

SY31-0461-3

IBM 5251 Display Station
Models 1 and 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 Models 1 and 11 Display Station. Customer engineers using this manual are assumed to have completed the course on the 5251 Models 1 and 11 Display Station.

The maintenance information manual (MIM) has 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 the *Glossary of Terms and Abbreviations*.

Setup instructions for the 5251 Models 1 and 11 Display Station are in *Appendix A*.

Note: MIM pages 1-5, 1-8, 1-27, 1-45, 1-48, 1-49, 1-77, 1-78, 1-80, 1-81, 1-83, 1-89, 1-91, 1-92, 1-95, 1-96, 1-99, 1-100, 1-103, 3-2, and A-1 have DANGER and/or CAUTION notices. If desired, translate these notices and write your own words on the blank lines provided on these pages.

Fourth Edition (July 1979)

This edition has important changes. It obsoletes SY31-0461-2 and Technical Newsletter SN31-6259. The changes are extensive and the manual should be reviewed in its entirety.

Use this publication only for the purpose stated in the *Preface*.

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Related Publications

Related information can be found in the following IBM 5250 Information Display System manuals:

- *IBM 5250 Display System Reference Card*, GX21-9249
- *IBM 5251 Display Station Models 1 and 11, IBM 5252 Dual Display Station Operator's Guide*, GA21-9248
- *IBM 5251 Display Station Models 1 and 11 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
- *IBM 5252 Dual Display Station Maintenance Information Manual*, SY31-0492
- *IBM 5252 Dual Display Station Maintenance Analysis Procedures*, SY31-0584
- *IBM 5250 Information Display System Planning and Site Preparation Guide*, GA21-9337

Safety

The 5251 Models 1 and 11 Display Stations have 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 if it falls.

- 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.

activity: Action or process.

addr: Address.

alpha: Alphabetic.

ALU: Arithmetic logic unit.

amplifier: A device that increases a voltage or a signal to a usable level.

anode: A positive terminal of a diode.

arithmetic: The adding, subtracting, multiplying, or dividing of two or more numbers.

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

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

brightness limiter potentiometer: A potentiometer that prevents too much brightness. See reference 150.

buffer: A temporary storage area.

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

callout: A character used to identify a particular portion of an illustration.

capacitive: Having capacitance.

cathode: A negative terminal of a diode.

char: Character.

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

character window: A part of the display screen that is 24 dots high by 10 dots wide and includes the character matrix.

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

Cmd key: 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 on the top row of the display station keyboard that are used with the Cmd (command) key to request functions.

cont: Controller.

Contrast control: The device that changes the contrast. See reference 100.

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

data stream: A continuing flow of data.

diag: Diagnostic.

driver: A source that sends (drives) a signal from one location to another. See reference 212.

dual: Having two similar parts.

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

EOM: End of message.

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

EOQ: End of queue.

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: The bottom of a key module. See reference 135.

FRU: Field-replaceable unit.

hex: Hexadecimal.

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

ID: Identification.

implode: To break inward suddenly.

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

IPL: Initial program load.

KBD: Keyboard.

key stem: The connecting part between the keytop and the key module. See reference 135.

Keylock feature: A feature with a lock and key that restricts the 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 of equal width.

line turnaround: The time between the reception of the last bit of a frame by a work station and the start of transmission by that same work station.

LP: Light pen.

LRC: Longitudinal redundancy check.

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.

mandatory: Something that must be done or must be present.

menu: A list of options that can be selected.

microfarad: One millionth part of a farad.

microinstruction: A basic or elementary machine instruction.

microprocessing: Operations performed by 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.

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.

MSR: Magnetic Stripe Reader feature.

mm: Millimeter.

ms: Millisecond.

msg: Message.

MSIPL: Main storage initial program load.

multiframe response: More than one frame of data is being sent.

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

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

null: A hex character composed of all zeros; this character occupies a position in the buffer and is displayed as a blank.

online test: A series of tests that can be requested from the system after power on and before sign-on. See reference 206.

option: One of the items listed on a display screen menu.

overview: A short description.

P-P: Peak-to-peak.

PC: Printed circuit.

planar: See *main planar*.

PM: Preventive maintenance.

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

POR: Power on reset.

port: The place where a cable is connected to a machine.

protector: A device that aids in preventing injuries to persons or damage to machines.

R/D: Receiver/driver.

raster: The image on the CRT that is made by the action of the CRT electron beam as it scans across the area of the CRT where data is displayed. Normally, the intensity of the raster is not high enough to be visible. However, the raster can be displayed if you install a raster check jumper.

read-only storage (ROS): A storage area in the MPU from which data can be read but not changed.

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

receivers: Those parts that accept data or voltages.

refresh: To continuously redisplay data on the display screen to prevent the data from fading out; the display adapter refreshes the data.

regen buffer: 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 by the system to execute input/output, storage, processing, and control operations.

related: Having a common use.

required: See mandatory.

resolution: The visual quality of display screen data.

retaining ears: The projections located on the bottom of a key module; these projections hold the module to the frame. See reference 133.

retrace lines: The lines that appear on the display screen when the display adapter returns the sweep to the upper left corner of the display screen. Retrace lines are normally blanked out. See reference 156.

retry: To repeatedly send frames of information until the frames are received without an error by the display station; the controller sends the frames.

ripple: Small waves present on DC voltages.

ripple level: A measurement of the AC voltage carried on the DC voltage.

rolling: Pertains to movement on a display screen; the movement can be either horizontal, vertical, 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 and receive data between the display station and the controller.

setup: To prepare a device for operation.

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

slot: A narrow opening or groove.

SOM: Start of message.

stabilizer: A rod on the Spacebar. See reference 134.

stat addr: Station address.

stem: See *key stem*.

stiffener: A part used to supply rigidity to a logic card or planar.

storm: Electrical discharges in the air.

strain relief cable: A cable that supports the planar.

SVCS: Services.

SYS: System.

Sys Req key: A key that is used to send a request directly to the system.

taper: Increasing in size toward one end.

TB: Terminal block.

Terminator switch: A switch used to terminate the customer system 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.

transfer: To move from one person, place, or thing to another.

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

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

undefined: The meaning is not known or described.

underscore: A line under all positions of a field. Underscore is controlled by an attribute.

US: United States.

Vac: Volts alternating current.

Vdc: Volts direct current.

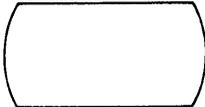
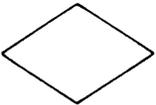
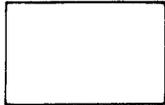
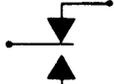
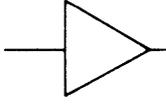
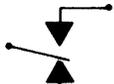
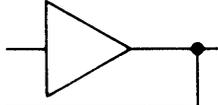
verification: Testing an operation or machine.

video: Pertains to the display screen image.

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

Legend

The following symbols are used in flowcharts and figures throughout this manual.

	Display Screen		Zener Diode
	Start and End of Flowchart		Diode
	Off-Page Connector		Capacitor
	On-Page Connector		Ground
	Decision Block		Transformer
	Comment Block		Relay
	Information Block		Contact (relay not energized)
	Logic (indicates signal direction)		Contact (relay energized)
Driver			Resistor
	Logic		Jumper
Driver/Receiver			
	Relay Driver		
	Detector		

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Using the IBM 5251 Display Station Models 1 and 11 Maintenance Information Manual

The information in this MIM is to be used as reference material when you are diagnosing machine failures. This MIM contains a *Maintenance Procedures* section, a *Preventive Maintenance* section, a *Tools and Test Equipment* section, a *Theory* section, and a *Features* section. Appendixes give general information (such as setup procedures) that is not directly related to the maintenance of the 5251 Models 1 and 11 Display Station.

The format for page numbering is X-YYY.Z. X is the section number, YYY is the page number, and Z (although not normally used) is the number used 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 that are referred to in the MAPs. For example, 130 indicates the keyboard locations of the display station.

MAINTENANCE PROCEDURES SECTION

The *Maintenance Procedures* section contains location drawings, maintenance procedures, mini-MAPs, and diagnostic aids for repairing, installing, or diagnosing the failing FRUs (field-replaceable units).

Location Drawings

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

Maintenance Procedures

Maintenance procedures contain removal, replacement, and adjustment procedures. All procedures and drawings have assigned three-digit reference numbers.

Mini-MAPs

You are sent to mini-MAPs to continue the failure analysis to locate a failing field-replaceable unit.

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

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 to locate a failing field-replaceable unit.

Diagnostic Aids

Diagnostic Aids describe diagnostic programs, how to use them, and what is available when they are in control. To aid in diagnosing machine failures in more detail, a list of error conditions is included.

PREVENTIVE MAINTENANCE SECTION

The *Preventive Maintenance* section describes any preventive maintenance required by the display station.

TOOLS AND TEST EQUIPMENT SECTION

The *Tools and Test Equipment* section describes the tools that are needed to service the display station.

THEORY SECTION

The *Theory* section describes 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 how each function or feature relates to the operation.

FEATURES SECTION

The *Features* section describes the features that are available with the 5251 Models 1 and 11 Display Station.

APPENDIXES

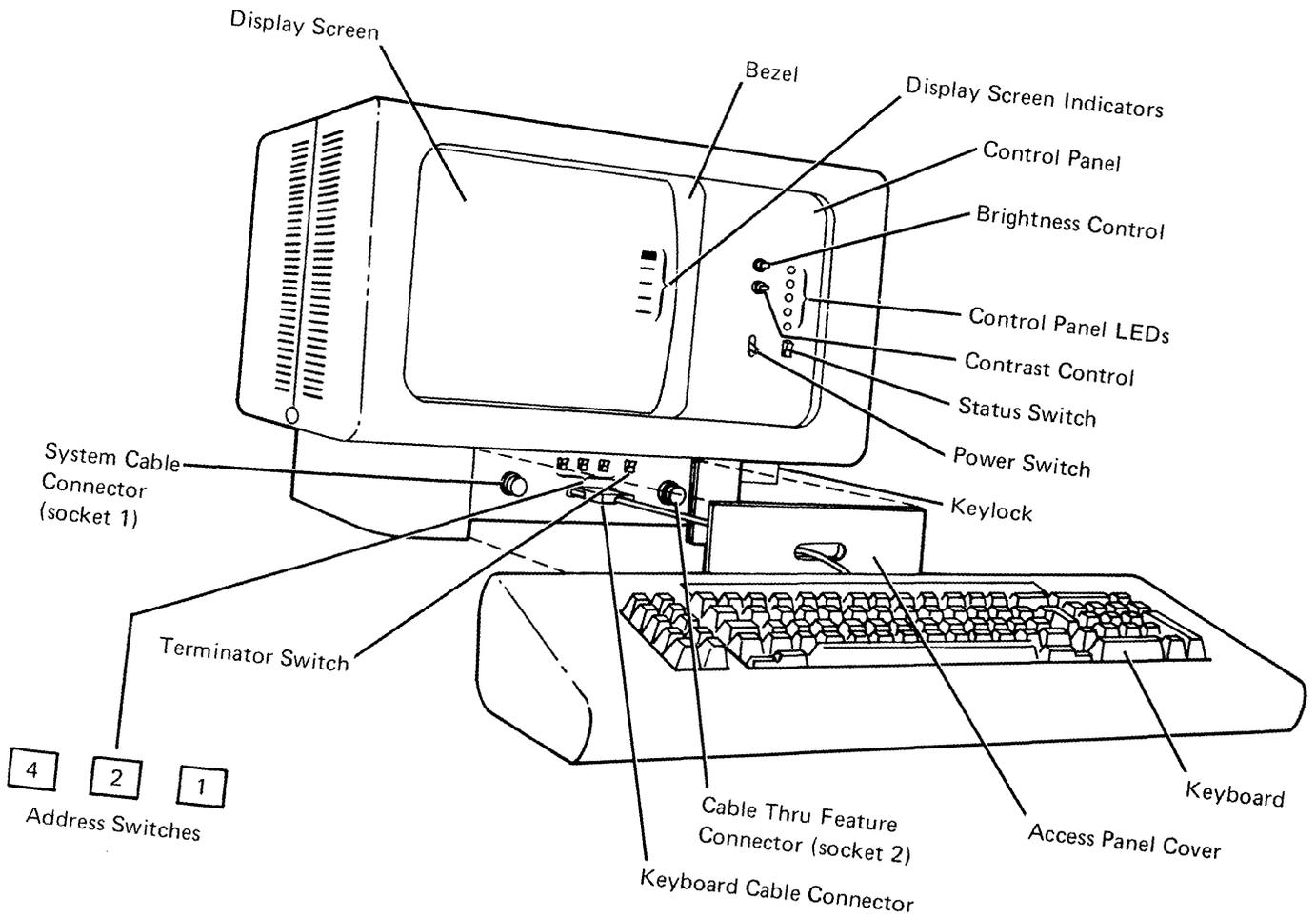
Appendix A contains the setup procedures required to make a new display station operational. Appendix B explains the operation of the Self-Check feature. Self-Check is a host system feature.

INDEX

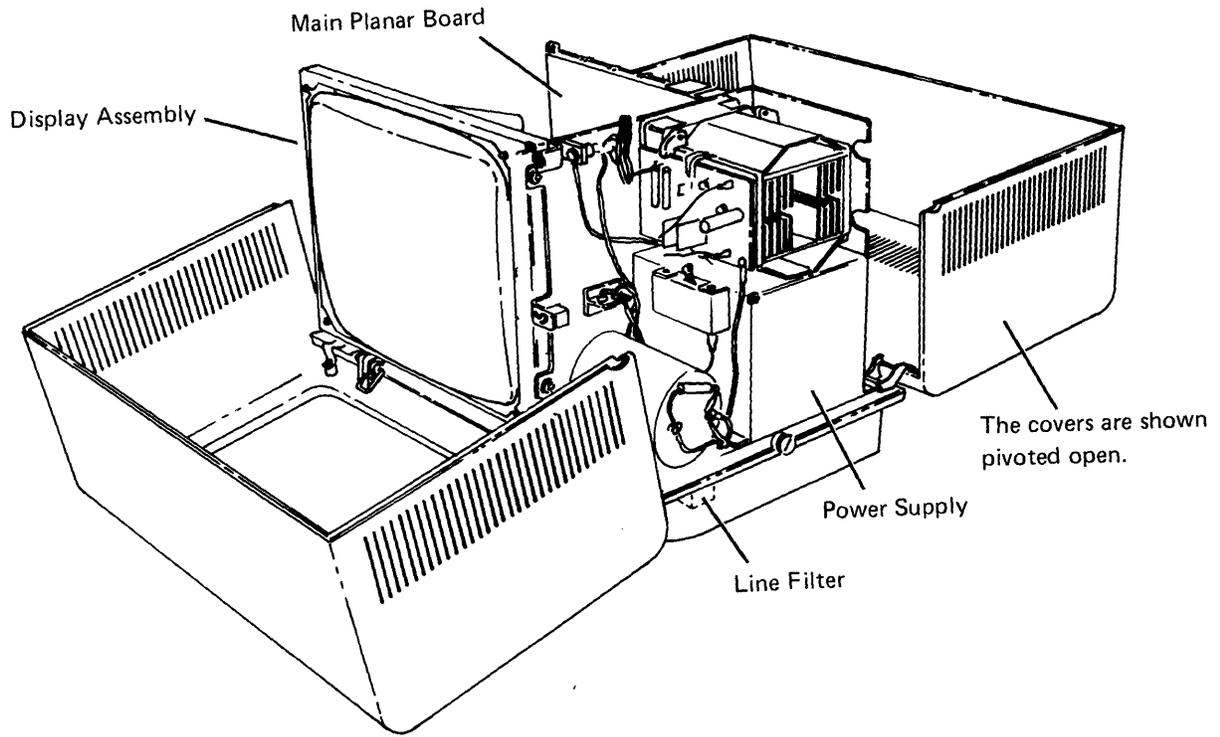
The index is a detailed list of all the material contained in the MIM.

