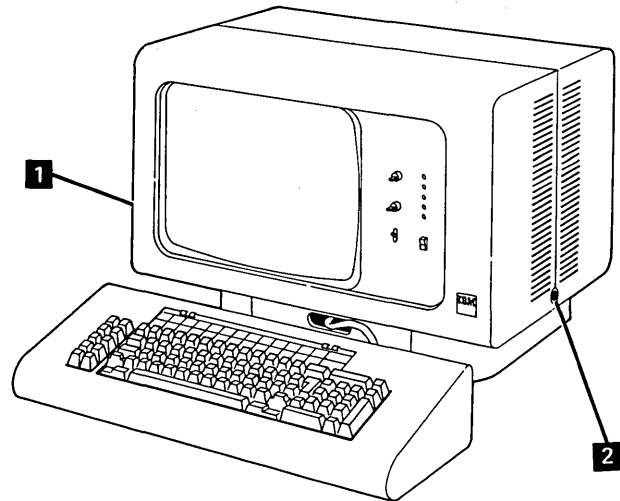
To close the covers:

CAUTION

When reinstalling the covers, ensure that the cup of the screw fits over the lip of the cover to prevent damage to the cover and to ensure that the cover is securely fastened down.



1. Pivot the front half of the cover toward the rear of the display station.
2. Pivot the back half of the cover toward the front of the display station.
3. Tighten the cup screws **1** and **2**. Ensure that the cup fits over the lip on the cover.



109 KEYBOARD COVERS

Removal

1. Loosen the 4 screws on the bottom of the keyboard assembly.
2. Lift the cover away from the keyboard.

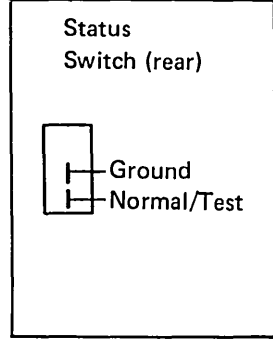
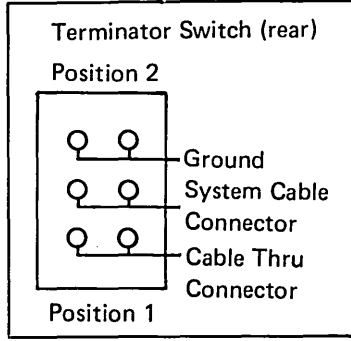
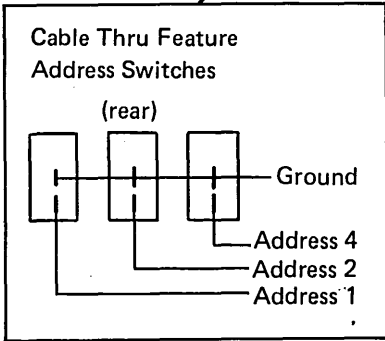
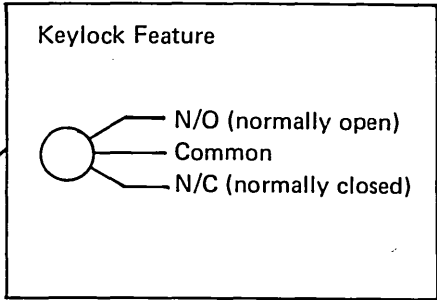
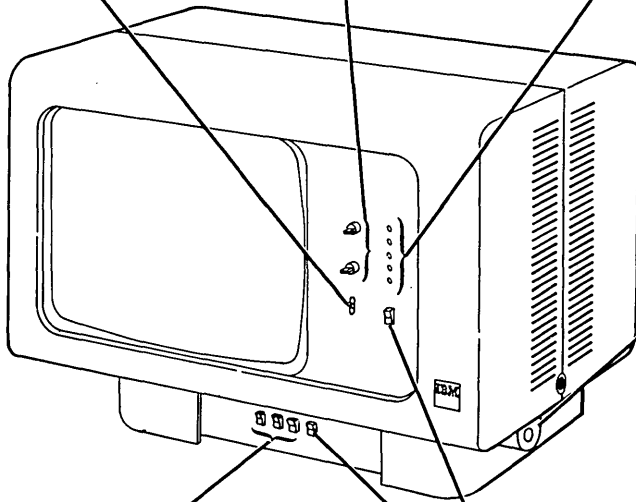
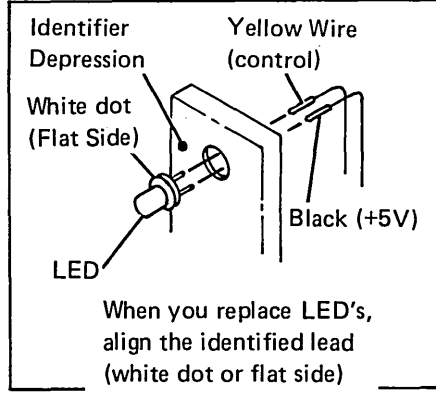
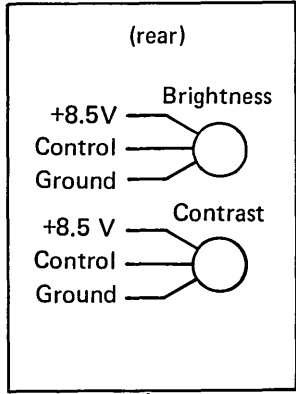
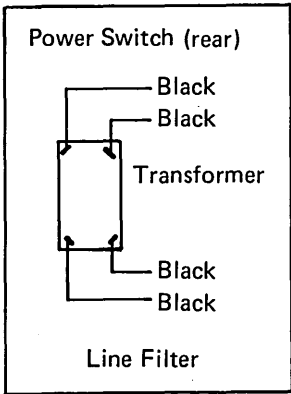
Replacement

1. Place the cover on the keyboard assembly.
2. Tighten the 4 screws on the bottom of the keyboard assembly.

Note: Ensure that the keys do not rub on the cover.

Control Panel and Keylock

110 CONTROL PANEL



111 BRIGHTNESS AND CONTRAST CONTROLS MINI MAP

- Use this figure to locate problems with the Brightness and Contrast controls.
- For Mini MAP example, see *Troubleshooting Aids* (212).

Conditions after Power-On

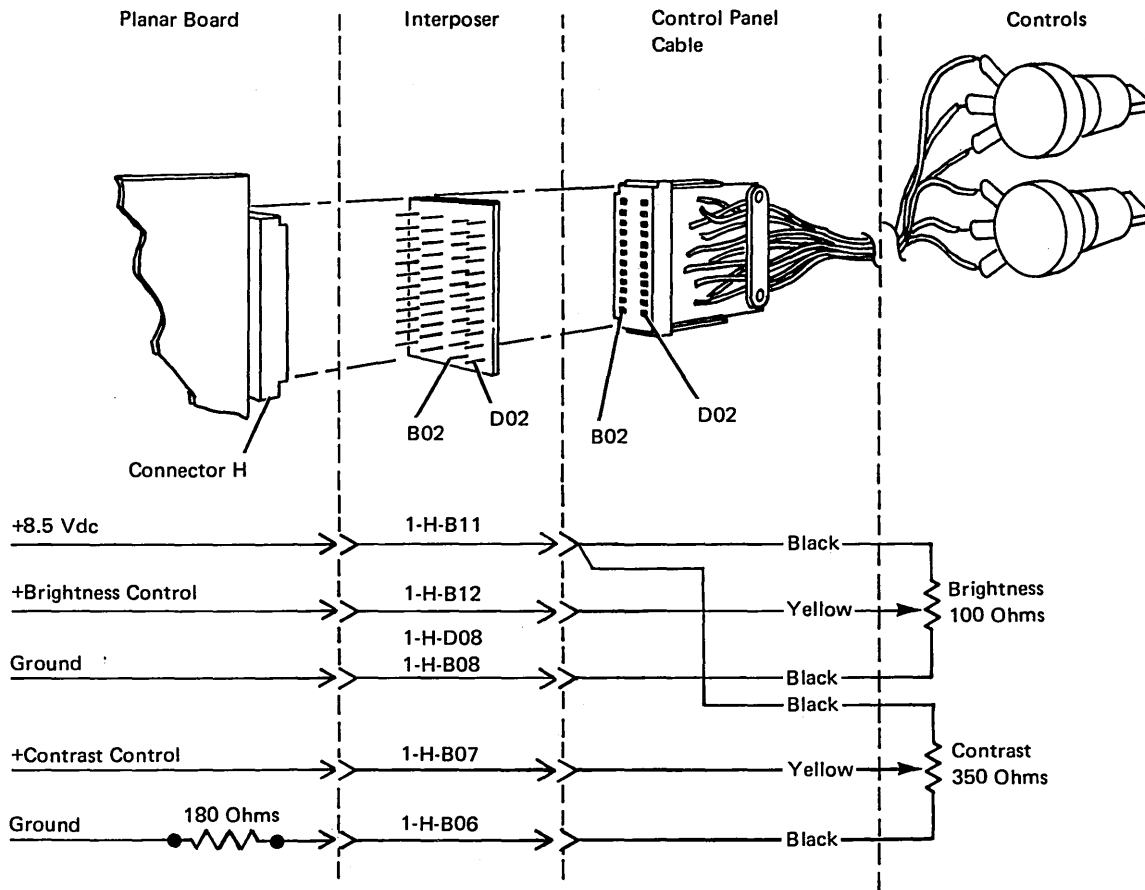
- The '+8.5 Vdc' line is active. The voltage on the '+ brightness control' line will vary with the setting of the control, and will be between 0 and +8.5 volts. The voltage on the '+ contrast control' line will vary from less than 3 to +8.5 volts.

Service Aids

- The display station will *not* be damaged if powered-on after the control panel cable is disconnected.

Tools

- Ground the CE meter on frame ground at the power supply.



111 (continued)

- Check the control line at the planar (brightness or contrast) for a change in voltage as the control is turned fully counterclockwise and then clockwise.
- The voltage limits are:

	<i>Fully CCW</i>	<i>Fully CW</i>
Brightness	0 Vdc	8.5 Vdc
Contrast	Less than 3.0 Vdc	8.5 Vdc

Are the voltage limits correct?

Y N

- Check the center tab of the control.
- Turn the control fully counterclockwise and then clockwise.

Are the voltage limits present at the center tab of the failing control?

Y N

- Check for 8.5 volts on one top tab of the failing control.
 - Check the lower tab of the failing control.
- The voltage should be:
0 volts if checking the brightness control. Less than 3 volts if checking the contrast control.

Are the voltages correct?

Y N

- The cable or the planar is failing.
 - Trace the failing line back to the planar.
- Replace the control.

- Check the control line for an open.

- Inspect the interposer.
- Replace the planar (set the jumpers correctly on the new planar (103) (105)).

Suggested action for an intermittent problem:

- Analyze the suspected line; inspect all the connector contacts.
- Replacement sequence:
 - Control
 - Planar
 - Control Panel Cable

112 CONTROL PANEL LEDS MINI MAP

- Use this figure to locate a control panel LED problem. For detailed information,
- For Mini MAP example, see *Troubleshooting Aids* (212).

Conditions after Power-On

- The '+5 Vdc' line is active.

Service Aids

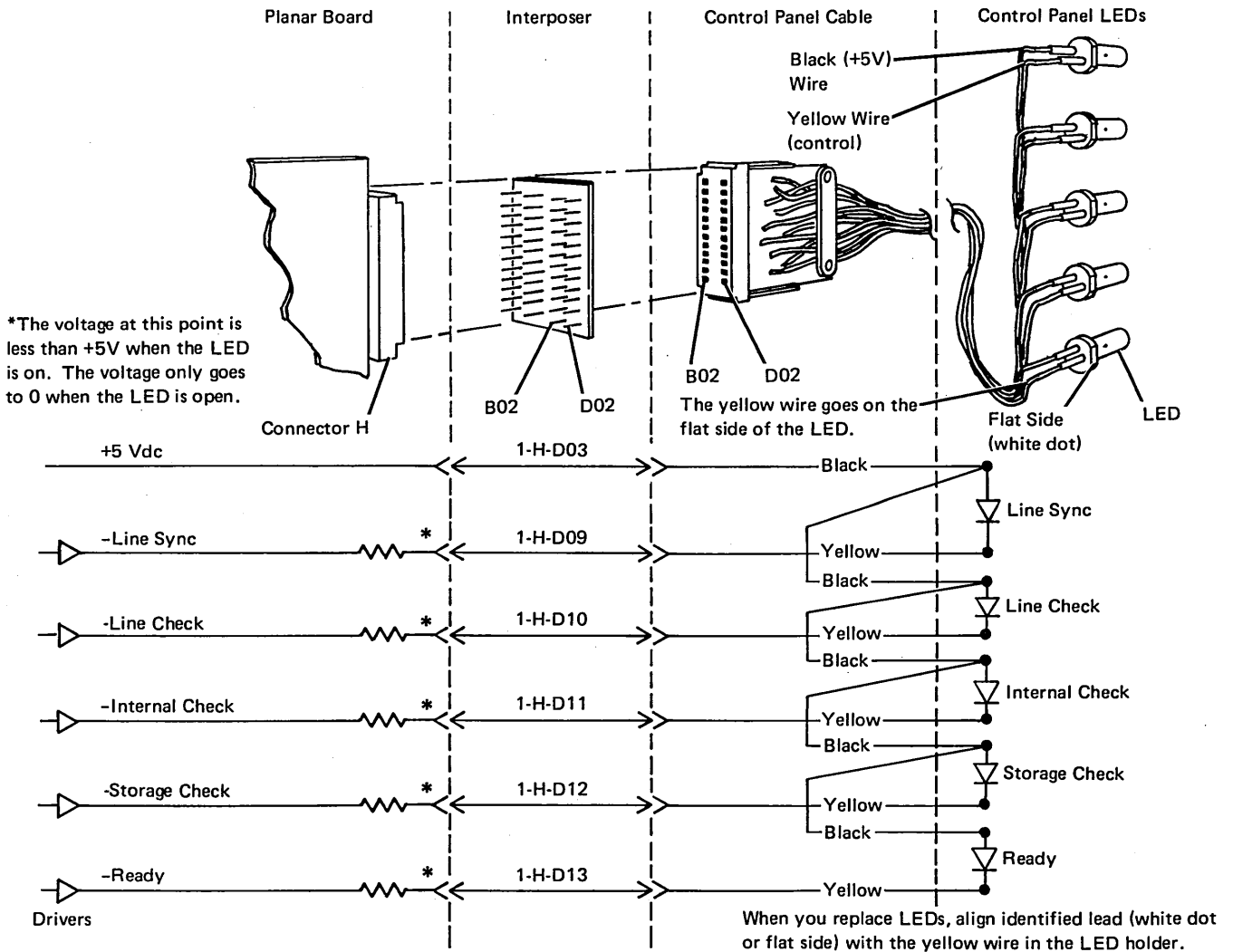
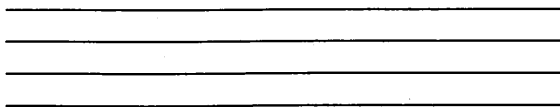
CAUTION

Grounding any indicator line will damage the LED or the main planar board.

- LEDs may be swapped to isolate failures.
- The LEDs flash on for about 1 second during power-on.
- Grounding the '-force POR' line at 1-G-D11 turns on all LEDs.
- The display station will *not* be damaged if powered-on after the control panel cable is disconnected.
- The forward resistance of a good LED is about 4,000 ohms and the reverse resistance of a good LED is more than 20,000 ohms.

Tools

- Ground the CE meter on frame ground at the power supply.



112 (continued)

The LEDs will turn on about 1 second during power-on.

Do all the LEDs fail?

Y N

- Move the 2 wires for the failing LED to an LED that works (maintain polarity when leads are moved).

Does that LED light?

Y N

The cable is open or the planar is failing.

- Trace the failing line back to the planar.

Is the cable OK?

Y N

- Repair or replace the cable.

– Inspect the interposer.

– Replace the planar (set the jumpers correctly on the new planar (103) (105)).

– Connect the wires to the proper LED.

– Replace the failing LED.

– Connect the wires to the proper LED.

- Trace the +5 Vdc common line from the LEDs back to the planar.

Suggested action for an intermittent problem:

- Analyze the suspected line; inspect all the connector contacts.
- Replacement sequence:
 - LED
 - Planar
 - Control Panel Cable

113 CONTROL AND ACCESS PANEL SWITCHES MINI MAP

- Use this figure to locate problems with the Address switches and the Status switch.
- For Mini MAP example, see *Troubleshooting Aids* (212).

Conditions after Power-On

- The '-test sw' line is at a Down level when the Status switch is in the Test (closed) position.
- A station address line is at a Down level when the Address switch is in the closed position and '1' is displayed in the address field when the display station is in Test mode.

Service Aids

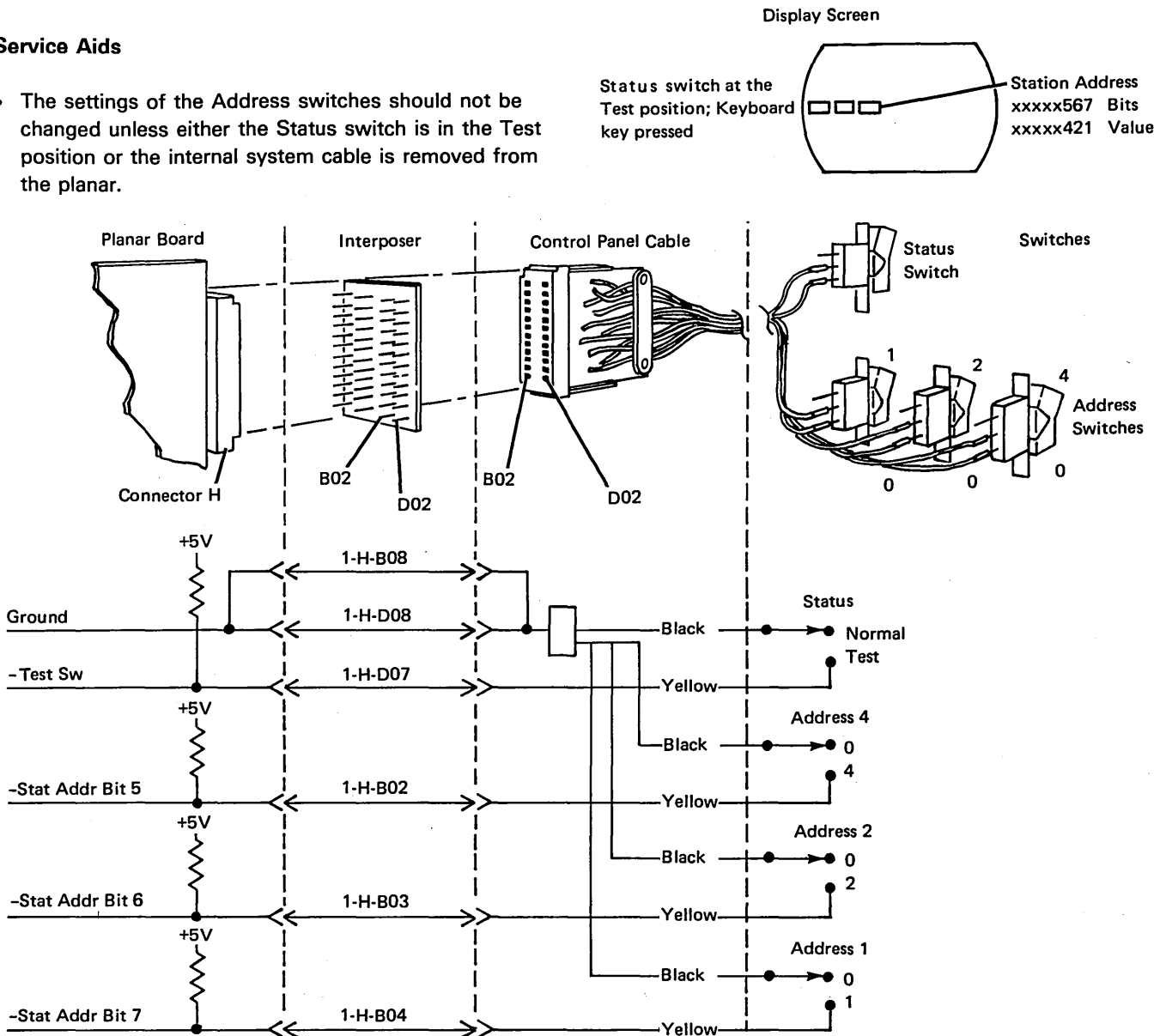
- The settings of the Address switches should not be changed unless either the Status switch is in the Test position or the internal system cable is removed from the planar.

- The display station will *not* be damaged if powered-on after the control panel cable is disconnected.
- The display assembly must be removed (151) to service the Address switches.

Tools

Connect the CE probe as follows:

- +lead-1-G-D03
- -lead-1-G-D08
- Ground-1-B-D08



113 (continued)

- Check the failing line at the planar with the switch closed.

Is the line at a Down level?

Y N

- Check for an open through the switch back to the ground line.
- Check the failing line at the planar with the switch open.

Is the line at an Up level?

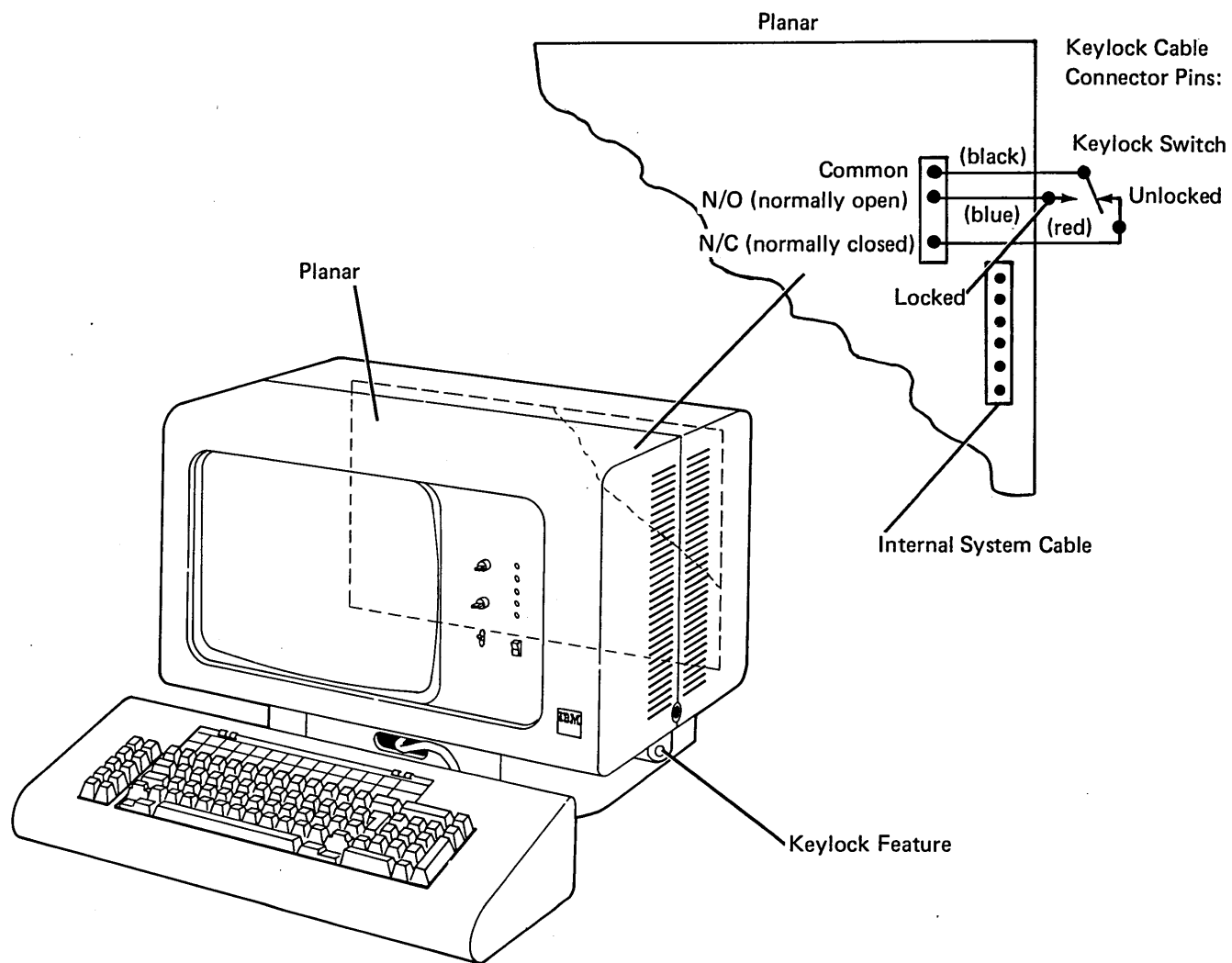
Y N

- Leave the switch open.
 - Check the line back through the switch for a grounded line or a short circuit in the switch.
- Is the line OK?**
- Y N**
- Replace the cable or switch.
 - Inspect the interposer.
 - Replace the planar (set the jumpers correctly on the new planar (103) (105)).
 - Set the Address switches correctly.
- Inspect the interposer.
- Replace the planar (set the jumpers correctly on the new planar (103) (105)).
 - Set the Address switches correctly.

Suggested action for an intermittent problem:

- Analyze the suspected line; inspect all the connector contacts.
- Replacement sequence:
 - Switch
 - Planar
 - Control Panel Cable

114 KEYLOCK MINI MAP



114 (continued)

- Remove the connector from the planar.
- Use a CE meter.
- Check continuity at the planar end of the cable between the common and the normally open lines with the switch in the locked position.

Is there continuity?

Y N

- Repair or replace the keylock assembly.
- Check continuity at the planar end of the cable between the normally open and the normally closed lines with the switch in the locked position.

Does the meter indicate an open?

Y N

- Repair or replace the keylock assembly.
- Check continuity at the planar end of the cable between the normally closed and the common lines with the switch in the unlocked position.

Is there continuity?

Y N

- Repair or replace the keylock assembly.
- Replace the planar board (set the jumpers correctly on the new planar (103) (105)).

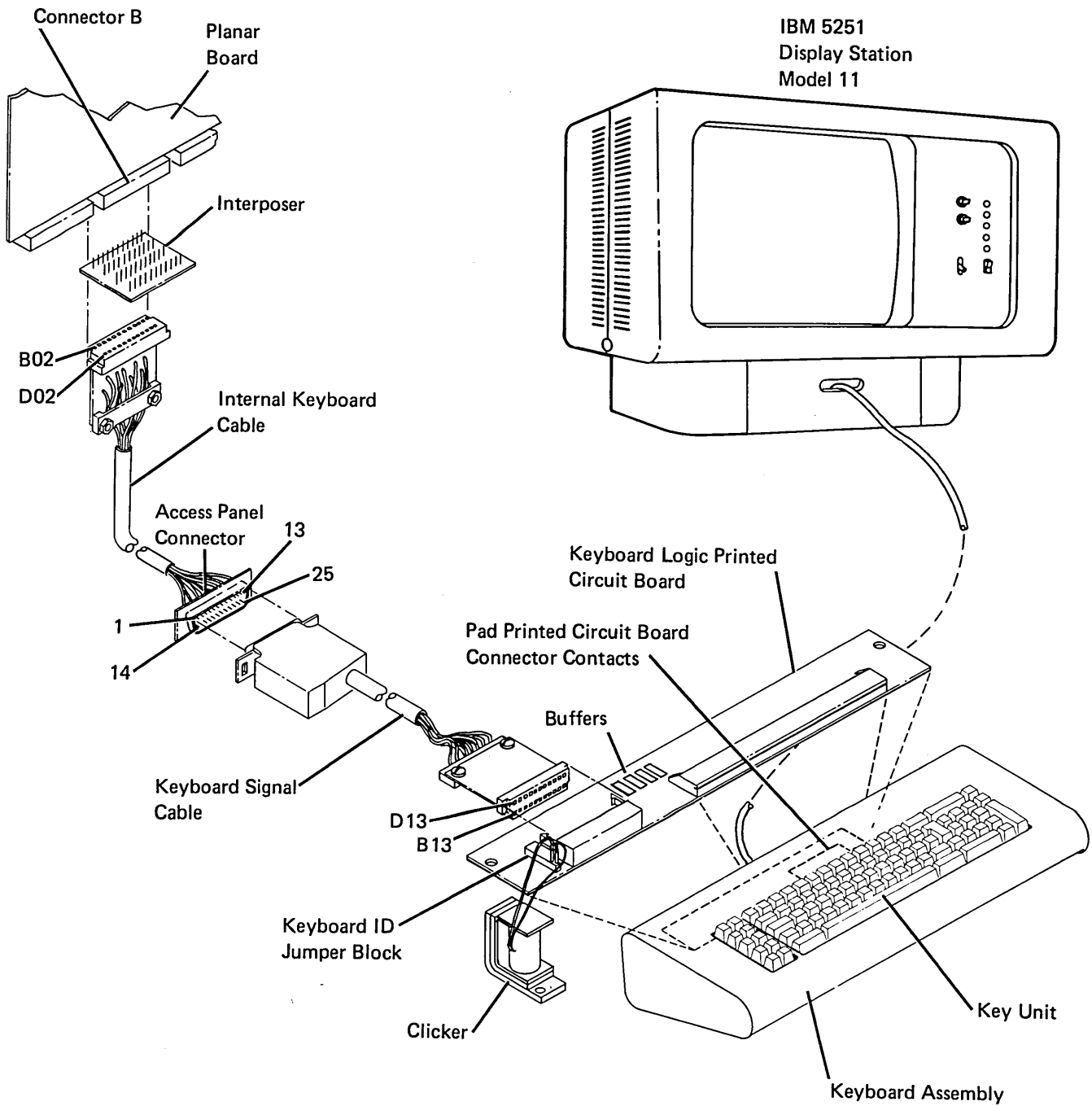
Suggested action for an intermittent problem:

- Analyze the suspected line; inspect all the connector contacts.
- Replacement sequence:
 - Keylock Assembly
 - Planar

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KEYBOARD

130 KEYBOARD LOCATIONS



131 KEYBOARD REMOVAL AND DISASSEMBLY

1. Power off.
2. Remove the top cover by loosening the 4 screws on the bottom of the keyboard assembly.
3. Remove the keyboard logic printed circuit board (130).
4. Remove 2 screws on each side of the keyboard (130).
5. If a key module is to be removed, locate the position of the key before the keyboard is inverted.
6. Lift the keyboard out of the keyboard base.

CAUTION

The keyboard assembly must be kept free of dirt.

7. Invert the keyboard and reinstall it on the original mounting block using a screw on each side to hold the assembly in place.

CAUTION

Removing the pad printed circuit board with a key pressed causes the flyplate to jump out of the key module.

8. Ensure that there is no pressure on any keys.
9. Remove the screws from the pad printed circuit board.
10. Lift the pad printed circuit board from the key assembly.
11. To assemble, reverse the above procedure.

132 CLEANING

1. Disassemble the keyboard (131).
2. Clean the pad printed circuit board with a water moistened, lint free cloth. Check the flyplates for

dirt; clean only those flyplates that are dirty or are causing failures.

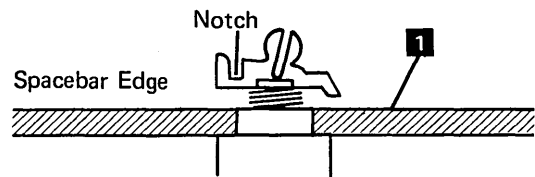
133 KEY MODULE

Removal

1. Use the keytop removal tool (part 9900373) to lift the keytop pushbuttons from the keys to be removed.
2. Disassemble the keyboard (131).
3. Reach under the key unit and push up the failing key modules until they are free.

Note: The module retaining ears must clear the frame

1 as shown.



CAUTION

To prevent loosening a flyplate, ensure that no keys are pressed.

Installation

1. Insert the key module. Align the opening in the key module with the orientation lug in the mounting hole. The key stem notch must be put in position toward the spacebar edge of the key board.
2. Reinstall the pad printed circuit board.
3. Turn the key unit over and, if necessary, position the dust shield.
4. Put the keytop on the key unit.
5. Reinstall the logic printed circuit board and covers.

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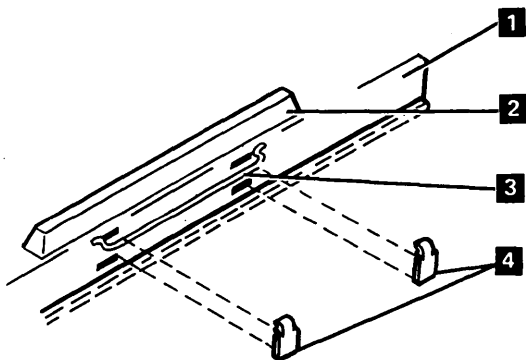
134 SPACEBAR

Removal

1. Disassemble the keyboard (131).
2. Hold the ends of the Spacebar and pull up to slide the bar off the key stems.
3. If the pivots need to be removed, insert a screwdriver tip in the opening in the side of the frame; then, twist the screwdriver slightly until the pivot is removed.

Installation

1. Press the pivots **4** into place in the frame **1**.
2. Place the Spacebar **2** in position over its key modules.
3. Guide the stabilizer **3** into the openings in the pivots.
4. Press the Spacebar on the key stems.

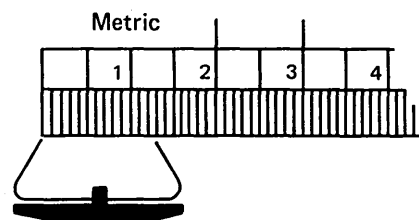


135 FLYPLATE REPLACEMENT

Reinstalling a disconnected flyplate in a key module is not recommended.

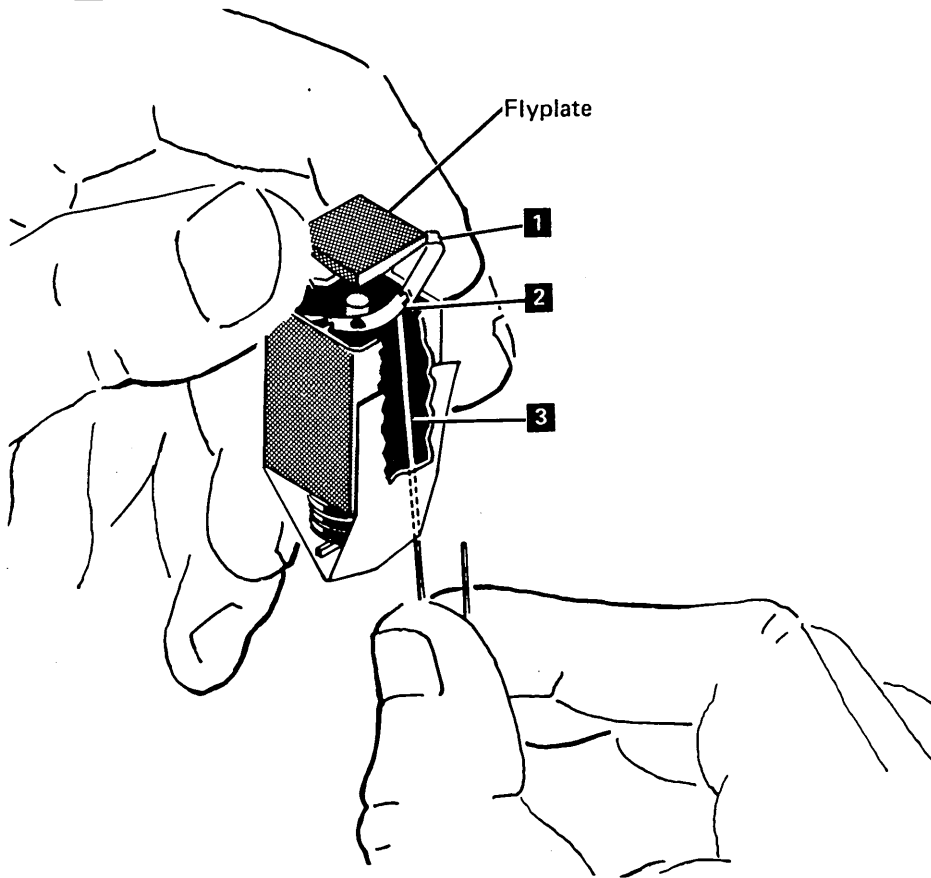
If replacement is necessary because a new key module is not available, inspect the flyplate to ensure the connection is not loose between the spring and flyplate or the flyplate is not damaged.

1. Disassemble the keyboard (131).
2. Remove the key module (133).
3. Form the spring on the flyplate so that there is 12.7 mm (0.5 inch) between the ends of the spring.



135 (continued)

4. Remove the keytop from the key module; then, remove the module from the keyboard.
5. Tape the key stem down as shown.
6. Hold the key module and flyplate as shown, line up the ends of the flyplate spring **1** with the tips of the flat spring **2** attached to the key stem.
7. Insert a small stylus or straightened paper clip through one of the access holes in the key module **3**.



8. Push the tip of the flat spring up on the inside of the flyplate spring.
9. Move the flat spring down until the tab drops into the opening of the flyplate spring.
10. Attach the other end of the spring in the same way.

11. Carefully remove the tape holding the key stem.
12. Check the key stems for taper in the center opening and form them if necessary.

Correct



Wrong



13. Install the key module in the key assembly.

136 KEYBOARD ID MINI MAP

- Use this figure to locate an open or grounded ID line.
- For Mini MAP example, see *Troubleshooting Aids* (212).

Conditions after Power-On

- ID lines *with* jumpers are at a Down level (displays a '1' in the ID field in Test mode).
- ID lines *without* jumpers are at an Up level (displays a '0' in the ID field in Test mode).

Service Aids

- Verify the ID jumpers at the *Keyboard Identification* chart (142).
- The display station will *not* be damaged if powered-on after the keyboard cable is disconnected.

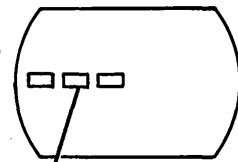
Tools

Connect the CE probe as follows:

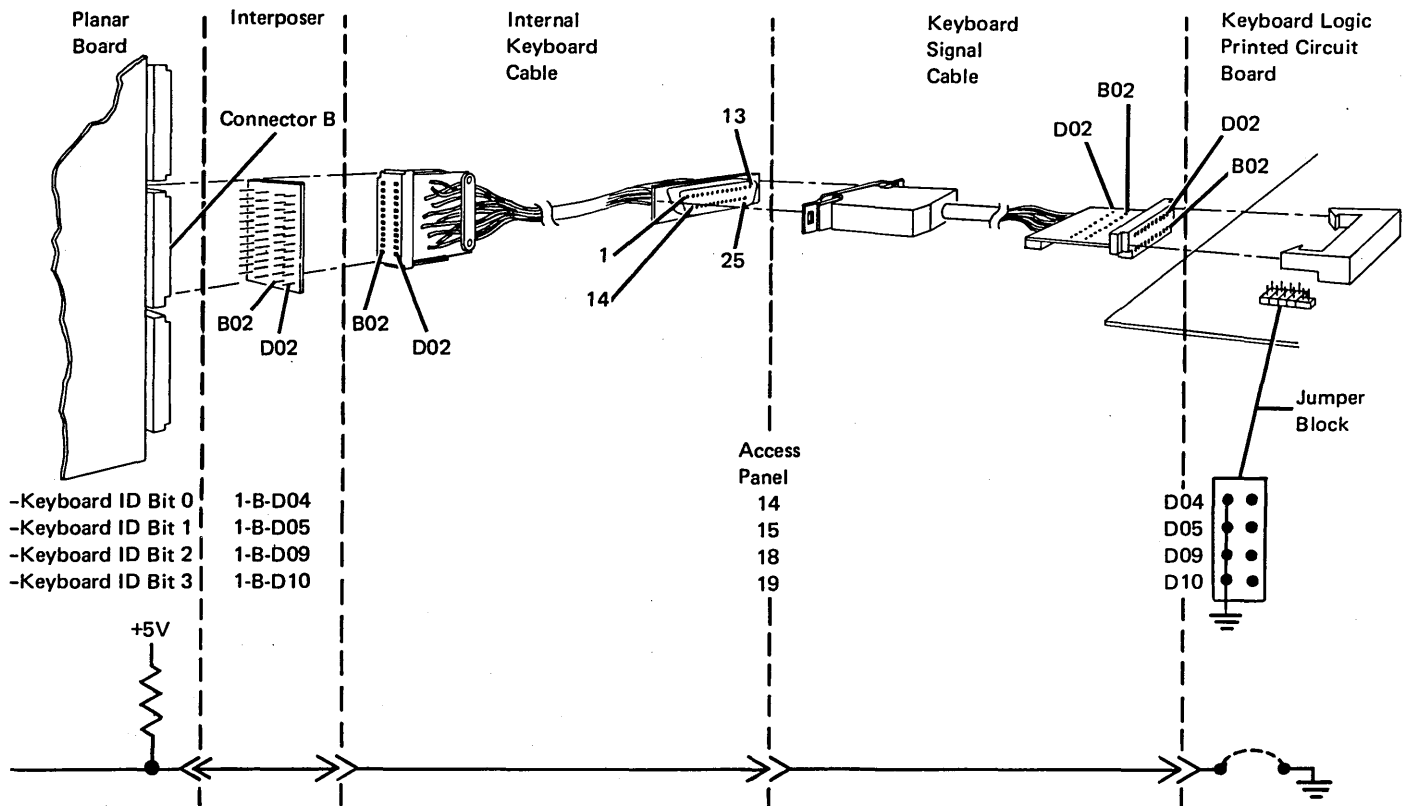
- +lead-1-G-D03
- -lead-1-G-D08
- Ground-1-B-D08

Display Screen

The Status switch at the Test position; Keyboard key pressed



Keyboard ID
0123xxxx



136 (continued)

- Check the failing line at the planar with the ID jumper installed on the jumper block.

Is the line at a Down level?

Y N

- Check for an open line back through the keyboard logic PC board.
- Check the failing line at the planar with the jumper ID removed.

The line should be at an Up level.

Is the line at an Up level?

Y N

- Leave the jumper off.
- Check the line from the planar back to the jumper block on the logic PC board for a ground.

Is the line OK?

Y N

- Replace the cable or keyboard logic PC board.
- Inspect the interposer.
- Replace the planar (set jumpers correctly on the planar (103) (105)).
- Set the ID jumper correctly.
- Inspect the interposer.
- Replace the planar (set jumpers correctly on the planar (103) (105)).
- Set the ID jumper correctly.

Suggested action for an intermittent problem:

- Analyze the suspected line; inspect all the connector contacts.
- Replacement sequence:
 - Planar
 - Keyboard Cables
 - Keyboard Logic PC Board

137 KEYBOARD SCAN CODE MINI MAP

- Use this figure to locate an open or grounded scan code line.
- For Mini MAP example, see *Troubleshooting Aids (212)*.

Conditions after Power-On

- The scan code lines are valid after a key is pressed.

Service Aids

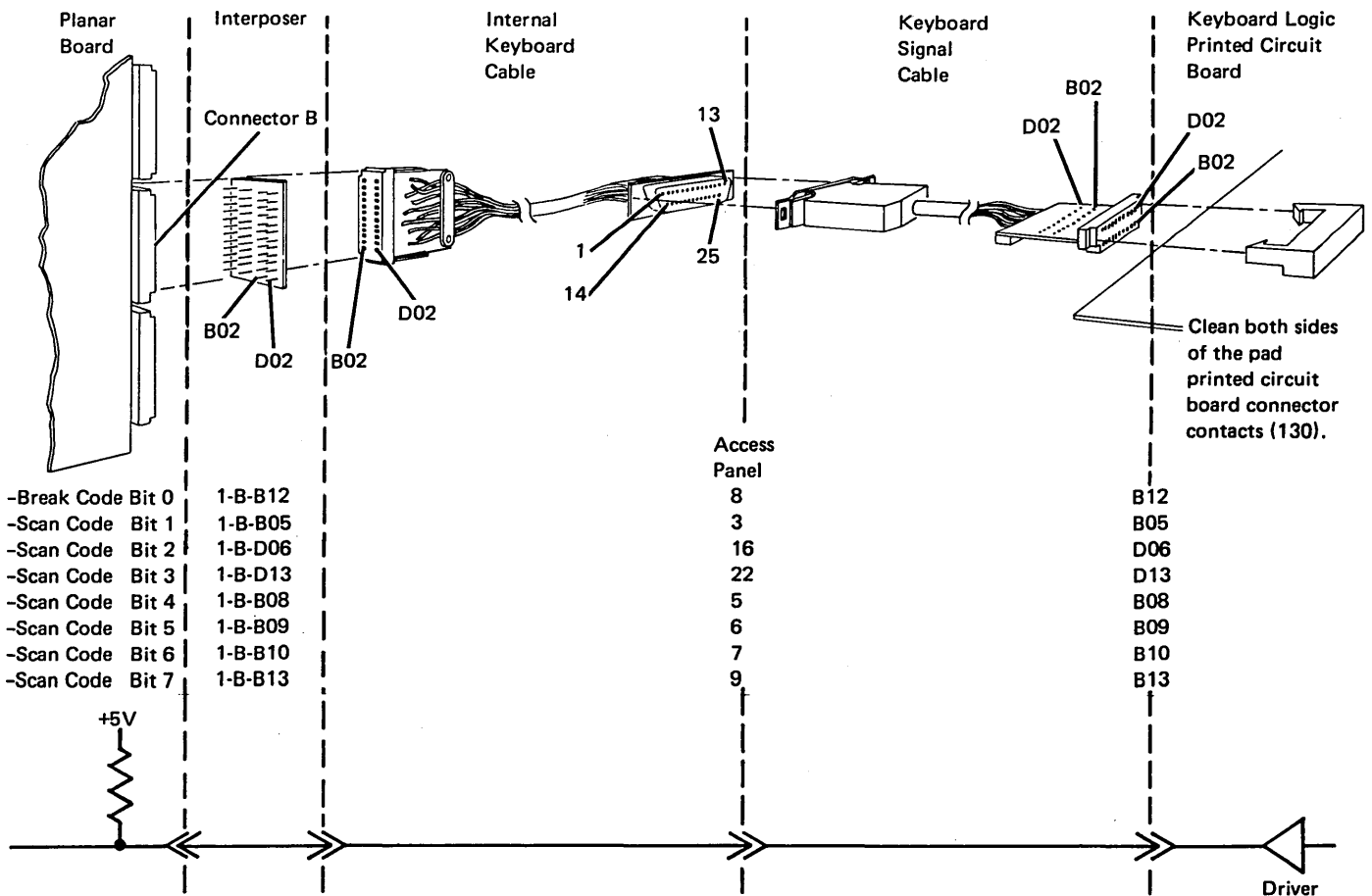
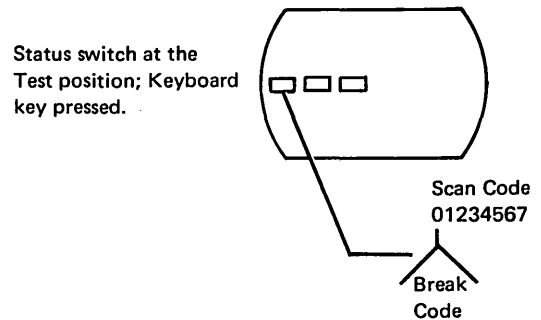
- All scan code lines switch Up and Down when a keyboard key is pressed. A '1' is displayed in the scan code field on the display screen when a line is active.
- Use the Shift key to test the '-break code' line. The break code position in the displayed field is normally '0'. The position changes to '1' only after the Shift key is pressed and released.
- The display station will *not* be damaged if powered-on after the keyboard cable is disconnected.

Tools

Connect the CE probe as follows:

- +lead-1-G-D03
- -lead-1-G-D08
- Ground-1-B-D08

Display Screen



137 (continued)

- Check the failing scan code line at the planar (the bit line that did not change).
- Press and release a key that activates the line.

Does the line pulse?

Y N

Is the line at a Down level?

Y N

- Check the line in the cables for an open.

Are the cables OK?

Y N

- Replace the failing cable.
- Replace the keyboard logic PC board.

- Disconnect the cable at the keyboard end.

Is the line still at a Down level?

Y N

- Replace the keyboard logic PC board.

- Disconnect the cable at Socket B on the planar.

Is the line still at a Down level?

Y N

- Repair or replace the failing keyboard cable.

- Replace the planar (set the jumpers correctly on the new planar (103) (105)).

- Inspect the interposer.
- Replace the planar (set the jumpers correctly on the new planar (103) (105)).

Suggested action for an intermittent problem:

- Analyze the suspected line; inspect all the connector contacts.
- Clean the pad PC board contacts.
- Replacement sequence:
 - Keyboard Logic PC Board
 - Planar
 - Keyboard Cables

138 KEYBOARD VOLTAGE AND STROBE MINI MAP

- Use this figure to correct a data strobe or strobe delay problem.
- For Mini MAP example, see *Troubleshooting Aids* (212).

Conditions after Power-On

- The voltage lines are active.
- The '-data strobe' line is positive (+) (the pulse will be negative when a key is pressed).
- The '+delay strobe' line is negative (-) (the pulse will be positive when a key is pressed.)

Service Aids

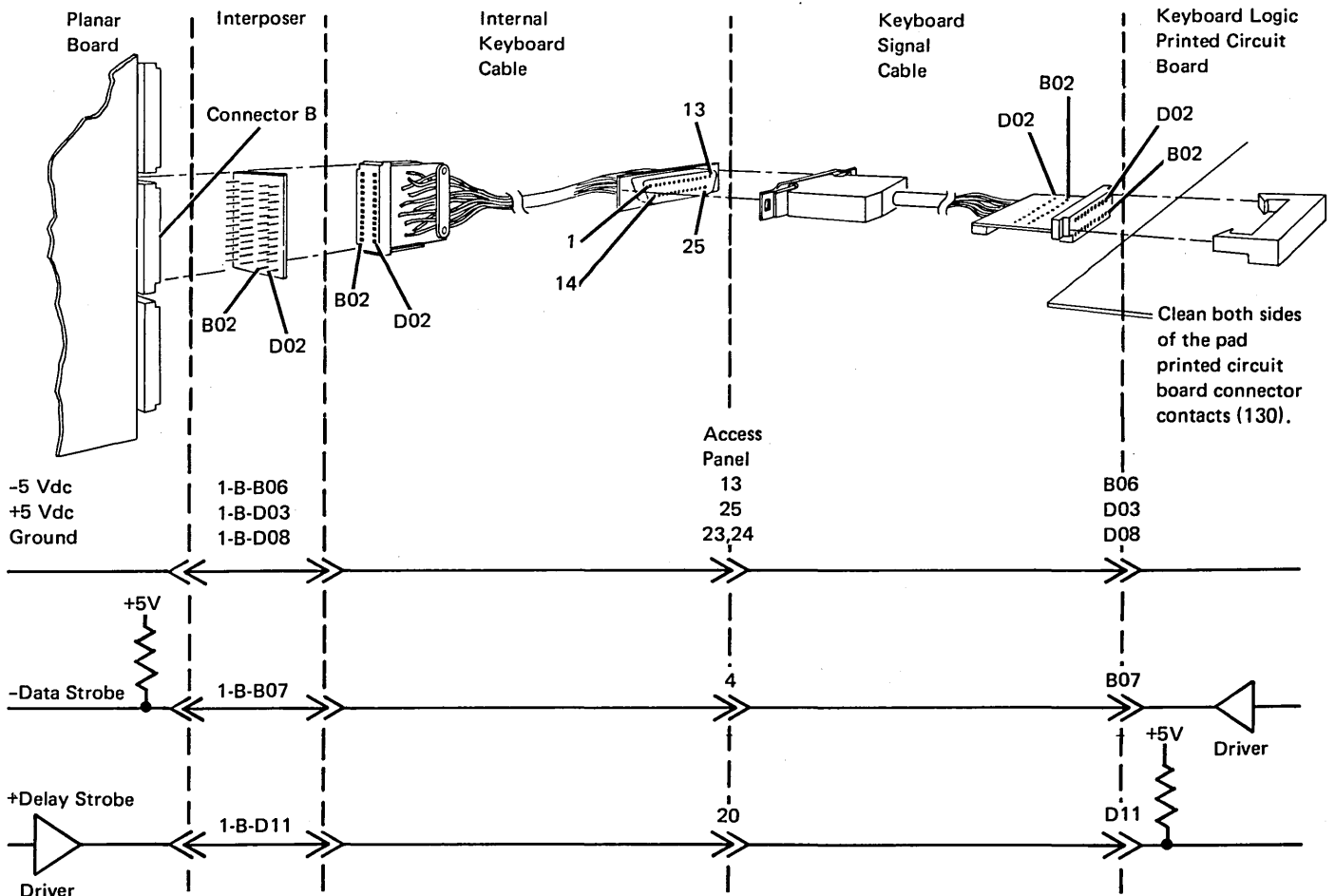
- When a key is pressed, the '-data strobe' line pulses at a Down level.
- When the planar receives the '-data strobe' line, it pulses the '+delay strobe' line at an Up level.

- A failure in the '-5 Vdc', '+5 Vdc', '-data strobe', or '+delay strobe' line causes both the '-data strobe' and '+delay strobe' lines to fail.
- The display station will not be damaged if powered-on after the keyboard cable is disconnected.

Tools

Connect the CE probe as follows:

- +lead-1-G-D03
- -lead-1-G-D08
- Ground-1-B-D08



— Check the '+5 Vdc' and '-5 Vdc' lines at the planar.

Are the voltages correct?

Y N

A ground in the cable or keyboard logic PC board could have damaged the planar.

— Check for a grounded voltage line and then replace the planar (set the jumpers correctly on the new planar (103) (105)).

— Check the '+5 Vdc' and '-5 Vdc' lines at the keyboard end of the cable.

Are the voltages correct?

Y N

— Check for an open voltage line in the cables.

— Check the 'DATA strobe' line at the planar.

Does the line pulse when a key is held down?

Y N

Is the 'DATA strobe' line at an Up level?

Y N

— Disconnect the cable at the keyboard end.

Is the line at a Down level?

Y N

— Replace the keyboard logic PC board.

— Check the 'DATA strobe' line for a ground.

Is the 'DELAY strobe' line Down at the planar?

Y N

— Replace the planar (set the jumpers correctly on the new planar (103) (105)).

— Check the 'DATA strobe' line at the keyboard end of the cable.

Does the line pulse when a key is held down?

Y N

— Check the 'DELAY strobe' line for an open.

— Inspect the -5, +5, and B07 ('DATA strobe' line) contacts on the keyboard end of the cable.

A B

A B

Are the cables OK?

Y N

— Repair or replace the failing cable.

— Replace the keyboard logic PC board.

— Check the 'DATA strobe' line in the cables for an open.

Are the cables OK?

Y N

— Repair or replace the failing cable.

— Inspect the interposer.

— Replace the planar (set the jumpers correctly on the new planar (103) (105)).

— Check the 'DELAY strobe' line for a ground.

— Disconnect the cable at the keyboard end.

Is the line still at a Down level?

Y N

— Replace the planar (set the jumpers correctly on the new planar (103) (105)).

— Check the 'DELAY strobe' line for a ground.

Suggested action for an intermittent problem:

- Analyze the suspected line; inspect all the connector contacts.
- Clean the pad PC board contacts.
- Replacement sequence:
 - Logic PC Board
 - Planar
 - Keyboard Cables

139 KEYBOARD CLICKER MINI MAP

- Use this figure to locate a keyboard clicker problem.
- For Mini MAP example, see *Troubleshooting Aids* (212).

Conditions after Power-On

- The '+8.5 Vdc' line is active.
- The '-clicker activate' line is at an Up level.

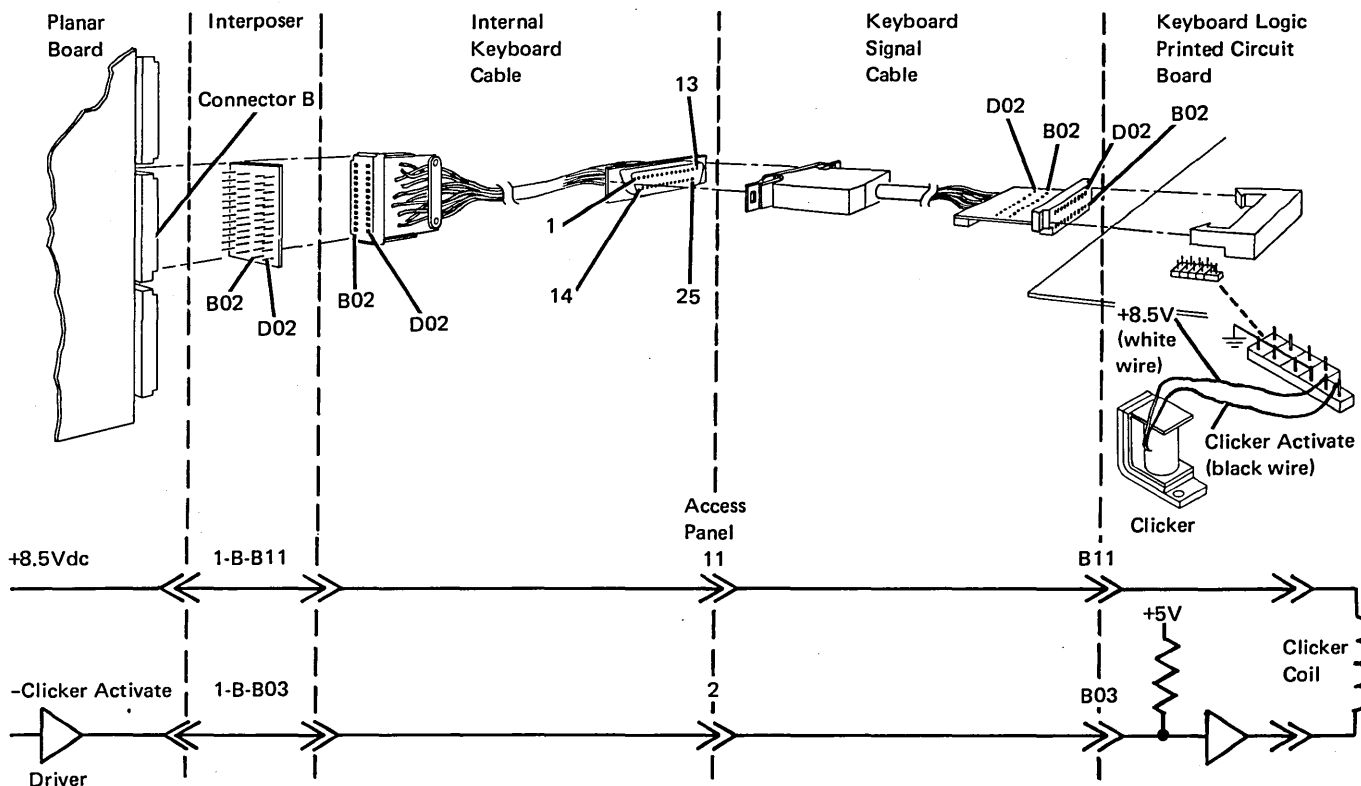
Service Aids

- The '-clicker activate' line pulses at a Down level when a key is pressed causing the clicker to sound. This line also pulses each time the program loops in Test mode.
- The clicker coil can be tested by removing the lower wire from the connector block and touching ground.
- The display station will *not* be damaged if powered-on after the keyboard cable is disconnected.

Tools

Connect the CE probe as follows:

- +lead-1-G-D03
- -lead-1-G-D08
- Ground-1-B-D08



139 (continued)

- Check the clicker coil and the '+8.5 Vdc' line as follows.
- Remove the lower coil wire.

Does the clicker sound each time the wire is touched to a ground pin?

Y N

The '+8.5 Vdc' line is open or the clicker is failing.

- Check for +8.5 Vdc at the upper clicker pin.

Is the voltage correct?

Y N

- Check for an open '+8.5 Vdc' line back to the planar.

- Replace the clicker.

- Check the clicker activate line (B03) at the keyboard end of the cable.

Does the line pulse each time a key is pressed?

Y N

Is the line at a Down level?

Y N

Does the line (1-B-B03) pulse at the planar each time a key is pressed?

Y N

- Inspect the interposer.
- Replace the planar (set the jumpers correctly on the new planar (103) (105)).

- Check the cable for an open.

- Check the clicker activate line for a ground.

- Check the keyboard end of the cable.
- Replace the logic PC board.

Suggested action for an intermittent problem:

- Analyze the suspected line; inspect all the connector contacts.
- Replacement sequence:
 - Clicker
 - Keyboard Logic PC board
 - Planar
 - Keyboard Cables

140 KEYBOARD CABLE CHECK MINI MAP

- Use this figure to locate an open in the cable check
- For Mini MAP example, see *Troubleshooting Aids (212)*.

Conditions after Power-on

- Both the '-cable check A' and '-cable check B' lines are at a Down level.

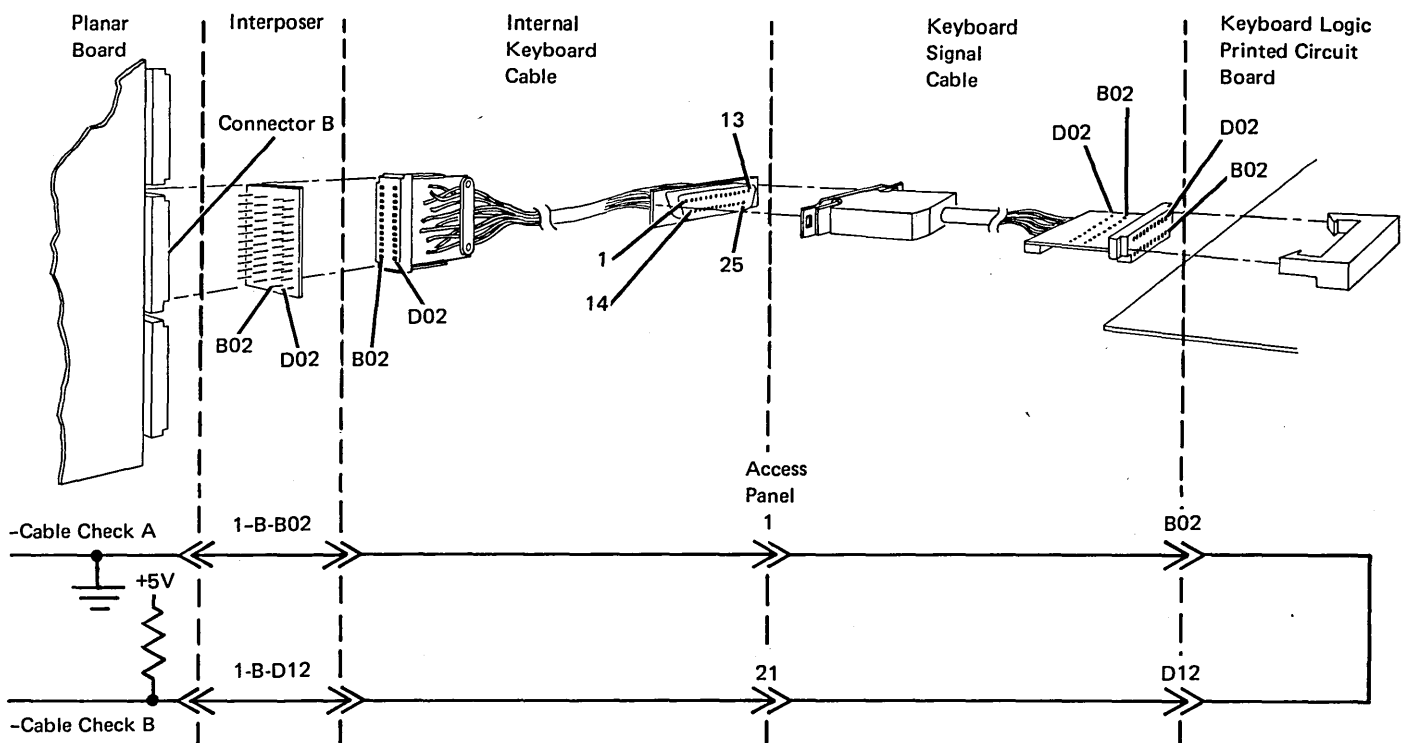
Service Aids

- The display station will *not* be damaged if powered-on after the keyboard cable is disconnected.

Tools

Connect the CE probe as follows:

- +lead-1-G-D03
- -lead-1-G-D08
- Ground-1-B-D08



140 (continued)

— Probe cable check B (B-D12) at the planar.

Is the line at a Down level?

Y N

- Check for an open through the cable and keyboard logic PC board back to ground on the planar.
- Inspect the interposer.
- Replace the planar (set the jumpers correctly on the new planar (103) (105)).

Suggested action for an intermittent problem:

- Jumper 1-B-D02 to 1-B-D12
- If the problem still occurs, replace the planar. If not, the cable or keyboard logic PC board could be open.

141 KEYBOARD POR MINI MAP

- Use this figure to locate an open or grounded 'power on reset' (POR) line.
- For Mini MAP example, see *Troubleshooting Aids (212)*.

Conditions after Power-On

- The '-power on reset' line is at an Up level.

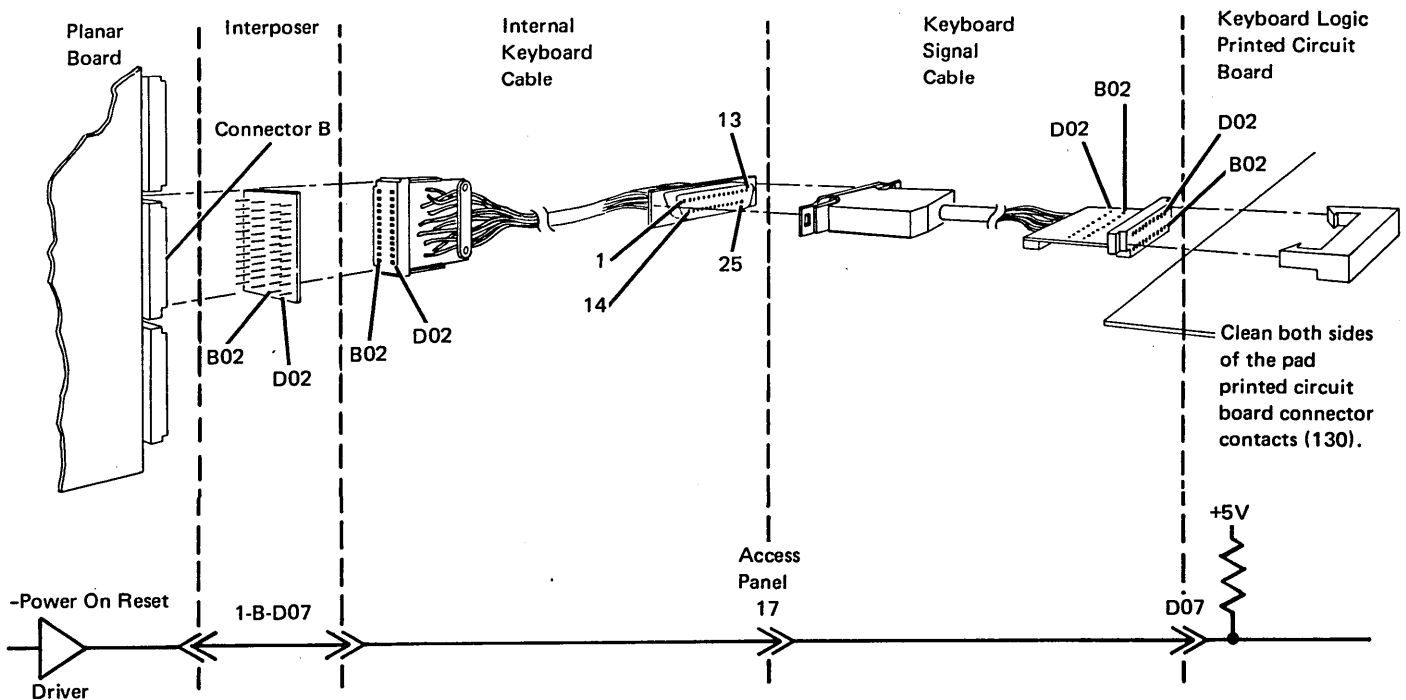
Service Aids

- The '-power on reset' line is at a Down level for about 0.5 seconds during power on.
- The display station will *not* be damaged if powered-on after the keyboard cable is disconnected.

Tools

Connect the CE probe as follows:

- +lead-1-G-D03
- -lead-1-G-D08
- Ground-1-B-D08



141 (continued)

MAP 0002 sends you to this service page for a grounded 'power on reset' line only.

- Check the 'power on reset' line at the planar.

Is the line at a Down level?

Y N

Does the line pulse Down for about 1 second during power on?

Y N

- Inspect the interposer
- Replace the planar (set the jumpers correctly on the new planar (103) (105)).

You have taken the wrong path.

- **Go to MAP 0001, Start of Call.**

- Power off.
- Remove the cable at socket B.
- Power on.

Is the line at a Down level at the planar?

Y N

- Check for a ground in the cable or keyboard logic PC board.

- Inspect the interposer.
- Replace the planar (set the jumpers correctly on the new planar (103) (105)).

Suggested action for an intermittent problem:

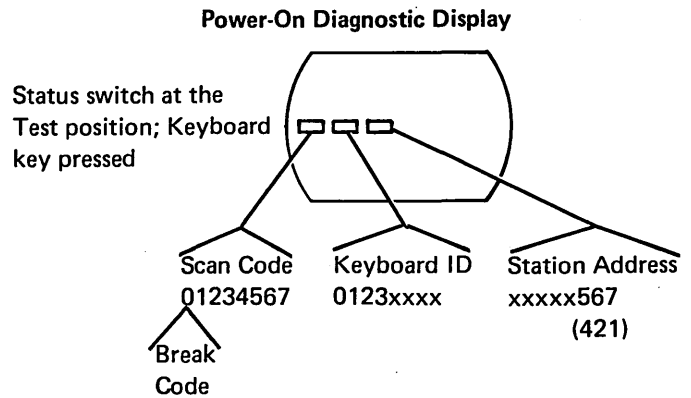
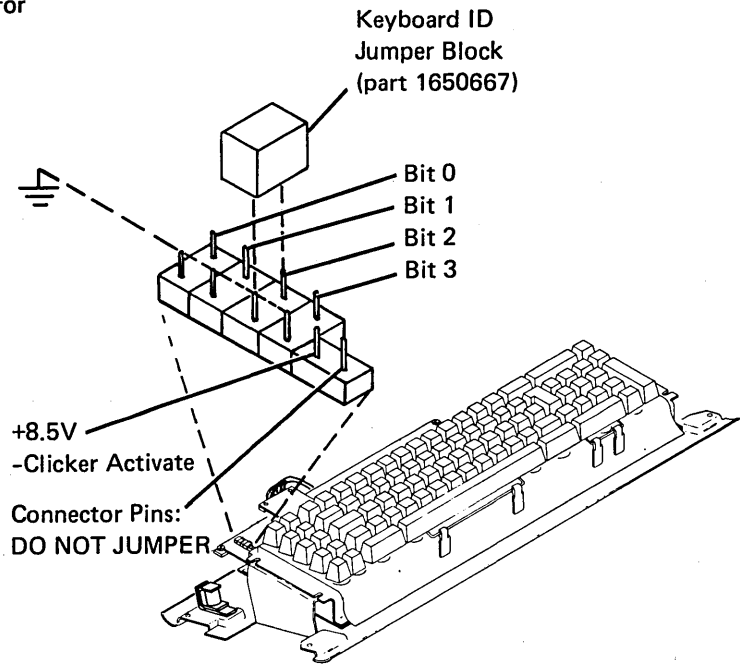
- Analyze the suspected line; inspect all the connector contacts.
- Clean the pad PC board contacts.
- Replacement sequence:
 - Logic PC Board
 - Planar
 - Keyboard Cables

142 KEYBOARD IDENTIFICATION

The following shows the jumpers that are necessary for keyboard identification.