Locations

100 FRONT VIEW

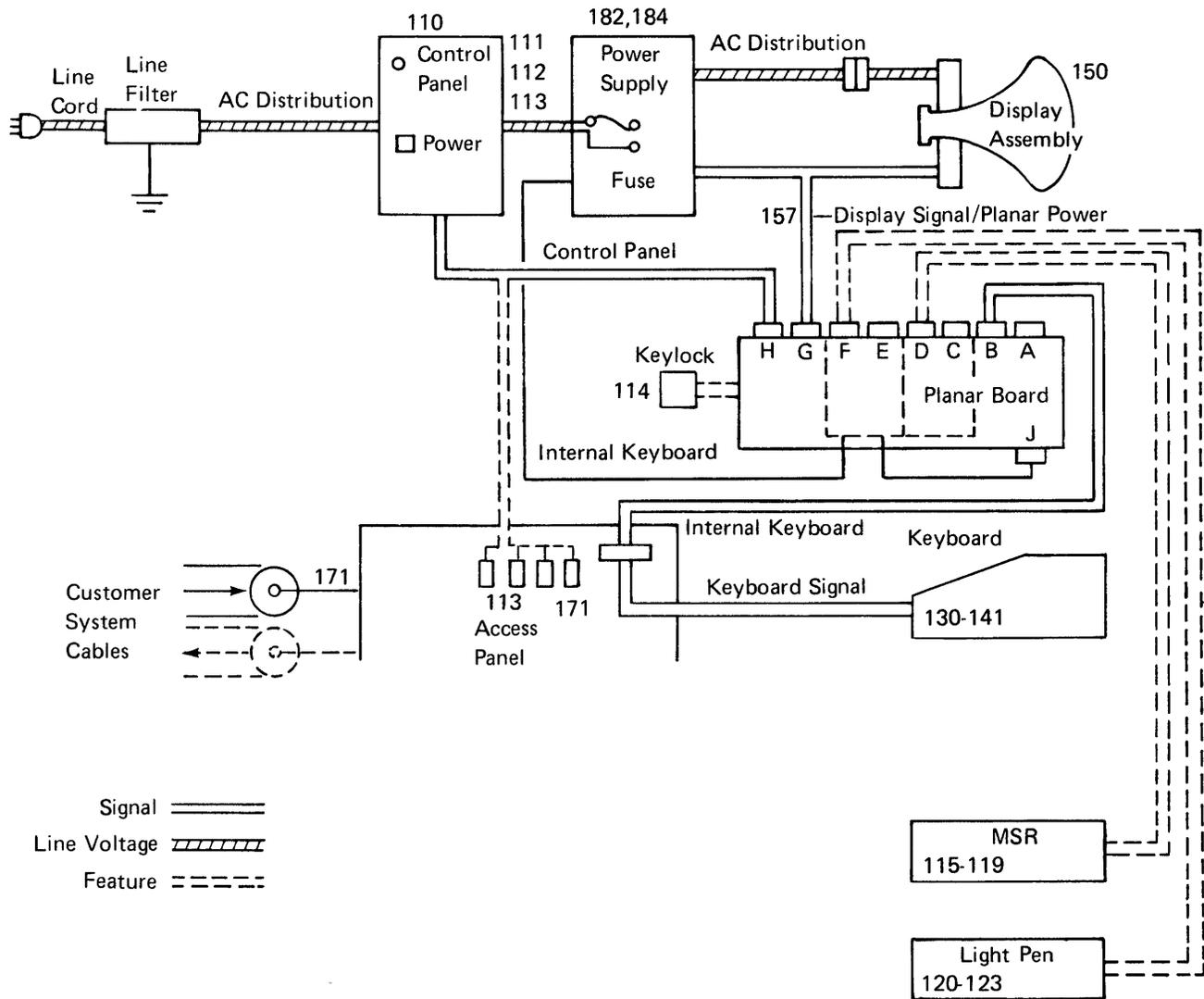


101 COVERS OPEN

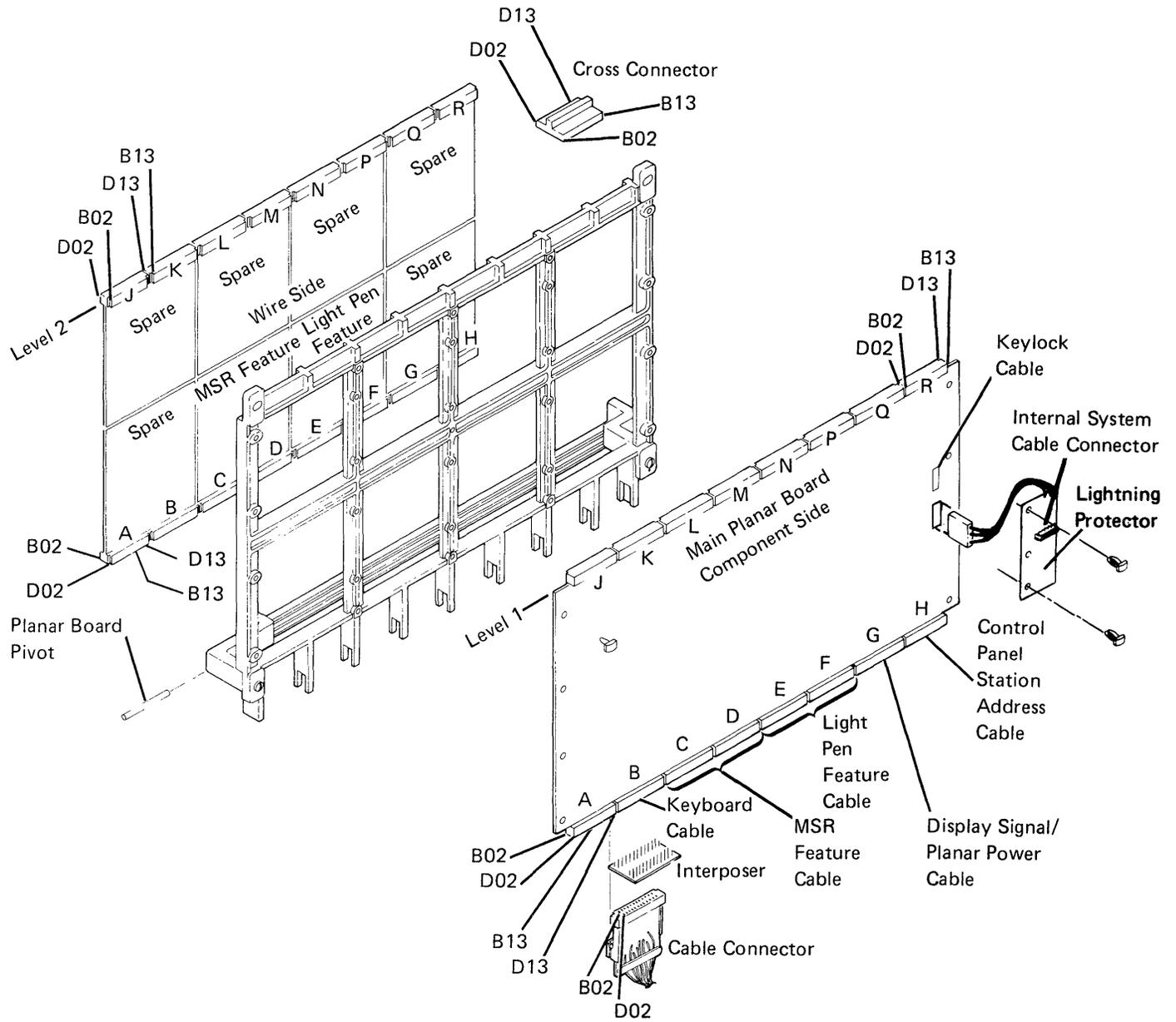


102 CABLE CHART

The numbers shown on the chart indicate the section in the MIM where detailed information about cables for that portion of the chart is located.



103 MAIN PLANAR BOARD AND CARD LOCATIONS



104 LOGIC PART NUMBERS

CAUTION

The logic used on planar boards can be damaged by an electrostatic discharge. Prevent any contact with conductors. Handle the planar by the plastic frame only.

Discharge both you and the plastic container containing the new planar by holding the bag and momentarily touching the machine frame.

Ensure that the wire side is face down when placing a planar on any surface.

The MSR feature card part number is 2767396. The Light Pen feature card part number is 7362298.

Some planars might have a lightning protector (Part Number 2767867) at the internal twinaxial connector. Ensure that a lightning protector card is installed on the new planar if a lightning protector card was on the planar you are replacing (103). Refer to 173 for testing the lightning protector.

Without Country Jumpers:

Country	Main Planar Board Part Numbers	
	Model 1	Model 11
US and Canada	2767295	2767311
ASCII	2767296	2767312
Japan (English)	2767297	2767313
Japan (Katakana)	2767298	2767314
Austria/Germany	2767299	2767315
Belgium	2767300	2767316
Brazil	2767301	2767317
Canada (French)	2767302	2767318
Denmark/Norway	2767303	2767319
Finland/Sweden	2767304	2767320
France	2767305	2767321
Italy	2767306	2767322
Portugal	2767307	2767323
Spain	2767308	2767324
Spanish-Speaking	2767309	2767325
United Kingdom	2767310	2767326

104 (continued)

With Country Jumpers:

Country	Main Planar Board Part Numbers	
	Model 1	Model 11
US (with multinational character set)	8330748	8330749
ASCII	8330748	8330749
Japan (English)	8330748	8330749
Japan (Katakana)	2767770	2767772
Austria/Germany	8330748	8330749
Belgium	8330748	8330749
Brazil	8330748	8330749
Canada	8330748	8330749
Denmark/Norway	8330748	8330749
Finland/Sweden	8330748	8330749
France	8330748	8330749
Italy	8330748	8330749
Portugal	8330748	8330749
Spain	8330748	8330749
Spanish-Speaking	8330748	8330749
United Kingdom	8330748	8330749

105 MAIN PLANAR BOARD JUMPERS

Either of the shown planars can be used with both the Model 1 and the Model 11. Both are shown because of the different locations of the jumper pins. If you have the planar with the country jumpers, disregard the callouts for jumper positions 8A and 8B.

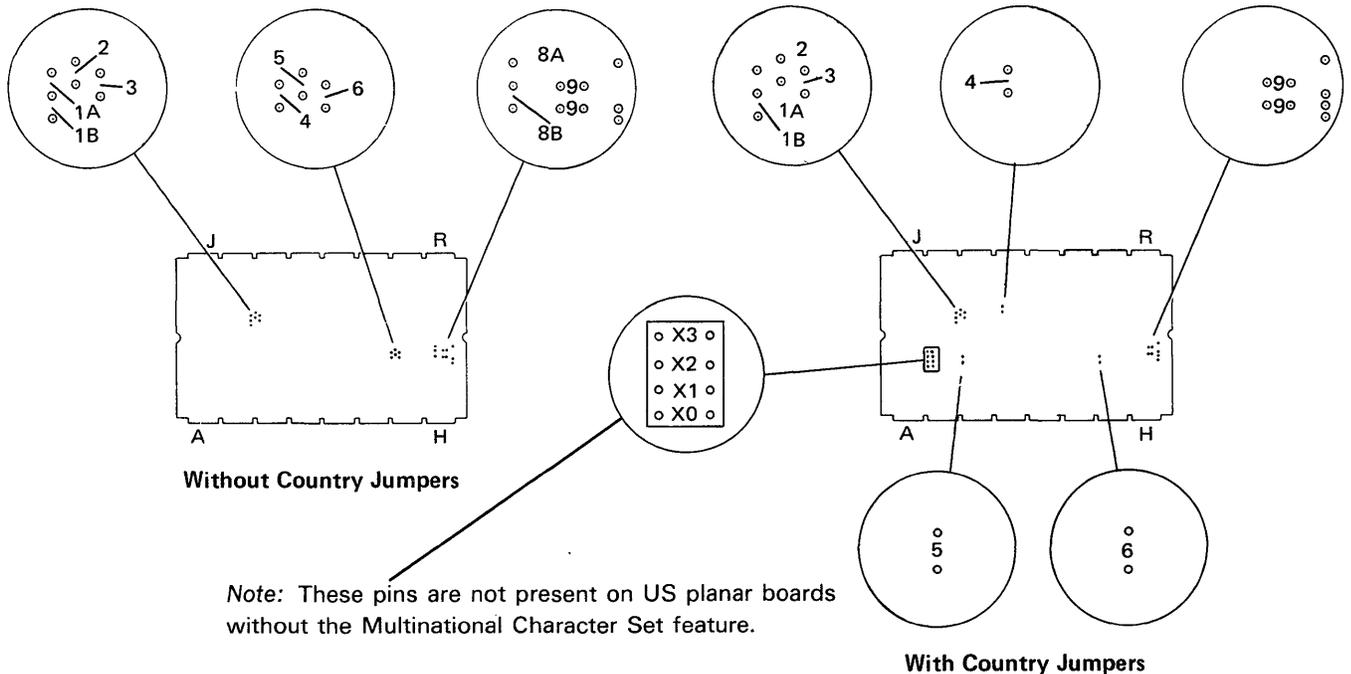
The jumper part number is 1794401.

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

X0, X1, X2, and X3 pins are not present on US planar boards without the Multinational Character Set special feature.

Country	Jumper			
	X0	X1	X2	X3
U S and Canada	off	off	off	on
ASCII/Intl	off	off	off	off
Austria/Germany	on	off	off	off
Belgium	on	on	on	off
Brazil	off	on	on	off
Canada (French)	on	on	off	on
Denmark/Norway	on	off	on	off
Finland/Sweden	on	off	off	on
France	on	on	off	off
Italy	on	off	on	on
Japan (English)	off	off	on	on
Portugal	off	on	on	on
Spain	off	on	off	on
Spanish-Speaking	off	on	off	off
United Kingdom	off	off	on	off

Note: A planar with country jumpers is required to implement the Overstrike feature. (Overstrike is a feature of the host system.) The planar must be jumped for ASCII/Intl to make Overstrike operational. Use the displayable characters option on the Display Verification Menu (206) to verify the character set.

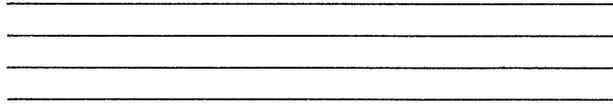


Covers

108 DISPLAY STATION COVERS

CAUTION

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

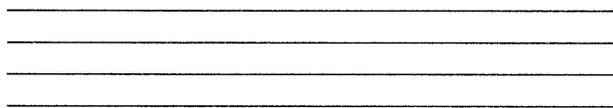


To open the covers:

1. Loosen the screw **1** on the left side of the display station.
2. Loosen the 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 back of the display station.