Country	Standard Keyboard
	Bit Assignment* 0 1 2 3
ASCII	0 0 1 1
Austria/Germany	1 0 1 0
Belgium	1 0 1 0
Brazil	1 0 1 0
Denmark	1 0 1 0
Finland	1 0 1 0
France AZERTY	1 0 1 0
Canada (French)	1 0 1 0
France QWERTY	1 0 1 0
International	1 0 1 1
Italy	1 0 1 0
Japan (English)	1 0 1 0
Japan (Katakana)	1 0 1 0
Latin America	1 0 1 0
Norway	1 0 1 0
Portugal	1 0 1 0
Spain	1 0 1 0
Sweden	1 0 1 0
United Kingdom	1 0 1 0
U.S./Canada	0 0 1 0

* 1 = Jumpared
0 = Not Jumpared



143 KEYBOARD ARRANGEMENT

This section shows the key numbers for the keyboards. The key numbers compare with the key positions in the scan code table (144).

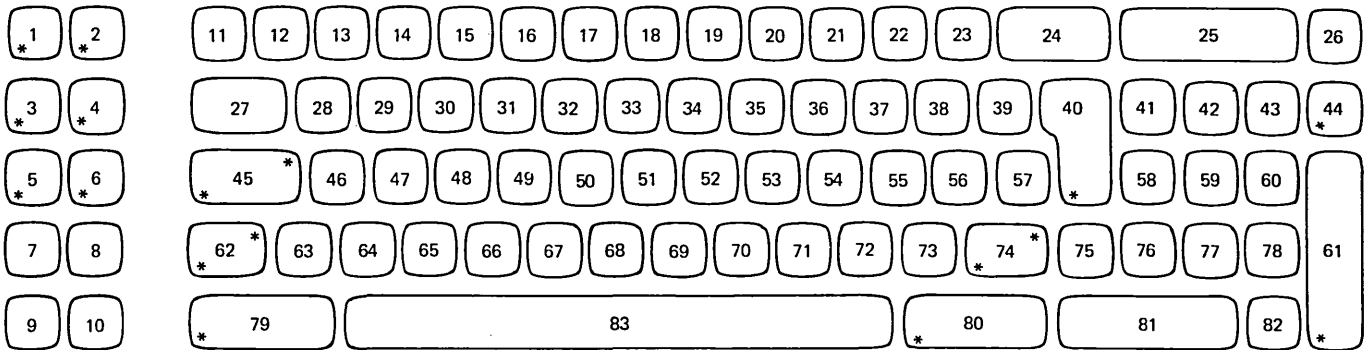
Keyboard Template (GX21-9266)

Display Mode	13	14	15	16	17	18	19	20	21	22	23	24	Clear
	1	2	3	4	5	6	7	8	9	10	11	12	Test Request

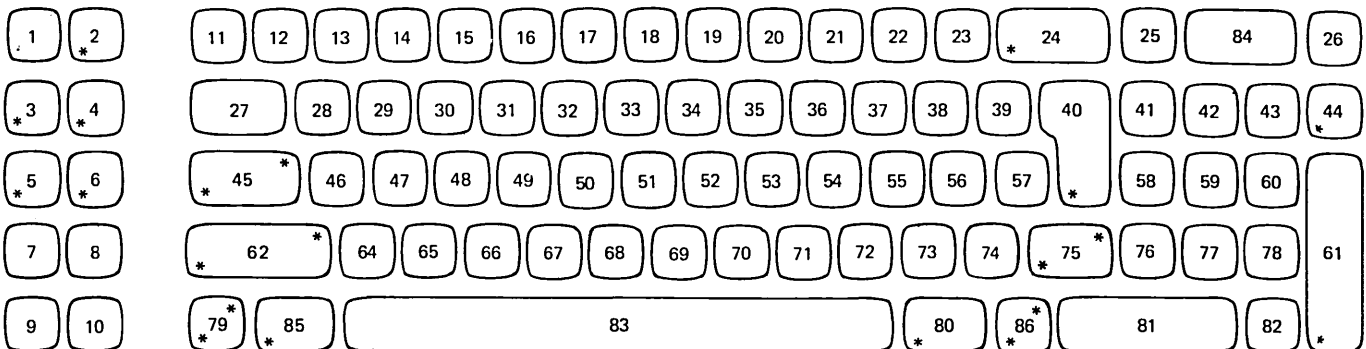
The top row of keys on the keyboard permit command functions. Pressing the Cmd (command) key and then one of the top row keys selects command functions 1 through 12, or Test Request. Pressing Cmd, then holding down the Shift key and pressing one of the top row keys selects Display Mode, command functions 13 through 24, or Clear.

The keyboard template is placed in the opening above the top row of keys on the keyboard cover. The customer can change the template to indicate the name of the command function that compares to the top row key numbers.

Standard Keyboard Layout



Standard Keyboard Layout (Katakana)



Not a typematic key.

A make/break key.

144 SCAN CODE TABLES

Scan codes are a function of the physical position of the keyboard keys. The following tables show the 8-bit scan code, the hexadecimal code, and the key position

for the keyboards. The * indicates a make/break key with a bit setting of either 0 or 1. When a make/break key is pressed, bit 0 of the code is a 0. When a make/break key is released, bit 0 of the code is a 1.

STANDARD KEYBOARD

Key Position	Hex Code	Scan Code 01234567	Key Position	Hex Code	Scan Code 01234567
1	7C	01111100	44	4E	01001110
2	6F	01101111	45	54	*1010100
3	6C	01101100	46	11	00010001
4	6D	01101101	47	12	00010010
5	6E	01101110	48	13	00010011
6	7D	01111101	49	14	00010100
7	71	01110001	50	15	00010101
8	70	01110000	51	16	00010110
9	72	01110010	52	17	00010111
10	73	01110011	53	18	00011000
11	3E	00111110	54	19	00011001
12	31	00110001	55	1A	00011010
13	32	00110010	56	1B	00011011
14	33	00110011	57	1C	00011100
15	34	00110100	58	44	01000100
16	35	00110101	59	45	01000101
17	36	00110110	60	46	01000110
18	37	00110111	61	4D	01001101
19	38	00111000	62	57	*1010111
20	39	00111001	63	0E	00001110
21	3A	00111010	64	01	00000001
22	3B	00111011	65	02	00000010
23	3C	00111100	66	03	00000011
24	3D	00111101	67	04	00000100
25	4B	01001011	68	05	00000101
26	4C	01001100	69	06	00000110
27	20	00100000	70	07	00000111
28	21	00100001	71	08	00001000
29	22	00100010	72	09	00001001
30	23	00100011	73	0A	00001010
31	24	00100100	74	56	*1010110
32	25	00100101	75	0C	00001100
33	26	00100110	76	41	01000001
34	27	00100111	77	42	01000010
35	28	00101000	78	43	01000011
36	29	00101001	79	7E	01111110
37	2A	00101010	80	68	01101000
38	2B	00101011	81	40	01000000
39	2C	00101100	82	4A	01001010
40	2D	00101101	83	0F	00001111
41	47	01000111			
42	48	01001000			
43	49	01001001			

STANDARD KEYBOARD (KATAKANA)

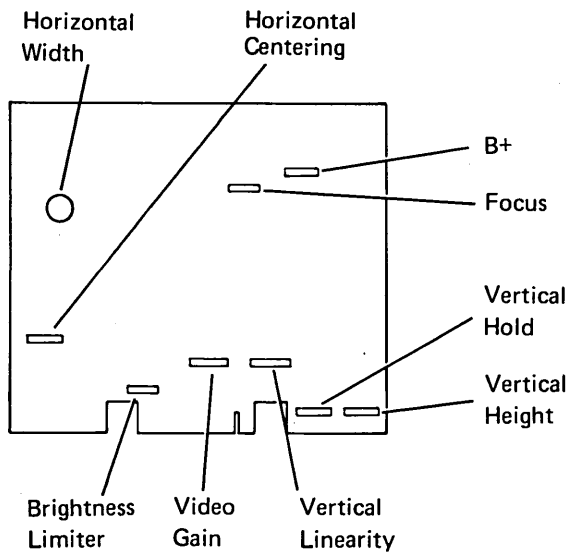
Key Position	Hex Code	Scan Code 01234567	Key Position	Hex Code	Scan Code 01234567
1	7C	01111100	44	4E	01001110
2	6F	01101111	45	54	*1010100
3	6C	01101100	46	11	00010001
4	6D	01101101	47	12	00010010
5	6E	01101110	48	13	00010011
6	7D	01111101	49	14	00010100
7	71	01110001	50	15	00010101
8	70	01110000	51	16	00010110
9	72	01110010	52	17	00010111
10	73	01110011	53	18	00011000
11	3E	00111110	54	19	00011001
12	31	00110001	55	1A	00011010
13	32	00110010	56	1B	00011011
14	33	00110011	57	1C	00011100
15	34	00110100	58	44	01000100
16	35	00110101	59	45	01000101
17	36	00110110	60	46	01000110
18	37	00110111	61	4D	01001101
19	38	00111000	62	57	*1010111
20	39	00111001			
21	3A	00111010	64	01	00000001
22	3B	00111011	65	02	00000010
23	3C	00111100	66	03	00000011
24	61	01100001	67	04	00000100
25	3D	00111101	68	05	00000101
26	4C	01001100	69	06	00000110
27	20	00100000	70	07	00000111
28	21	00100001	71	08	00001000
29	22	00100010	72	09	00001001
30	23	00100011	73	0A	00001010
31	24	00100100	74	0C	00001100
32	25	00100101	75	56	*1010110
33	26	00100110	76	41	01000001
34	27	00100111	77	42	01000010
35	28	00101000	78	43	01000011
36	29	00101001	79	53	*1010011
37	2A	00101010	80	68	01101000
38	2B	00101011	81	40	01000000
39	2C	00101100	82	4A	01001010
40	2D	00101101	83	0F	00001111
41	47	01000111	84	4B	01001011
42	48	01001000	85	7E	01111110
43	49	01001001	86	52	*1010010

Display

Four manufacturers supply the display assembly for the display station. The B-type, E-type, M-type, and V-type, display assemblies function differently, look different, but are compatible and generate the same display.

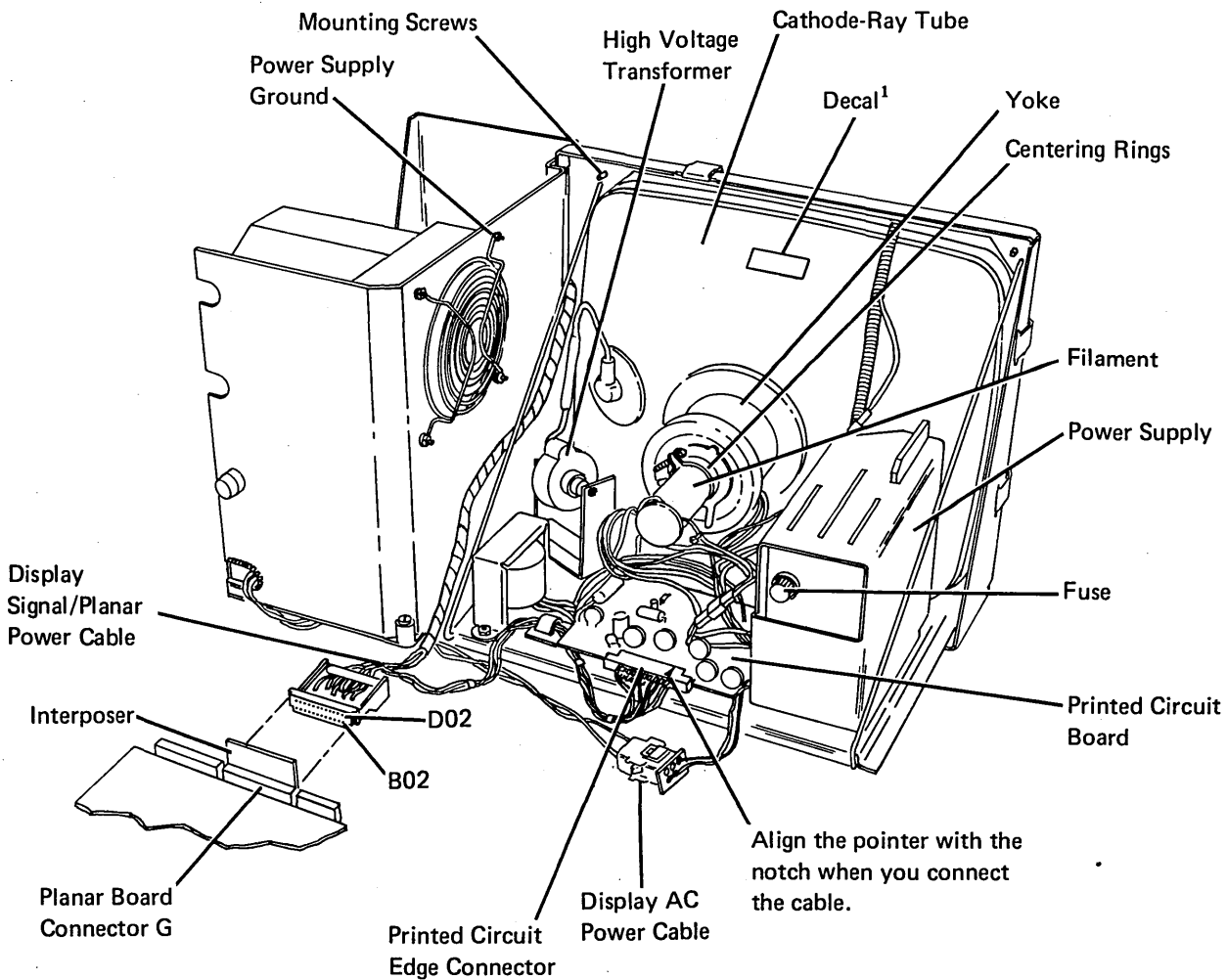
Note: Use fiber screwdriver (part 460811) for display assembly adjustments.

¹ Refer to the decal if it is present.



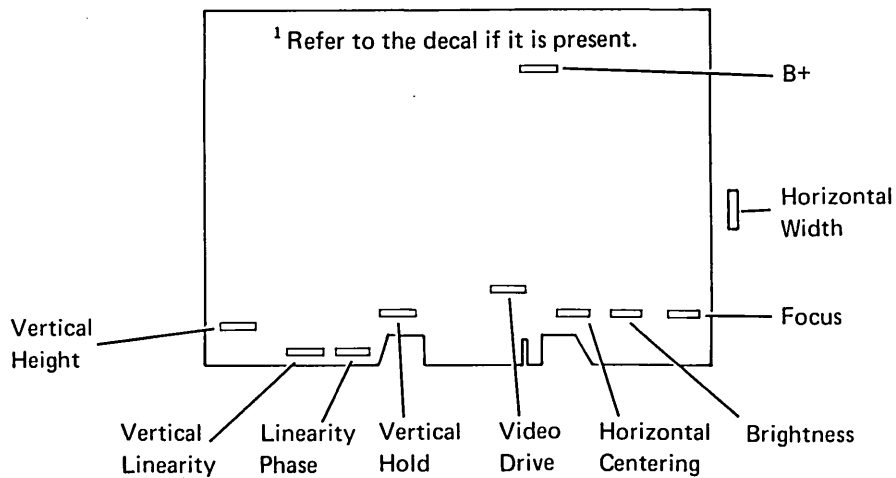
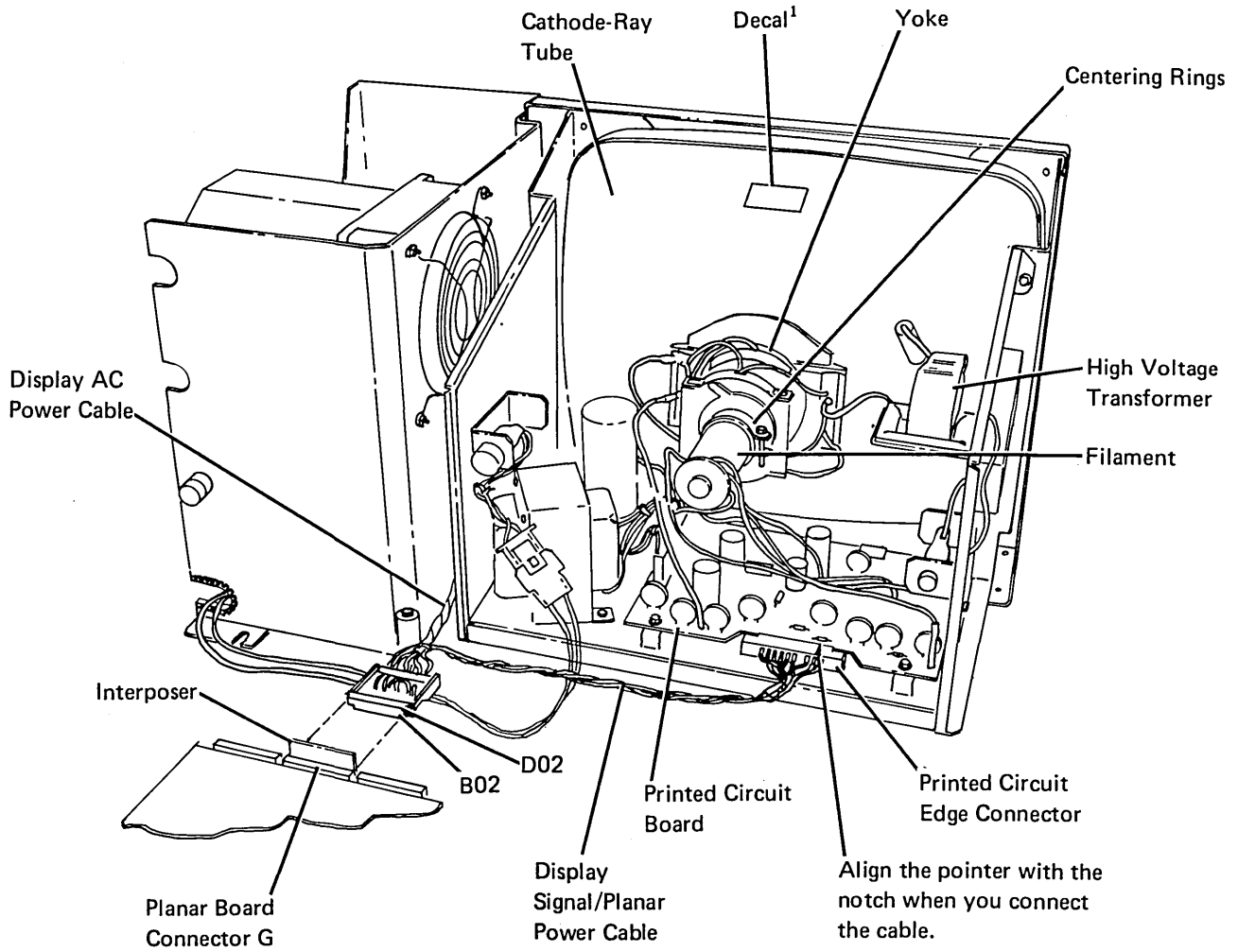
150 B-TYPE DISPLAY ASSEMBLY LOCATIONS

Top View



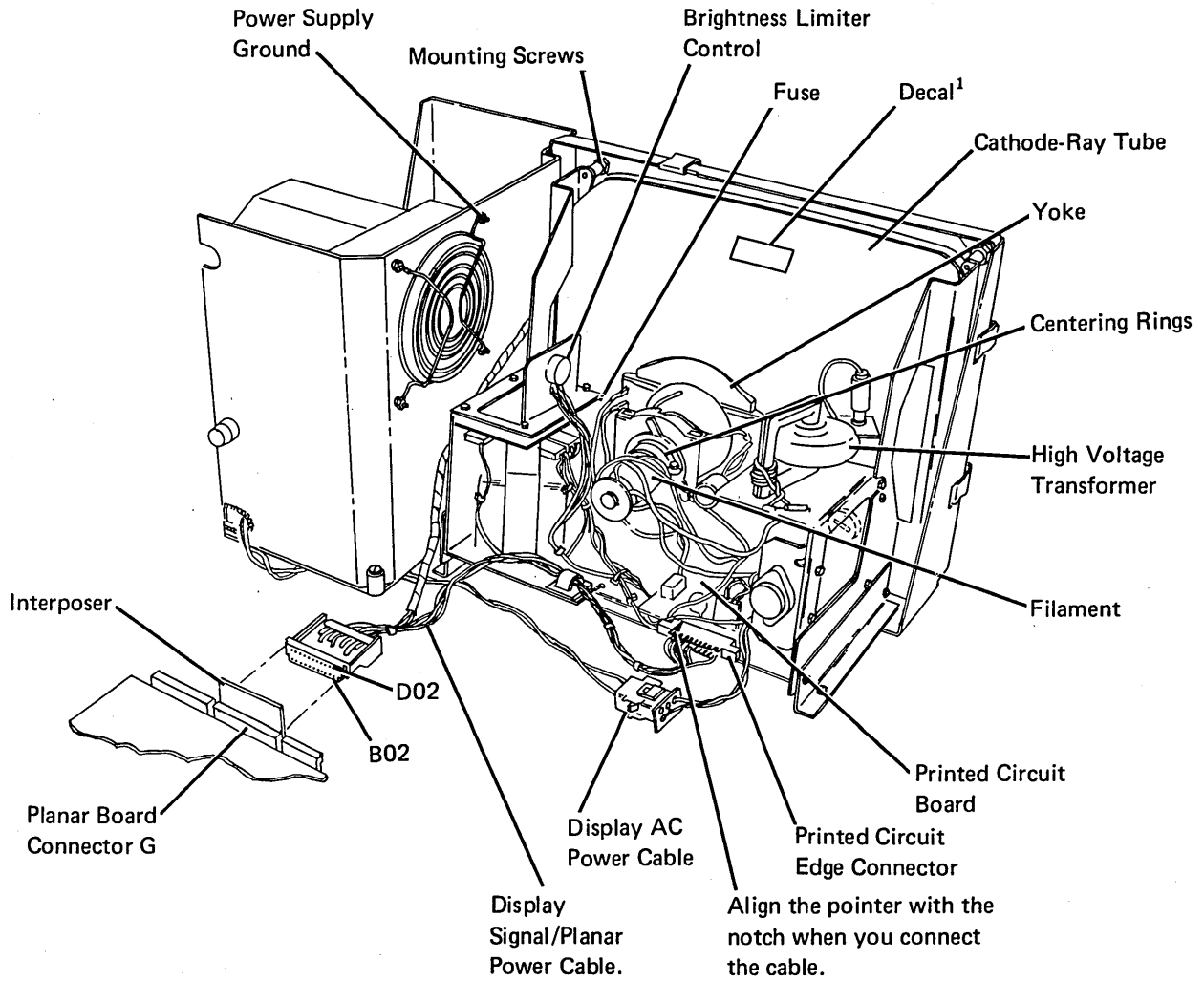
150 E-TYPE DISPLAY ASSEMBLY LOCATIONS

Top View

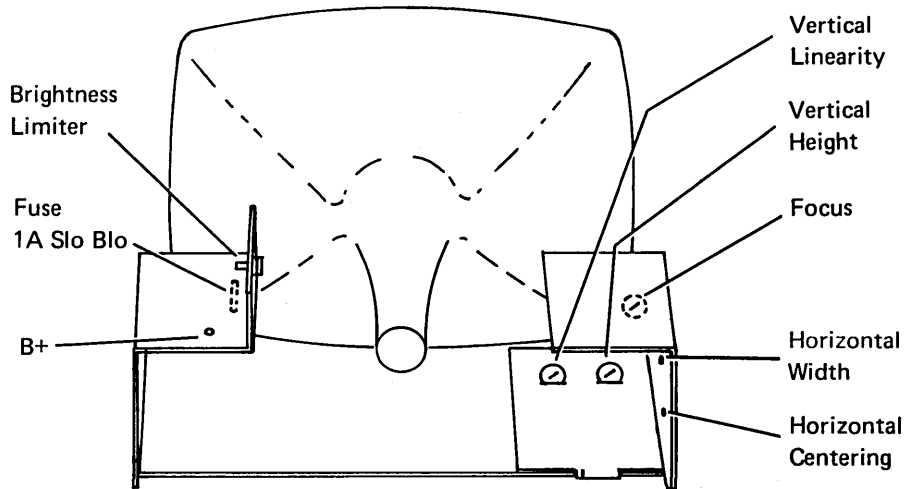


150 M-TYPE DISPLAY ASSEMBLY LOCATIONS

Top View

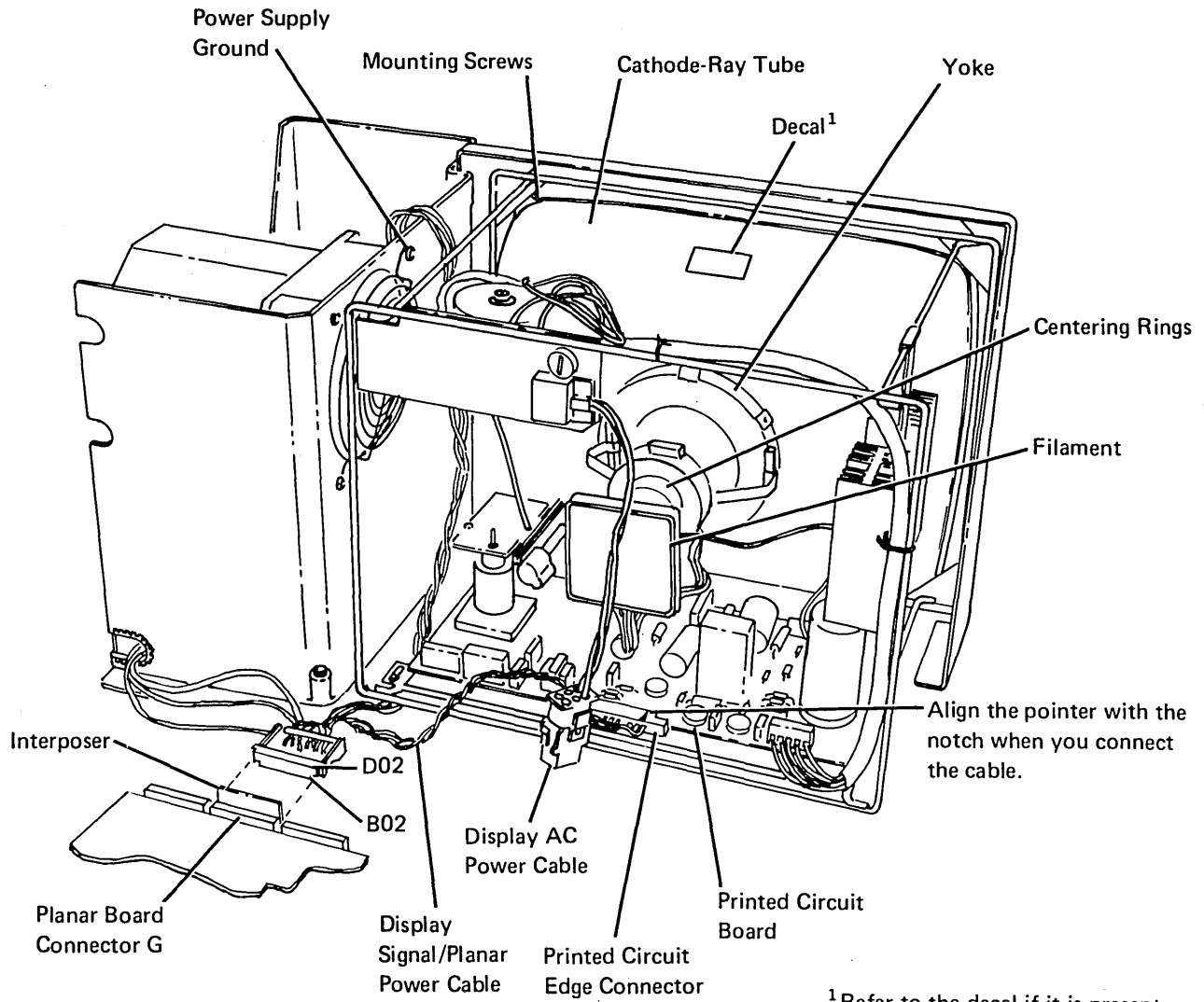


¹ Refer to the decal if it is present.

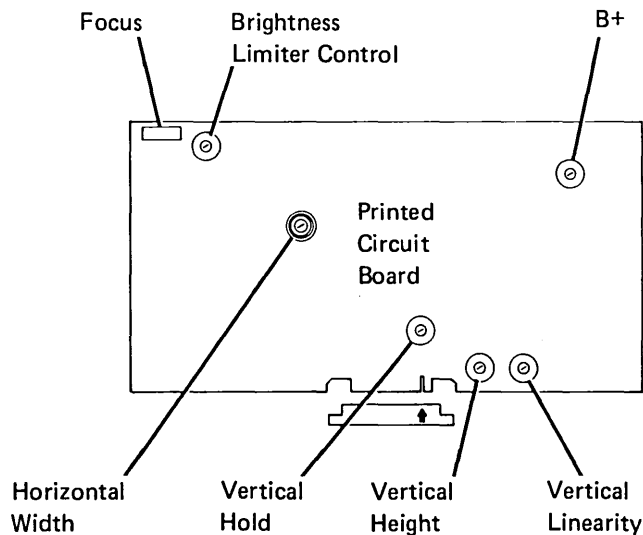


150 V-TYPE DISPLAY ASSEMBLY LOCATIONS

Top View (World Trade Display Assembly)



¹ Refer to the decal if it is present.



151 DISPLAY ASSEMBLY REMOVAL AND REPLACEMENT

DANGER

The display assembly contains high voltages and the green wire in the display assembly is *not* at ground voltage. Therefore, use extra caution when making internal adjustments.

-
-
-
1. Power off.
 2. Open the front and rear covers (108).
 3. Disconnect the display AC power cable connector.
 4. Disconnect the printed circuit edge connector.
 5. Remove the 6 mounting screws on the M-type display assembly. On the other types of display assemblies, remove the 2 mounting screws and 4 nuts.

DANGER

Be careful when working with the display assembly. The cathode-ray tube can implode when it is hit or falls. For personal safety, wear safety glasses.

-
-
-
6. Lift the display assembly from the display station housing.
 7. Install the new display assembly. Place the used display assembly in the shipping container for return to the branch office.
 8. Fasten the display assembly with the hardware that is provided on the new display assembly.
 9. Connect the printed circuit edge connector. Align the pointer of the label on the connector with the notch in the printed circuit board (157).
 10. Connect the display AC power cable.
 11. If necessary, make the display adjustments (152 through 155).
 12. Align the display assembly to allow the front cover to close properly.

13. Close the front and rear covers (108).
14. Check the bezel to display assembly gap to ensure that the gap is not excessive (100).
15. If the gap is excessive, return to step 12.

Display Adjustments

DANGER

The display assembly contains high voltages and the green wire in the display assembly is *not* at ground voltage. Therefore, use extra caution when making internal adjustments.

152 VIDEO ADJUSTMENTS

The three adjustments common to all display assemblies are:

- The Brightness control on the control panel.
- The Contrast control on the control panel.
- The Brightness Limiter control on the display assembly.

Brightness Limiter Adjustment

1. Turn the Brightness control on the control panel fully clockwise.
2. Turn the Brightness Limiter control on the display assembly until the retrace lines just disappear. See the raster figure (156).

Note: Too much brightness could cause poor focus.

Contrast Control and Brightness Control Adjustments

1. Display Option 1 (Display Attributes) of the Display Verification Menu of the Online Test (206).
2. The pattern of H's around the display screen are of both normal intensity and of high intensity. Adjust the Contrast control and the Brightness control for the best display screen image.

Video Gain

On some display assemblies, this adjustment limits the character brightness. Normally, use the Brightness control on the control panel for attaining the best display screen image. The video gain can correct the horizontal or vertical intensity of a character.

153 VERTICAL AND HORIZONTAL ADJUSTMENTS

Vertical Adjustments

The vertical adjustments could interact. You should adjust the vertical hold anytime the picture rolls before you continue with the other vertical adjustments.

Vertical Hold

Adjust the vertical hold for a stable display (not rolling) without display distortion (flat top).

1. Place the Status switch in the Test position to display the scan code, address, and ID fields.
2. Observe the display screen while you turn the vertical hold to its limit.
3. Set the vertical hold adjustment in the middle of its range. Do *not* allow the picture to roll. If a small adjustment causes the picture to roll up then down, replace the display assembly.

Vertical Height

This adjustment controls the overall display screen height. The nominal height should be 190 mm (7.6 inches).

Vertical Linearity

This adjustment controls the uniform character height.

The vertical height and vertical linearity can interact. Adjust for the desired result.

Linearity Phase

This adjustment controls the uniform character height between the top of the screen and the bottom of the screen.

153 (continued)**Horizontal Adjustments***Horizontal Width*

The horizontal width controls the width of a display. A special tool is needed to adjust it. The adjustment is preset to a 6.35 mm (0.25 inch) tolerance. If there is a horizontal position problem, use the centering rings and correct the problem with that adjustment (155). The nominal width is 250 mm (10 inches).

Horizontal Centering

Horizontal centering is on a few display assemblies. This adjustment centers the video within the raster.

Horizontal Linearity

Horizontal linearity controls the uniform character width.

154 YOKE ADJUSTMENT (150)

Adjust the yoke for correct size and horizontal alignment of the display.

1. Loosen the clamp screw on the yoke collar.
2. Position the yoke against the cathode-ray tube for correct sized display.
3. Adjust the yoke to correct the tilted display.
4. Tighten the clamp screw on the yoke collar.

Note: If the adjustment cannot be made, replace the display assembly (151).

155 CENTERING ADJUSTMENT (150)

Ring magnets determine the horizontal and vertical positions of a display. If the display is tilted, do not adjust the ring magnets; turn the yoke (154). The following adjustments will interact. Adjust both rings to attain the best results.

1. Adjust the rear ring magnet for horizontal centering. The space on the left and right margins of the display should be equal. (This space can be determined from the 80th character on the right of the display.)
2. Adjust the front ring magnet for vertical centering. The space on the top and bottom margins of the display should be equal.

3. If the adjustment cannot be made, replace the display assembly (151).

Additional Adjustment Information

Note: The following adjustments should not be attempted, but are described for your information only:

- Focus.

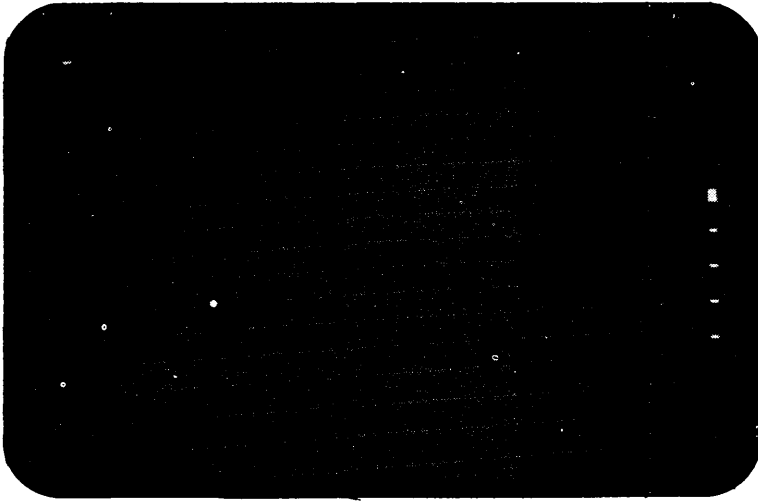
The focus control permits a desired display focus. The adjustment is made at the factory for the best character definition.

- B+

The B+ adjustment is set at the factory with a precision meter. No attempt should be made to adjust this voltage. Symptoms of this voltage being out of adjustment is a loss of display. Because many other parts in the display assembly can cause the same symptom, the display assembly should be replaced. In most cases, this indicates a failing part instead of the B+ voltage out of adjustment.

156 RASTER

Raster is a condition of the display screen whenever the display screen area is lighted.



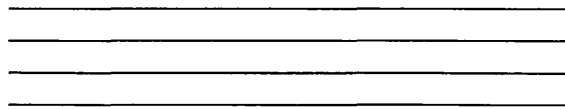
Note: The cursor and indicators may, or may not be displayed.

If there is a raster condition on the display screen, ensure that the raster check jumper is removed, then perform *Video Adjustments* (152).

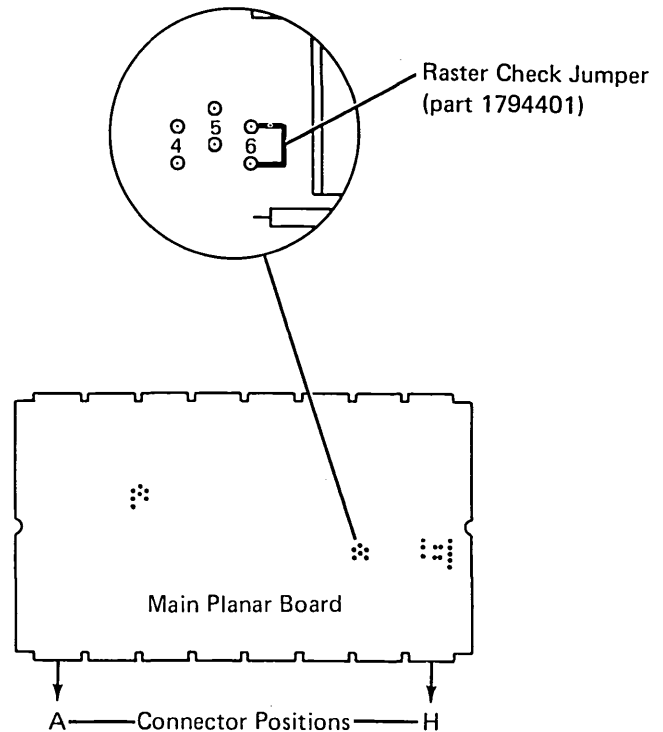
Raster Check

CAUTION:

Power off when installing jumpers to prevent damage to the planar board.



To display a complete raster, install a jumper on jumper position 6 on the the main planar board. This places a solid high level voltage on the video signal line. A complete raster will check the display assembly and display signal cable.



157 DISPLAY SIGNAL/PLANAR POWER CABLE MINI MAP

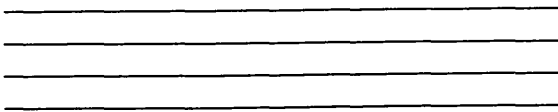
- Use this figure to locate problems with the horizontal sync, vertical sync, and video lines.
- For Mini MAP example, see *Troubleshooting Aids* (212).

Conditions after Power-On

- Each line is pulsing.

CAUTION

Do not power on the display station with the display signal/planar power cable disconnected unless the display AC power is also disconnected.



Service Aids

- Open lines continue to pulse because of feedback from the display assembly. When probing for an open line, disconnect the display AC power connector (150).

All Types (Except the M-Type Display) (150) Vertical Rolling or Overlaid Lines of Data

- Check the vertical sync line for an open.
- Check the adjustments (153).

All Types (Except the M-Type Display) (150) Dark Screen

- The raster check jumper (156) forces a high video signal that lights the display screen.
- A video or horizontal sync failure causes a dark screen.

M-Type Display (150) Rolling or Unstable Display

- Check the horizontal and vertical lines for opens.
- Check the adjustments (153).

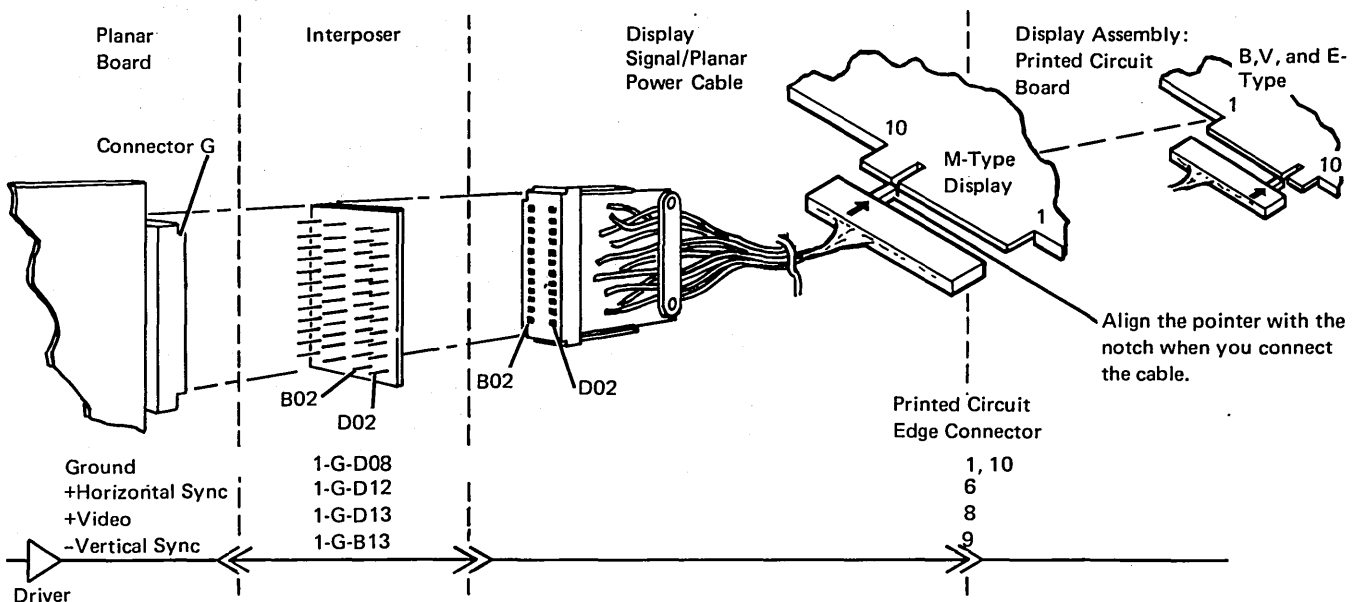
M-Type Display (150) Dark Screen

- Check the video lines for an open.
- The raster check jumper (156) forces a high video signal that lights the display screen.

Tools

Connect the CE probe as follows:

- +lead-1-G-D03
- -lead-1-G-D08
- Ground-1-B-D08



157 (continued)

- Determine which display you have.
 - Trace the line called out in the MAP.
- All signals come from the planar; however, the display will cause an open line to continue to pulse at a high enough level to trigger the CE probe.
- Power off.
 - Disconnect the display AC power connector (150).
 - Power on.
 - Check the signal at the planar.

Note: The Brightness control must be turned up (clockwise) all the way to make the video signal large enough to trigger the CE probe.

Is the line pulsing at the planar?

Y N

- Power down.
- Disconnect the cable at the display.
- Power up.

Does the line pulse now?

Y N

- Check the cable for a grounded signal line.

Is the cable OK?

Y N

- Repair or replace the cable.
- Replace the planar (set the jumpers correctly on the new planar (103) (105)).
- Replace the display.

Is the line pulsing at the display?

Y N

- Check the cable for an open.

Is any other line called out by the MAP that has not been checked?

Y N

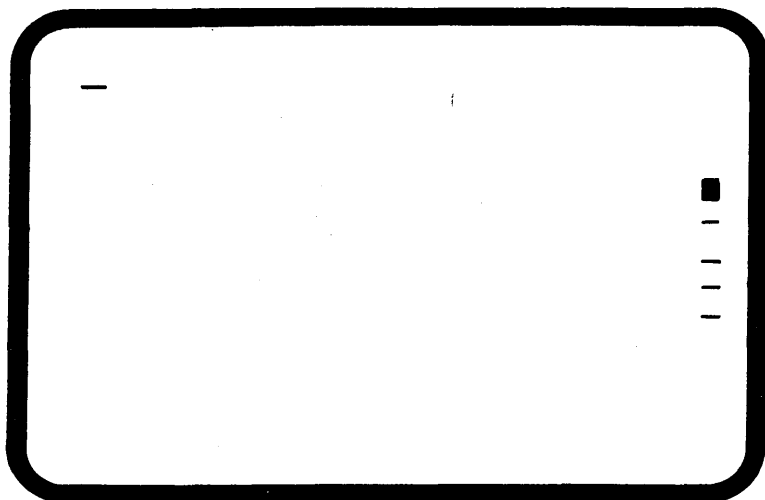
- Reconnect the display AC power connector (150).
 - Make adjustments if applicable (153)
 - Replace the display assembly.
- Repeat this procedure for the other line.

Suggested action for an intermittent problem:

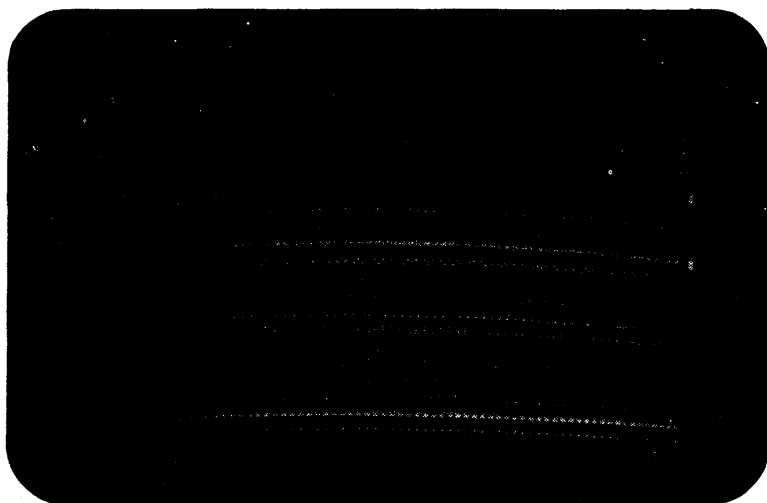
- Analyze the suspected line; inspect all the connector contacts.
- Replacement sequence:
 - Display Assembly
 - Planar
 - Display Signal/Planar Power Cable

158 DISPLAY SCREEN EXAMPLES

Normal screen (free key mode):



Display not centered

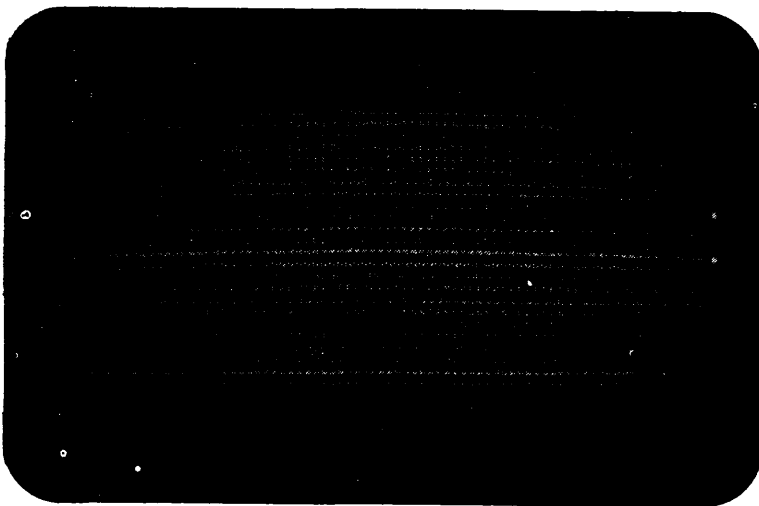


158 (continued)

Tilted display

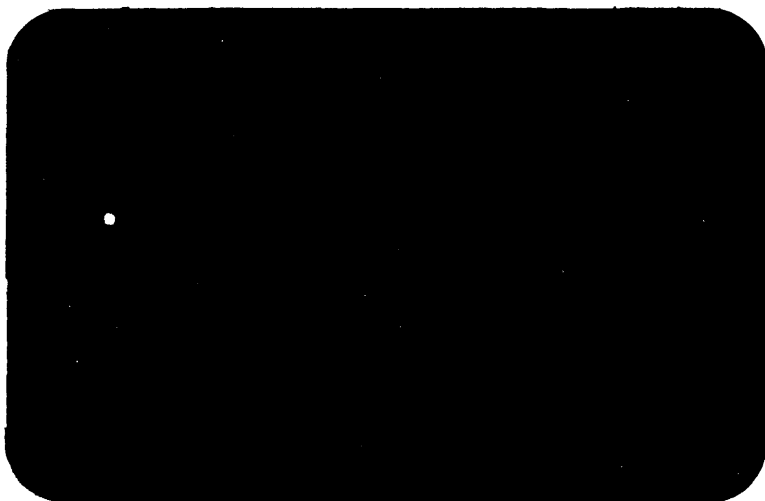


Display size not correct (too small)

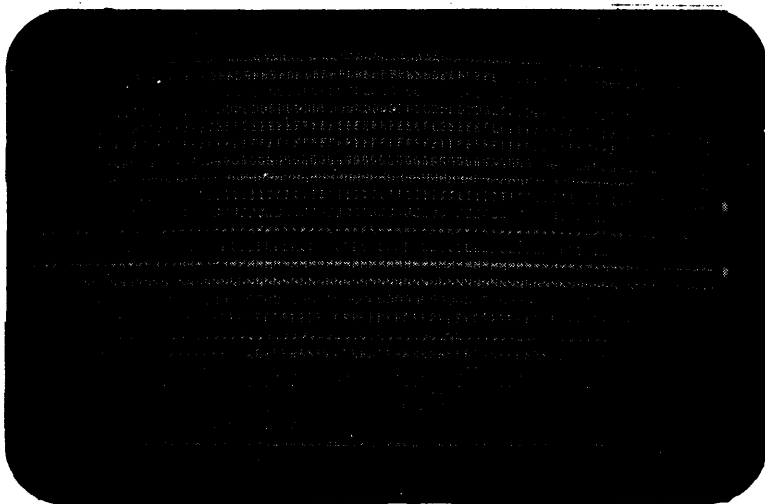


158 (continued)

Display size not correct (expanded vertically)



Characters missing only in the corners



CUSTOMER TWINAXIAL CABLE

170 CABLE SIGNAL QUALITY CHECK

This check is a Controller diagnostic procedure. Refer to the Controller documentation. All display stations will be taken offline. The signal quality check requires an oscilloscope. If you are not trained on the controller, call for a system trained service representative.

171 TWINAXIAL CABLE AND TERMINATOR SWITCH

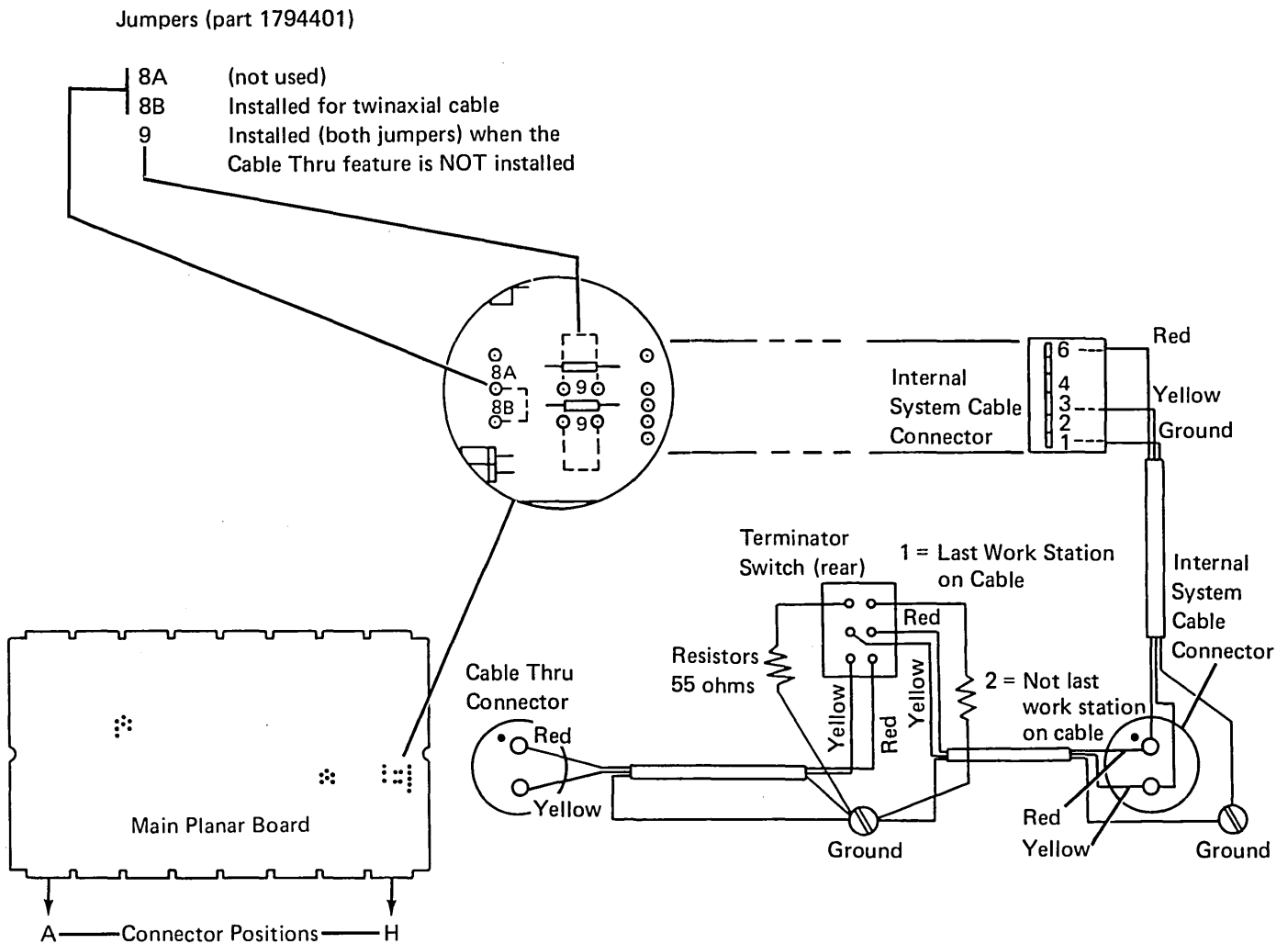
One jumper is always required on the main planar board for the twinaxial cable. If the Cable Thru feature is not installed, two additional jumpers are required.

The two jumpers on jumper position 9 of the main planar board must be removed if the Cable Thru feature is installed on the display station.

The Terminator switch (cable thru feature) on the access panel has a position 1 and position 2. *Position 1* stops the communications signal and completes the circuit. *Position 1* is the required position when the display station is the last work station on the line. All other stations in the series must have the Terminator switch in position 2.

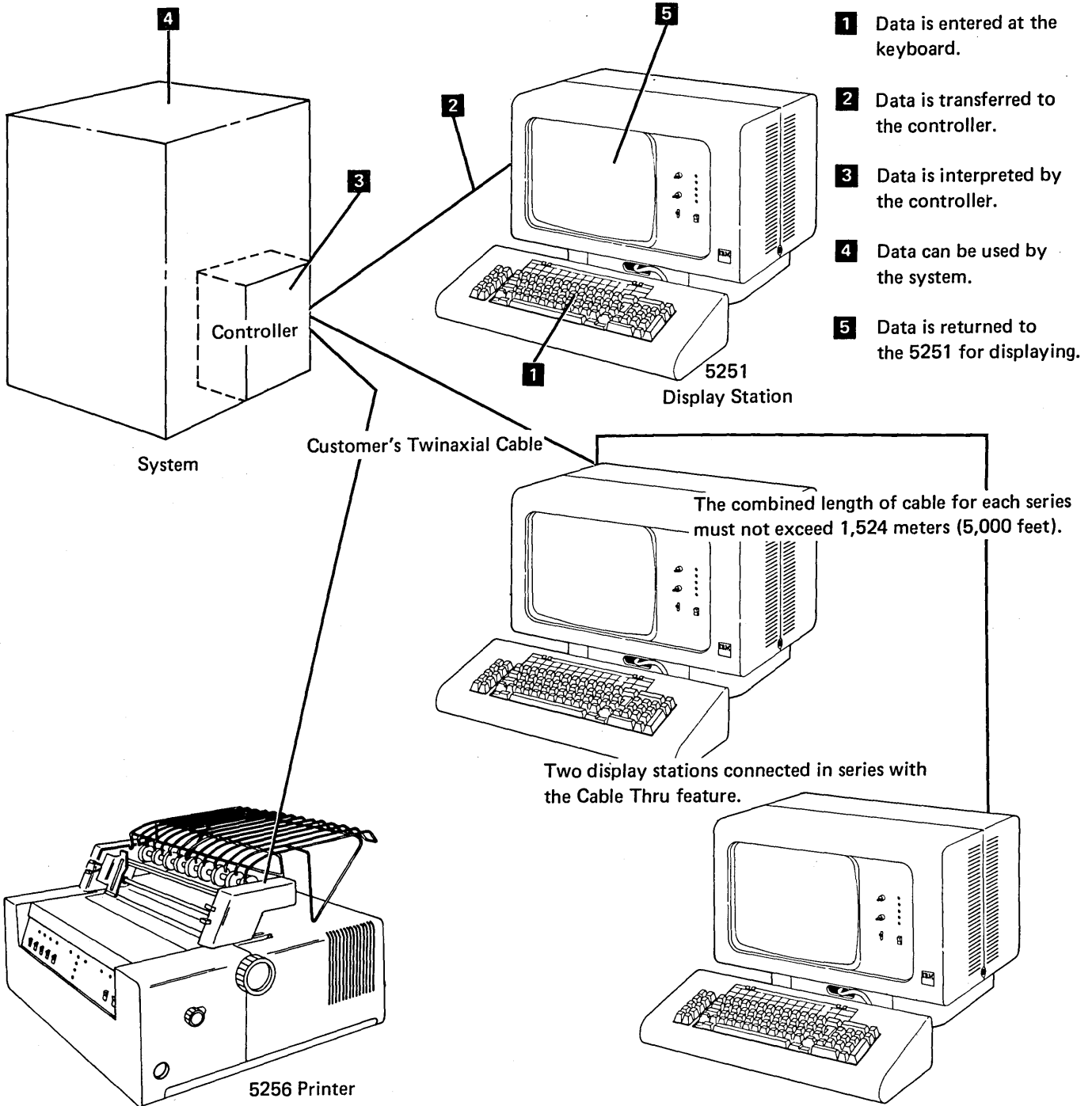
Position 2 allows the communications signal to flow through the display station to the next work station.

Note: Do not leave the twinaxial cable disconnected when servicing the display station with the Cable Thru feature. Other devices are taken offline when this cable is disconnected. The display assembly must be removed (151) to service the Terminator switch.



172 TYPICAL DISPLAY STATION CONFIGURATION

The following figure shows a 5251 Model 11 Display Station attached to a controller at a system location. Display stations and printers can be attached in a point-to-point configuration, or can be attached in a series configuration by means of a Cable Thru feature on each work station in the configuration.



173 STATION PROTECTOR

See *IBM 5250 Information Display System Installation Manual—Physical Planning, GA21-9277* for detailed information.

The station protector is owned and maintained by the customer. The following procedure can be used to check an IBM supplied station protector.

The cables to the station protector must be disconnected before the checks can be made. This will disconnect the work stations from the system.

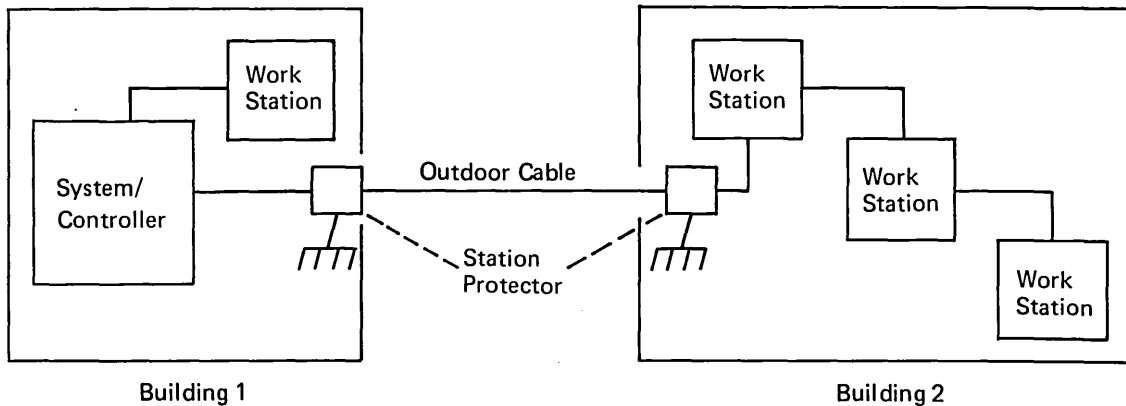
DANGER

Never handle cables or connectors during an electrical storm.

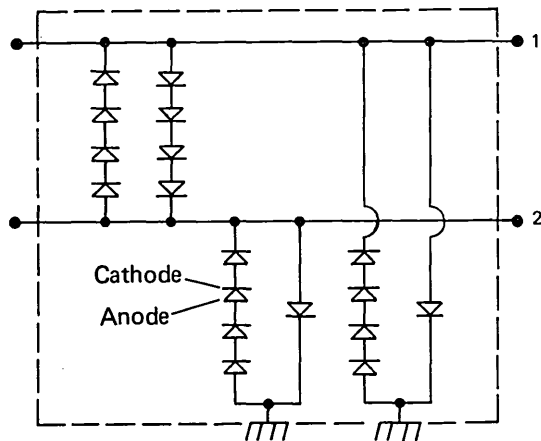
Only use CE meter part 1749231. Use the R x 100 scale.

1. Check each diode with the black lead connected to the anode and the red lead connected to the cathode. The resistance should be less than 2,000 ohms.
2. Check each diode with the black lead connected to the cathode and the red lead connected to the anode. The resistance should exceed 10,000 ohms.

Typical Installation

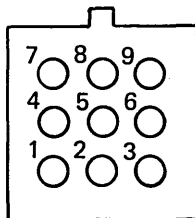
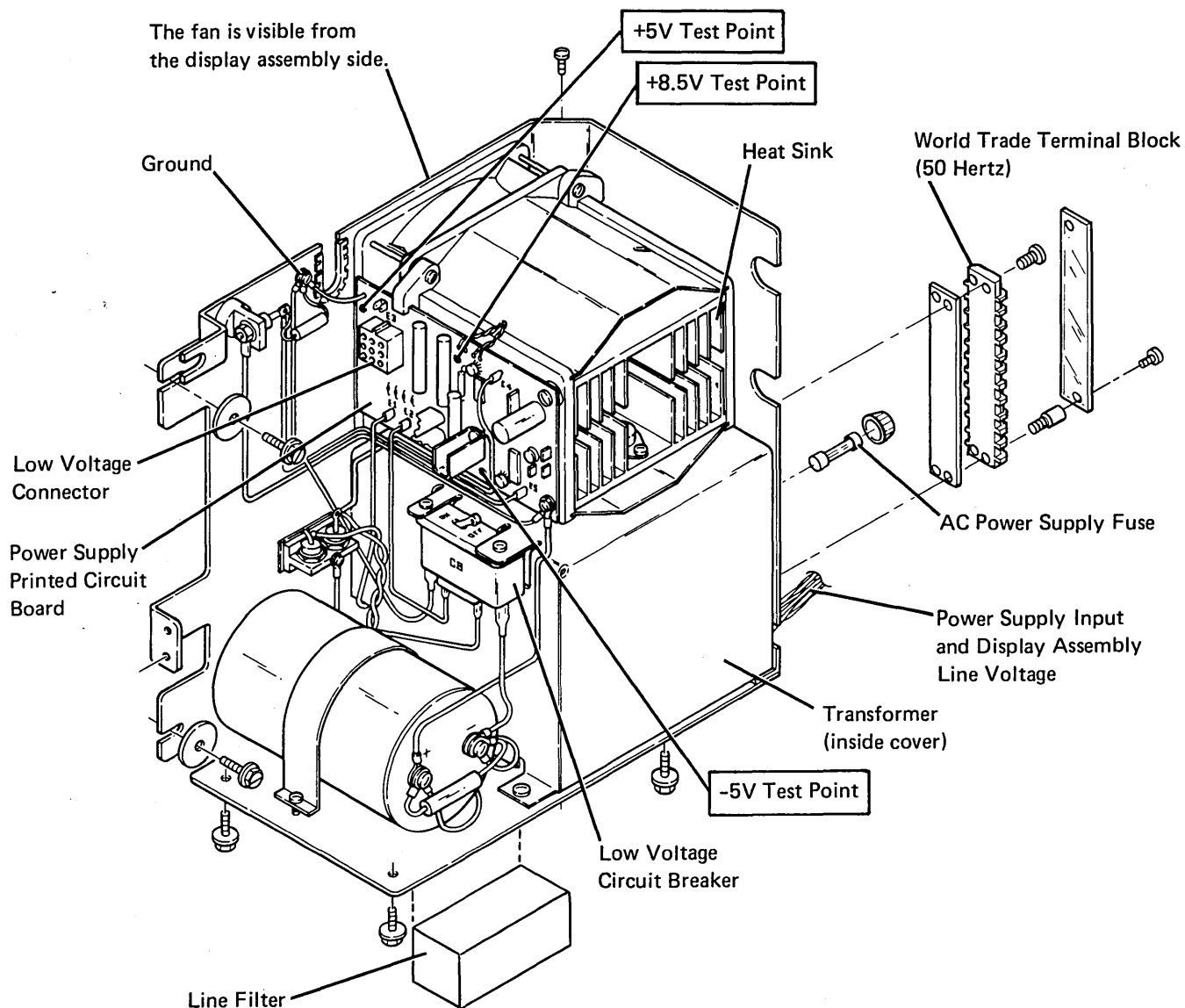


Station Protector Board



POWER SUPPLY

180 POWER SUPPLY LOCATIONS



Low Voltage Connector Detail

Connector Pin	Description
2	-5V
3,5,6	+5V
1,4,7,8	Ground
9	+8.5V

181 POWER SUPPLY REMOVAL AND REPLACEMENT

1. Power off.
2. Disconnect the line cord from the customer outlet.
3. Open the front and rear covers.
4. Disconnect the cables to the display assembly, the Power switch, and the main planar board.

CAUTION

Place the display station away from the edge of the table to prevent it from falling, and do not tip the machine on its back or side when removing the power supply.

5. Using a socket tool, remove the 6 power supply mounting screws.
6. Lift the power supply from the display station housing.
7. Install the new power supply. Place the used power supply in the shipping container for return to the branch office.
8. Fasten the power supply with the mounting screws.
9. Reconnect the cables.
10. Check the World Trade transformer connections (184).

182 VOLTAGE LEVEL CHECKS

Voltage levels can be checked as follows on the power cable to the main planar board or at the power supply.

DANGER

Line voltage is present at the power supply.

Low Voltage DC Connector	DC Voltage Level	Planar Board Connector G
1, 4, 7, 8	Ground	D05-D10
3, 5, 6	+5 (+4.6 to +5.5)	B02, B03, D02, D03
2	-5 (-4.6 to -5.4)	B06
9	+8.5 (+7.7 to +9.4)	B09-B11

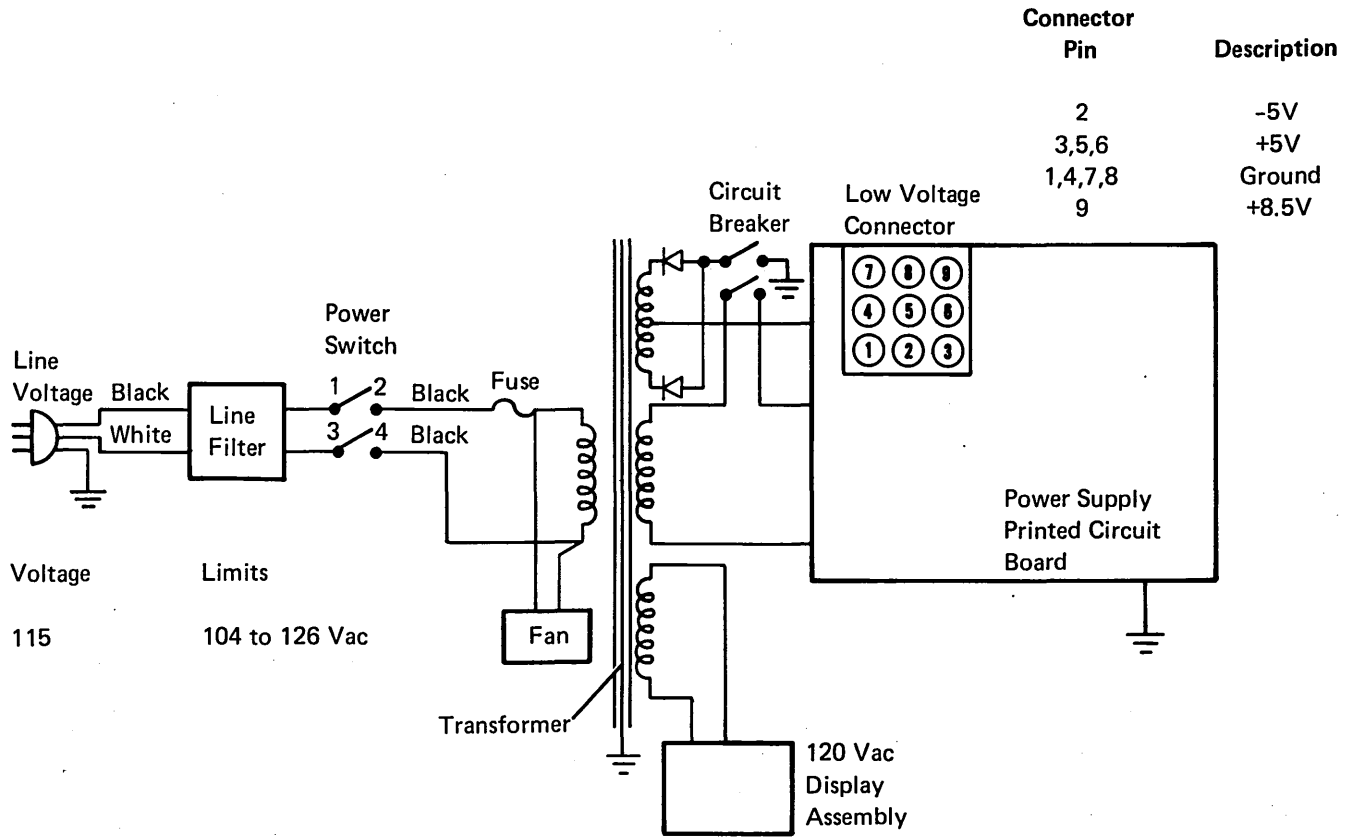
(This cable is part of a cable assembly that carries the display assembly signal lines to the main planar board.)

183 POWER SUPPLY RIPPLE LEVEL CHECK

The peak-to-peak output ripple level should be less than 3% of the respective DC voltages when measured with an oscilloscope.

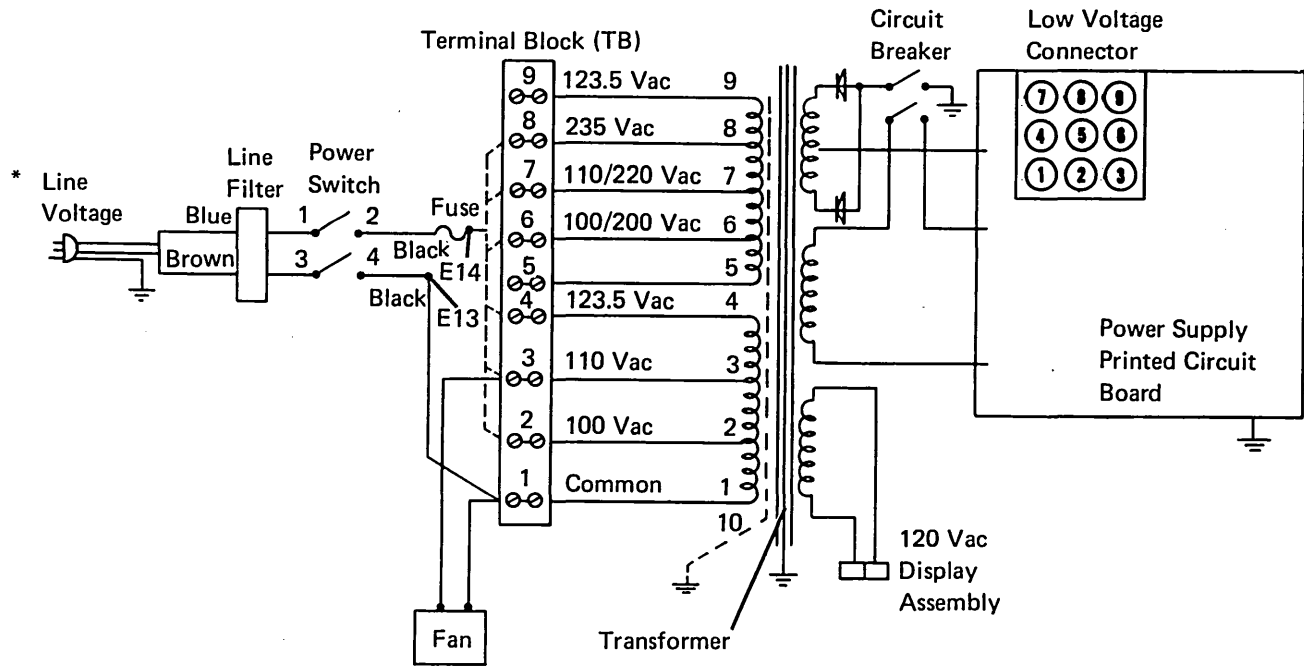
184 POWER SUPPLY CHARTS

115 Volt Power Supply (US)



World Trade Power Supply

Connector Pin	Description
2	-5V
3,5,6	+5V
1,4,7,8	Ground
9	+8.5V



World Trade Transformer Primary Connections for Terminal Block

Line Voltage	*Voltage Limits	E13 To	E14 To	Transformer Connections To TB
100 Vac	90 to 110 Vac	TB-1	TB-2	1 and 5 to TB-1 2 and 6 to TB-2
110 Vac	99 to 121 Vac	TB-1	TB-3	1 and 5 to TB-1 3 and 7 to TB-3
123.5 Vac	112 to 135 Vac	TB-1	TB-4	1 and 5 to TB-1 4 and 9 to TB-4
200 Vac	180 to 220 Vac	TB-1	TB-6	2 and 5 to TB-2
220 Vac	198 to 242 Vac	TB-1	TB-7	3 and 5 to TB-3
235 Vac	212 to 258 Vac	TB-1	TB-8	4 and 5 to TB-4

185 LINE CORD/LINE FILTER REMOVAL AND REPLACEMENT

1. Remove the power supply (181).
2. Repair or replace the line cord or the line filter.

Note: For the location of the line filter, see 180.