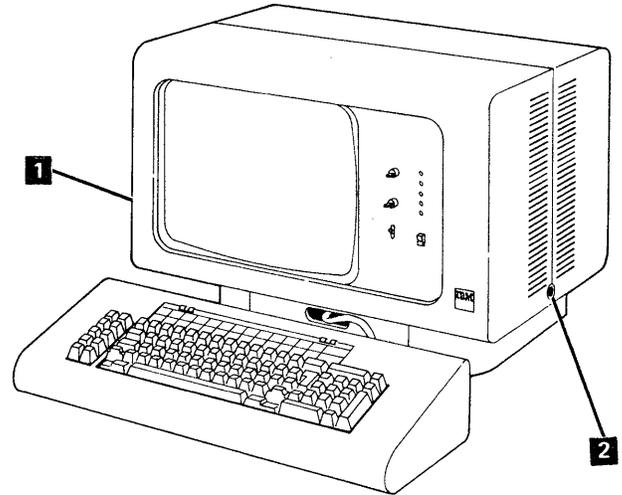
CAUTION

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



To close the covers:

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



109 KEYBOARD COVERS

Removal

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

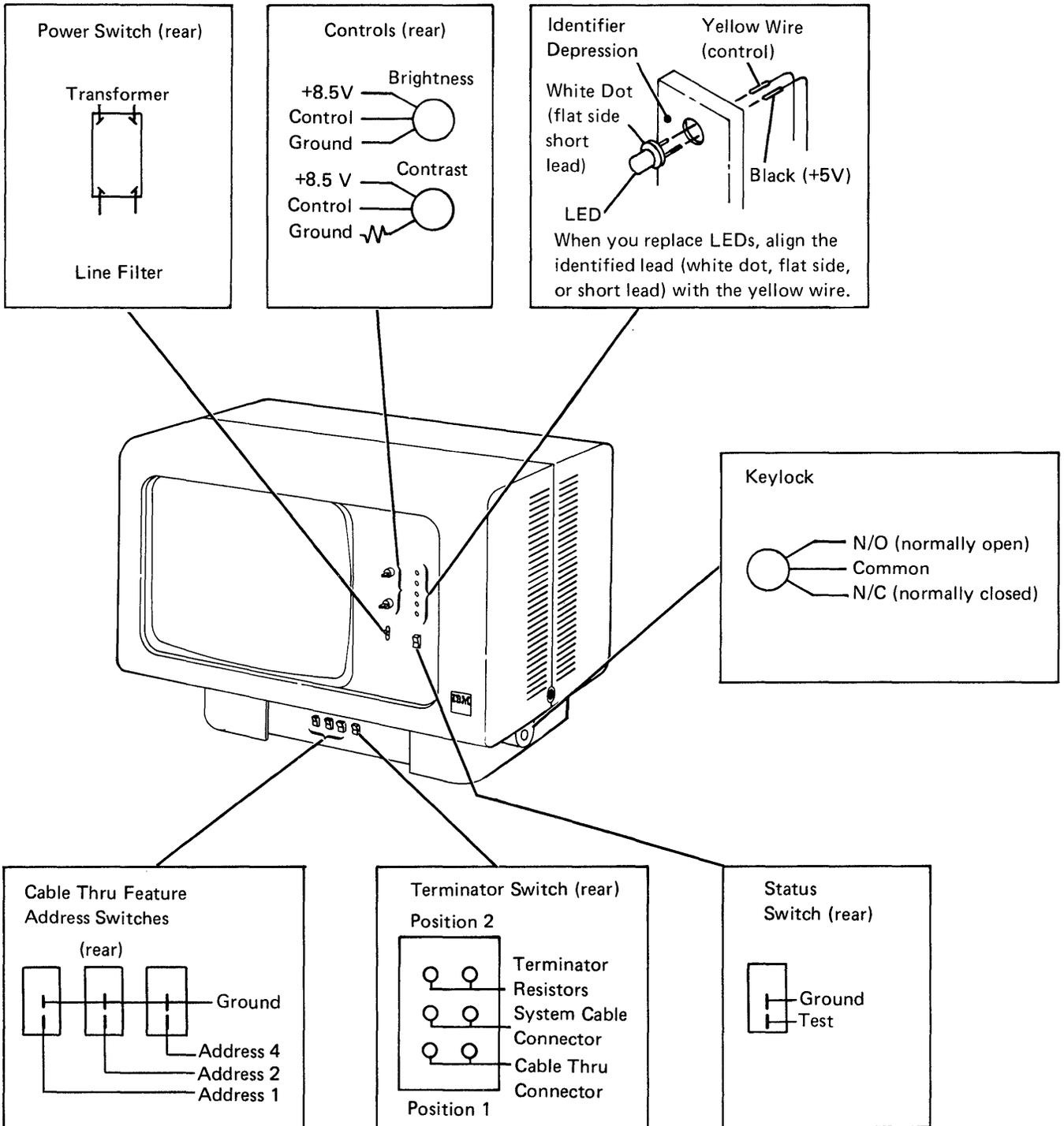
Replacement

1. Place the cover on the keyboard assembly.
2. Tighten the four 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, 112, 113 CONTROL PANEL CABLE MINI-MAP

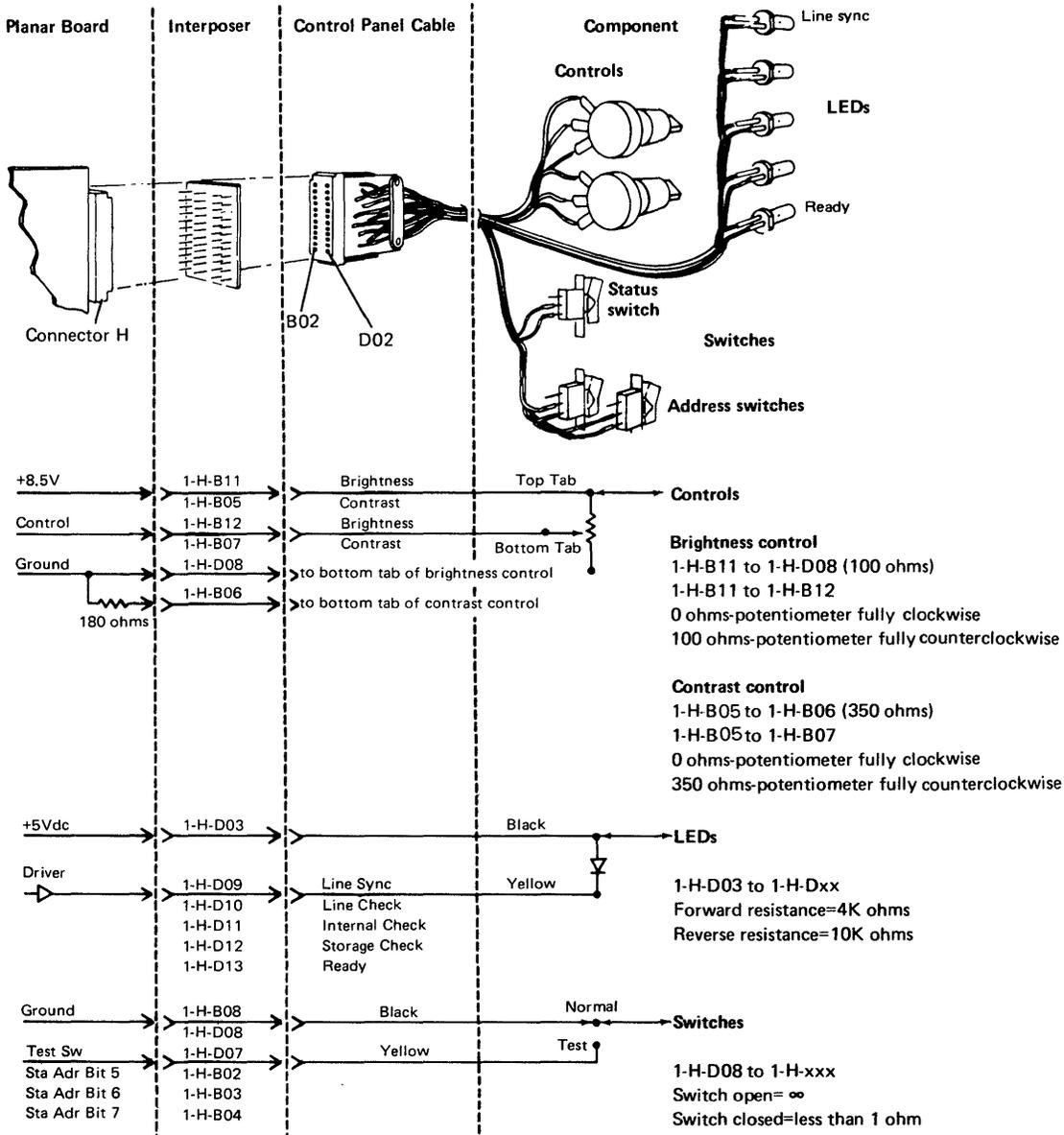
- For mini-MAP example, see *Troubleshooting Aids* (212).

Conditions After Power On

- All voltages are active.
- When a switch is closed the line is a down level and displayed as a 1 bit.

Service Aids

- Do not ground an LED line. Planar or LED damage will result.
- LEDs may be swapped to isolate the failure.
- Do not change the setting of the address switches when the power switch is on.



111 (continued)

Check the voltages and grounds.

1-H-B11 (+8.5V)

1-H-B08 (GND) or down light on probe

1-H-D08 (GND) or down light on probe

1-H-D03 (+5V)

Are the conditions normal?

Y N

- Inspect the interposer.
- Replace the planar.
- Power off.
- Select the failing circuit (see above).
- Remove the cable at the planar.
- Using an ohmmeter, measure the resistance of the selected circuit at the cable.

Are the conditions normal?

Y N

- Trace the conditions to the component (see above).
- Repair or replace the cable or replace the component.
- Check the circuit for grounds in the cable.

Were there any grounds at the cable?

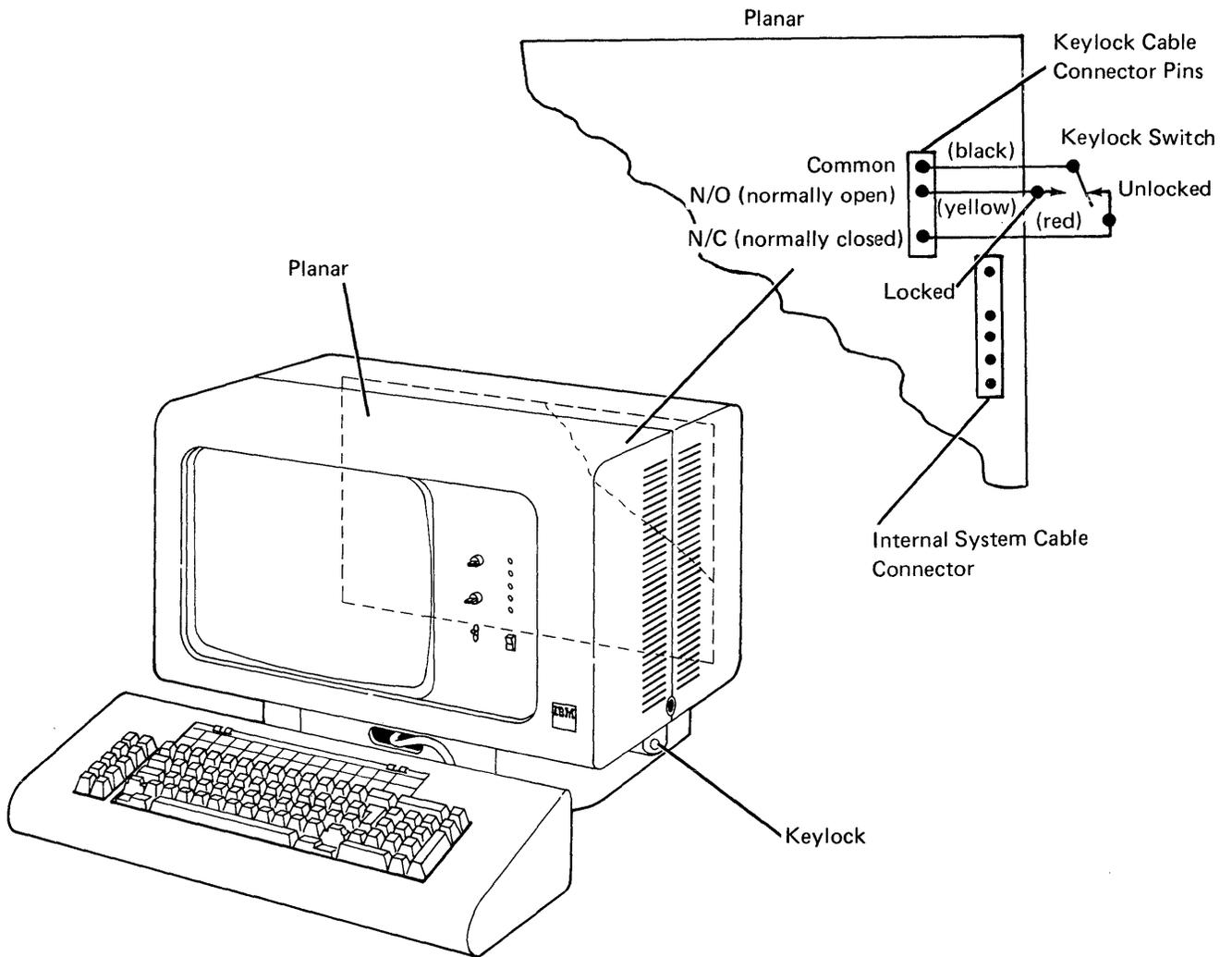
Y N

- Verify that the address switches are set correctly.
- Inspect the interposer.
- Check the jumpers and replace the planar.
- Trace the ground on the component (see circuit).
- Repair or replace the cable.
- Replace the component.

Suggested action for an intermittent problem:

- Analyze the suspected line; inspect all the connector contacts.
- Replacement sequence:
 - Component
 - 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 CE meter indicate an open circuit?

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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Magnetic Stripe Reader

115 MAGNETIC STRIPE READER VOLTAGE AND CONTROL MINI-MAP

- Use this mini-MAP to correct an MSR problem when the reader fails to read and the characters displayed from the keyboard are correct.
- For mini-MAP example, see *Troubleshooting Aids* (212).

Conditions After Power On

- The voltage lines are active.
- The '-POR' line will be at an Up level.
- The '1.0 MHz osc' line will be pulsing after power on.
- The '+photocell' line will pulse when a card is read by the MSR.
- The 'reg 25 bit 1' line will change level when a card is read by the MSR.

Service Aids

- The '-POR' line will change level during the power-on sequence.
- The display station will *not* be damaged if it is powered on after the MSR cable has been disconnected.
- The MSR test card part number is 8331402.
- The characters that will be displayed in the lower left portion of the display screen when the test card is read by the reader when the display station is in the free key mode are:

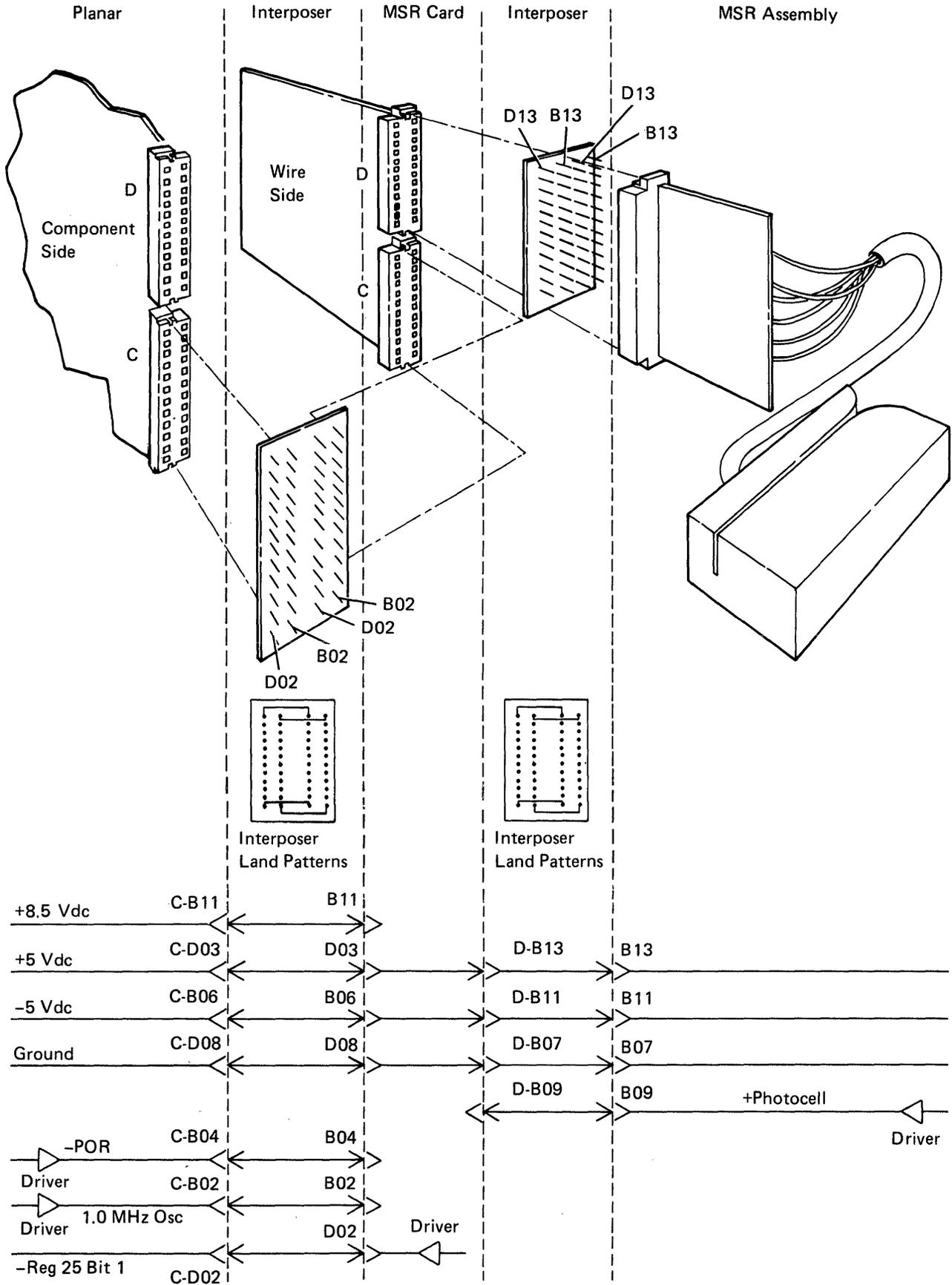
%% %0123456789 %:@=0123456789

Tools

Connect the CE probe as follows:

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

115 (continued)



115 (continued)

- Check the '+8.5 Vdc' line at connector C of the MSR card.