3. Replace the power supply (181).

Diagnostic Aids

200 CONTROL PANEL LEDs

Five lights (LEDs) are located on the control panel of the display station, and are used by the operator and the customer engineer. All five lights are on momentarily during power on to test the LEDs. After power on, the following descriptions apply. The lights are:

Line Sync: When on, this light indicates that the display station has recognized a poll or data that the controller sent over the system cable. The poll or data can be for any display station on the cable (Cable Thru feature). The light goes off if more than 160 ms elapse between recognizable characters.

Line Check: When on, this light indicates that the display station has detected a parity error in the poll or data the controller sent. When the Cable Thru feature is installed, each display station turns this light on even if the poll or data is not addressed to that work station. The addressed work station returns an error response to the controller. The controller resends the information that caused the error until the information is received at the display station error free, at which time, the light will be turned off.

Internal Check: When on, this light indicates that a parity error has been found in the data bus while getting data from read/write storage. The Internal Check light can be reset (off) by setting the Test switch to the Test position. A power on reset occurs when this light is being reset by the Status switch.

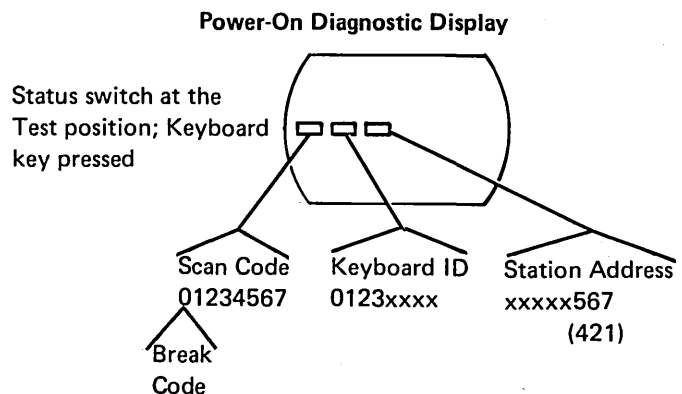
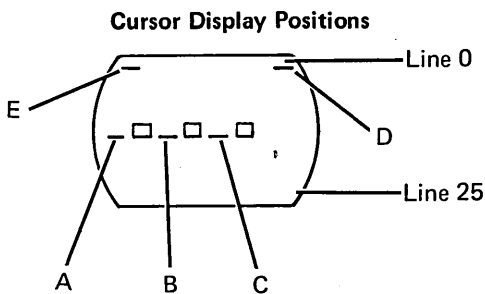
Storage Check: (reserved)

Ready: When on, this light indicates that the power-on diagnostic has completed correctly. The Ready light is off if the Status switch is in the Test position; if either or both the Storage Check and Internal Check lights are on; or if the microprocessor is in a diagnostic sequence. The MPU controls this light.

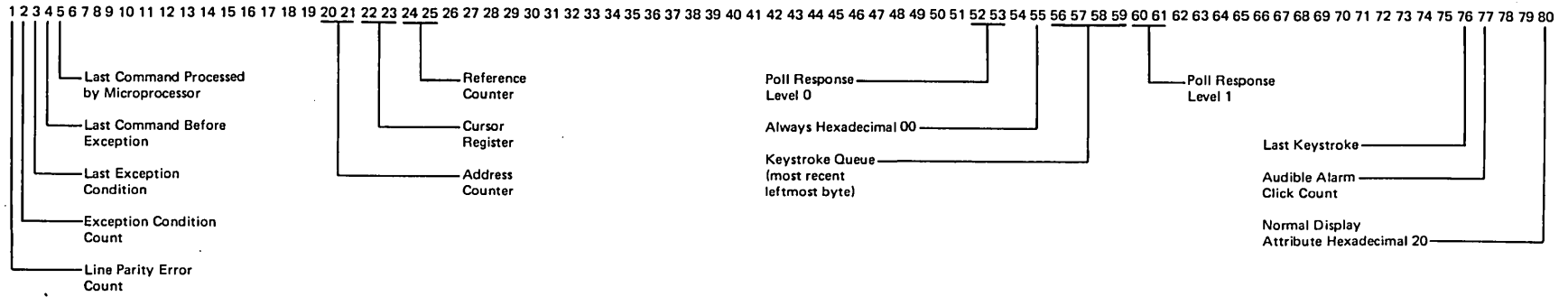
201 STATUS SWITCH

The Status switch on the control panel is a diagnostic aid for the customer engineer. It also functions as a reset switch.

1. If the switch is in the Test position when the display station is powered-on, the power-on diagnostic displays the scan code for each key pressed. The power-on diagnostic will continue to loop with the cursor in position B until the switch is set to the Normal position.
2. The settings of the Address switches (Cable Thru feature) should not be changed while the power-on diagnostic is looping, unless a keyboard data key is pressed and held down. Release the key to allow the power-on diagnostic to loop after the desired settings of Address switch are changed, so that the changes can be seen in the address field of the display screen.
3. If the cursor is in position D and the Status switch is in the Normal position, the clicker will sound only for the first 4 keys pressed. Additional keys can be pressed, but the clicker will be inactive. If the Status switch is now set to the Test position, lines 0 and 25 will be displayed for approximately 5 seconds. During this 5 seconds, the hexadecimal code of the last key pressed will be displayed in position 76 of line 25.
4. Lines 0 and 25 are displayed when the Status switch is set to the Test position during a customer job or when the cursor is in position E. Display station operation is not affected. Lines 0 and 25 are removed when the Status switch is set to the Normal position.
5. The Storage check light and Internal Check light are reset by setting the Status switch to the Test position. The operator must sign-on and restart the customer job after the Status switch is set to the Normal position.
6. The field attribute will be displayed when the Status switch is in the Test position.



Line 25 description is as follows:



Line Position

- 1 Line parity error count
- 2 Exception condition count
- 3 Last exception condition
- 4 Last command before exception
- 5 Last command processed by microprocessor
- 6-11 (not used)
- 12 Time slice return address hi
- 13 Time slice return address lo
- 14-19 Time slice register save area
- 20 Address counter hi
- 21 Address counter lo
- 22 Cursor register hi
- 23 Cursor register lo
- 24 Reference counter hi
- 25 Reference counter lo
- 26-35 (not used)
- 36-51 Cable adapter command queue
- 52-53 Poll response level 0

Line Position

- 54 Poll response delimiter
- 55 Always hexadecimal 00
- 56-59 Keyboard keystroke queue
- 60-61 Poll response level 1
- 62 Poll response delimiter
- 63-67 (not used)
- 68 Cable adapter control register hi
- 69 Cable adapter control register lo
- 70 Cable adapter address register hi
- 71 Cable adapter address register lo
- 72 Cable adapter length register hi
- 73 Cable adapter length register lo
- 74 Cable adapter sense register
- 75 Last cable adapter sense register value (stored by microcode)
- 76 Keycode of last key that was pressed
- 77 Audible alarm clicker count
- 78-79 User accessible address limit
- 80 Normal display attribute hexadecimal 20

Alternative Display

Line Position

- 1-16 (not used)
- 17-32 I/O device data storage area
- 33 Keylock feature status hexadecimal 00 if off or not installed
- 34-39 (not used)
- 40-43 Subroutine save area
- 44-45 Save area
- 46 Same as position 1 of main display

Line 25 Information

The illustration shows the most commonly used information. The table indicates all the information displayed on line 25 when the Status switch is set to the Test position. An alternative display of line 25 occurs whenever contents of the last key log (position 76) contains the break bit. This is a result of pressing and releasing any shift key before or during the time the Status switch is set to the Test position.

202 FIELD ATTRIBUTE CHARACTERS

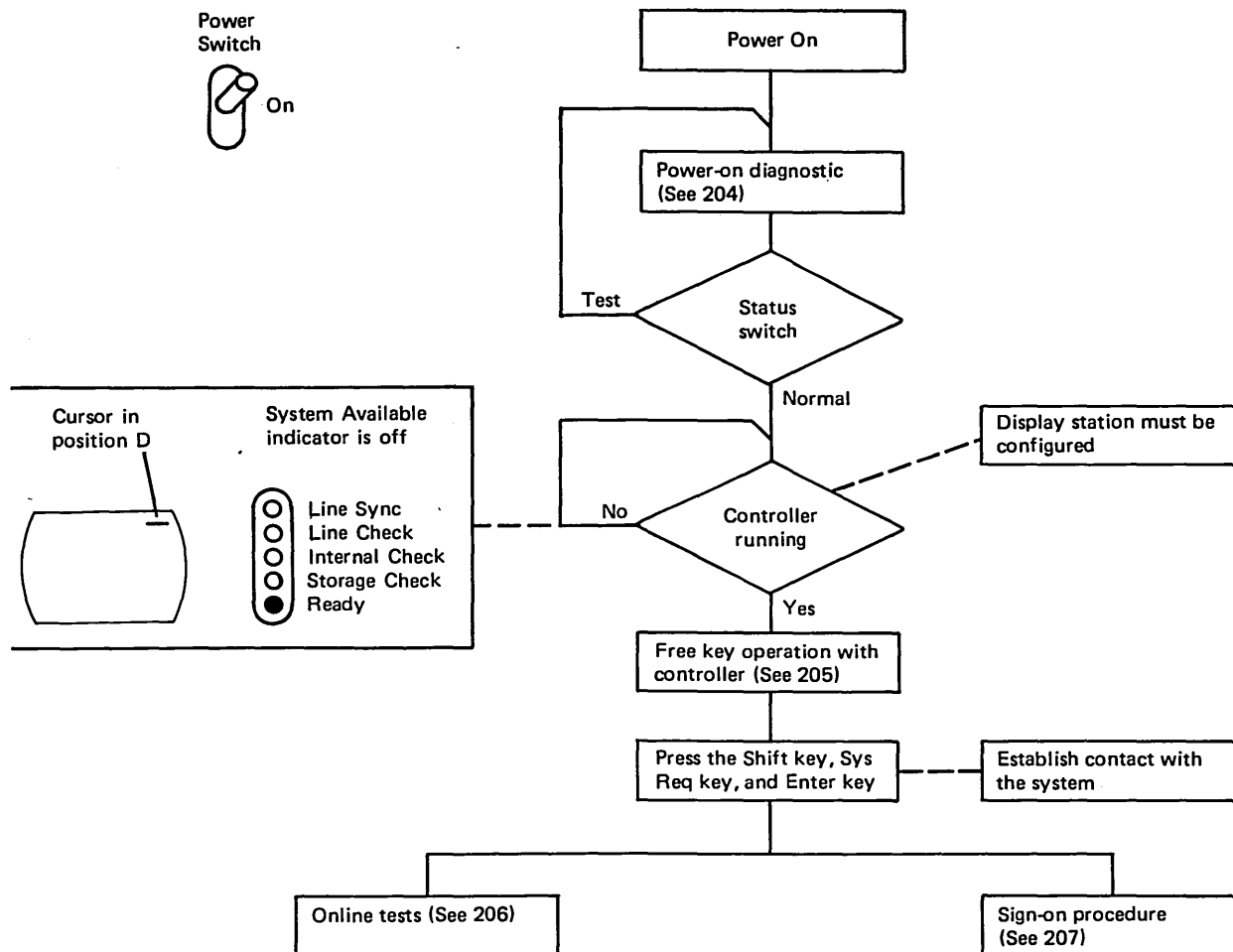
Field attribute characters can be displayed by setting the Status switch to the Test position. The hexadecimal code is displayed to the left of the field that it converts as follows:

Hex Code	Description
20	Normal display
21	Reverse image
22	High intensity
23	Reverse image, high intensity
24	Underscore
25	Underscore, reverse image
26	Underscore, high intensity
27	No display
28	Blink
29	Blink, reverse image
2A	Blink, high intensity
2B	Blink, high intensity, reverse image
2C	Blink, underscore
2D	Blink, underscore, reverse image
2E	Blink, underscore, high intensity
2F	No display

Hexadecimal codes 30 through 3F are the same as 20 through 2F but include column separators between each character in the field.

203 DISPLAY STATION OPERATION OVERVIEW

The following flowchart shows the sequence of operations from power on to either customer sign-on or online test.

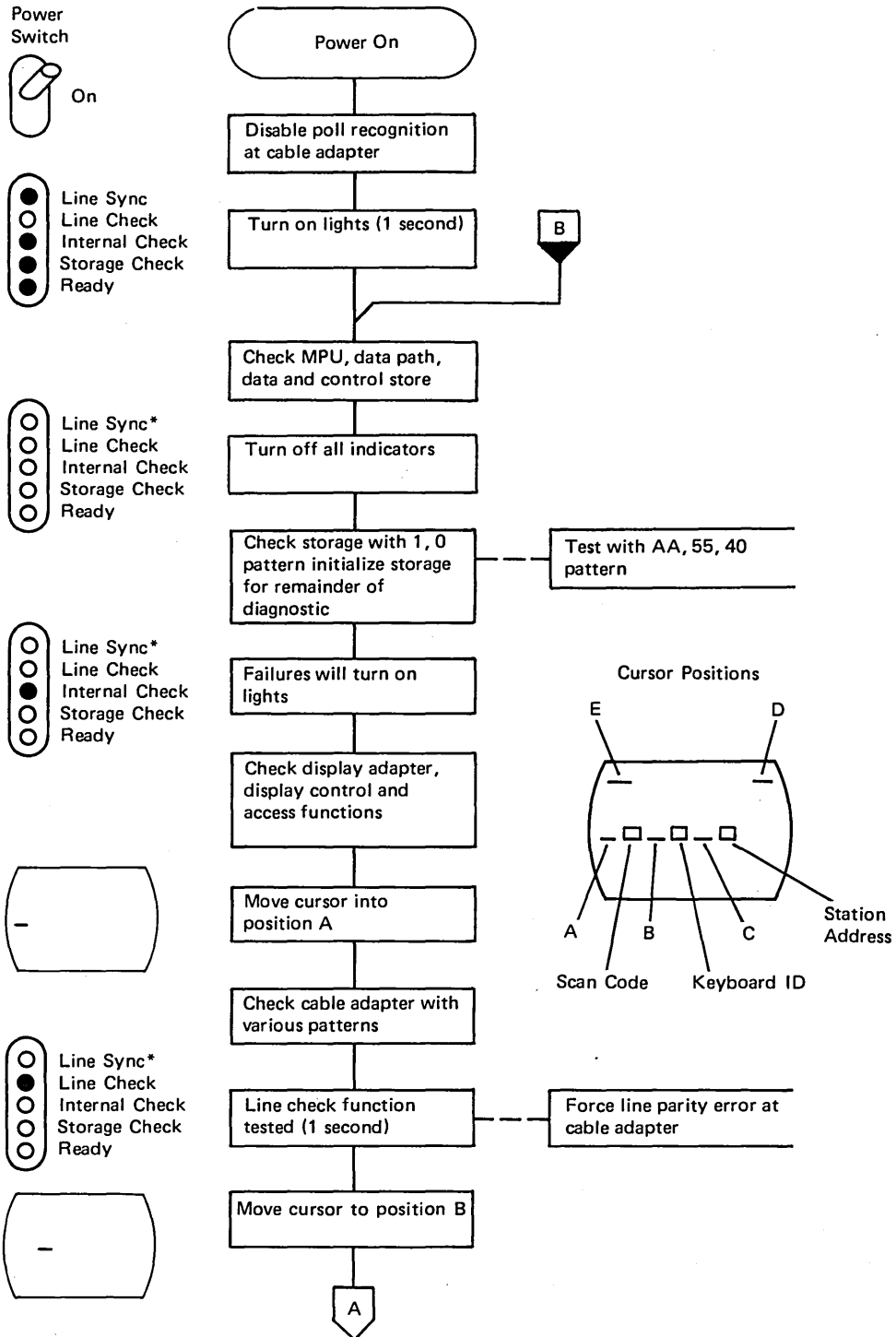


204 POWER-ON DIAGNOSTIC

The following flowchart shows the steps of the internal diagnostics performed when the display station is powered on.

At the end of this diagnostic, more tests or sign-on can be done with the free key operation, online test, or sign-on procedure.

Power-On Diagnostic Flowchart (Part 1 of 3)



*The Line Sync light is on when the controller is polling.

Power-On Diagnostic Flowchart (Part 2 of 3)

Status Switch



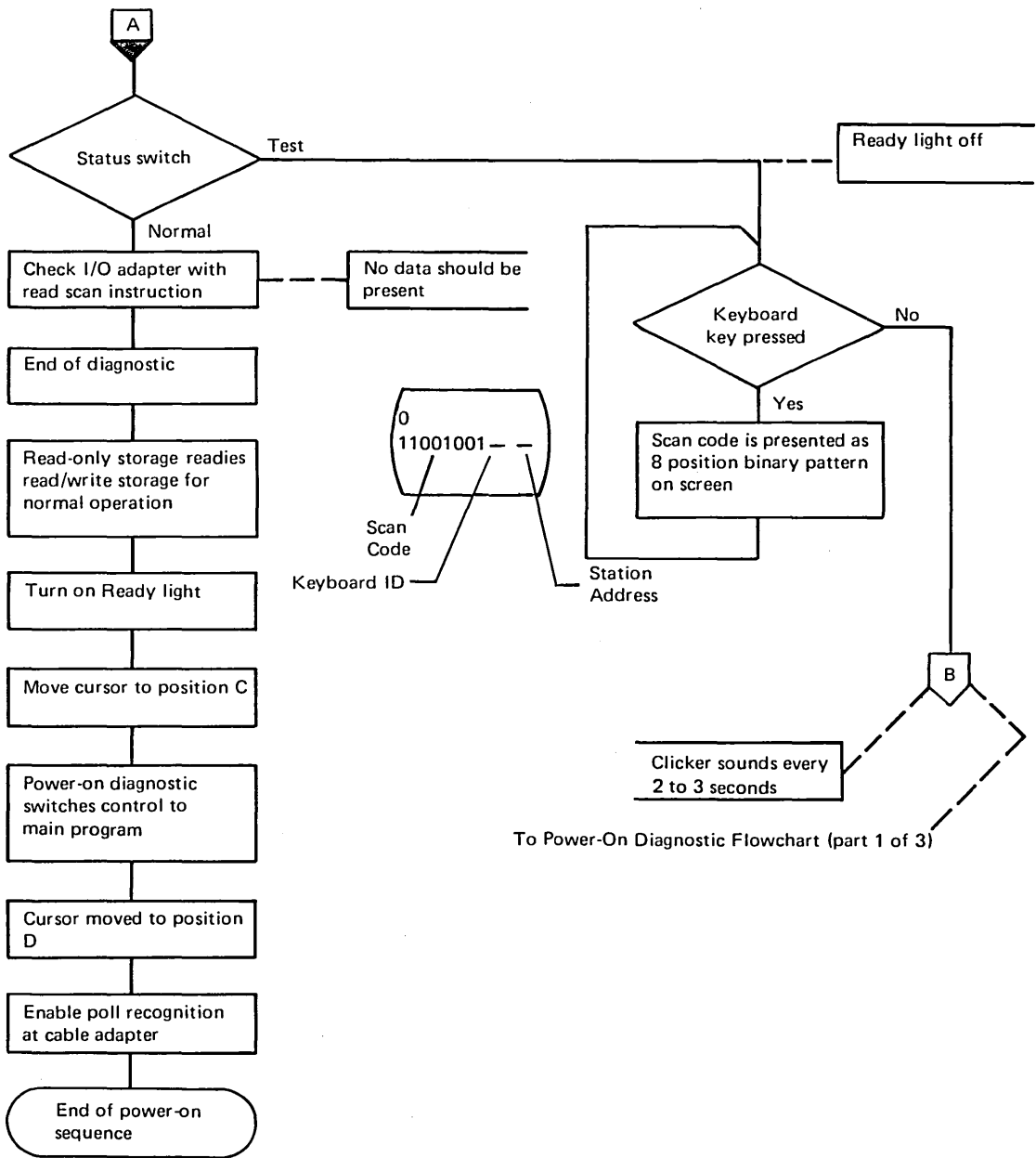
Test

Status Switch



Normal

- Line Sync*
- Line Check
- Internal Check
- Storage Check
- Ready

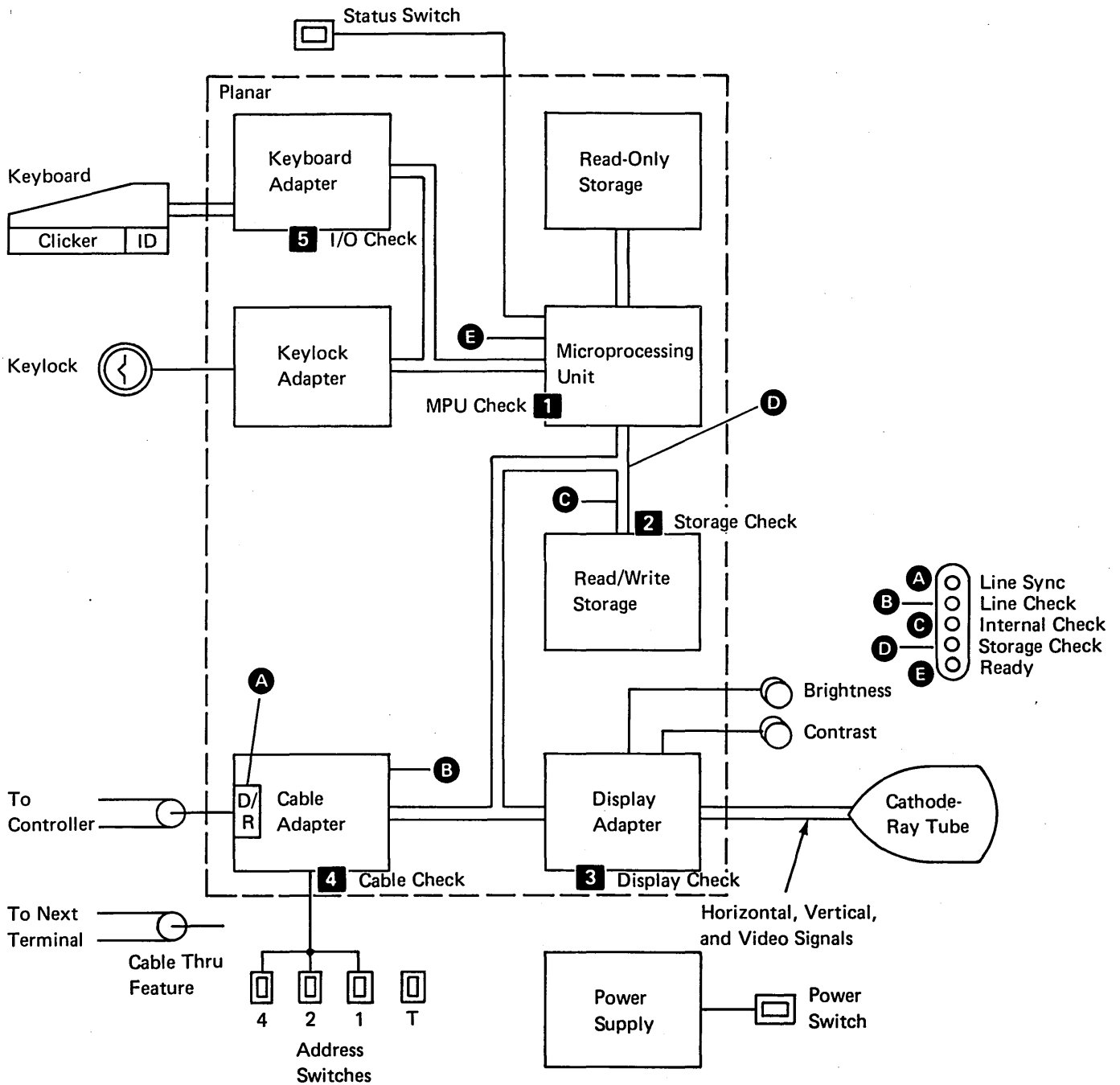


To Power-On Diagnostic Flowchart (part 1 of 3)

*The Line Sync light is on when the controller is polling.

Power-On Diagnostic Flowchart (Part 3 of 3)

The numbers indicate the sequence of major areas of adapters the power-on diagnostic checks.

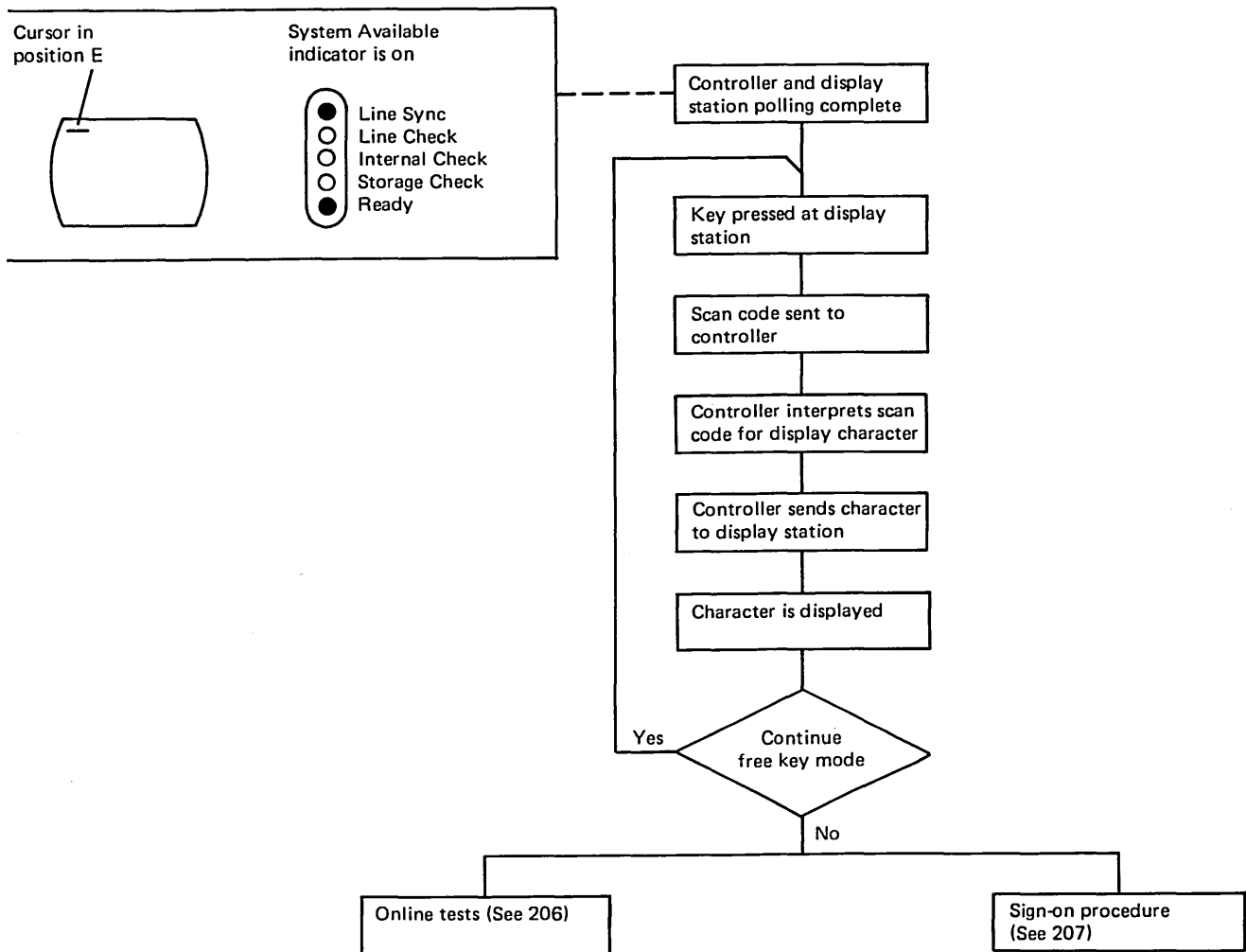


205 FREE KEY OPERATION

A free key operation can be entered after the power-on diagnostic and before the customer sign-on. In free key operation, the display station communicates with the controller and permits key character displays; this checks alphameric keys and most function keys. The following function keys, if pressed in free key mode, will return an error code 0099:

Print	Enter/Record Advance
Help	Test Request
Roll↑ (Up)	Attention
Roll↓ (Down)	Command function keys 1 through 24

Use online tests (206) to check these key operations.

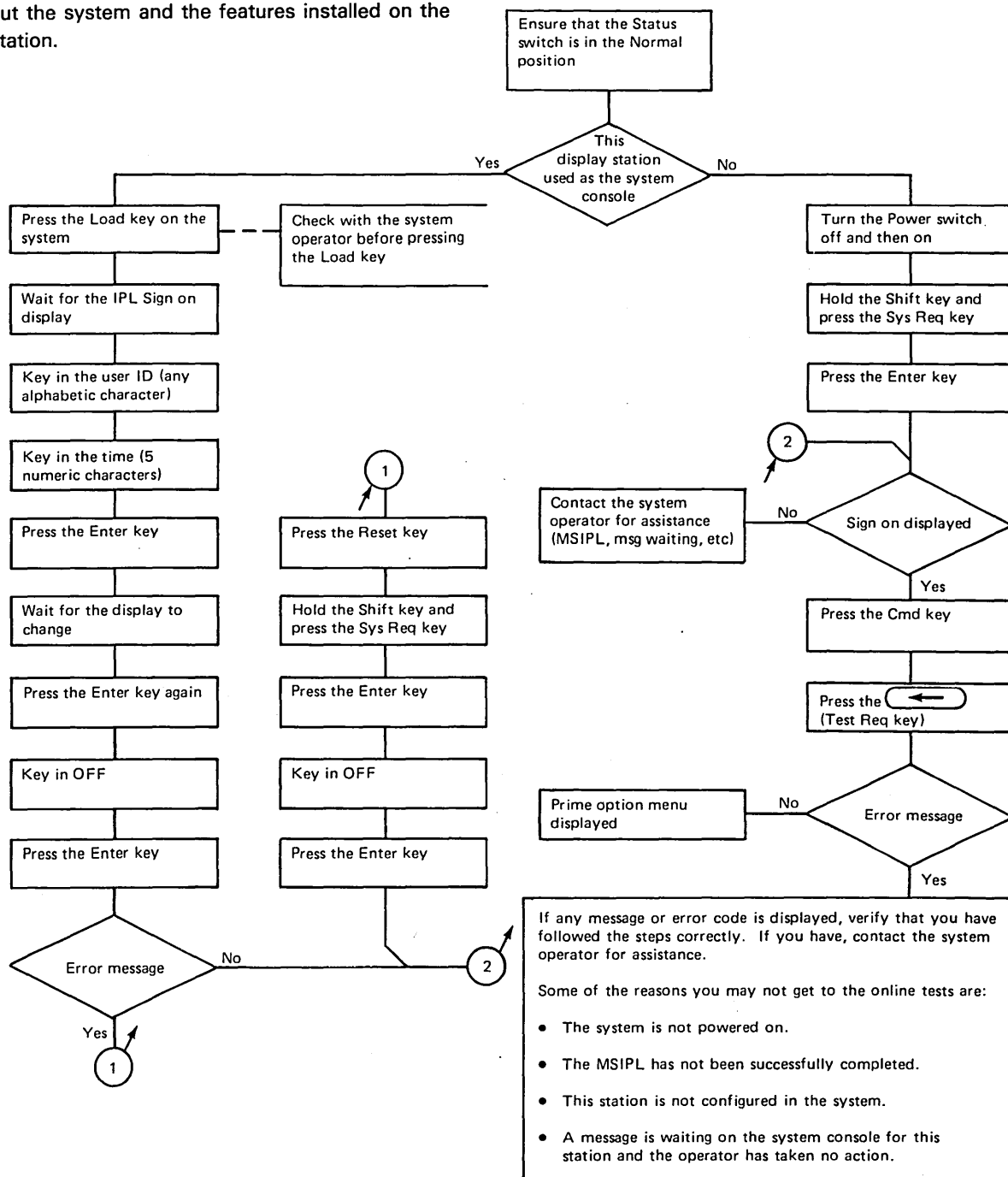


206 ONLINE TESTS

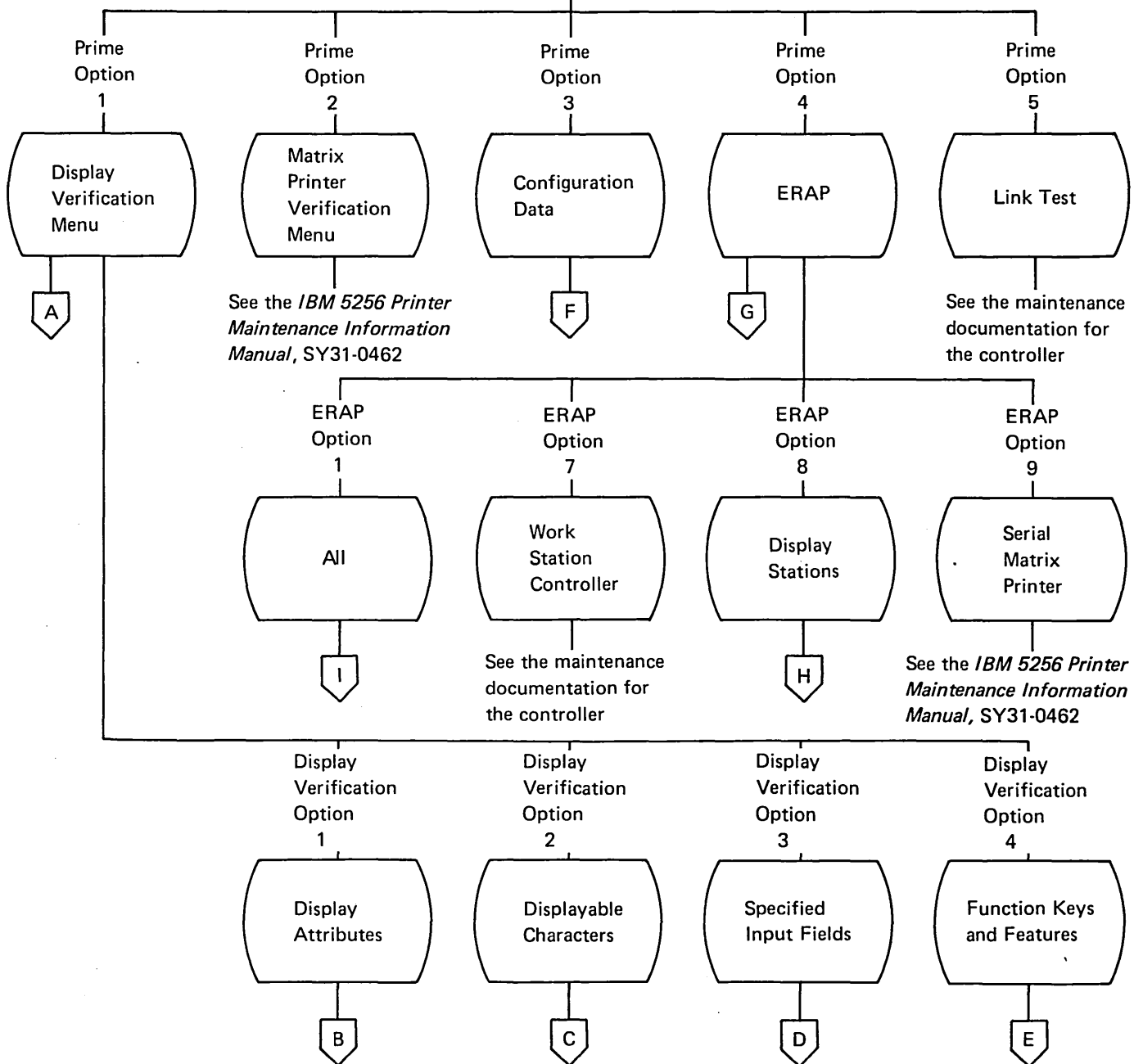
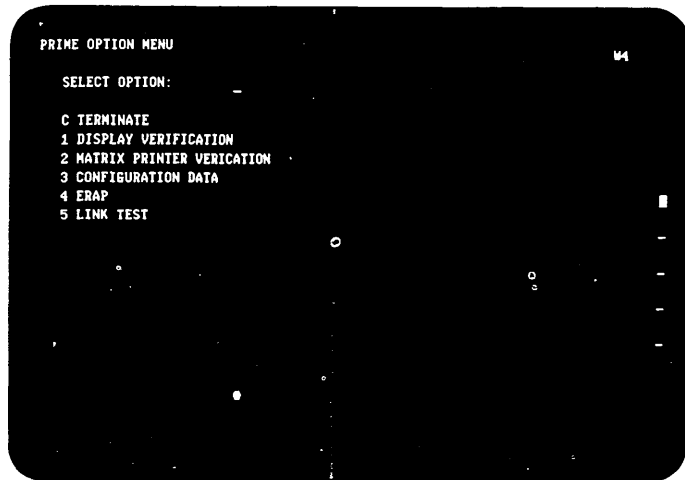
Online tests include work station exerciser routines that reside in the system. A Prime Option Menu is displayed that provides the selection of display verification, matrix printer verification, configuration data, and ERAP (error recording analysis procedures).