Is the voltage correct?

Y N

- Inspect the interposer.
- Replace the planar; set the jumpers correctly on the new planar (103) (105).
- Check the '+5 Vdc' and the '-5 Vdc' lines at connector C of the MSR card.

Are the voltages correct?

Y N

- Inspect the interposer.
- Replace the planar; set the jumpers correctly on the new planar (103) (105).
- Check the '+5 Vdc' and the '-5 Vdc' lines on the interposer test pins at connector D of the MSR card.

Are the voltages correct?

Y N

- Inspect the interposer.
- Replace the MSR card (119).
- Probe the '+photocell' signal on the interposer test pins at connector D of the MSR card.
- Pass the test card through the reader.

Does the line pulse?

Y N

- Probe the 'ground' line at connector C of the MSR card.

Is the line at a Down level?

Y N

- Inspect the interposer.
- Replace the planar; set the jumpers correctly on the new planar (103) (105).
- Probe the 'ground' line on the interposer test pins at connector D of the MSR card.

Is the line at a Down level?

Y N

- Inspect the interposer.
- Replace the MSR card (119)

A B

A B

- Power off.
- Disconnect the MSR cable.
- Power on.
- Probe the '+photocell' signal on the interposer at connector D of the MSR card.

Is the line at an Up level?

Y N

- Inspect the interposer.
- Replace the MSR card (119).
- Replace the MSR assembly (119).

- Power off.

- Disconnect the MSR cable.

- Power on.

- Probe the '+photocell' signal on the interposer at connector D of the MSR card.

Is the line at an Up level?

Y N

- Inspect the interposer.
- Replace the MSR card (119).
- Reconnect the MSR cable.

- Power off.

- Reconnect the MSR cable.

- Probe the '-POR' signal at connector C of the MSR card.

- Power on.

Note: The level should change from Down to Up.

Does the line change level?

Y N

- Power off.
- Remove the MSR card (119).
- Probe the '-POR' signal at the planar.
- Power on.

Does the line change level?

Y N

- Inspect the interposer.
- Replace the planar; set the jumpers correctly on the new planar (103) (105).
- Replace the MSR card (119).

C

115 (continued)

C

- Probe the '1.0 MHz osc' signal at connector C of the MSR card.

Is the line pulsing?

Y N

Is the line at an Up level?

Y N

- Replace the MSR card (119).
- Inspect the interposer.
- 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).
- Probe the '-reg 25 bit 1' signal at connector C of the MSR card.

Are both probe lights Off?

Y N

- Check for proper positioning of the jumpers (118).
- Replace the MSR card (119).
- 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:
 - MSR card
 - MSR assembly
 - Planar

116 MAGNETIC STRIPE READER REGISTER 5 MINI-MAP

- Use this mini-MAP to correct an MSR problem when the reader fails to read correctly.
- For mini-MAP example, see *Troubleshooting Aids* (212).

Conditions After Power On

- The '-raw data' line pulses when a card is read by the MSR.
- The '-reg 5' bit line pulses when a card is read by the MSR.

Service Aids

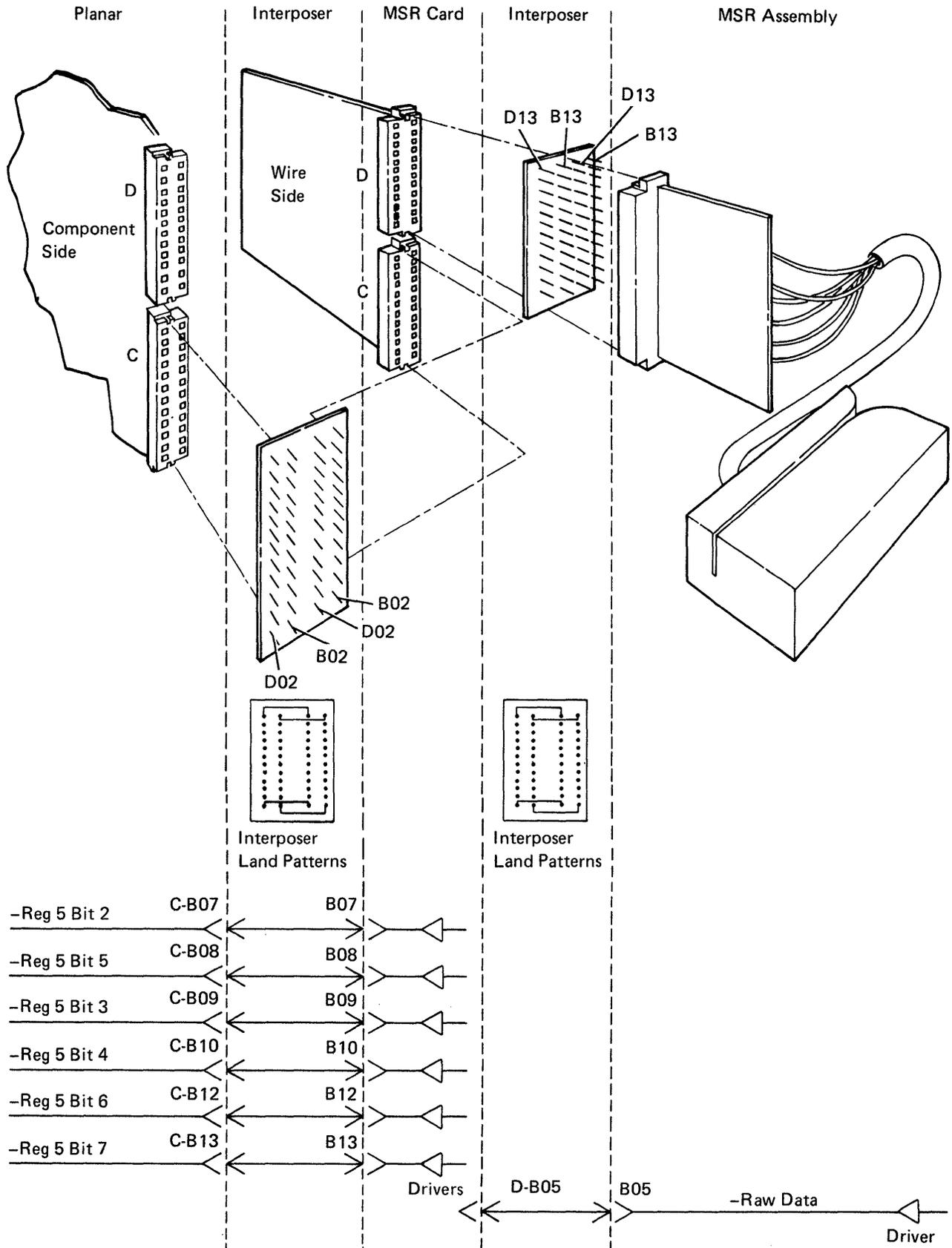
- The display station will *not* be damaged if it is powered on after the MSR cable has been disconnected.
- The MSR test card part number is 8331402.
- The characters that will be displayed in the lower left portion of the display screen when the test card is read by the reader when the display station is in the free key mode are:

% % %0123456789% :@=0123456789

Tools

Connect the CE probe as follows:

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



116 (continued)

- Probe the '-raw data' signal on the interposer test pins at connector D of the MSR card.
- Pass the test card through the reader.

Does the line pulse?

Y N

- Power off.
- Disconnect the MSR cable.
- Power on.
- Probe the '-raw data' signal on the interposer at connector D on the MSR card.

Is the line at an Up level?

Y N

- Replace the MSR card (119).
- Reconnect the MSR cable.
- Replace the MSR assembly (119).

- Power off.
- Disconnect the MSR cable.
- Power on.
- Probe the '-raw data' signal on the interposer at connector D of the MSR card.

Is the line at an Up level?

Y N

- Replace the MSR card (119).
- Reconnect the MSR cable.

- Power off.
- Reconnect the MSR cable.
- Power on.
- Probe the register 5 bit lines at connector C of the MSR card.

Are both probe lights off for any line?

Y N

- Replace the MSR card (119).
- 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:
 - MSR card
 - MSR assembly
 - Planar

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117 MAGNETIC STRIPE READER REGISTERS 5 AND 13 MINI-MAP

- Use this mini-MAP to correct an MSR problem when the reader fails to read correctly.
- For mini-MAP example, see *Troubleshooting Aids* (212).

Conditions After Power On

- The '-station 1/2 jumper' line is at an Up level.
- The five register lines pulse when a card is read by the MSR.

Service Aids

- The display station will *not* be damaged if it is powered on after the MSR cable has been disconnected.
- The MSR test card part number is 8331402.
- The characters that will be displayed in the lower left portion of the display screen when the MSR test card is read by the reader when the display station is in the free key mode are:

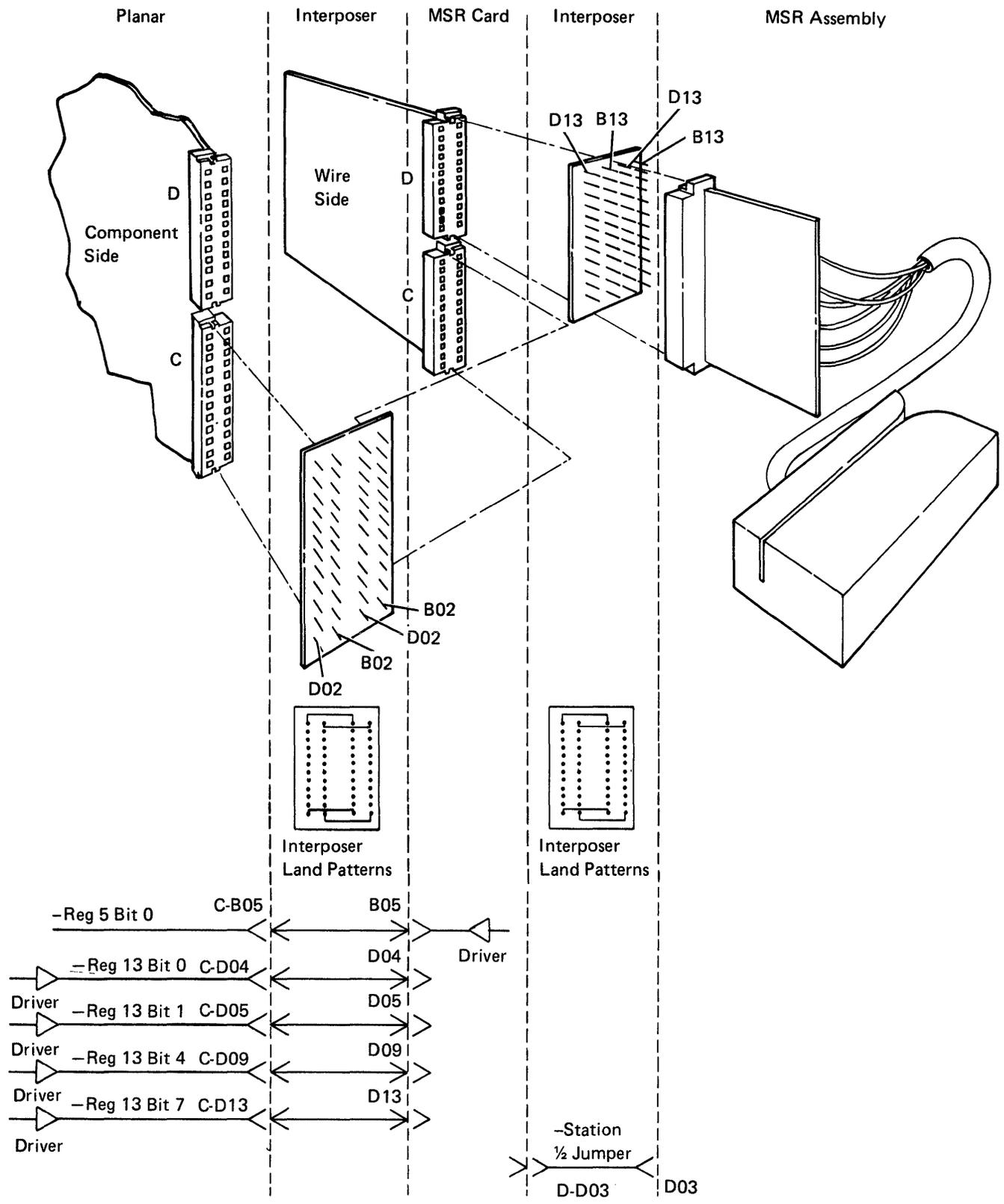
% % %0123456789 % :@~0123456789

Tools

Connect the CE probe as follows:

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

117 (continued)



117 (continued)

- Power off.
- Disconnect the MSR cable.
- Power on.
- Probe the '-station 1/2 jumper' signal on the interposer at connector D of the MSR card.

Is the line at an Up level?

Y N

- Check for proper positioning of the jumpers (118).
 - Inspect the interposer.
 - Replace the MSR card (119).
 - Reconnect the MSR cable.
-
- Power off.
 - Reconnect the MSR cable.
 - Power on.
 - Probe the five register signals at connector D of the MSR card.

Are both probe lights off for any line?

Y N

- Replace the MSR card (119).
-
- Inspect the interposer.
 - Replace the planar; set the jumpers correctly on the new planar (103) (105).

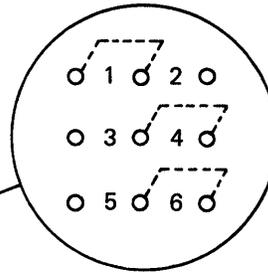
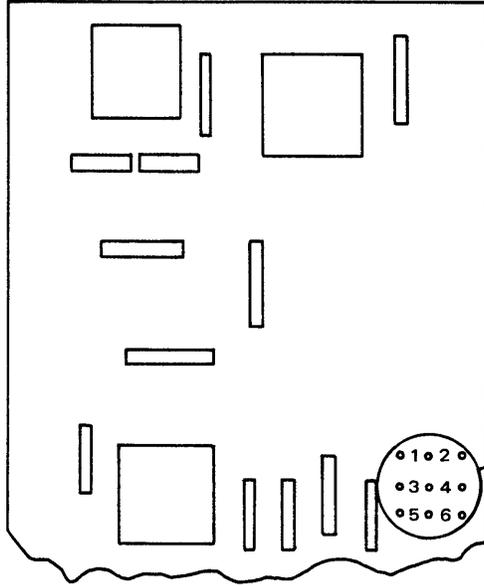
Suggested action for an intermittent problem:

- Analyze the suspected line; inspect all the connector contacts.