The display verification includes the Display Attributes test and the Displayable Characters test that check out the planar. The Specified Input Fields test checks out the controller. The Function Keys and Features test checks out the system and the features installed on the display station.

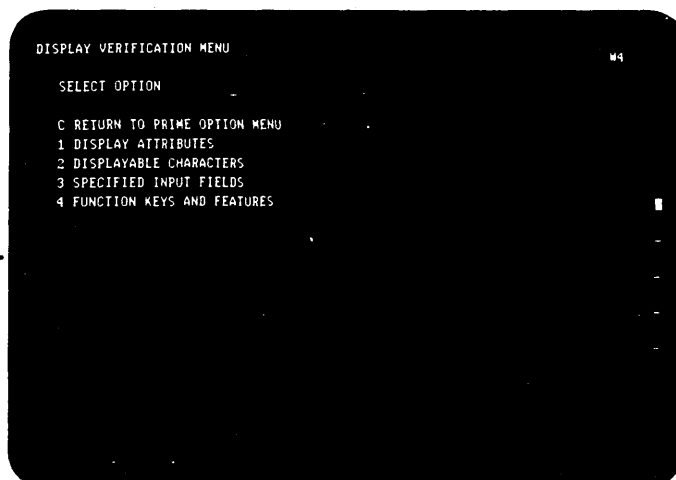
Online tests can be run on the work station at the same time other jobs are being run on the system. However, the work station must be in a signed off condition before online tests can be run on that work station. There may be various ways to terminate or sign off a job. To describe them here is beyond the scope of this manual as the methods used are system operating procedures. If you are not familiar with the system, use the procedure in the following flowchart:



Online Tests Overview



Online Tests Displays



Select the Display Verification Menu by:

- a. Pressing the 1 key.
- b. Pressing the Enter key.

B



Select the Display Attributes option by:

- a. Pressing the 1 key.
- b. Pressing the Enter key.

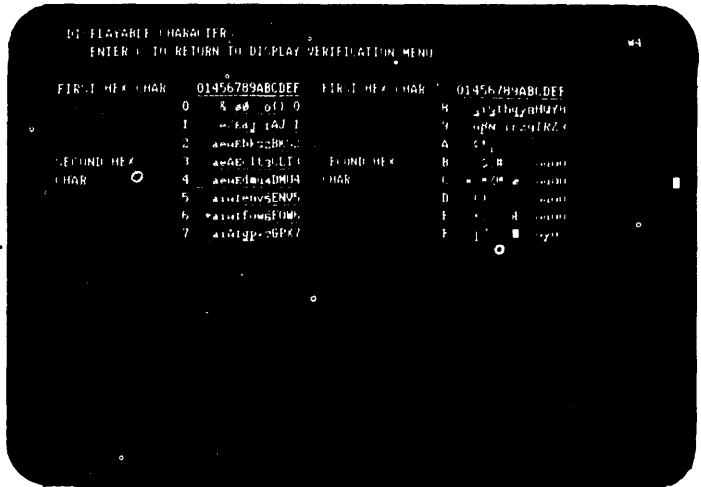
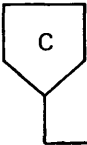
This display tests the attributes, Contrast control, and alignment of characters on the display screen.

How to use this display:

1. Turn the Contrast control fully clockwise and slowly decrease the Brightness control observing the pattern of H's that alternate in intensity.
2. Set the Brightness control for the best character image.
3. Press the Spacebar once to position the cursor on the right side of the display screen.
4. Key in one of the hexadecimal numbers shown on the left side of the display screen and press the Enter key. Observe the results that take place on the right side of the display screen. Compare these results to the attribute description on the left. An incorrect entry causes the entry to blink at high intensity. Repeat steps 3 and 4 for each of the remaining hexadecimal numbers.

Note: Attribute combinations are not shown on this display screen. Refer to *202 Attribute Characters* for these combinations.

5. Return to the Display Verification Menu by:
 - a. Pressing the C key.
 - b. Pressing the Enter key.



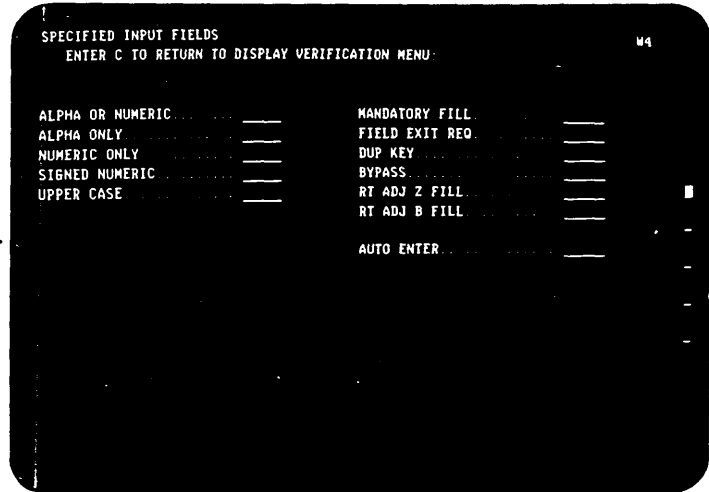
Select Displayable Characters by:

- a. Pressing the 2 key.
- b. Pressing the Enter key.

This display provides a matrix of characters representing the character set of the keyboard.

Return to the Display Verification Menu by:

- a. Pressing the C key.
- b. Pressing the Enter key.



Select Specified Input Fields by:

- a. Pressing the 3 key.
- b. Pressing the Enter key.

This display tests the controller operations that are used by the display station. Fields of information are entered, read by the controller, and written back to the display screen next to the input field.

How to use this display:

1. Press the Spacebar once to position the cursor at the beginning of the first input field. The cursor moves from the field on the left to the field on the right when the input field information has been entered.
2. Enter information in the fields as described on the display screen. If an error is made, press the Error Reset key and correct the error.

Field Description:

Alpha or Numeric: Key in 5 alpha or numeric characters.

Mandatory Fill: This field must be filled with 5 alpha or numeric characters.

Alpha Only: Key in 5 alpha characters.

Field Exit Req: Key in 5 alpha or numeric characters and then press the Field Exit key.

Numeric Only: Key in 5 numeric characters.

Dup Key: Press the Dup key once. The key code of the Dup key will be shown until the screen is written by the controller. This field will duplicate the Numeric Only Field.

Signed Numeric: Key in 4 numeric characters. The cursor will remain under the last character keyed. Press the Field Exit key (positive) or the Field - key (negative).

Bypass: This field will be automatically bypassed and no entry will be required.

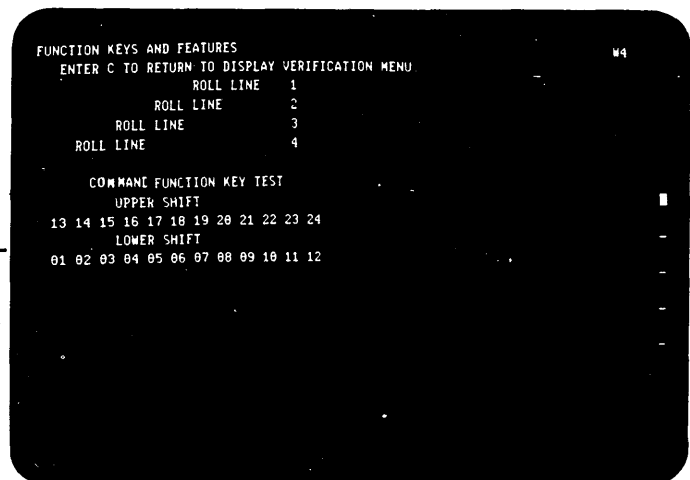
Upper Case: Key in 5 alpha characters.

Rt Adj Z Fill: Key in 1 alpha or numeric character. Press the Field Exit key. The character entered will be moved to the right of the field and the left 4 positions will be filled with zeros.

Rt Adj B Fill: Key in 1 alpha or numeric character. Press the Field Exit key. The character entered will be moved to the right of the field and the left 4 positions will be filled with blanks.

Auto Enter: Key in 5 alpha or numeric characters. As soon as the last character is entered, the controller reads all the input fields, passes the information to the system, and writes it back to the display screen next to the input fields.

3. Return to the Display Verification Menu by:
 - a. Pressing the C key.
 - b. Pressing the Enter key.



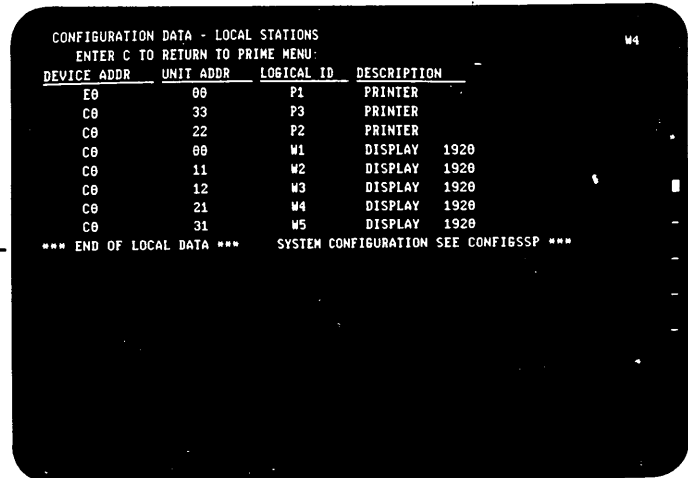
Select Function Keys and Features by:

- a. Pressing the 4 key.
- b. Pressing the Enter key.

This display tests the roll keys and command function keys.

How to use this display:

1. Press and hold the Upper Shift key with either the Roll↑ or Roll↓ key.
2. Observe roll lines 1, 2, 3, and 4. Lines rolled off the display screen can be returned by pressing the Enter key.
3. Observe the intensity of the numbers on the display screen while performing step 4.
4. Press and hold the Cmd key and press command function key 1. Release both keys. Repeat until command function keys 1 through 12 have been pressed. Now press and hold the Cmd key and the Upper Shift key while pressing command function key 13. Release all three keys. Repeat until command function keys 13 through 24 have been pressed.
5. Repeat step 4 and a normal display of the numbers reappears.
6. Return to the Display Verification Menu by:
 - a. Pressing the C key.
 - b. Pressing the Enter key.
7. Return to the Prime Option Menu by:
 - a. Pressing the C key.
 - b. Pressing the Enter key.



Select Configuration Data by:

- a. Pressing the 3 key.
- b. Pressing the Enter key.

The descriptions for Configuration Data are:

1. Device Addr is the address of the controller.
2. Unit Addr is the stations(s) assigned to the controller. The first digit is the port number and the second digit is the station address.
3. Logical ID is the name the system uses to address this station.
4. Return to the Prime Option Menu by:
 - a. Pressing the C key.
 - b. Pressing the Enter key.

G

```

ERROR RECORDING ANALYSIS PROCEDURE   SELECT DESIRED OPTION
0 END                               5
1 ALL                               7 WORKSTATION CONTROLLER
2                                   8 DISPLAY STATIONS
3                                   9 SERIAL MATRIX PRINTERS
4                                   10
5

```

Select the Error Recording Analysis Procedures (ERAP) Menu by:

- a. Pressing the 4 key.
- b. Pressing the Enter key.

Select Display Stations by:

- a. Pressing the 8 key.
- b. Pressing the Field Exit key.

Note: For a detailed ERAP explanation, refer to the system documentation. For display station problem identification, see *208 Error History Table* in this section.

H

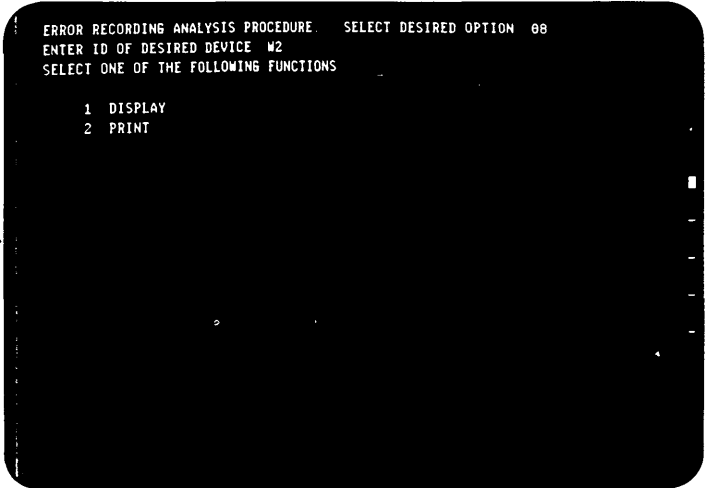
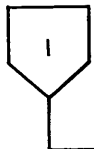
```

ERROR RECORDING ANALYSIS PROCEDURE   SELECT DESIRED OPTION 08
ENTER ID OF DESIRED DEVICE
M1  M2  M3  M4  M5  M6

```

Select the desired device by:

- a. Entering the ID of the device.
- b. Pressing the Enter key.



If you only want to look at the error tables on the display screen:

- a. Press the 1 key.
- b. Press the Enter key.

If you want a printout of the error tables:

- a. Press the 2 key.
- b. Press the Enter key.

If you have selected the ALL option, the ERAP tables will be displayed for all devices on the line, one at a time. When the Error History Table for the first device is displayed and the Enter key is pressed, the I/O Counter Table for the second device will be displayed. This sequence will be repeated until each device Error History Table has been displayed.

If you have selected a specific device, these three tables may be redisplayed or reprinted (in order) as many times as desired by pressing the Enter key after each one has been displayed or printed.

```

DEPRESS ENTER TO VIEW NEXT DISPLAY   ENTER C TO RETURN TO MAIN MENU
I/O COUNTER TABLE FOR DISPLAY STATION   WE/ 0011
DATE LAST RESET                         00/00/00
NUMBER OF SVCS                           4414
***** END OF TABLE *****

```

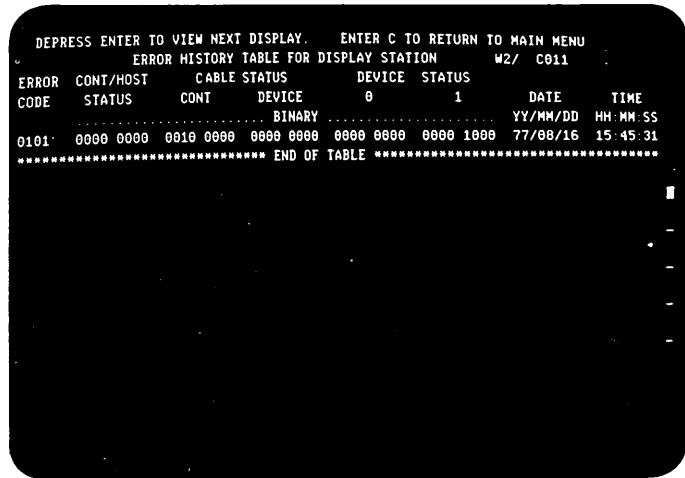
Press the Enter key.

```

DEPRESS ENTER TO VIEW NEXT DISPLAY   ENTER C TO RETURN TO MAIN MENU
ERROR COUNTER TABLE FOR DISPLAY STATION   WE/ 0011 DATE LAST RESET 00/00/00
RECEIVE PARITY CHECKS                     0
LINE PARITY CHECKS                         0
***** END OF TABLE *****

```

Press the Enter key.



For display station problem identification, see *208 Error History Table*.

1. Return to the ERAP Menu by:
 - a. Pressing the C key.
 - b. Pressing the Enter key.

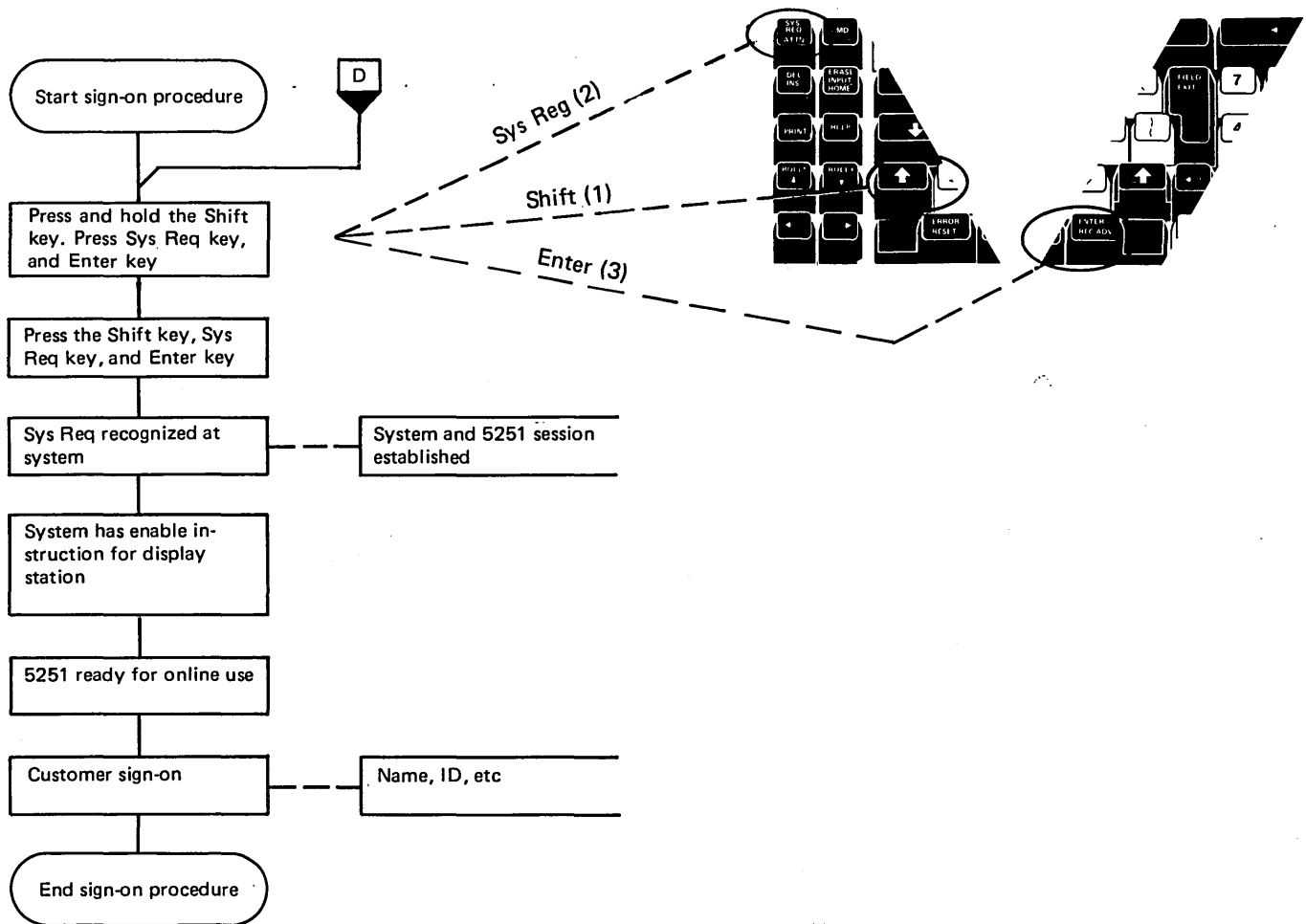
2. Return to the Prime Option Menu by:
 - a. Pressing the 0 key. (Numeric 0)
 - b. Pressing the Field Exit key.

3. Return to the Sign On Menu by:
 - a. Pressing the C key.
 - b. Pressing the Enter key.

207 SIGN-ON PROCEDURE

This is the procedure the operator and customer engineer use to sign-on for display station application use. It is also a diagnostic, in that all parts of the display station, customer twinaxial cable, controller, and system, must be operating correctly.

The initial program load (IPL) sign-on procedure must be completed before this procedure can be used.



208 ERROR HISTORY TABLE

This is an example of an error history table. It describes the fields that are displayed on the display station or that can be printed on the printer. The example is printed on the side of this page so that it can be held on the display screen for easier problem identification.

	ERROR CONT/HOST		CABLE STATUS		DEVICE STATUS		DATE	TIME
	CODE	STATUS	CONT	DEVICE	0	1		
	0123	0123 4567	0123 4567	0123 4567	0123 4567	0123 4567	YY/MM/DD	HH:MM:SS
	0104	0000 0000	0000 0000	0100 0001	0000 0000	0000 1000	76/08/24	04:46:19
	0120	0000 0000	0000 0000	0000 1001	0000 0000	0000 0000	76/07/24	02:32:06
Device 01 = 5251								
Error type								
Controller defined any error bit present; see Controller/Host MAP								
(reserved)								
No response								
Transmit activity check								
(reserved)								
Receive parity check								
Receive length check								
(reserved)								
Even/odd timeout								
Busy								
Line parity								
(reserved)								
Outstanding status								
					456			
					000			No exception status
					010			Invalid activate
					011			(reserved)
					100			Invalid command
					101			Input Q/storage overrun
					110			Invalid register value
					111			Power-on transition

Defines status byte 0
0010 = keyboard scan code

Scan code or command

Even/odd response level
0 = Even
1 = Odd

209 ERROR CODES

Two types of error codes are described here. The display station error codes and operator error codes.

Display Station Error Codes

Errors that are relative to hardware failures or servicing of a display station are listed first. These errors are sensed at the controller by the status sent from the display station or as a result of either no response or a wrong response.

Errors are stored in the order they are received and are listed here in groups. Error code 01xx identifies a display station error.

Line/Interface Errors

0100 No Response

This error is reported when a display station is in session and no response to a poll occurs.

0101 Transmit Activity Check

This error is found at a controller during a poll or command being executed by the controller.

0103 Receive Parity Error

The controller reports this error when a frame is received and parity is wrong in response to a poll or command.

0104 Line Parity Check

The display station reports this error when a frame is received and parity is wrong when receiving a poll or command.

0106 Receive Length Check

The controller received the wrong number of bytes as a result of a poll or command.

0108 Power On Transistion

This status bit is set when the display station is powered-on. The bit is reported as an error only if the display station was in session.

0109 Activate Command Failure

The controller checked the device status and found that the busy bit was not on after an activate command.

Keyboard Errors

0111 Scan Code Not Valid

The 8-bit code sent in the keyboard response frame does not translate to an assigned character or function as the controller specified.

Command/Function Errors

0120 Command Not Valid

This condition indicates that the poll/command sent to the display station is not a valid command or the device ID is not correct.

0121 Register Value Not Valid

This condition indicates that the address counter value is not in the user accessible limits.

0122 Storage or Input Queue Overrun

This condition occurs when more than 16 commands and associated data frames are sent, or when an attempt is made to store data beyond the user accessible storage.

0123 Null or Attribute Exception

No attribute was found or the address counter points to an attribute.

0124 Activate Not Valid

This condition indicates that the activate command sent to the display station is not valid.

0125 Undefined Exception Status

This condition indicates an undefined exception status is returned by the display station in response to a poll.

0149 Undefined Error Status

The controller found an error but cannot determine what caused the error.

Time-Out Errors

0190 Even/Odd Change In Status

Status sent to the controller from the display station has not changed in 225 ms after the controller has sent a positive acknowledgment and has received a nonbusy response.

0191 Busy

The controller finds that the busy bit has been on for a period greater than 400 ms.

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Operator Error Codes

These errors are caused by pressing the wrong key, pressing a key that is not recognized by the controller, or entering the wrong data in a specified input field. Errors appear on the display screen with the format 00xx. These numbers will be blinking. To display the type of error, press the Help key.

If an error is displayed and no error condition is present, the most probable cause of the error is in the controller. Refer to the system documentation for the cause of the error.

However, you can check the error conditions with the Online Test (206). For example, the Specified Input Fields display (selected from the Display Verification Menu, option 3) contains specific data fields. You can intentionally make errors by entering the wrong data in a field and check the error condition that appears.

The following list of operator error codes shows the error code number and the description, followed by a description of the cause of the error.

For error recovery on all these errors, press the Error Reset key.

KBD-0000 HELP KEY NOT ALLOWED NOW

You have pressed the Help key; however, either no error code was displayed or the error was issued by a program that does not support the Help key.

KBD-0001 LAST KEYSTROKE NOT RECOGNIZED

The controller has not kept up with the rate you were entering information and the last character you entered was not recognized. This is a keyboard overrun.

KBD-0002 LAST KEYSTROKE NOT RECOGNIZED

The controller received a key code that is not valid and does not know what key you pressed.

KBD-0003 INVALID KEY FOLLOWED CMD KEY

You have pressed the Cmd key but the next key you pressed was not one of the command function keys.

KBD-0005 CURSOR IN PROTECTED AREA OF DISPLAY

You have attempted to enter data; however, the cursor is not in an input field on the display. Data cannot be entered in a protected area of the display.

Move the cursor to a field where the data can be entered and enter the data.

KBD-0006 INVALID KEY FOLLOWED SYS REQ KEY

You pressed the Sys Req key but did not follow it by pressing either the Enter key or the Error Reset key.

KBD-0007 MANDATORY ENTER FIELD—MUST ENTER DATA

There is at least one mandatory enter field on the display that you must enter data into before the display can be changed or moved.

KBD-0008 THIS FIELD REQUIRES ALPHABETIC CHARACTERS

The field you are now trying to enter data into will take only alphabetic data and you have pressed a nonalphabetic key.

Valid characters are A through Z, blank, comma, period, hyphen, and apostrophe. The Dup key can be used to duplicate these characters into this field.

KBD-0009 THIS FIELD REQUIRES NUMERIC CHARACTERS

The field you are now trying to enter data into will take only numeric data and you have pressed a nonnumeric key.

Valid characters are 0 through 9, blank, comma, period, plus, and minus. The Dup key can be used to duplicate these characters into this field.

KBD-0010 ONLY CHARACTERS 0 THROUGH 9 ALLOWED

The field you are now trying to enter data into will take only signed numeric data and you have pressed some other key.

Valid characters are 0 through 9 and the Dup key.

209 (continued)

You can either continue to enter data or press the Field Exit key to leave the field.

KBD-0011 INVALID KEY FOR SIGN POSITION OF FIELD

You have attempted to enter data into the last position of a signed numeric field.

KBD-0012 INSERT MODE—NO ROOM TO INSERT DATA

There is no room to insert data into this field. Either there is no more room in the field or the cursor is in the last position of the field.

Do not use Insert mode to change data or enter the last character into this field.

KBD-0013 INSERT MODE—ONLY DATA KEYS ALLOWED

You are now in Insert mode; however, you have pressed a nondata key. Only data keys are valid after pressing the Ins key.

To use Insert mode, press the Ins key and then a data key.

KBD-0014 MANDATORY FILL FIELD—MUST FILL TO EXIT

You have pressed a function key that would move the cursor out of this field; however, the cursor is not in the first or last position of this mandatory fill field. A mandatory fill field must be completely filled unless you exit the field from the first position in the field and no data is entered into the field.

Enter data to the end of the field or move the cursor to the start of the field and then use the Field -, Field +, or Field Exit key to blank all of the field.

KBD-0015 CHECK DIGIT ERROR

The number and the check digit you have just entered do not compare.

KBD-0016 FIELD MINUS KEY INVALID WITH THIS FIELD

You have pressed the Field - key, but the field you are in is not a signed numeric field.

KBD-0017 MANDATORY FILL FIELD—KEY USED INVALIDLY

You have pressed the Field -, Field +, or Field Exit key; however, the cursor is not in the first or last position of this mandatory fill field. A mandatory fill field must be completely filled unless you exit the field from the first position in the field and no data is entered into the field.

Enter data to the end of the field or move the cursor to the start of the field and then use the Field -, Field +, or Field Exit key to blank all of the field.

KBD-0018 INVALID KEY USED TO EXIT THIS FIELD

The cursor is in the last position of this field. You must use a nondata key (for example, the Field Exit key) to leave this field.

KBD-0019 DUP KEY NOT ALLOWED IN THIS FIELD

You have pressed the Dup key; however, the Dup key is not permitted in this field.

KBD-0020 ENTER KEY NOT ALLOWED IN THIS FIELD

You have pressed the Enter key; however, the Enter key is not permitted in this field. This is either a right adjust or a signed numeric field and you must exit the field before pressing Enter.

Continue by pressing the Field +, Field -, or the Field Exit key and then press the Enter key.

KBD-0021 MANDATORY ENTER FIELD—MUST ENTER DATA

The cursor is positioned in a mandatory enter field. A mandatory enter field must have data entered in the field before you can exit the field.

KBD-0022 STATUS OF FIELD NOT KNOWN

A system error has occurred. The status of the present field is not known. This error can occur when the Del or Ins key is pressed.

KBD-0027 KEY NOT DEFINED—KEY CANNOT BE USED

You pressed a key that is not used by this system.

KBD-0099 KEY NOT VALID AT THIS TIME

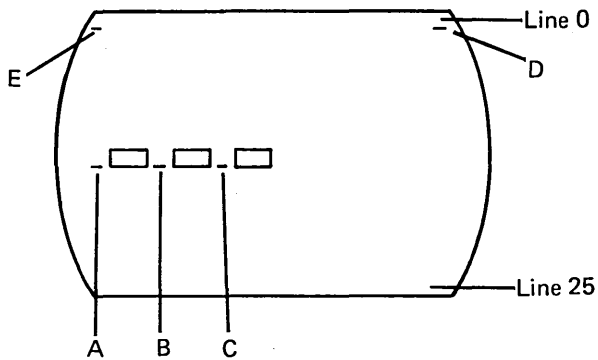
The key you pressed is not valid at this time. Either the program or utility would not recognize the key or you pressed a function key before pressing the Sys Req key.

Continue without using this key. If you have not yet used the system request functions, the Sys Req key is the only valid function key at this time.

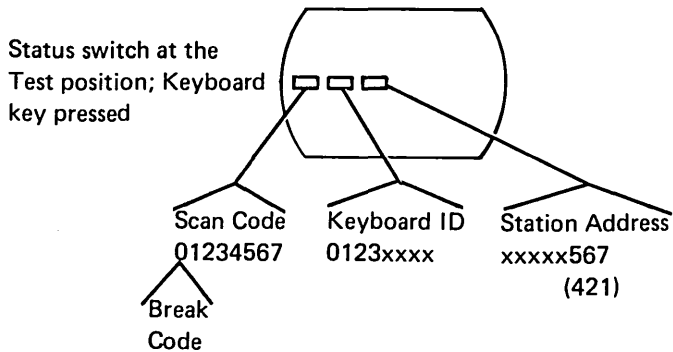
Note: When this error occurs, the display station is in free key operation. Free key operation is described in reference 205.

210 DIAGNOSTIC DISPLAY LOCATIONS

Cursor Display Positions



Power-On Diagnostic Display



211 (not used)

212 TROUBLESHOOTING AIDS

MiniMAPs provide you with three levels of information. These levels are:

1. A figure showing the circuit line names and pin numbers.
2. A description of the circuit and how it can be tested.
3. A detailed guide that uses the yes and no path of questions that you can follow to isolate the failures.

This procedure is used to give you as much information as possible about the failing circuit.

It is possible the symptoms could change or disappear during probing on an intermittent problem.

All the diagrams use the same format.

Conditions After Power-On

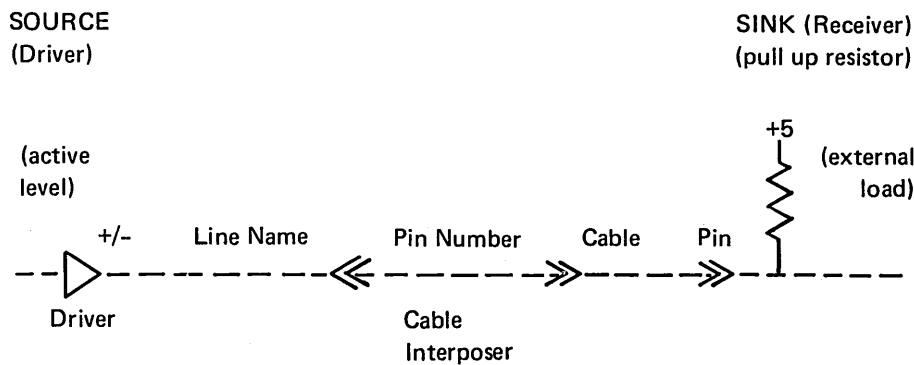
Describes the normal condition of the circuit after Power-On.

Service Aids

Lists suggestions as to how the circuit may be tested and additional information about the circuit.

Tools

Suggests which tool to use.



212 (continued)

- Use this general procedure for the normal condition and then for the conditions listed in the service aids.

Is the signal present at the SOURCE (driver)?

Y N

Is the line at a Down level?

Y N

- Replace the SOURCE (driver).

The line could be either grounded or logically driven to the Down level by the SOURCE.

- Check for a ground.

Is the line grounded?

Y N

- Replace the SOURCE (driver).

- Replace the FRU that caused the ground.

Note: A pull up resistor at the SINK (receiver) will cause an up level at the SINK (receiver) if the cable is open.

Is the signal present at the SINK (receiver)?

Y N

- Repair or replace the interposer or cable.

Is this the last signal line to be checked?

Y N

- Go through the same procedure for any other lines called out by the MAP.

- Replace the SINK (receiver).

Suggested action for an intermittent problem:

- Analyze the suspected line; inspect all the connector contacts.
- Replacement sequence:
 - FRU A
 - FRU B

Note: The FRUs are listed in the order they should be replaced considering repair time, failure rate, and parts cost.

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Preventive Maintenance

Preventive maintenance is not required on the display station.