- Replacement sequence:
 - MSR card
 - MSR assembly
 - Planar

118 MAGNETIC STRIPE READER CARD JUMPERING

MSR Card



1,4, and 6 = on
2,3, and 5 = off

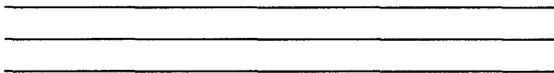
119 MAGNETIC STRIPE READER INSTALLATION AND REMOVAL

Installation

1. Power off.
2. Open the rear cover.
3. Hold the MSR feature card so that the component side is facing you.
4. Place the small interposer on the left hand side connector of the card; the test pins on the interposer must face the component side of the card.
5. Place the MSR feature card in positions C and D on the stiffener; ensures that the component side of the card is facing away from the stiffener (103).
6. Secure the card to the stiffener, using plastic clips.
7. Lower the planar to allow access to the bottom row of connectors.
8. While holding the MSR feature card, insert the large interposer in position C so that the pins on the interposer enter the slots on both the card and the planar.
9. Place the planar in the service position.
10. Loosen the screw on the plate that covers the line cord. This plate is located on the right rear corner.
11. Remove the plate.

CAUTION

Ensure that the remaining three corners remain firmly on the table.



12. Rotate the 5251 until the right rear corner is positioned off the table.

13. Feed the MSR cable through the same slot that the line cord passes through. Feed in enough cable so that the ground strap on the cable is inside the machine.
14. Connect the ground strap to a ground screw on the machine.
15. Connect the cable to position D on the MSR card (103).
16. Place the plate that was removed in step 11 over the MSR cable and the line cord and tighten the screw.
17. Move the 5251 back onto the table.
18. Place the planar in the operating position.
19. Close the rear cover.

Removal

To remove the MSR feature, reverse the preceding steps.

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120 LIGHT PEN VOLTAGE AND CONTROL MINI-MAP

- Use this mini-MAP to correct a light pen problem when the light pen is completely inactive.
- For mini-MAP example, see *Troubleshooting Aids* (212).

Conditions After Power On

- The '-end of row', '-vert blank', '+LNC', and '-horiz blank' lines should all be pulsing.
- The '-POR' and '-reg 25 bit 6' lines are both at an Up level.
- The '-LP photocell' line should be at an Up level.

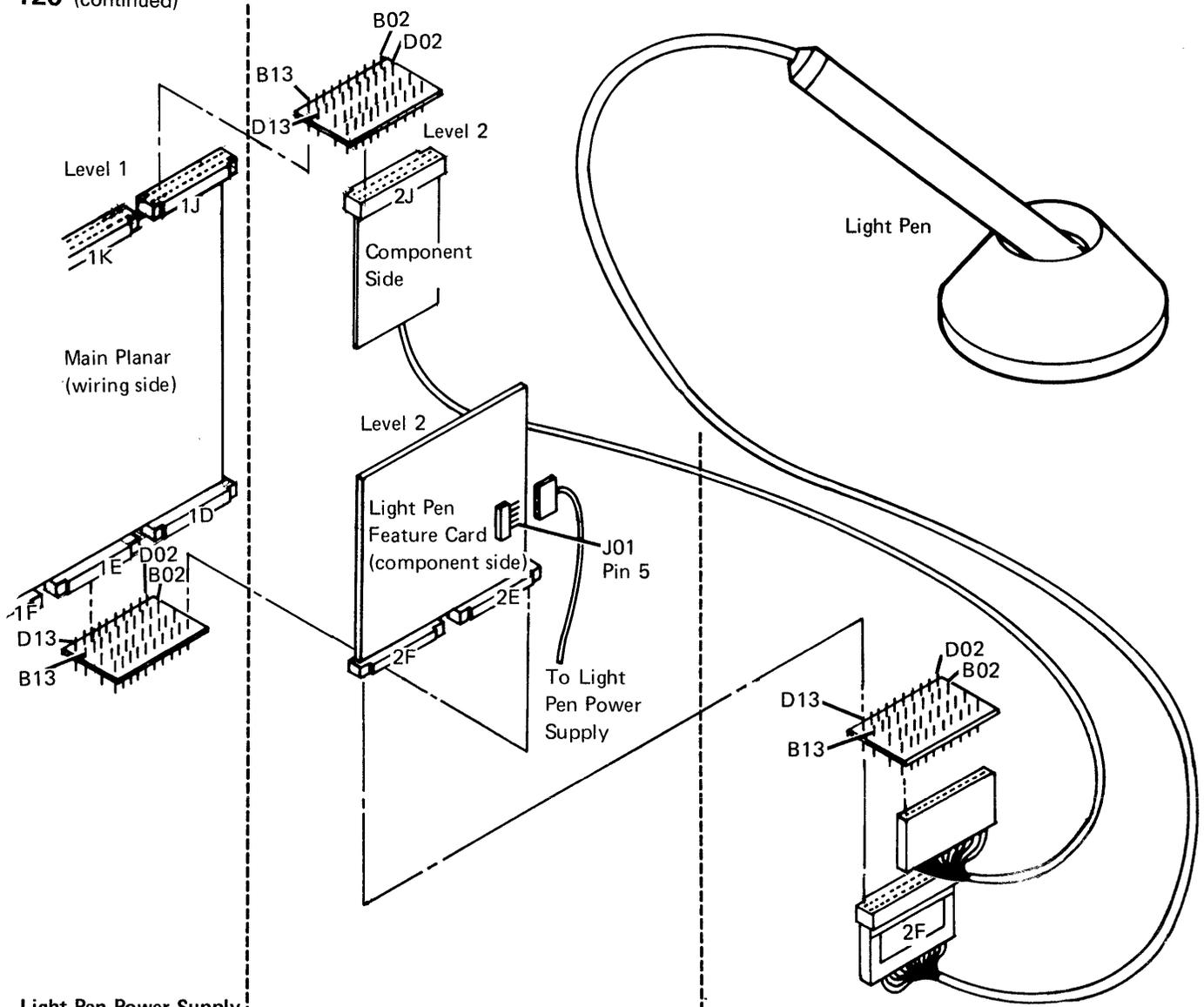
Service Aids

- The display station will *not* be damaged if it is powered on after the keyboard, MSR, or light pen has been disconnected.
- The '-LP photocell' and the '-reg 25 bit 6' lines will pulse when the light pen is placed at a displayed character on the CRT.

Tools

Connect the CE probe as follows:

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



Light Pen Power Supply

+12 Vdc
-6 Vdc
Ground

J01-5
J01-3
J01-1, J01-4

2-F-D12
2-F-D06
2-F-D08

Planar

+5 Vdc
Ground

1-J-D03
1-E-D08

2-J-D03
2-E-D08

-POR

1-E-B04

2-E-B04

-End of Row
-Vert Blank

1-J-B13
1-J-D02

2-J-B13
2-J-D02

2-F-B02
2-F-B12

-Reg 25 Bit 6

1-E-D06

2-E-D06

+LNC
-Horiz Blank

1-J-D07
1-J-D13

2-J-D07
2-J-D13

2-F-B08
2-F-B07

2-F-D13 -LP Photocell

120 (continued)

- Check for proper positioning of the jumper on the card (124).

Is the card jumpered correctly?

Y N

- Set the jumper correctly.
- Verify correct operation.
- Check the '+12 Vdc' line at 2FD12. The line should be between +11.8 Vdc and +13.3 Vdc.
- Check the '-6 Vdc' line at 2FD06. The line should be between -5.9 Vdc and -6.6 Vdc.

Are the voltages in tolerance?

Y N

- Check the '+12 Vdc' at J01-5 and the '-6 Vdc' at J01-3 on the light pen feature card.

Are the voltages within limits?

Y N

- Check the cable to the light pen power supply card.
- Replace the light pen power supply card.
- Inspect the 2F interposer.
- Replace the light pen feature card (125).
- Check the '+5 Vdc' line at 2-J-D03.

Is the voltage correct?

Y N

- Inspect the interposer for an open.
- Replace the planar; set the jumpers correctly on the new planar (103) (105).
- Probe the '-POR' line at 2-E-B04.

Is the line at an Up level?

Y N

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

A

A

- Probe the following lines on the interposer at the 2F socket of the planar.

Line Name	Pin	Level
-end of row	B02	Pulsing
-horiz blank	B07	Pulsing
+LNC	B08	Pulsing
-vertical blank	B12	Pulsing

Are all of the lines pulsing?

Y N

- Power off.
- Disconnect the 2J cable at the 2F interposer.
- Power on
- Probe the failing line at the 2F interposer.

Is any light on?

Y N

- Inspect the interposer.
- Replace the light pen feature card (125).

Is the Down light on?

Y N

- Probe the failing line at the 1J interposer.

Is the line pulsing?

Y N

- Power off.
- Disconnect the 2J cable at the planar interposer.
- Power on.
- Probe the failing line on the J interposer.

Is the line pulsing?

Y N

- Inspect the interposer.
- Replace the planar; set the jumpers correctly on the new planar (103) (105).
- Replace the 2J cable.
- Replace the 2J cable.

- Inspect the interposer.

- Replace the light pen feature card (125).

B

120 (continued)**B**

- Enter several characters and press the Field Exit key.
- Place the light pen tip on the CRT at a displayed character while probing the '-LP photocell' line at 2-F-D13.

Does the line pulse?**Y N**

- Check for a ground.
 - Replace the light pen assembly (125).
- Probe the '-reg 25 bit 6' line at 2-E-D06 while holding the light pen tip at a character on the CRT.

Does the line pulse?**Y N****Is the line at a Down level?****Y N**

- Replace the light pen feature card (125).
- Inspect the interposer.
 - Replace the planar; set the jumpers correctly on the new planar (103) (105).
- Inspect the interposer for an open.
 - Replace the planar; set the jumpers correctly on the new planar (103) (105).
- No failure was found. If the problem still exists, use the suggested action for an intermittent problem.

Suggested action for an intermittent problem:

- Analyze the suspected line; inspect all the connector contacts.
- Replacement sequence:
 - Light pen feature card
 - Light pen feature assembly
 - Light pen power supply card
 - Planar

121 LIGHT PEN REGISTER AND CONTROL MINI-MAP

- Use this mini-MAP to correct a light pen problem when the light pen feature causes a problem on the keyboard or display or when the cursor is unstable immediately after power-on.
- For mini-MAP example, see *Troubleshooting Aids* (212).

Conditions After Power On

- The reg 13 'bits 1, 2, 4, 5, and 6' lines are at an Up level.
- The reg 13 'bits 0, 3, and 7' lines are at a Down level.
- The '-LNC' line is pulsing.
- The '-LP photocell' line should be at an Up level.

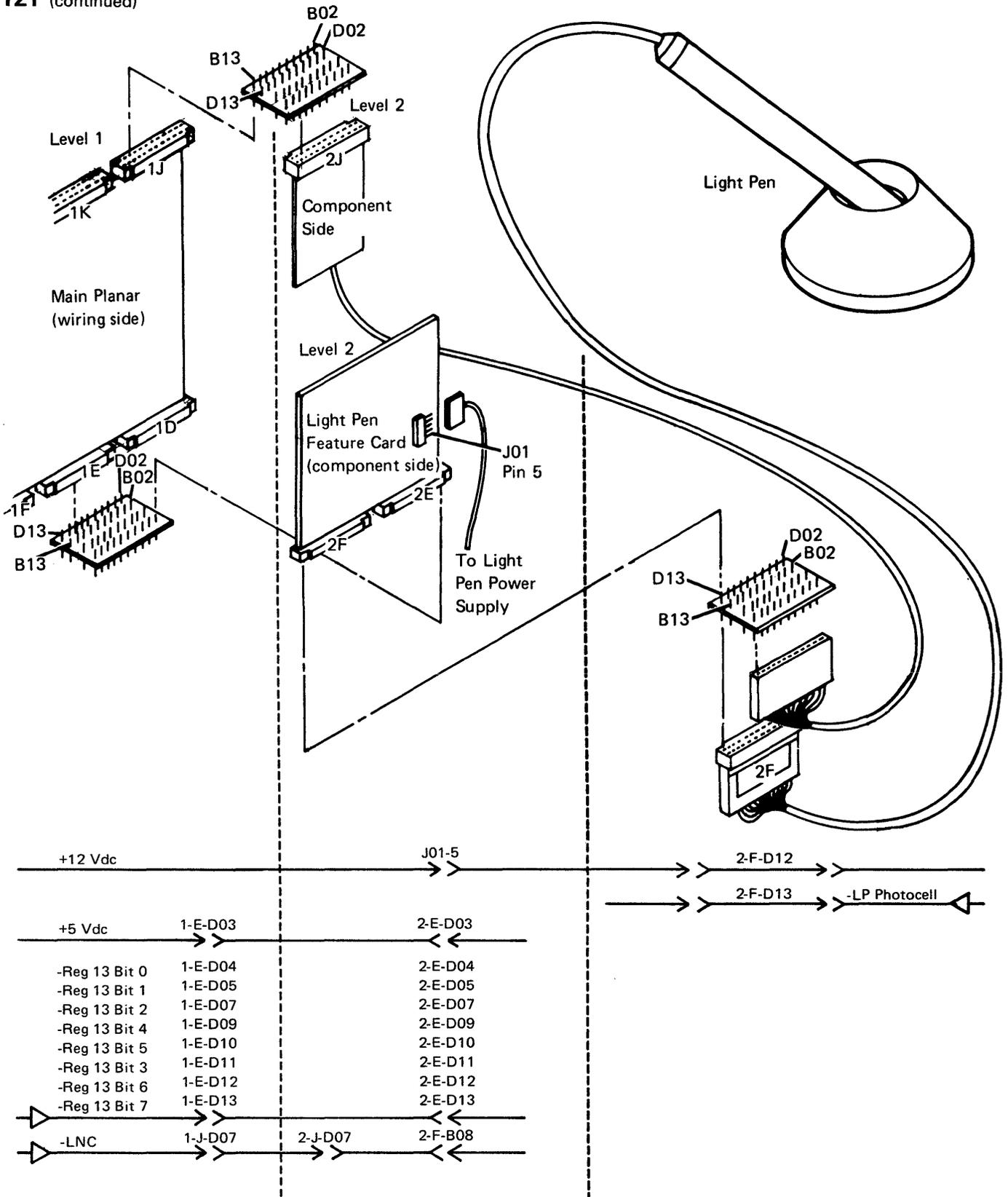
Service Aids

- The display station will *not* be damaged if it is powered on after the keyboard, MSR, or light pen has been disconnected.

Tools

Connect the CE probe as follows:

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



121 (continued)

- Check for proper positioning of the jumper on the card (124).

Is the card jumpered correctly?

Y N

- Set the jumper correctly.
- Verify correct operation.
- Power off.
- Disable the MSR feature if it is installed (119).
- Power on.
- Check the +12 Vdc at 2-F-D12.
- The +12 Vdc should be between 11.8 Vdc and 13.3 Vdc.

Is the voltage in tolerance?

Y N

- Check the '+12 Vdc' at J01-5 cable connector on the light pen card.

Is the voltage in tolerance?

Y N

- Check the cable to the light pen power supply card.
- Replace the light pen power supply card.
- Inspect the 2F interposer.
- Replace the light pen card (125).

- Check the +5 Vdc line at 2-E-D03.

Is the voltage correct?

Y N

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

A

A

- Probe the '-LP photocell' line at 2-F-D13.

Is the line at an Up level?

Y N

- Power off.
- Disconnect the light pen cable.
- Power on.
- Probe the '-LP photocell' line at 2-F-D13.

Is the line at a Down level?

Y N

- Inspect the interposer.
- Replace the light pen card (125).
- Replace the light pen assembly (125).

Is the problem invalid (unrecognizable) characters on the display screen?

Y N

- Probe the following lines on the interposer at the 1E socket of the planar:

Line Name	Pin	Level
-reg 13 bit 0	D04	Down
-reg 13 bit 1	D05	Up
-reg 13 bit 2	D07	Up
-reg 13 bit 4	D09	Up
-reg 13 bit 5	D10	Up
-reg 13 bit 3	D11	Down
-reg 13 bit 6	D12	Up
-reg 13 bit 7	D13	Down

Are all of the lines at the level as shown above?

Y N

B C D

121 (continued)

B C D

- Power off.
- Disconnect the 2J cable at the 2J interposer.
- Power on.
- Probe the failing line on the interposer at the 1E socket of the planar.

Is the line now at the correct level as shown above?

Y N

- Power off.
- Disconnect the light pen feature card by disconnecting the interposer at connector 1E and plugging it into the planar connector only.
- Power on.
- Probe the failing line on the interposer.

Is the line now at the correct level as shown above?

Y N

- Inspect the interposer.
- Replace the planar; set the jumpers correctly on the new planar (103) (105).
- Replace the light pen feature card (125).

- Replace the 2J cable.

B C

B C

- Press any data character key (grey key).
- Probe the '-reg 13 bit 3' line at 1-E-D11.

Is the line at an Up level?

Y N

- Power off.
- Disconnect the light pen feature card by disconnecting the interposer at connector 1E and plugging it into the planar connector only.
- Power on.
- Press any data character key (grey key).
- Probe the '-reg 13 bit 3' line at 1-E-D11.

Is the line at an Up level?

Y N

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

- Replace the light pen feature card (125).

- Probe the '-reg 13 bit 7' line at 1-E-D13 while pressing several data character keys (grey keys).

Does the line pulse with any key?

Y N

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

- Inspect the interposer.

- Replace the light pen feature card (125).

- The '-LNC' line is failing.

- Replace the light pen feature card (125).

Suggested action for an intermittent problem:

- Analyze the suspected line; inspect all the connector contacts.
- Replacement sequence:
 - Light pen feature card
 - Light pen feature assembly
 - Light pen power supply card
 - Planar

122 LIGHT PEN REGISTER AND CONTROL MINI-MAP

- Use this mini-MAP to correct a light pen problem when the cursor does not follow the light pen or when the light pen blanks data on the display screen.
- For mini-MAP example, see *Troubleshooting Aids* (212).

Conditions After Power On

- The '-reg 13 bit 2' line should be at an Up level.
- The '-reg 5 bit' lines should be Up except '-reg 5 bit 6', which should be Down.
- The '1.0 MHz', '-horiz blank', and '+LNC' lines should be pulsing.

Service Aids

- The '-reg 13 bit 2' line should pulse when the light pen is being used.
- The display station will *not* be damaged if it is powered on after the keyboard, MSR, or light pen has been disconnected.

Tools

Connect the CE probe as follows:

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

122 (continued)

- Check for proper positioning of the jumper on the card (124).

Is the card jumpered correctly?

Y N

- Set the jumper correctly.
 - Verify correct operation.
- Probe the '-reg 13 bit 2' line at 1-E-D07.

Is the line at an Up level?

Y N

- Inspect the interposer.
 - Replace the planar; set the jumpers correctly on the new planar (103) (105).
- Probe the '-horiz blank' line at 2-F-B07 and the '+LNC' line at 2-F-B08.

Are both lines pulsing?

Y N

- Power off.
- Disconnect the 2J cable at the 2F interposer.
- Power on.
- Probe the failing line at the 2F interposer.

Is any light On?

Y N

- Inspect the interposer.
- Replace the light pen feature card (125).

Is the Down light On?

Y N

- Probe the failing line at the 1J interposer.

Is the line pulsing?

Y N

- Power off.
- Disconnect the 2J cable at the planar interposer.
- Power on.
- Probe the failing line at the J interposer.

Is the line pulsing?

Y N

A B C D E

A B C D E

- Inspect the interposer.
- Replace the planar; set the jumpers correctly on the new planar (103) (105).
- Replace the 2J cable.
- Replace the 2J cable.

- Inspect the interposer.
- Replace the light pen feature card (125).

- Power off.
- Wait five seconds.
- Power on.
- Probe the following lines. Record any lines that are not at the level shown.
- Press the left shift key for each line. Do not press any other keys.

Line Name	Pin	Level
-reg 5 bit 1	1-E-B03	Down light pulses
-reg 5 bit 0	1-E-B05	Down light pulses
-reg 5 bit 2	1-E-B07	Up
-reg 5 bit 5	1-E-B08	Down light pulses
-reg 5 bit 3	1-E-B09	Down light pulses
-reg 5 bit 4	1-E-B10	Up
-reg 5 bit 6	1-E-B12	Down light pulses
-reg 5 bit 7	1-E-B13	Down light pulses

Are all the lines at the level shown above?

Y N

- Power off.
- Disconnect the light pen feature card by unplugging the interposer at connector 1E and plugging it into the planar connector only.
- Power on.
- Probe the failing line on the interposer.

Is the line at the correct level?

Y N

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

F G

122 (continued)**F G**

- Replace the light pen feature card (125).
- Press the I key (key position number 35) for each line.
- Probe the following lines. Record any lines not at the level shown.

Line Name	Pin	Level
-reg 5 bit 1	1-E-B03	Up
-reg 5 bit 0	1-E-B05	Up
-reg 5 bit 2	1-E-B07	Up (Down light pulses)
-reg 5 bit 5	1-E-B08	Up
-reg 5 bit 3	1-E-B09	Up
-reg 5 bit 4	1-E-B10	Up (Down light pulses)
-reg 5 bit 6	1-E-B12	Up
-reg 5 bit 7	1-E-B13	Up

Are all the lines at the level shown?**Y N**

- Power off.
- Disconnect the light pen feature card by unplugging the interposer at connector 1E and plugging it into the planar connector only.
- Power on.
- Probe the failing line on the interposer.

Is the line at the correct level?**Y N**

- Inspect the interposer.
- Replace the planar; set the jumpers correctly on the new planar (103) (105).
- Replace the light pen feature card (125).
- Probe the '1.0 MHz osc' line at 1-E-B02.

Is the line pulsing?**Y N**

- Inspect the interposer.
- Replace the planar; set the jumpers correctly on the new planar (103) (105).
- Inspect the interposer.
- Replace the light pen feature card (125).

Suggested action for an intermittent problem:

- Analyze the suspected line; inspect all of the connector contacts.
- Replacement sequence:
 - Light pen feature card
 - Light pen feature assembly
 - Light pen power supply card
 - Planar

123 LIGHT PEN TIP SWITCH MINI-MAP

- Use this mini-MAP to correct a light pen problem when the tip switch on the light pen is not operating correctly.
- For mini-MAP example, see *Troubleshooting Aids* (212).

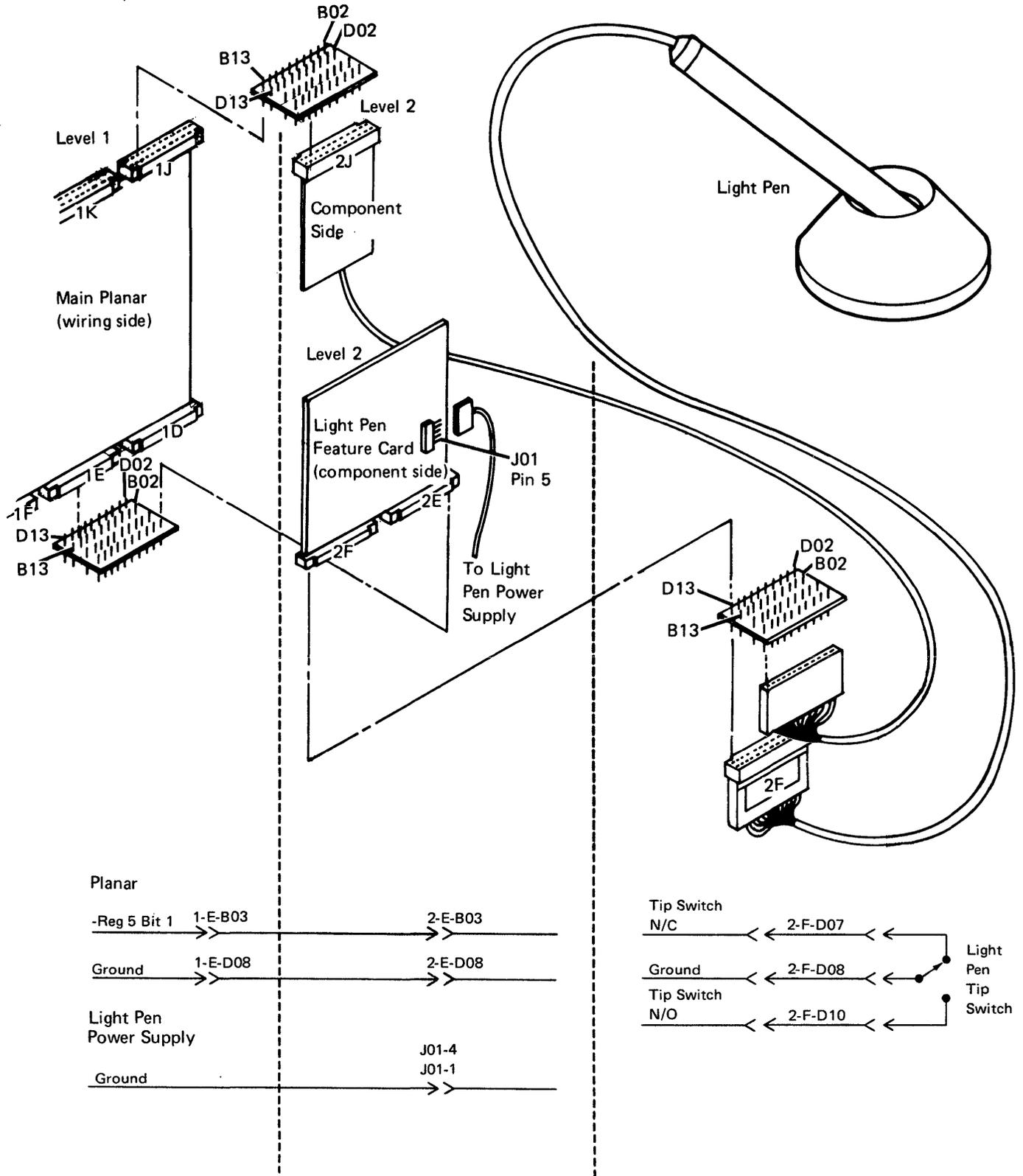
Service Aids

- The display station will *not* be damaged if it is powered on after the keyboard, MSR, or light pen has been disconnected.
- The '-reg 5 bit 1' line is used to send the tip switch signal to the planar.

Tools

Connect the CE probe as follows:

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



123 (continued)

—Probe the 'reg 5 bit 1' line
at 2-E-B03.

Is any probe light On?

Y N

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

—Check the ground at 2-F-D08.

Is the ground OK?

Y N

- Inspect the interposer.
- Replace the light pen feature card (125).

—Use a CE meter to check the operation of the tip switch.

Does the tip switch operate correctly?

Y N

- Replace the light pen feature assembly (125).

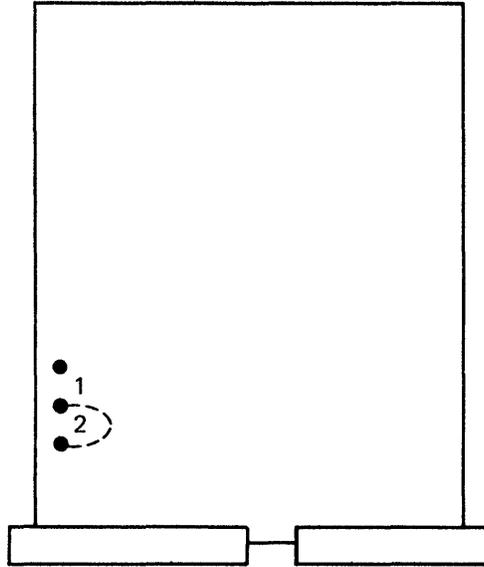
—Inspect the interposer.

—Replace the light pen feature card (125).

Suggested action for an intermittent problem:

- Analyze the suspected line; inspect all of the connector contacts.
- Replacement sequence:
 - Light pen feature card
 - Light pen feature assembly
 - Light pen power supply card
 - Planar

124 LIGHT PEN CARD JUMPERING



Jumper Positions

1	2
off	on

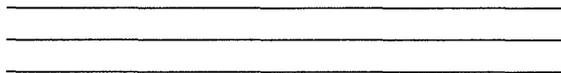
125 LIGHT PEN INSTALLATION AND REMOVAL

Installation

1. Power off.
2. Open the rear cover.
3. Hold the light pen feature card with the component side facing you.
4. Place the small interposer on the left hand side connector of the card with the test pins toward the component side.
5. Place the light pen feature card (with the component side out) on the stiffener in positions E and F.
6. Secure the card to the stiffener with plastic clips.
7. Lower the planar to allow access to the bottom row of connectors.
8. While holding the light pen feature card, insert the large interposer in position E in such a manner that the pins on the interposer enter the slots on both the card and the planar.
9. Place the planar into the service position.
10. Loosen the screw on the plate that covers the line cord. This plate is located on the right rear corner of the machine.
11. Remove the plate.
12. Rotate the 5251 until only the right rear corner is positioned off the table.

CAUTION

Ensure that the remaining three corners remain firmly on the table.



13. Feed the light pen cable through the same slot as the line cord. Feed enough cable in so that the ground strap on the cable is inside the machine.

14. Connect the ground strap to a ground screw on the machine.
15. Connect the cable to position F on the light pen card.
16. Place the plate that was removed in step 11 over the light pen cable and the line cord and tighten the screw.
17. Slide the light pen power supply card into the card guides behind the power supply.
18. Install 2 screws through the card into the power supply.
19. Connect the lead, with the slip on end, to the power supply printed circuit board at pin E4.
20. Connect the other lead, with the ring end, to the frame of the power supply.
21. Route the cable from the light pen power supply card to the planar board and connect it to the light pen card.
22. Move the 5251 back onto the table.
23. Place the planar into the operating position.
24. Close the rear cover.