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Tools and Test Equipment

Tools and test equipment needed to service the 5251 Display Station are:

1. CE general logic probe
2. Standard CE tool kit.

Tools the customer engineer normally uses are in this kit.

3. Metric tool kit

A kit of metric tools is available from Mechanicsburg by ordering bill of material 1749235.

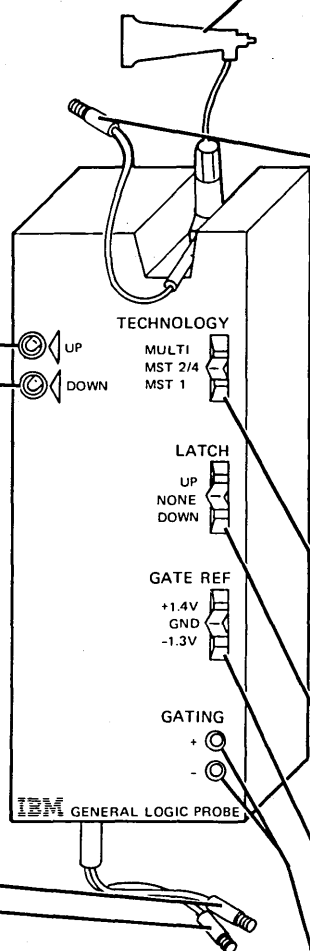
Note: In the display station, all metric screws are blue.

4. Fiber screwdriver

A Fiber screwdriver is required for adjusting the cathode-ray tube. This screwdriver is available by ordering part 460811.

CE General Logic Probe (Part 453212)

The universal logic probe provides a visual indication of a line level. (Refer to the handbook that comes with probe.)



Test Terminal

The line being probed is connected to this terminal.

Note: In order to avoid improper indications, lead should not be placed near the high voltage transformer or the neck of the cathode-ray tube (150).

Ground Lead

CAUTION

Connect this lead to any signal ground near the probe point. Do not use frame ground.

Indicator Lights

Up indicates a positive level (+).
Down indicates a negative level (-).

A pulsing line is indicated by both lights being on.

Improper indications result if this lead is not connected to signal ground.

Note: In order to avoid improper indications, lead should not be placed near the high voltage transformer or the neck of the cathode-ray tube (150).

Power Leads

+Red
-Black

Logic Selector (TECHNOLOGY)

Selects the type of logic to be probed. Use the Multi setting for the display station.

CAUTION

Improper connection of the power leads might cause the probe to malfunction.

Latch Switch

The Up position allows latching the Up light on a positive pulse. The Down position allows latching the Down light on a negative pulse. The None position resets the lights and prevents any latching action. The None position is used for most probing in the display station.

(For the following connection locations, see 103.)
Connect the black (-) lead to 1-G-D08 (ground).
Connect the other (+) lead to 1-G-D03.

Gate Ref Volts Switch

Set the Gate Ref Switch to ground (GND).

A voltage difference of 4V to 12V is needed to power the probe. The black lead is always the most negative.

Gating Terminals

Not required for probing in the display station.

Introduction

The IBM 5251 Model 11 Display Station is a tabletop, online work station for data entry or interactive display functions. The display station contains a display screen for displaying data, a keyboard for data entry, a control unit that contains storage, and a cable adapter for communication with a controller.

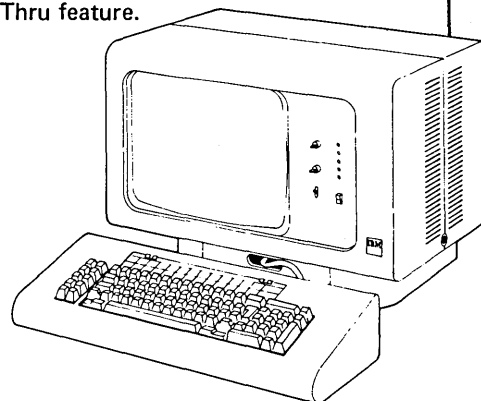
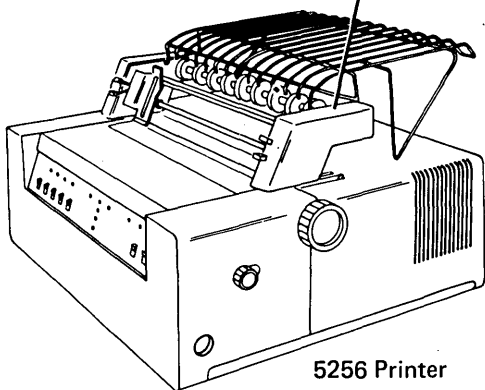
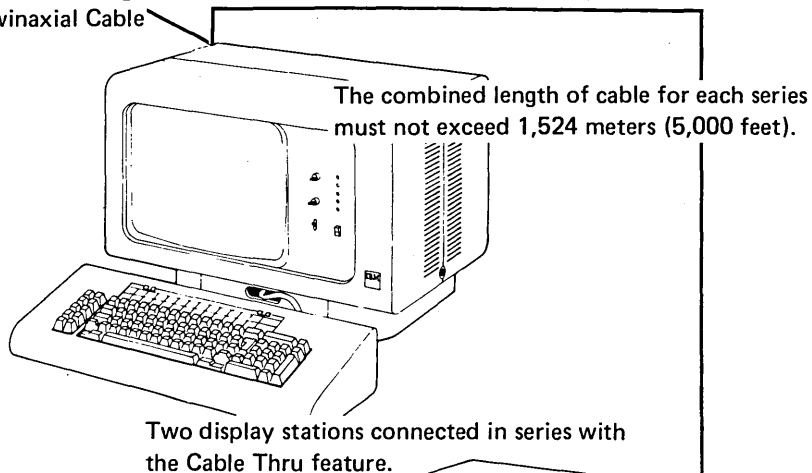
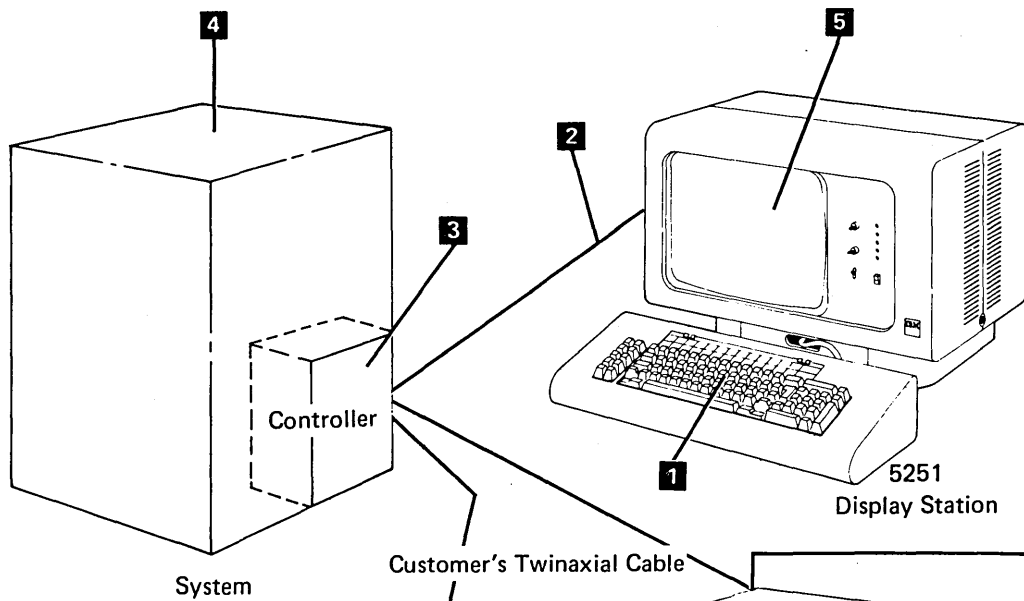
SYSTEM CONFIGURATION

The following figure shows a configuration of a 5251 Model 11 Display Station attached to a controller at a system location. The number of display stations attached to this system is specified during system configuration for the customer's application. Display stations and printers can be attached in a point-to-point configuration, or can be attached in a series configuration by means of a Cable Thru feature on each work station in the configuration.

Display stations rely on a controller and a system. Data entered at the keyboard **1** is moved into the microprocessing unit, to the cable adapter, and serially shifted on the system cable to the controller **2**. The controller receives the data, translates it **3** or sends it on to the system **4**. The data is then returned to the display station to be displayed **5**.

Data Flow

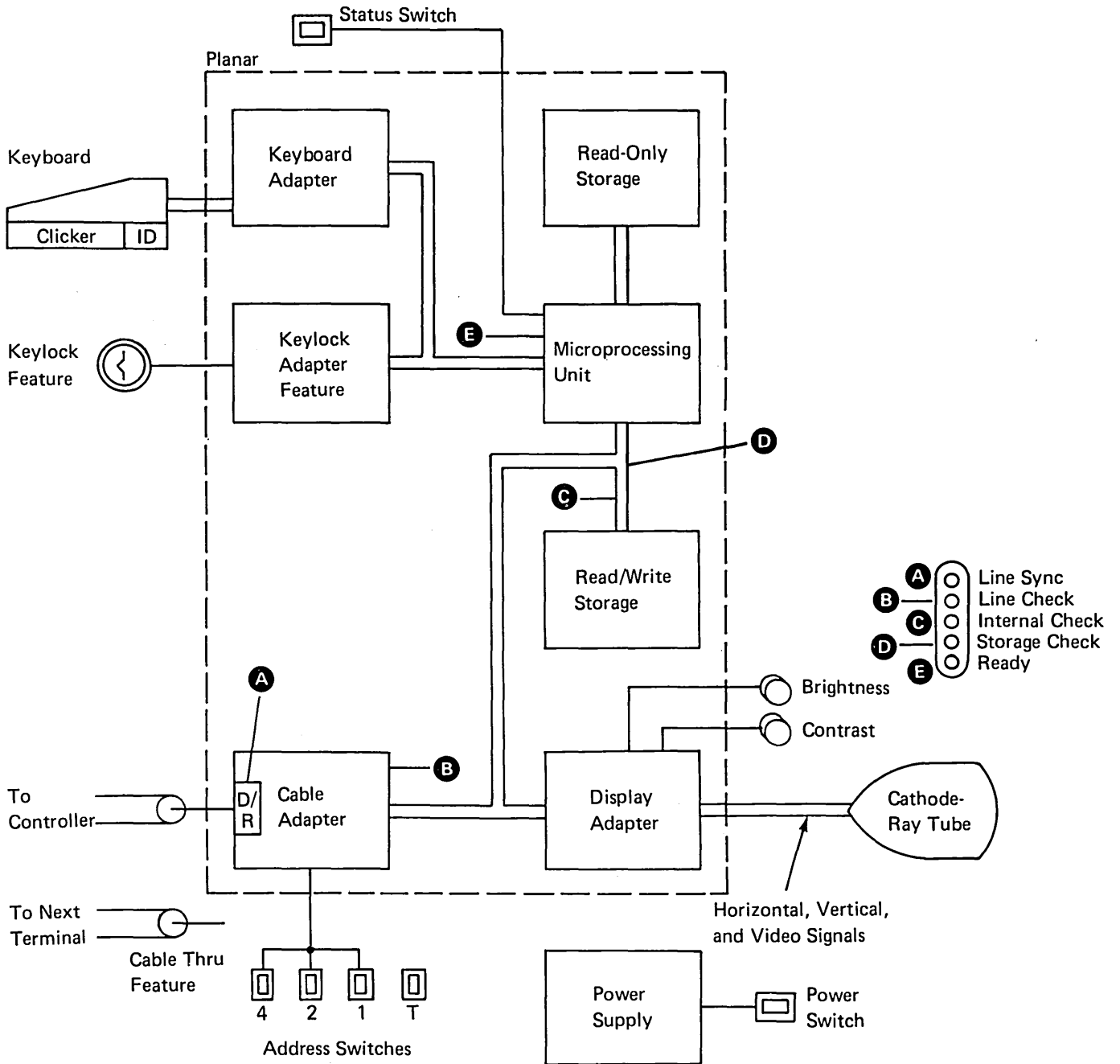
- 1** Data is entered at the keyboard.
- 2** Data is transferred to the controller.
- 3** Data is interpreted by the controller.
- 4** Data can be used by the system.
- 5** Data is returned to the 5251 for displaying.



DATA FLOW

The next figure shows the data flow of the display station. The following pages of this section describe functions in each of the major sections of the display station.

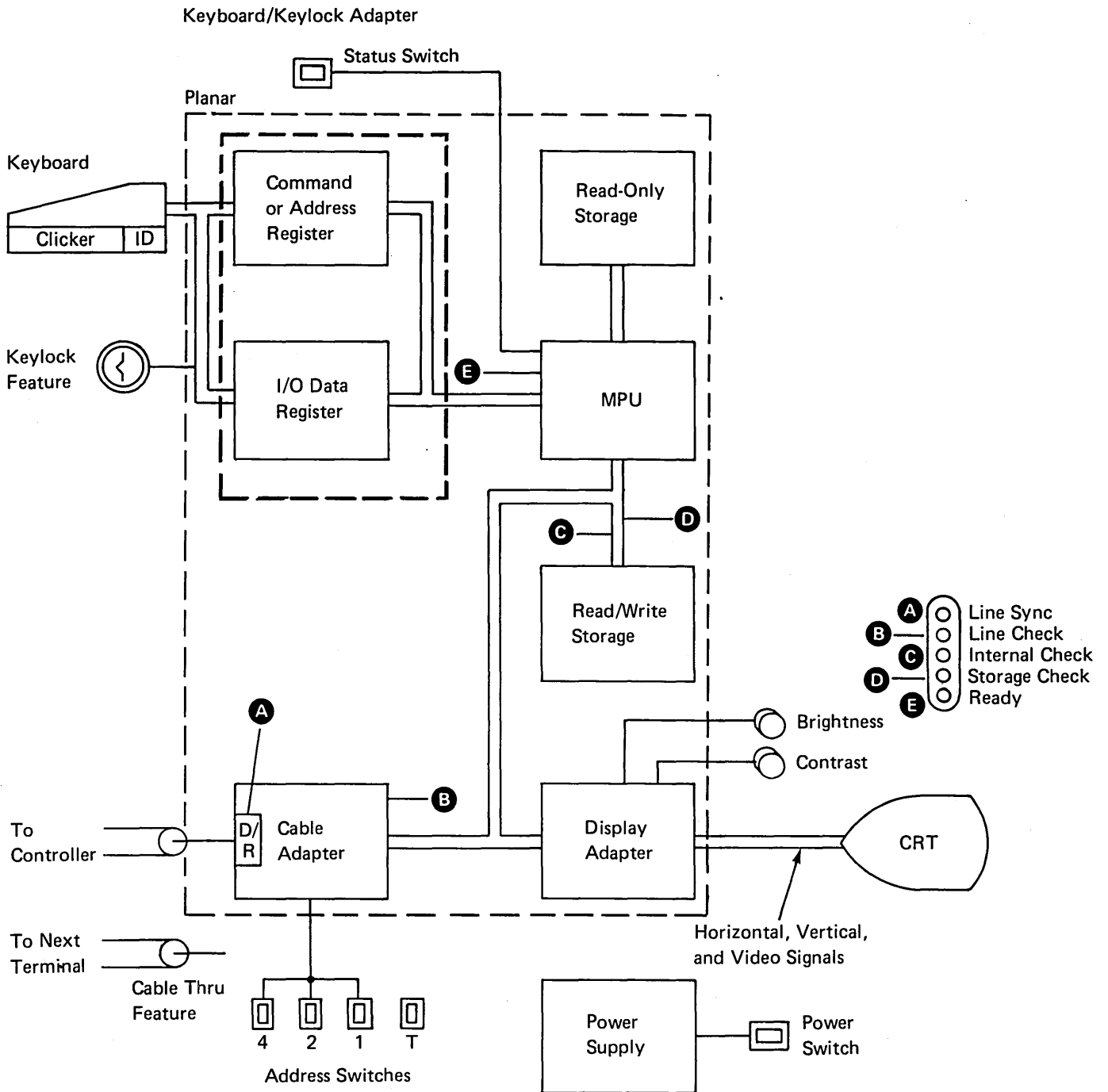
All the electronic logic of this display station is contained on a main planar board.



FUNCTIONAL UNITS

KEYBOARD AND KEYLOCK ADAPTER CONTROL

The keyboard and keylock adapter control is a group of registers controlling the interface and address functions of the I/O devices. These registers are controlled by the microprocessing unit (MPU) and loaded with data from the I/O devices. The data is then moved to the read/write storage by the MPU.



Keyboard

The keyboard has three major parts; key modules, pad printed circuit board, and logic printed circuit board. Key modules, including the keytops, are the physical switches the operator presses. A pad printed circuit board below the key modules senses the pressed key by capacitive coupling. The logic printed circuit board, attached to the pad printed circuit board, contains the scan counter that converts the pressed key to a scan code. The scan code is loaded into an eight position buffer on the logic printed circuit board, while the keyboard signals the keyboard adapter control that a keystroke is available to send. This interface is by a strobe pulse, that moves the keystroke scan code to the keyboard adapter.

The scan code moves through the display station, to the controller. The controller interprets and converts the scan code to the character comparable to the type of keyboard. The keyboard identification specifies how the scan code is interpreted.

Typamatic keys reload the character buffer with a scan code for each scan code cycle. The typamatic key operation is at a rate of 10 to 15 repeated operations per second (600 ms first cycle time).

The Shift and Shiftlock keys generate a break code pulse. The break code indicates a change in shift status to the controller.

Clicker

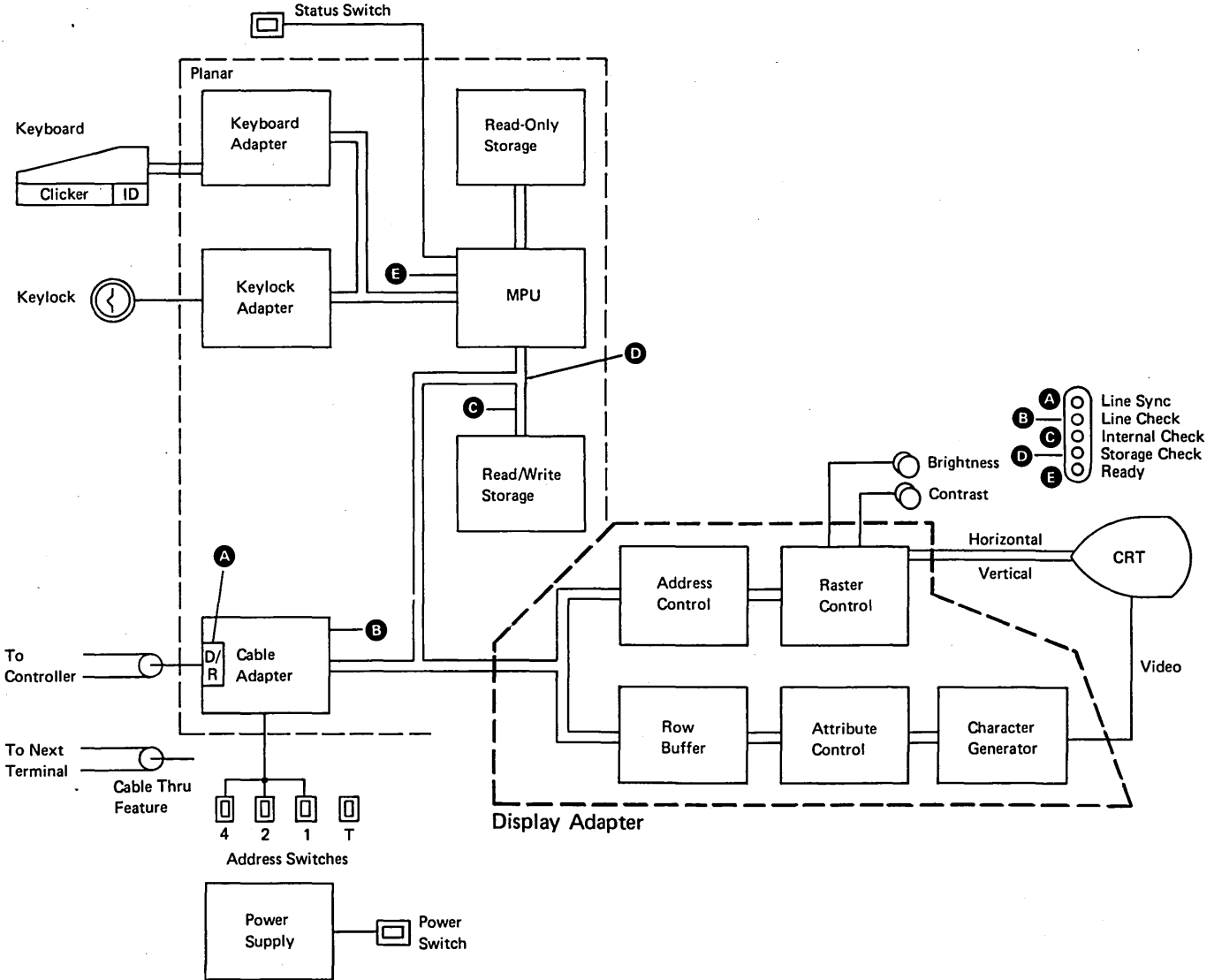
A solenoid attached to the keyboard is activated after data is sent from the logic printed circuit board and is stored by the MPU. The sound of the solenoid is an aid to the operator because it indicates that the next key may be pressed. Also, an alarm function can be performed by this solenoid when the keyboard adapter pulses the solenoid, with a series of pulses.

Keyboard Identification

A four-bit ID code is sent to the controller on request. The ID code identifies the keyboard to the controller. The ID code is physically wired with jumpers on a plug board at the keyboard logic printed circuit board.

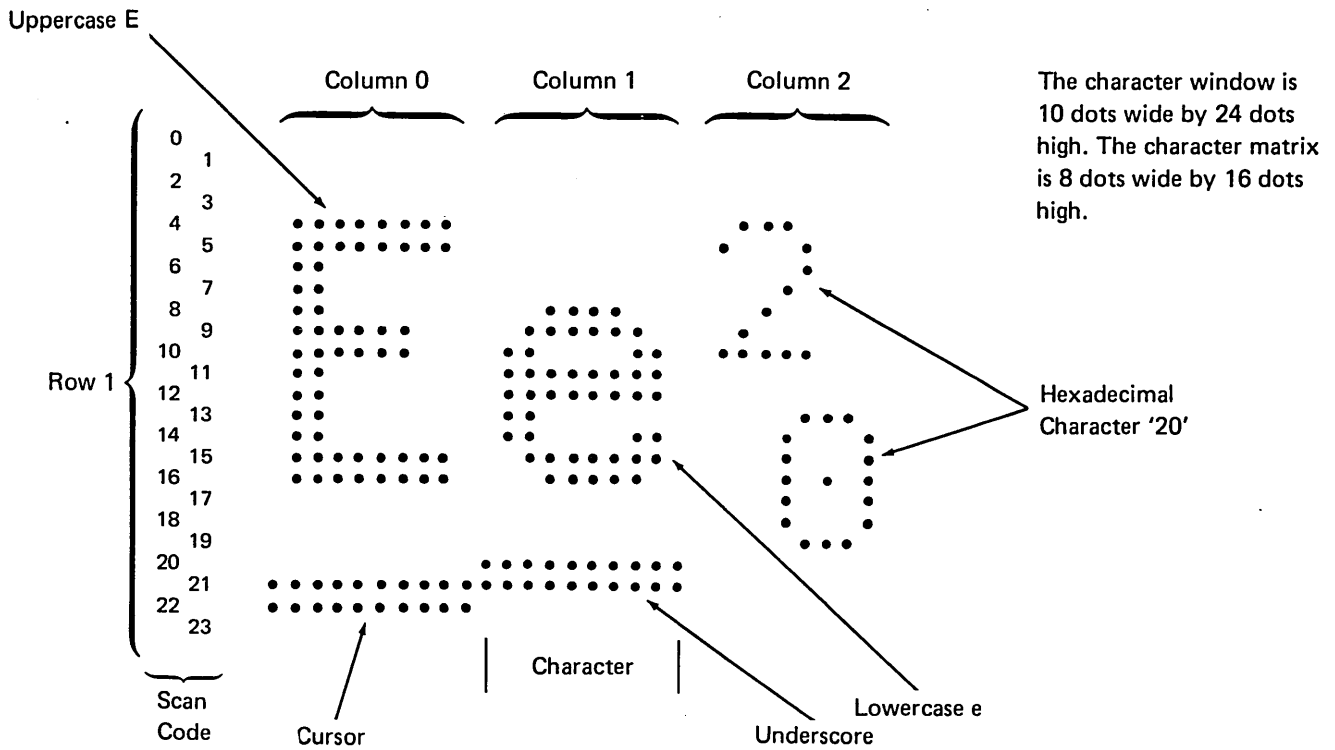
DISPLAY ADAPTER

The display adapter contains the circuits that control the video, horizontal, and vertical drive signals for the display assembly.



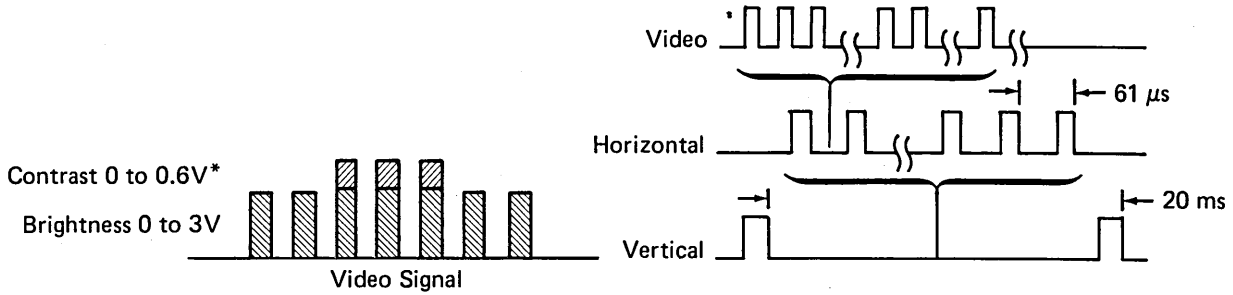
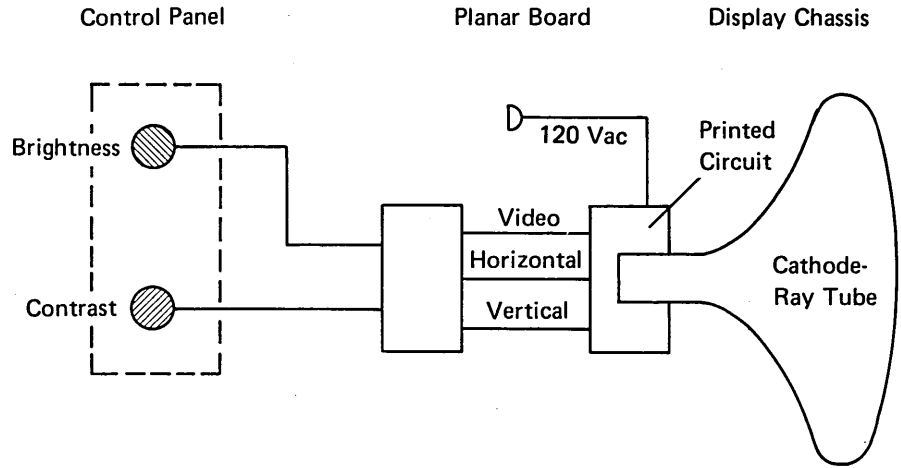
Buffering and Displaying

Data to be displayed is in read/write storage. The display adapter addresses the read/write storage area for this data, moves it to one of the two row buffers in the display adapter, converts the data into a dot pattern by a character generator, and shifts it into the video signal line to the cathode-ray tube. At the same time, the display adapter is determining the display position, converting the position into the vertical and horizontal drive signals for the cathode-ray tube. This routine is constantly repeated to refresh the display. The generated character matrix is a pattern of 16 scans by 8 dots wide.



CONTROL PANEL

The control panel has two display controls. The Brightness control determines the light difference between the displayed data and the remainder of the display screen. The Contrast control determines the brightness of the field intensified by the intensity field attribute. Both controls determine the voltage level of the video signal at the main planar.



*0 to 0.6V is added to the Brightness level voltage.

DISPLAY SCREEN

Field Attributes

Field attributes control how data in that field will be displayed on the display screen. They control display blinking, intensity, underscoring, column separation, reverse image, and no display. The application program controls field attributes. After power on, field attributes will default to normal intensity, no blinking, no underscoring, no column separators, and no reverse image when the screen is refreshed. Field attributes occupy one character space position and it is the first character of the field.

Display Screen Indicators

These indicators appear on the display screen. A bright square indicates the *on* condition and a dash indicates the *off* condition. The controller controls the indicators, except the System Available indicator. Power-on resets all indicators.

The display screen indicators, when on, indicate the following:

- System Available – indicates that the display station has received a poll or a command. This indicator will turn off if the display station does not receive a poll or command for 200 ms.
- Message Waiting – indicates that a message is waiting for the operator.
- Keyboard Shift – indicates that the display station is in upper (numeric) keyboard shift.
- Insert Mode – indicates that the key has started an operation.
- Input Inhibited – indicates that the system cannot process a keyboard scan code.

A cursor, controlled by the MPU or controller, indicates a position on the display surface, usually where the next keyboard character will be displayed.

CABLE ADAPTER

The cable adapter is the hardware (drivers, receivers, and logic) on the planar board that handles the incoming and outgoing communications between the controller and the display station.

Note: A twinaxial cable connects the display station to the controller. See the *Customer Twinaxial Cable* section in the maintenance section of this manual, and the Cable Thru description in the *Features* section.

The 16-Bit Frame

Frame Concept

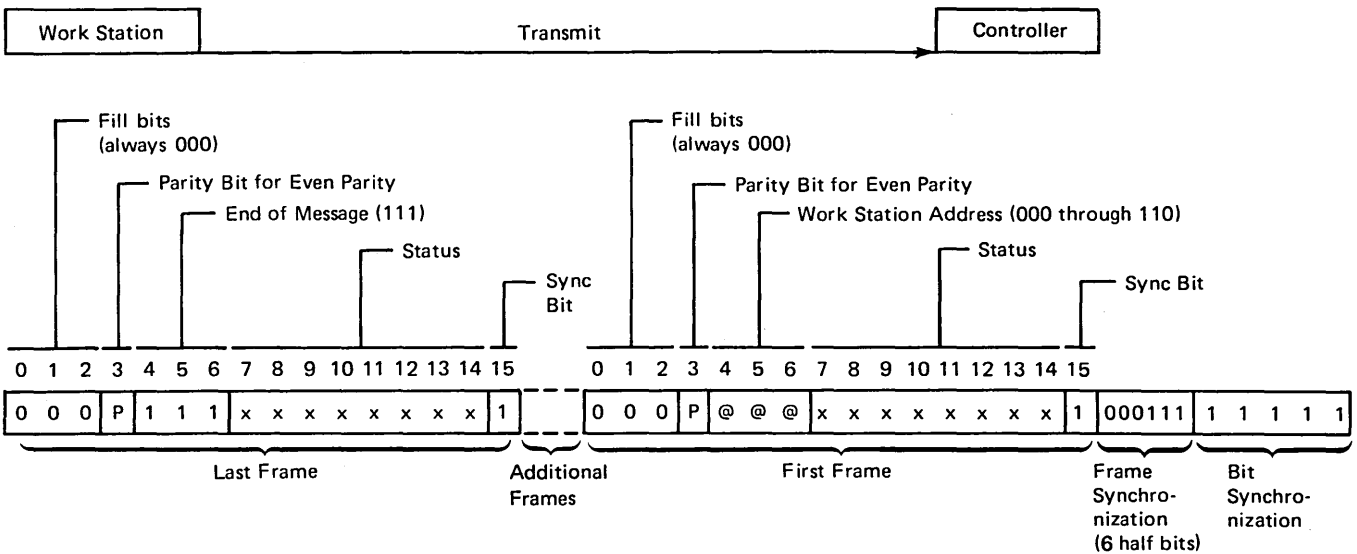
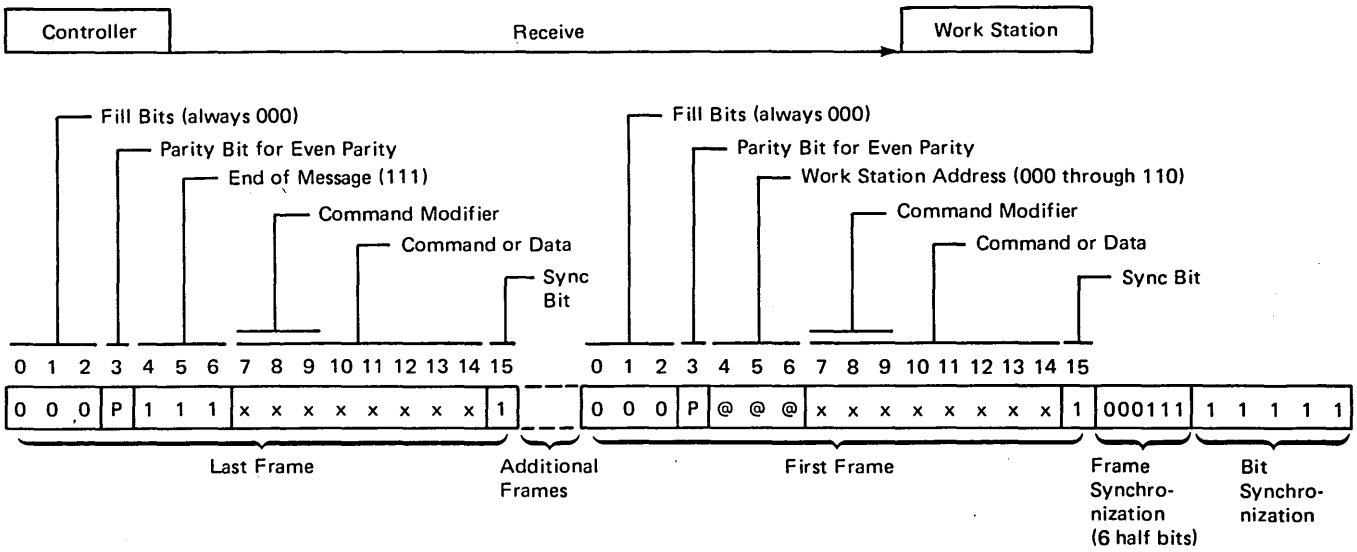
Communications between the controller and the cable adapter at the display station are carried by 16-bit frames that are sent to and from the controller on an as-required basis. The cable carries no signal between frames.

To understand what is to follow, it is necessary to explain briefly the phase encoding used for sending data on the system cable. The data is phase encoded so that a transition occurs during each bit time (a 0 to 1 transition for a 0 and a 1 to 0 transition for a 1). Because the transition divides the bit into 2 parts, the term *half* bit will be used in the explanation that follows. (The data sent on the system cable is a 4 level signal. Refer to the system documentation for a further explanation of the phase encoding process.)

When information is to be sent on the cable, a group of five 1 bits (10101010 half bits) is sent to establish bit synchronization. Immediately after the 1 bits, a group of 3 half bit 1's and 3 half bit 0's is sent to establish frame synchronization. After the frame synchronization half bits, the frame is sent, starting with the sync bit.

The transmission rate is 1.0 MHz (16 microseconds per frame). The frame bit assignment during transmit and receive is shown in the following diagram:

Transmission Sequences



The 16-bit frame carries 13 bits of information in each direction. The fill bits, always 000, serve as a timing delay. The parity bit makes the active bits in the frame even. The display station decodes the address bits and responds to a specific address. The display station sends a response frame that contains the display station address. A display station address of 111 indicates an end of message and causes a line turnaround. At the

work station, line turnaround extends from the time the last bit of a frame (bit 0) is received until the same work station starts sending bit and frame synchronization patterns. Bits 7 through 14 are the data or commands used throughout the display station and storage. Bit 15 (always on) is the synchronization bit for both the controller and the display station.

Commands

Note: The binary number in parentheses next to the command is the bits 10 through 14 of the command frame.

Clear (10010): clears the addressed feature or display station starting at the present value of the address counter to the present value of the reference counter.

EOQ (00010): designates the end of the command queue. Bits 8 and 9 of the command frame must be on (1). Only polls will be accepted until a not-busy status is returned to the controller in response to a poll.