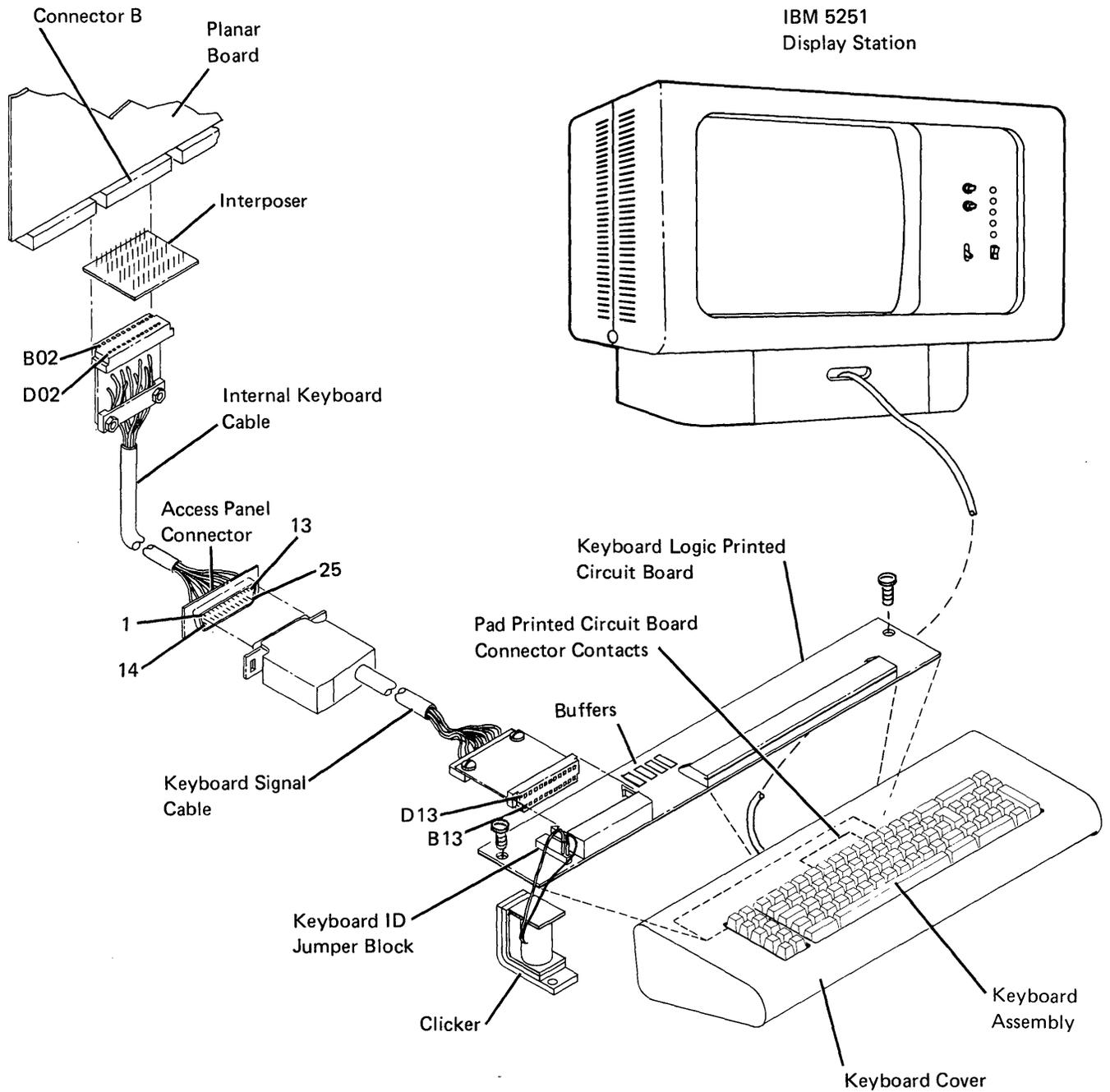
Removal

To remove the Light Pen feature, reverse the installation steps.

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KEYBOARD

130 KEYBOARD LOCATIONS



131 KEYBOARD REMOVAL AND DISASSEMBLY

Removal

1. Power off.
2. Loosen the four screws on the bottom of the keyboard assembly.
3. Remove the keyboard cover.

Disassembly

1. Remove four screws on each side of the keyboard (130).
2. Remove the keyboard logic printed circuit board (130).
3. If a key module is to be removed, locate the position of the key before the keyboard is inverted and pull off the keytop; use the keytop removal tool (part 9900373).
4. Lift the key unit out of the keyboard base.

CAUTION

The keyboard assembly must be kept free of dirt.

5. Invert the key unit and reinstall it on the original mounting block; use a screw on each side to hold the assembly in place.

CAUTION

Do not remove the pad printed circuit board while a key is pressed. Removing the pad printed circuit board while a key is pressed causes the flyplate to jump out of the key module.

6. Ensure that there is no pressure on any keys.
7. Remove the screws from the pad printed circuit board.
8. Slowly lift the pad printed circuit board from the key assembly.

Assembly

To assemble, reverse the above procedure.

132 CLEANING

CAUTION

If you use excessive pressure when cleaning the flyplates, you could cause them to become disengaged from the spring.

1. Disassemble the keyboard (131).
2. Clean the pad printed circuit board with a lint free cloth that is moistened with water. Check the flyplates for dirt; clean only those flyplates that are dirty or are causing failures.

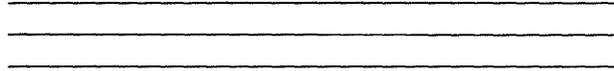
133 KEY MODULE

Removal

1. Use the keytop removal tool (part 9900373) to lift the keytops from the keys to be removed.

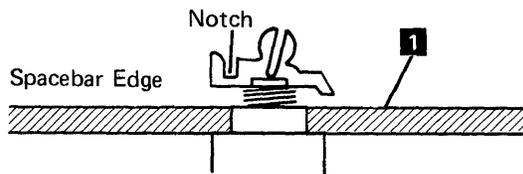
CAUTION

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



2. Disassemble the keyboard (131).
3. Reach under the key unit and push up the failing key module until it is free.

Note: The module retaining ears must clear the frame **1** as shown.



Installation

1. Insert the key module. Align the opening in the key module with the location lug in the mounting hole. The key stem must be positioned, so the notch is facing the Spacebar edge of the keyboard.
2. Reinstall the pad printed circuit board.
3. Turn the key unit over and, if necessary, place the dust shield in the correct position.
4. Put the keytop on the key unit.
5. Reinstall the logic printed circuit board and cover.

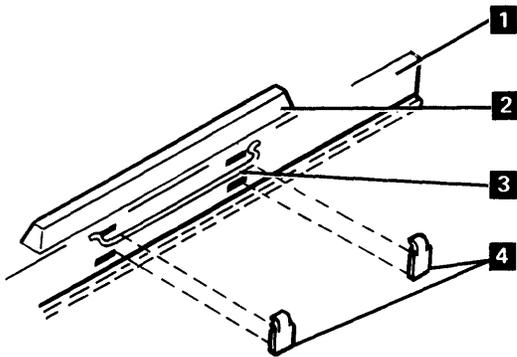
134 SPACEBAR

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

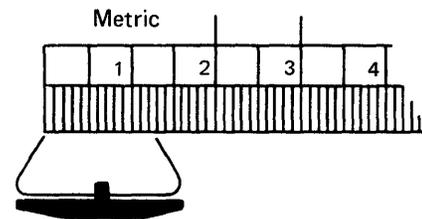


135 FLYPLATE REPLACEMENT

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 that the connection is not loose between the spring and flyplate or that the flyplate is not damaged.

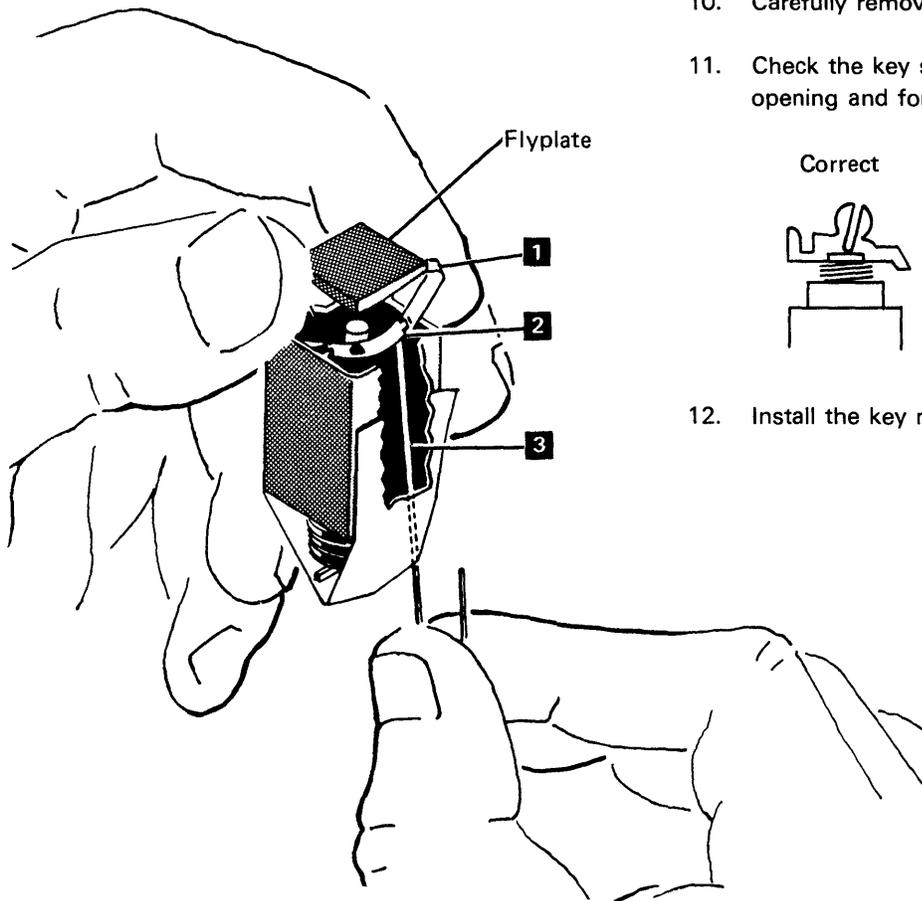
1. Disassemble the keyboard (131).
2. Remove the key module (133).
3. Form the spring on the flyplate so that there is 12.7 mm (0.5 inch) between the ends of the spring.



4. Tape the key stem down as shown.

135 (continued)

5. Hold the key module and flyplate as shown and line up the ends of the flyplate spring **1** with the tips of the flat spring **2** attached to the key stem.
6. Insert a small stylus or a straight paper clip in one of the access holes in the key module **3**.

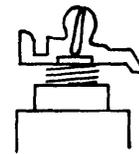


7. Push up the tip of the flat spring on the inside of the flyplate spring.
8. Move the flat spring down until the tab drops into the opening of the flyplate spring.
9. Attach the other end of the spring in the same way.
10. Carefully remove the tape holding the key stem.
11. Check the key stems for taper in the center opening and form them if necessary.

Correct



Wrong



12. Install the key module in the key assembly.

136 KEYBOARD ID MINI-MAP

- Use this mini-MAP 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 and a 1 is displayed in the ID field while the Status switch is in the Test position.
- ID lines *without* jumpers are at an Up level and a 0 is displayed in the ID field while the Status switch is in the Test position.

Service Aids

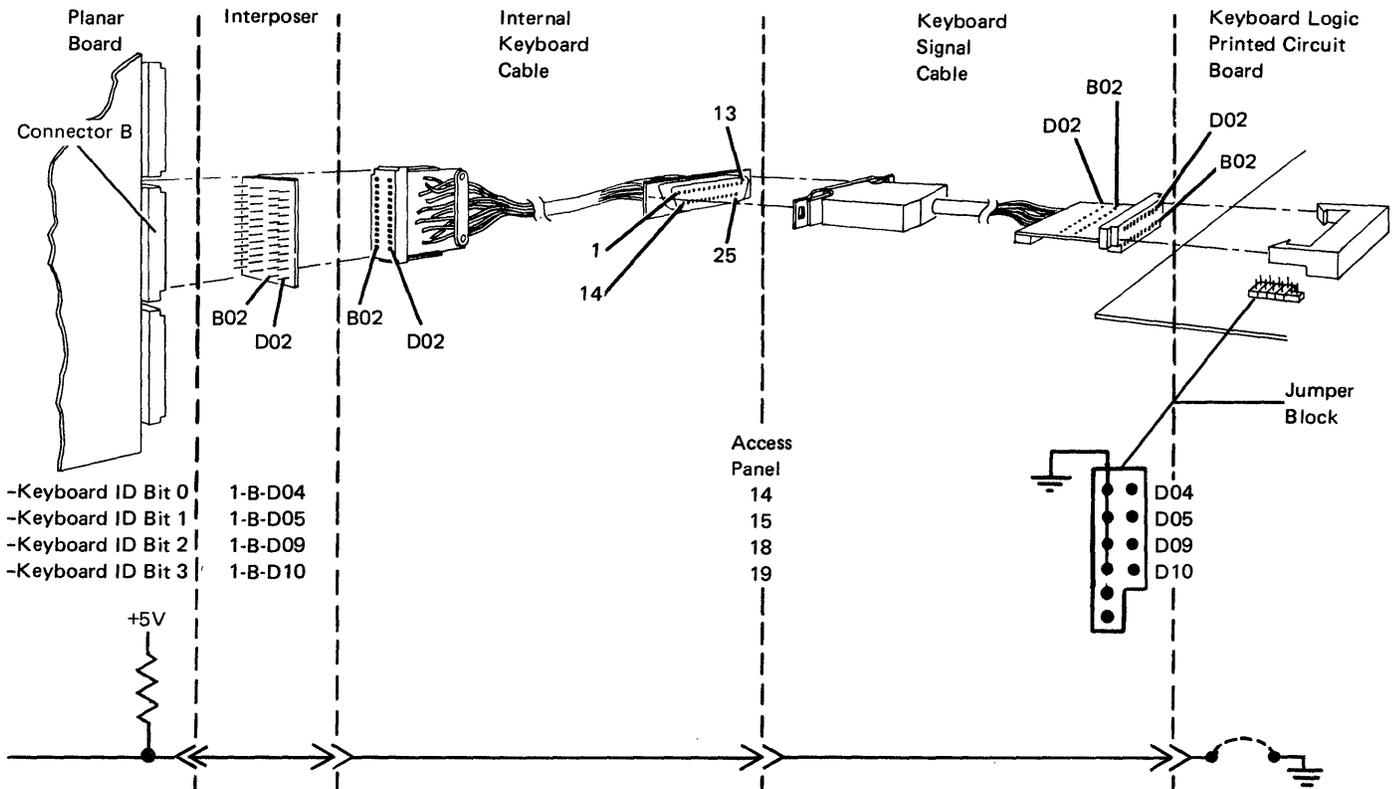
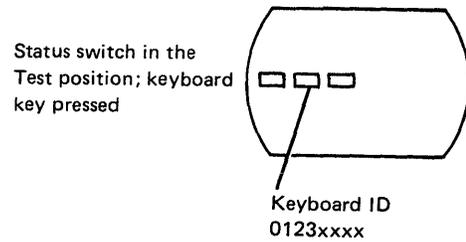
- Verify that the ID jumpers shown on the *Keyboard Identification* chart (142) are correct.
- The display station will *not* be damaged if it is powered on after the keyboard cable has been disconnected.

Tools

Connect the CE probe as follows:

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

Display Screen



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 ID jumper removed.

The line should be 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

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

Service Aids

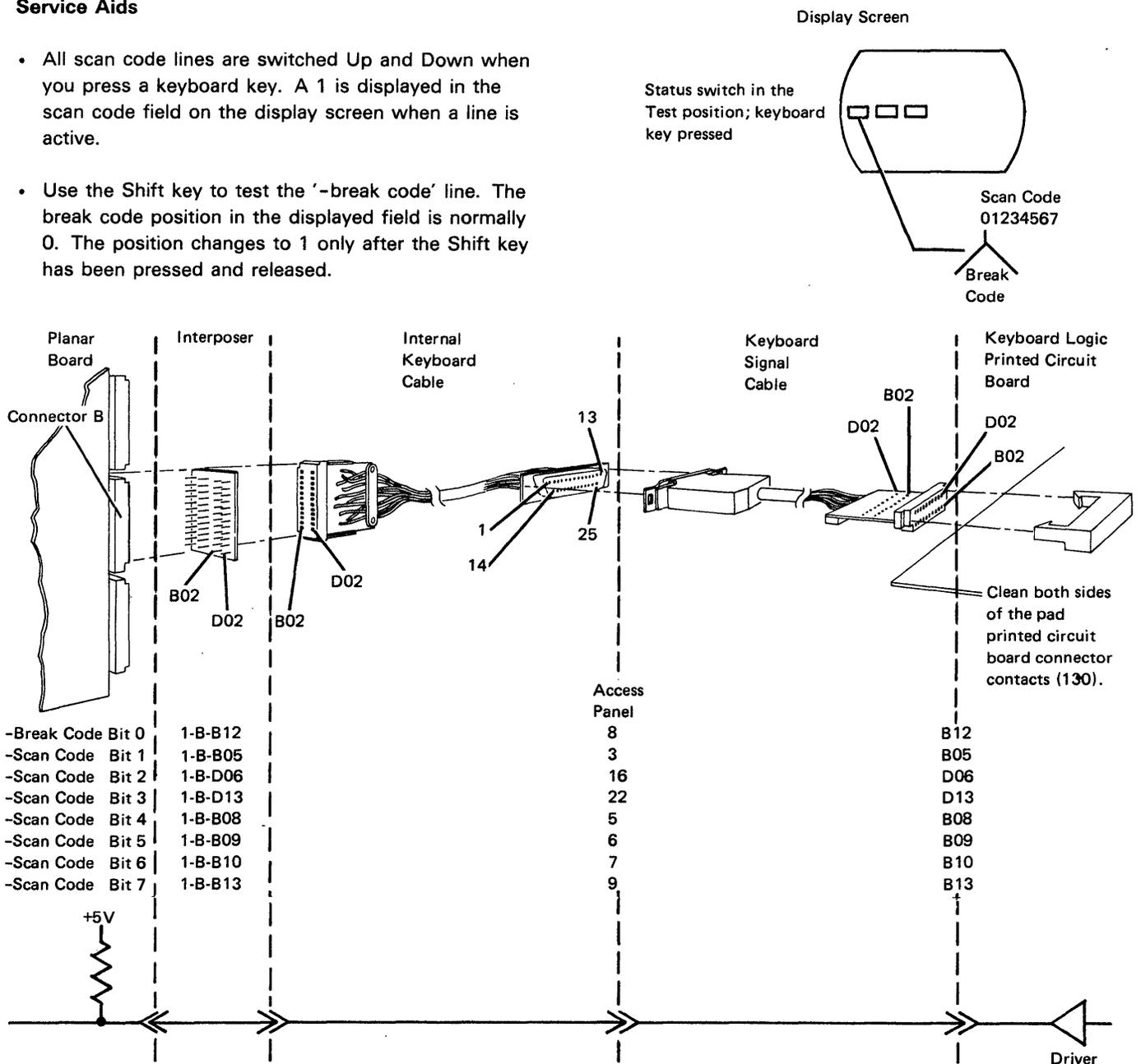
- All scan code lines are switched Up and Down when you press a keyboard key. A 1 is displayed in the scan code field on the display screen when a line is active.
- Use the Shift key to test the '-break code' line. The break code position in the displayed field is normally 0. The position changes to 1 only after the Shift key has been pressed and released.