Insert Character (00011): is followed by one data frame containing a character to be inserted at the address counter location.

Load Address Counter (10101): is followed by two data words and causes bits 7 through 14 of the data words to be written in the address counter.

Load Cursor Register (10111): is similar to the load address counter command for the cursor register.

Load Reference Counter (00111): is followed by two data words and loads the reference counter similarly to the load address counter command.

Move Data (00110): moves data between limits set by the value of the address counter and the value of the cursor register.

Poll (10000): is sent from the controller to the display station and starts the transmission of one or two status words per poll. The poll command acknowledges and resets a line parity error from the display station. It also acknowledges the receiving of the last status transmission by the display station.

Read Activate or Write Activate (Read activate = 00000; write activate = 00001): is inserted between a Read or Write command and the data frames that follow. Either is the command that starts the data transmission of any of the read or write commands.

Read Between Limits¹ (11010): causes data to be returned from an area in read/write storage within the limits of the address counter register and the reference counter register.

Read Data¹ (01000): starts the transmission of one byte of data from the display station to the controller.

Read Registers¹ (11100): starts the transmission of six data words containing the contents of the three control registers.

Read to End of Line¹ (01010): requests a response from the display station with one display line of data from the read/write storage.

Reset (00010): resetting can be selected by a specific address feature or by sending the display station address for a complete station reset. Attributes are set to normal, the cursor is moved to the upper left corner.

Search Next Attribute (00100): causes the display station to search the read/write storage for the next attribute.

Search Next Null (10100): causes the display station to search the read/write storage for the next null.

Set Mode (10011): causes the display station to receive one word that is specified as a mode control. This command must be sent before the 5251 makes any multiframe response.

Write Control Data (00101): controls the display screen during error conditions, conditionally resets the exception status, controls the keyboard clicker during input inhibit, and controls the audible alarm.

Write Data and Load Cursor (10001): is followed by 1 to 14 data frames. The cursor register is updated to the new value in the address counter.

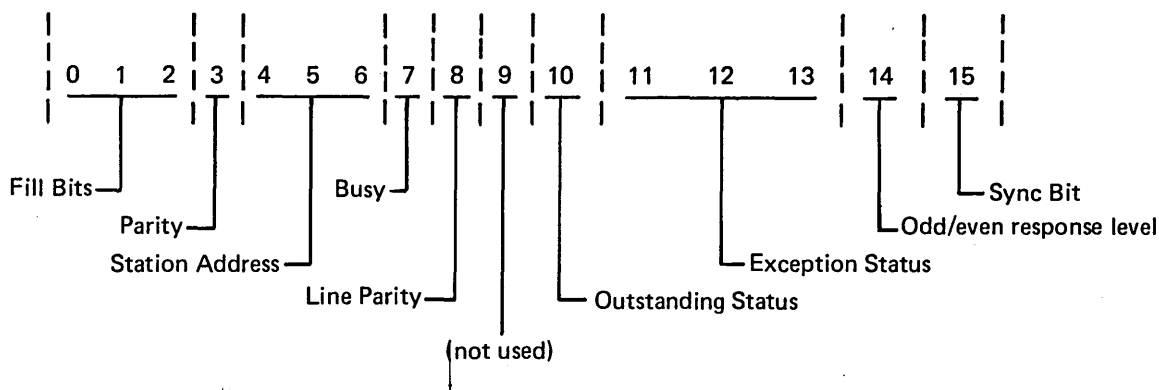
Write Immediate Data¹ (11101): causes the display station to store all the data the controller sends. If the storage area is exceeded, a storage overrun error occurs.

¹Commands that must be followed by either a read activate or write activate command.

Response Frame

A response frame is returned to the controller after the display station is polled following a power-on reset. The controller receives the first response frame and returns a set mode command.

A two-frame response is made to every poll command after the set mode command. The second frame contains a station address of all 1's (indicating the last message frame) and the scan code in bits 7 through 14. The first frame in the response contains the status information as follows:



Bit 7

- 0 = Display station not busy
- 1 = Display station busy

Bit 8

- 0 = No line parity error found
- 1 = Line parity error found

Bit 10

Indicates there is feature data or status from an I/O device to send to the controller.

Bits 11, 12, and 13

These three bits are encoded to indicate the exception status as follows:

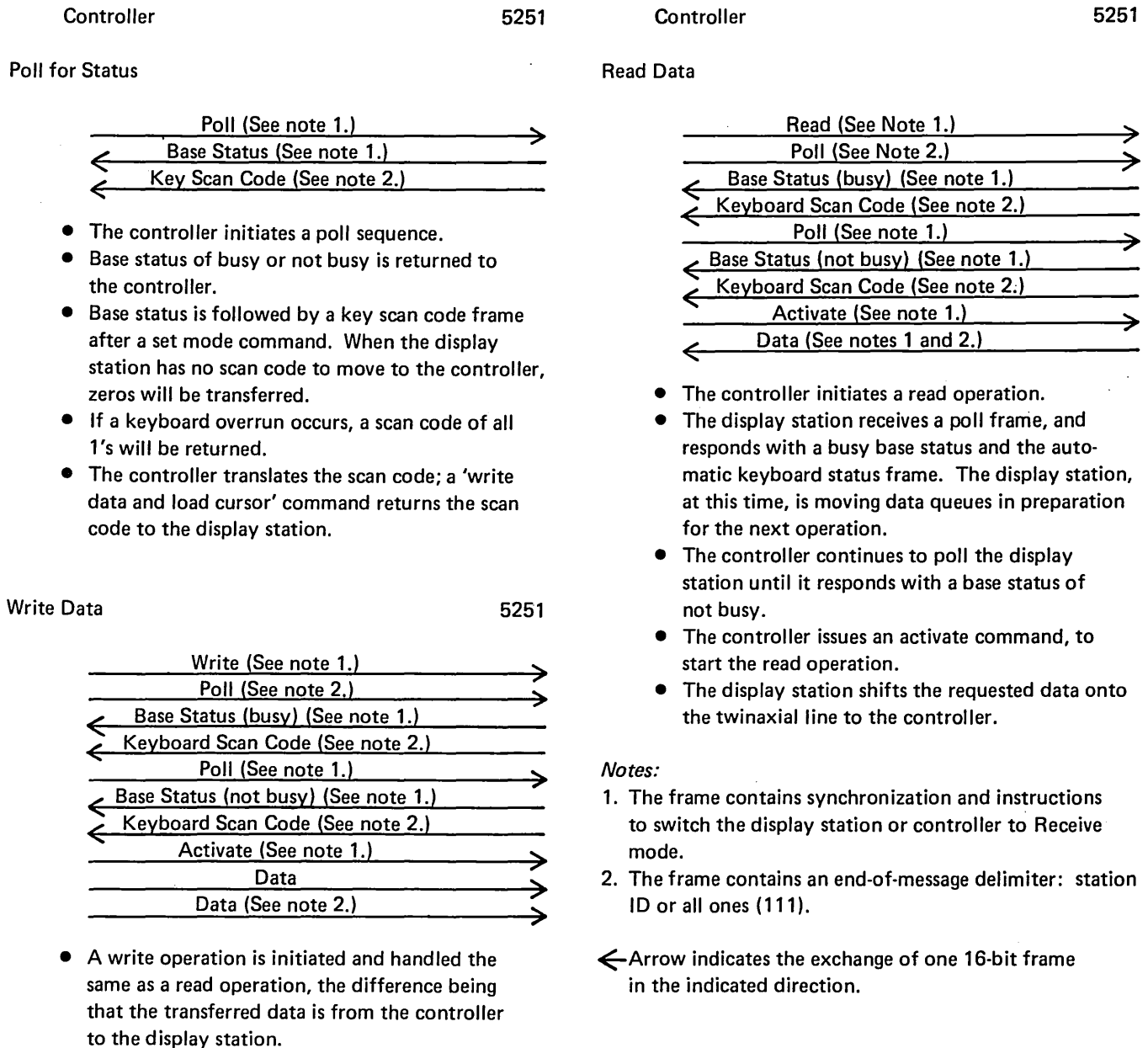
Bit	11	12	13	Description
	0	0	0	No exception status
	0	0	1	Null or attribute error
	0	1	0	Activate not valid
	1	0	0	Command or device ID not valid
	1	0	1	Input queue or storage overrun
	1	1	0	Register value not valid
	1	1	1	Power on transition

Bit 14

By analyzing bit 14, the controller can determine if the information in the response frame received is the same as the previous response frame, or if the information has changed. Bit 14 is set to zero (0) after power on. Any change in the response frame changes bit 14 from its previous condition.

Interface

The following figure shows action and synchronization between a display station and controller. All exchanges are started from the controller by a command. The flow is in two directions, one direction at a time.



Data Transfer

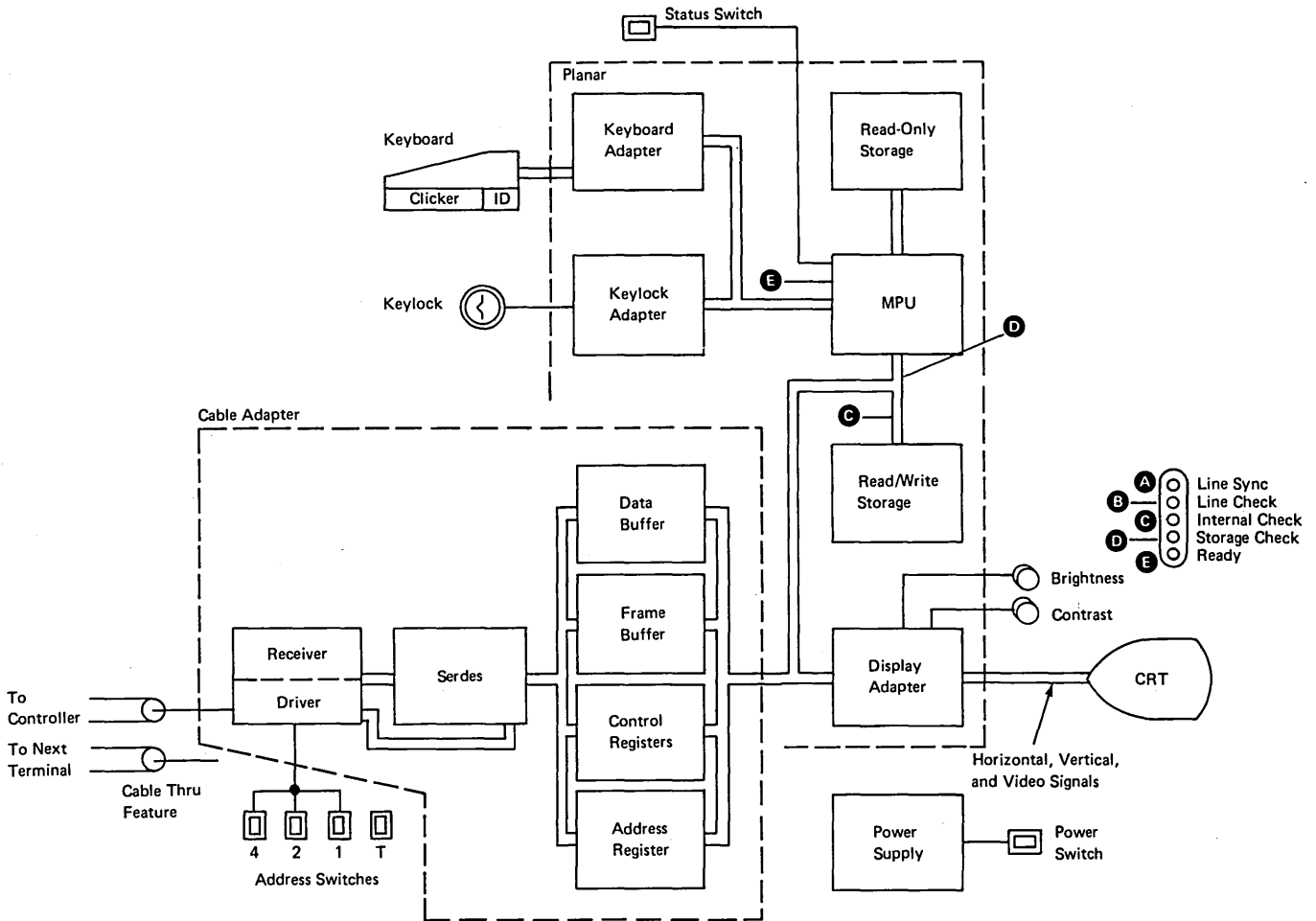
During data transfer, the cable adapter has three major functions:

1. To respond to polling.
2. To shift data to the customer twinaxial cable for transmission to the controller.
3. To receive data from the cable and decode the data for either or both of the following:
 - Commands
 - Transferring data to read/write storage

The cable adapter finds the display station address on the first frame of a message transmitted. The address for a single online display station is 000. As this address is received and recognized, and a response is returned, polling is complete.

Data to be transmitted to the controller is moved from read/write storage, through a serializer/deserializer (serdes) register, and to the customer twinaxial cable under control of the cable adapter.

Received data is moved into the serdes until the sync bit is in the high-order position. The serdes is stopped, permitting time for the data to be moved to read/write storage.



MICROPROCESSING UNIT (MPU)

The MPU (microprocessing unit) is the control center of the display station. The MPU receives data from the keyboard and from input/output controls. The MPU controls the displaying of data, and the flow of information to and from the controller. It is a processing unit that is microprogram controlled and performs internal machine operations such as testing and comparing data, checking for machine errors, operating the I/O devices, and storing and getting data from the read/write storage.

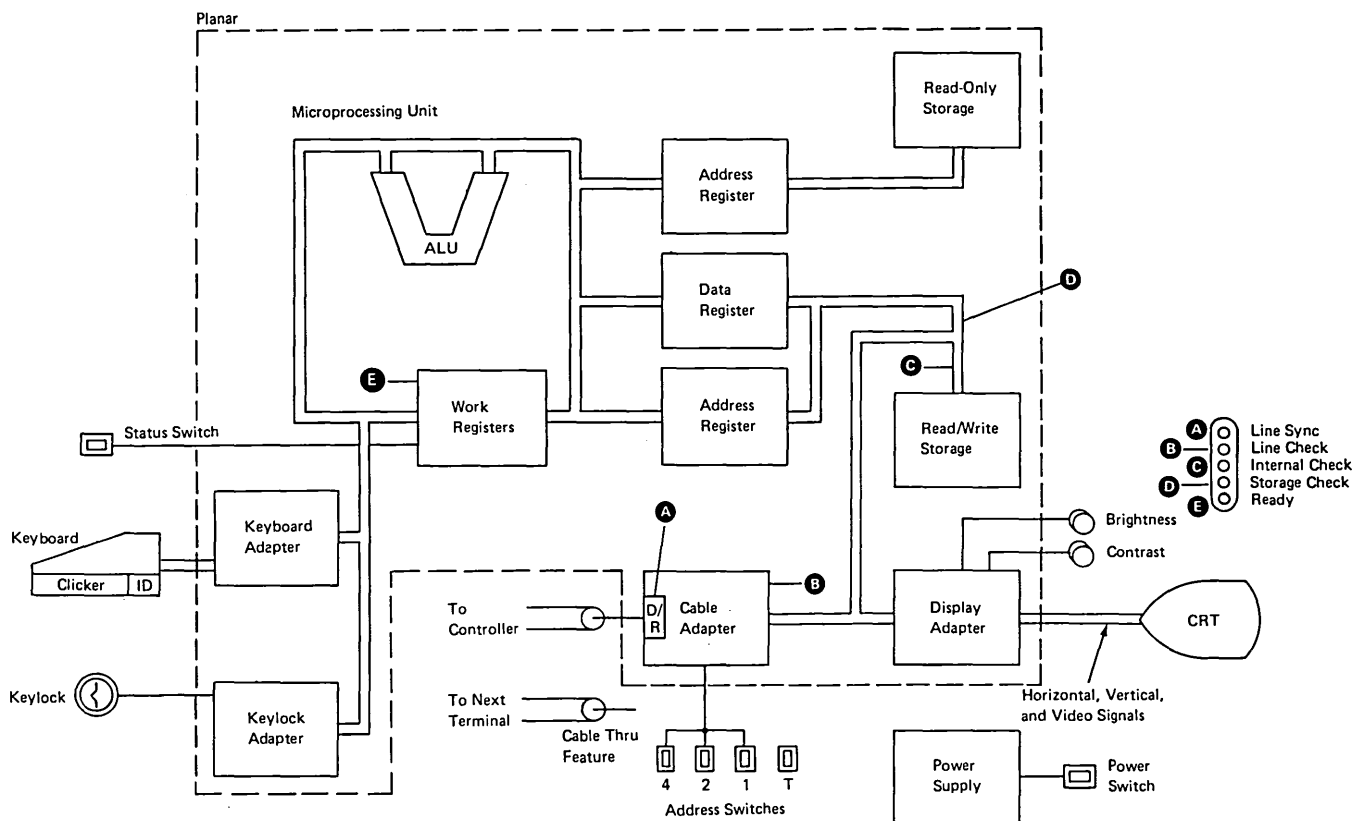
The major parts of the MPU are read/write and read-only storage, storage registers, work registers, and an arithmetic and logic unit (ALU).

Read/Write Storage

Read/write storage is divided into two major parts: a display regen area and an I/O device control area. The I/O device control area is also divided into parts for display control, cable adapter control, and microprocessing unit work space.

Internal Processing Queue

Each display station keeps a work area large enough to hold up to 16 frames of commands or associated data. Commands and associated data are executed from this queue on a first-in, first-out method.



Control Registers

Each display station contains three registers that the controller can access. Each register is an address pointer. The registers are named the cursor, address counter, and the reference counter.

The 'cursor' register controls the location of the cursor on the display screen. The 'address counter' register is used in reading data from, as well as writing data. The 'reference counter' register is used for moving data from one display area to another.

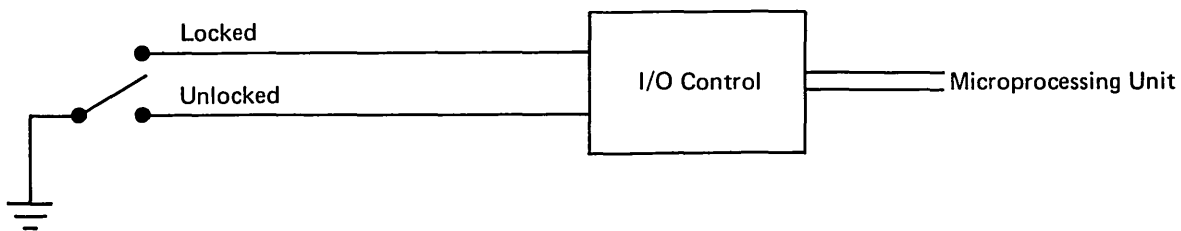
KEYLOCK

A Keylock feature is available on the display station for security of data.

When the keylock is in the locked position with the Status switch at the Normal position, the display screen is blank except for the system indicators on the right side of the screen. Data displayed at the time the keylock is changed to the locked position is controlled by the application program. Keyboard data entered while the keylock is in the locked position will not be displayed by the display station.

The Keylock feature can be in either the locked or unlocked position and the power-on diagnostic still functions the same.

Keylock

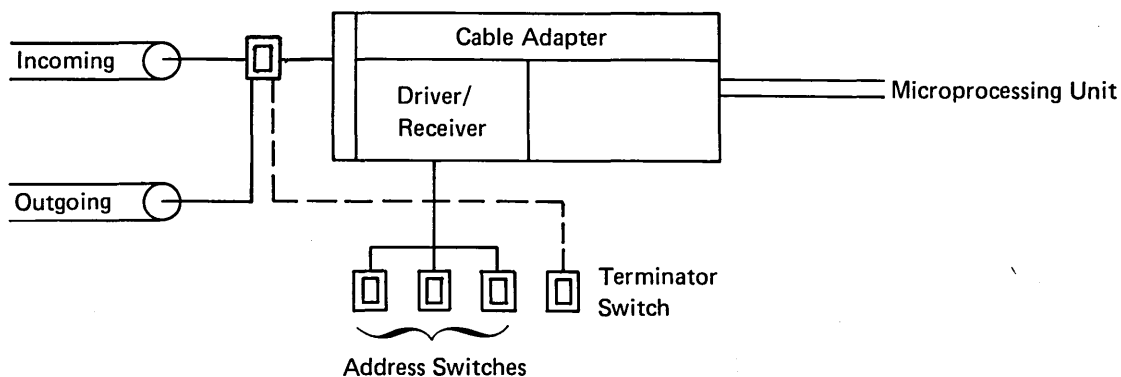


CABLE THRU

If more than one work station (either a display station or a printer) is connected in series on the customer twinaxial cable, this feature must be installed on each of those work stations to supply connectors for the customer twinaxial cable to the next work station in the series. This feature also has four switches. Three switches permit a unique address for the work station. The fourth switch permits termination for the work station when this is the last station in the series. A maximum of seven work stations can be connected in this series. Addresses range from 000 to 110. The last work station in a series does not require the Cable Thru feature. (The basic machine has a built-in termination and requires a station address of 000.)

See the *Customer Twinaxial Cable* section in the maintenance section of this manual.

Note: Do not leave the twinaxial cable disconnected when servicing the display station with the Cable Thru feature. When this cable is disconnected, other devices are taken offline. Quick-disconnect adaptor (IBM part 7362230 or Amphenol part 82-5588 or equivalent) can be used to connect the twinaxial incoming and outgoing cables bypassing the display station.



Address	Switch
0	000
1	001
2	010
3	011
4	100
5	101
6	110
7	Invalid

0 = Off, 1 = On

Appendix A. Display Station Setup Instructions

The display station is shipped from the factory fully tested and adjusted. If the display station is still in the shipping container, follow the unpacking instructions fastened to the outside of the container.

This setup procedure should be used after the display station is unpacked and located where it is to be used or whenever it is disconnected and relocated.

DANGER

The display station has a weight of approximately 34 kilograms (75 pounds). **NEVER LIFT IT BY YOURSELF.**

If the display station has the Keylock feature, a small envelope containing 2 keys is taped to the machine. Place the keys in a safe place; you will need one of them later in these setup instructions.

Before you start the setup instructions, ensure that a grounded power outlet is available; US 115 Vac; for World Trade, see the installation planning representative.

If problems occur during these instructions, go to the *Start of Call MAP*.

The setup instructions are written in two sections:

- Section 1 can be completed without connecting the display station to the system.
- Section 2 describes how to connect the display station to the system.

Setup Instructions - Section 1

1. Remove the front access panel cover.
2. Plug the keyboard cable into the keyboard cable connector.
3. Verify that the Power switch is in the Off position.
4. Verify that the Status switch is in the Normal position.
5. Plug the power cord into the grounded power outlet.
6. If the display station has the Keylock feature, insert the key and turn it clockwise to the Unlock position.
7. Set the Power switch to the On position and turn the Brightness control full clockwise.
8. When the display station warms up (about 20 to 30 seconds), slowly turn the Brightness control counterclockwise to a comfortable brightness.

The following conditions indicate that the display station is working properly:

- The cursor is in the upper right corner.
- A dash line is on the display screen to the left of all display screen indicator labels.
- The Ready light is on and all other lights are off.

Setup Instructions - Section 2

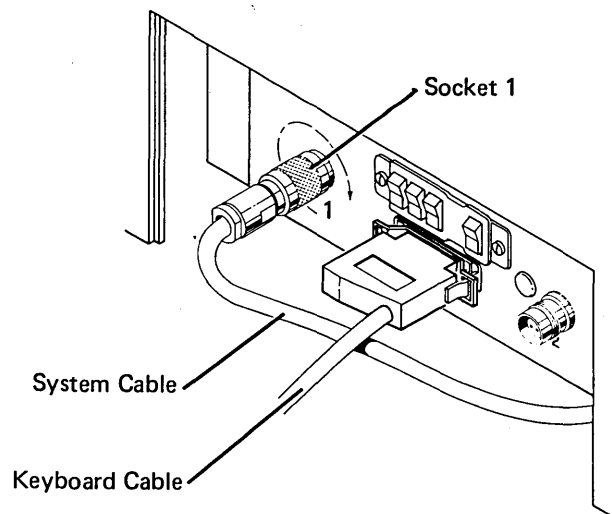
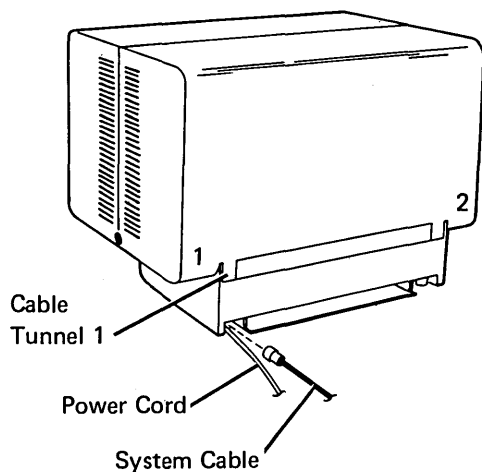
Before you start connecting the display station to the system, ensure that the following is complete:

- The system operator knows that you are going to connect the display station to the system.
- The system cable (with a proper connector) is installed and ready to use.
- The system cable is connected to the system.
- If the display station is to be connected to a preceding display station or printer (Cable Thru feature) the Terminator switch on the preceding work station must be set to position 2 (171).

9. Set the Power switch to the Off position.

10. To connect the system cable:

- a. Insert the system cable into the cable tunnel 1 opening on the back of the machine, then push the cable into the opening until the cable connector appears at the front.
- b. From the front, hold the cable connector and pull enough cable out of the cable tunnel to reach across the keyboard cable to socket 1.



Connect the system cable to the socket 1 connector.

If your display station has the Cable Thru feature go to step 11. If not, go to step 12.

- Contact the system console operator for the address of this display station. Set the Address switches and the Terminator switch.

Use this table to determine the setting of the three Address switches:

If the address is:	↓	Address Switch Settings
		⏟
0	=	
1	=	
2	=	
3	=	
4	=	
5	=	
6	=	
7	=	Invalid

Set the Terminator switch to position 1:

- 2
1 Position 1 stops the communications signal and completes the electrical circuit. Position 1 is the required position when the display station is the last workstation on the line.
- 2
1 Position 2 allows communications signals to flow through the display station to the next workstation.

- Replace the front access panel cover.
- Set the Power switch to the On position.

The following conditions indicate that the display station is working with the controller:

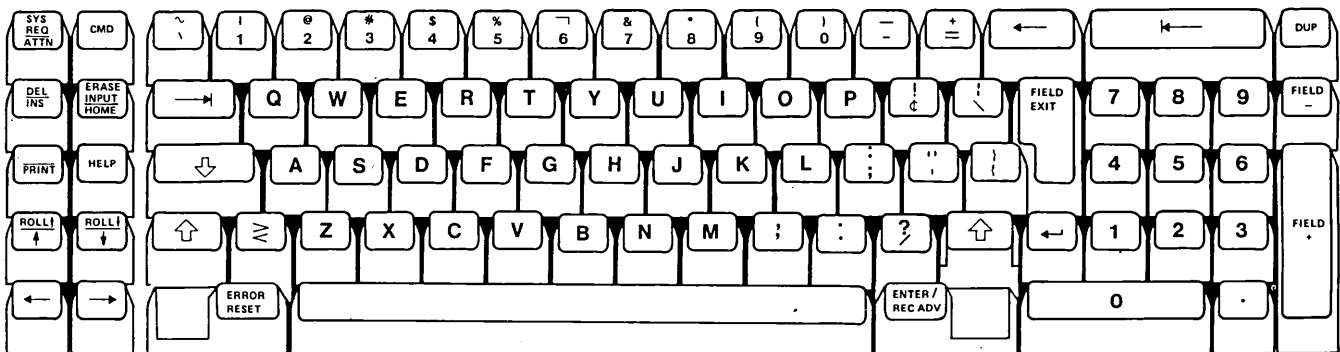
- The cursor is in the upper left corner.
- The System Available indicator is on.
- The Line Sync light is on.
- The Ready light is on.
- The three check lights are off.

If the display station has the condition as described in step 8, the system may not be powered up, running, or functioning properly, or your display station may not be in session.

- Press any numeric or alphabetic keys and listen for the clicker sound as each key is pressed. Observe the cursor move as each character is displayed.
- If the keylock feature is installed on the display station, give both keys to the customer.
- Setup is complete.

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Appendix B. Keyboard Functions



US keyboard as shown. World Trade keyboard will be different, but the functions will be similar.

System Request/Attention Key



The upper shift function of the Sys Req/Attn key is used for signing onto the system.

The lower shift function of the Sys Req/Attn key sends an attention command to the system.

An attention command can:

- Temporarily stop the present display station activity and allow selection of a new activity.
- Notify the system that the display station is ready to select a new program or activity.
- Request that the keyboard be unlocked (after normal error recovery action has failed) so that data entry can continue.

Command Key



Pressing the Cmd key directs the system to disregard the normal function of the top row of keys and instead perform the function assigned to that key in the program. A keyboard template indicates to the operator the command functions assigned to the top row of keys.

Delete/Insert Key



The upper shift function of this key is used to delete data from the display screen. When the Delete key is pressed, the character above the cursor is deleted and all characters to the right of the cursor (in the same field) are shifted to the left one position.

The lower shift function of this key allows a character or characters to be inserted into an existing input field on the screen without destroying data already there. New characters are inserted at the cursor position and the data above and to the right of the cursor is shifted to the right one position for each character inserted. The cursor also shifts to the right one position.

Erase Input/Home Key



The upper shift function of this key erases data in all input fields that have been modified. When this key is pressed in a program formatted display, all fields that have had data entered are erased. The cursor moves to the home position on the screen.

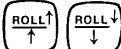
The lower shift function of this key moves the cursor to the home position of the formatted screen. It moves the cursor to the first input position on the upper left corner of the display screen in free key mode.

Print Key 

This key causes a print request to be sent to the system. The system program selects the printer that will be used.

Help Key 

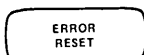
The help key is used to display a description of a current error condition or when further assistance from the system is needed.

Roll Keys 

The roll keys move the information on the display screen either up or down.

Horizontal Movement Keys 

These keys cause the cursor to move one position in the direction indicated by the arrow on the key.

Error Reset Key

This key will unlock the keyboard when it was locked because of an error condition. It will also reset the insert, system request, and command modes.

Enter/Record Advance Key

This key indicates to the system that the entered data is ready to be sent.

Field Exit Key

This key is used to exit from input fields. When this key is pressed, blanks are inserted from the cursor to the end of the field. When this key is pressed in a right-adjust field, the data to the left of the cursor is shifted to the right. The vacated positions are filled with zeros or blanks as specified by the format. This key must be used to exit from input fields that are specified by the program as right adjust or field exit required fields.

Field + Key

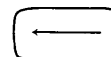
This key has the same function as the Field Exit key and is for your convenience when using the 10-key numeric pad:

Field - Key

This key functions the same as the Field Exit key except that it inserts a minus (-) sign in the last position of the input field. An error is displayed if you press this key in a field not programmed to accept negative numbers.

Dup Key

This key, in a field programmed to allow duplication, places an asterisk with an overscore ($\bar{*}$) in the cursor position and all the following positions of that field. This special symbol represents a request to the program to duplicate the information from the same field in the previous record or from another information source.

Character Backspace Key

This key causes the cursor to move back to the previous enterable character position (not necessarily the last position).

Field Advance Key

This key causes the cursor to move to the first position of the next established field.

Field Backspace Key

This key causes the cursor to move to the first character position of the field in which it is located. If the cursor is located in the first character position of a field when this key is pressed, it moves to the first character position of the preceding field.

New Line Key 

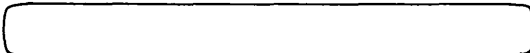
This key causes the cursor to move to the first character position of the first input field of the next line of the display screen. If the cursor is on the last input line of the display screen when this key is pressed, it moves to the first input position at the top of the display screen.

Shift Key 

When this key is pressed and held down, the alphabetic keys (A through Z) are entered as uppercase letters, the special characters identified on the tops of the numeric and symbol keys can be entered, and the function control keys on the left side of the keyboard can perform the function shown on the top half of the key.

Shift Lock Key 

This key locks the keyboard in upper shift. The keyboard can be returned to lower shift by pressing either of the shift keys.

Spacebar 

This key moves the cursor to the right one position at a time. As the cursor moves, the data located above the cursor is destroyed and a blank character is entered.

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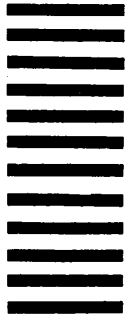
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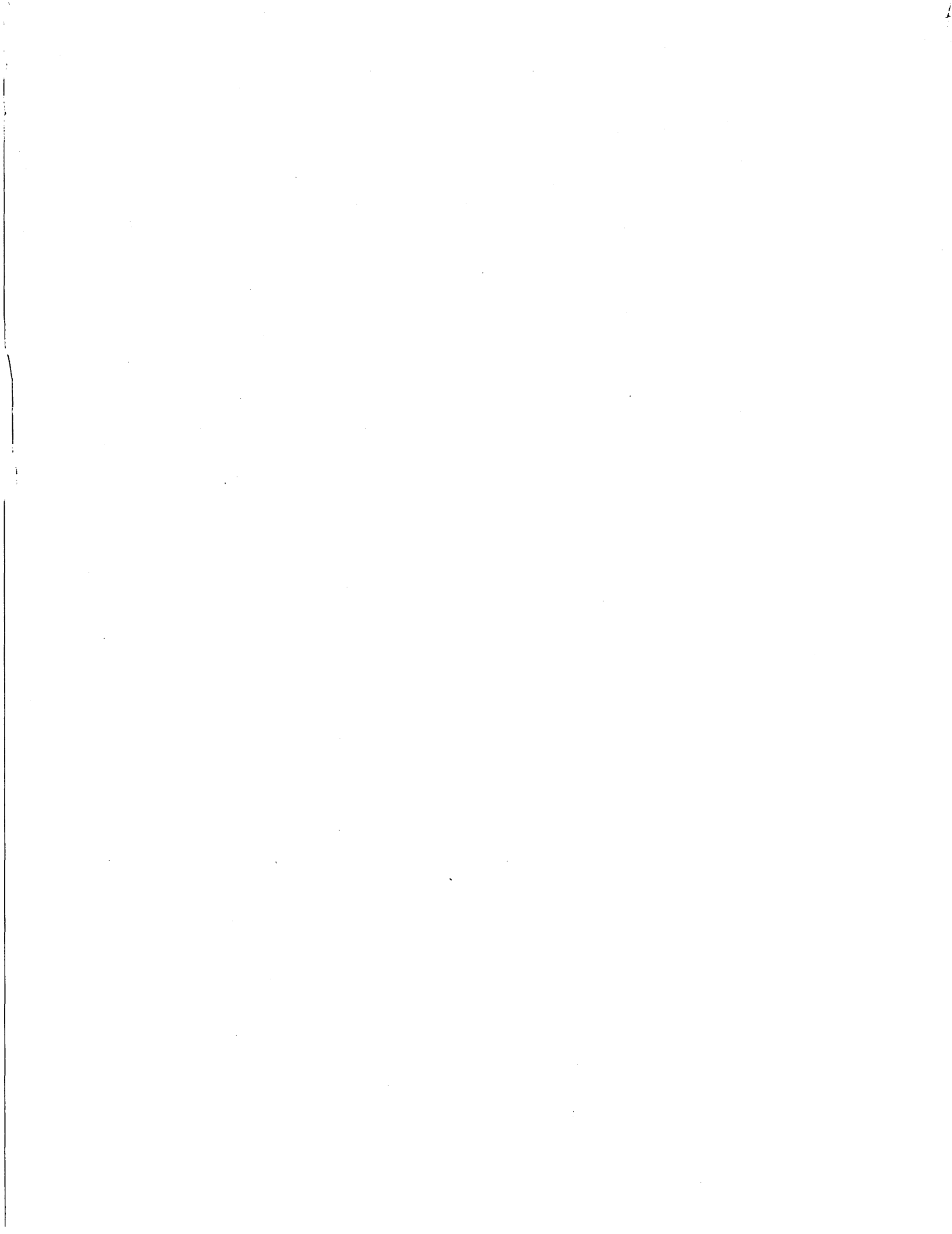
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