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

Tools

Connect the CE probe as follows:

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



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; set the jumpers correctly on the new PC board (142).
- Disconnect the cable at the keyboard end.

Is the line still at a Down level?

Y N

- Replace the keyboard logic PC board; set the jumpers correctly on the new PC board (142).
- 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



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138 KEYBOARD VOLTAGE AND STROBE MINI-MAP

- Use this mini-MAP to correct a data strobe, power-on reset, 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 you press a key).
- The 'power-on reset' line is at an Up level.
- The '+delay strobe' line is negative (-) (the pulse will be positive when you press a key.)

Service Aids

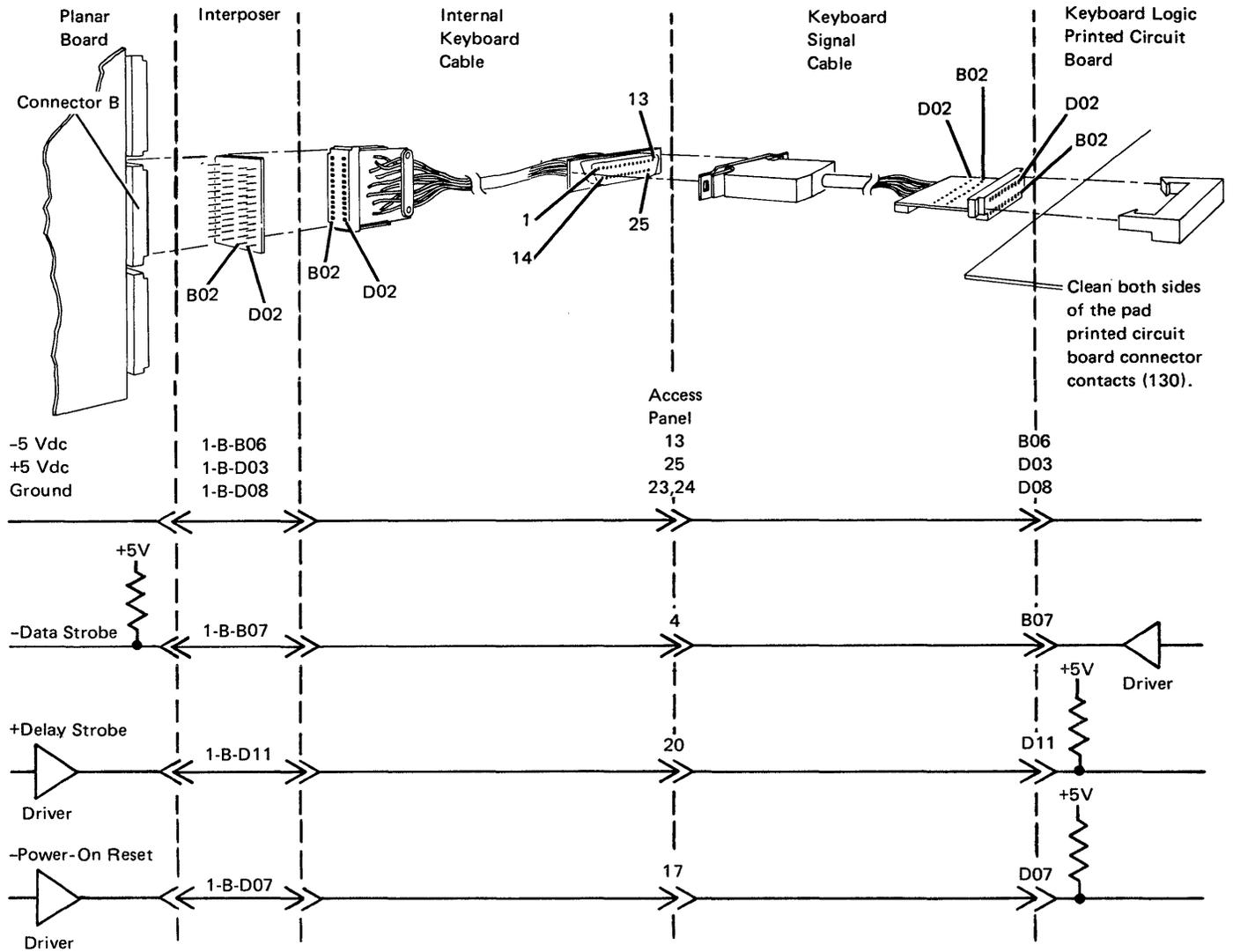
- The 'power-on reset' line is at a Down level for about 0.5 seconds during power on.
- When you press a key, the '-data strobe' line pulses at a Down level.
- When the planar receives the '-data strobe' line, it pulses the '+delay strobe' line at an Up level.
- A failure in the '-5 Vdc', '+5 Vdc', '-data strobe', or '+delay strobe' line causes both the '-data strobe' and '+delay strobe' lines to fail.
- The display station will *not* be damaged if it is powered on after the keyboard cable has been disconnected.

Tools

Connect the CE probe as follows:

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

138 (continued)



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

Is the line at an Up level?

Y N

- Use MIM 141 to isolate the failure.
- Check the '+5 Vdc' and the '-5 Vdc' lines at the planar.

Are the voltages correct?

Y N

- A ground in the cable or keyboard 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 the '-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.

A

A

Does the line pulse when a key is held down?

Y N

- Check the '+DELAY strobe' line for an open.
- Inspect the -5 Vdc, the +5 Vdc, and B07 ('-DATA strobe' line) contacts on the keyboard end of the cable.

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).

- Disconnect the cable at the keyboard end.
- Check the '+DELAY strobe' line for a ground.

Is the line grounded?

Y N

- Check the '+DELAY strobe' line for a ground at the cable connector on the keyboard logic PC board.

Is the line grounded?

Y N

- Replace the planar; set the jumpers correctly on the new planar (103) (105).
- Replace the keyboard logic PC board; set the jumpers correctly on the new PC board (142).

- Disconnect the cable at the planar.
- Check the '+DELAY strobe' line for a ground at the planar.

Is the line grounded?

Y N

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

138 (continued)

Suggested action for an intermittent problem:

- Analyze the suspected line; inspect all the connector contacts.
- Clean the pad PC board contacts (132).
- Replacement sequence:
 - Logic PC board
 - Planar
 - Keyboard cables

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139 KEYBOARD CLICKER MINI-MAP

- Use this mini-MAP 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.

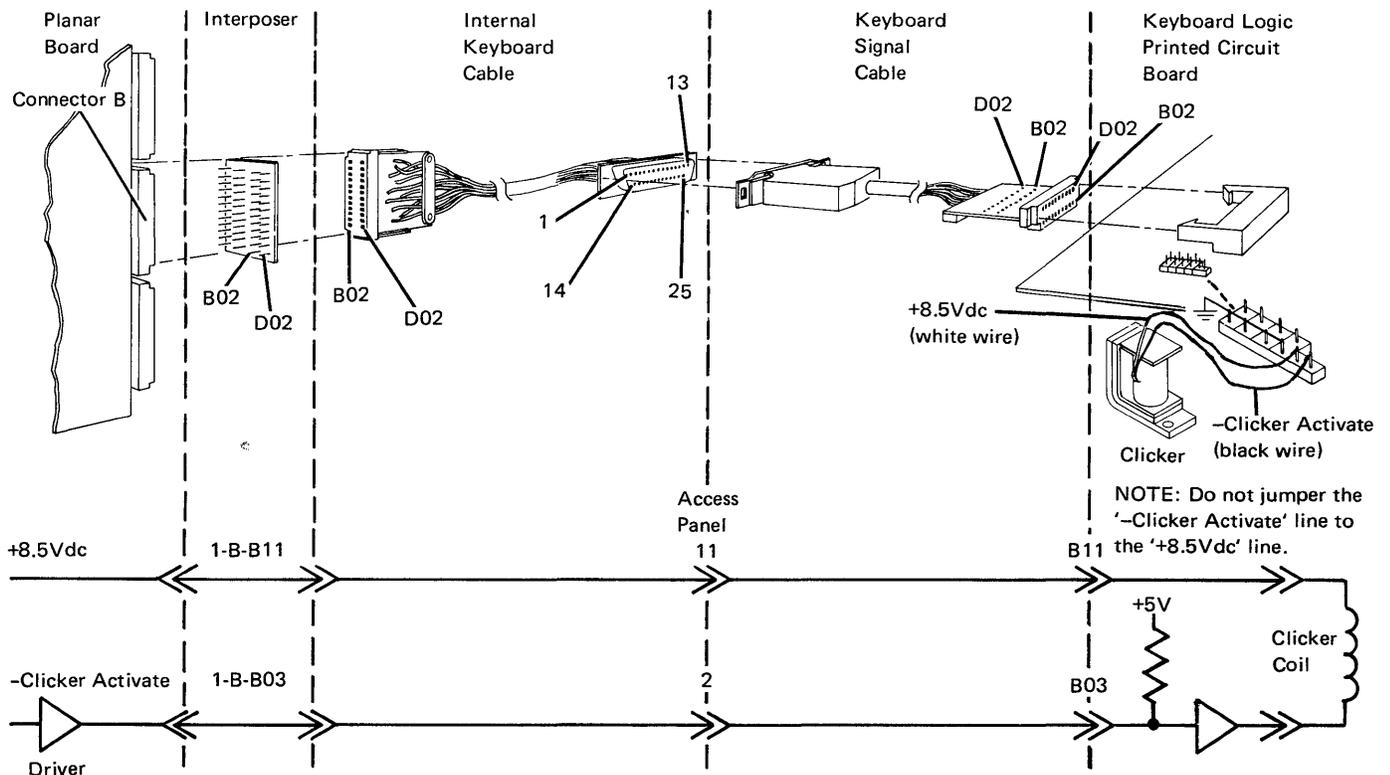
Service Aids

- The '-clicker activate' line pulses at a Down level when you press a key. This pulsing causes the clicker to sound. This line also pulses each time the program loops while the Status switch is in the Test position.
- To test the clicker coil, you can remove the lower wire from the connector block and touch a frame ground. You should hear a click each time you touch the wire to ground.
- The display station will *not* be damaged if it is powered on after the keyboard cable has been 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

- 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 planar.

Note: When **no** key is pressed, the line should be at an Up level. If the line is not at an Up level, answer no to the next question.

Does the line pulse each time a key is pressed?

Y N

Is the line at a Down level?

Y N

Does the line (B03) pulse 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:
 - Keyboard logic PC board
 - Planar
 - Keyboard cables

140 KEYBOARD CABLE CHECK MINI-MAP

- Use this mini-MAP to locate an open in the cable check lines.
- 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.

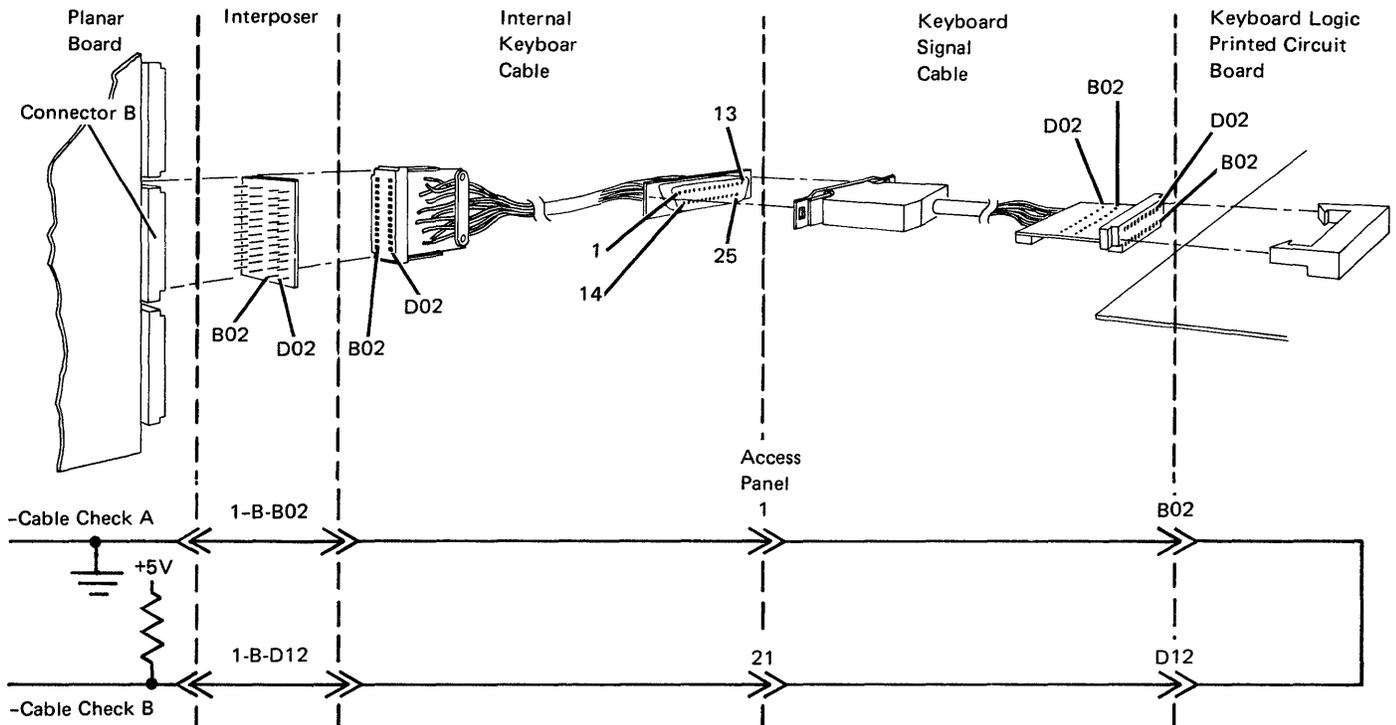
Service Aids

The display station will *not* be damaged if it is powered on after the keyboard cable has been 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’ (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 B02 to D12
- If the problem still occurs, replace the planar. If the problem does not occur, the cable or keyboard logic PC board could be open.

141 KEYBOARD POR MINI-MAP

- Use this mini-MAP 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.

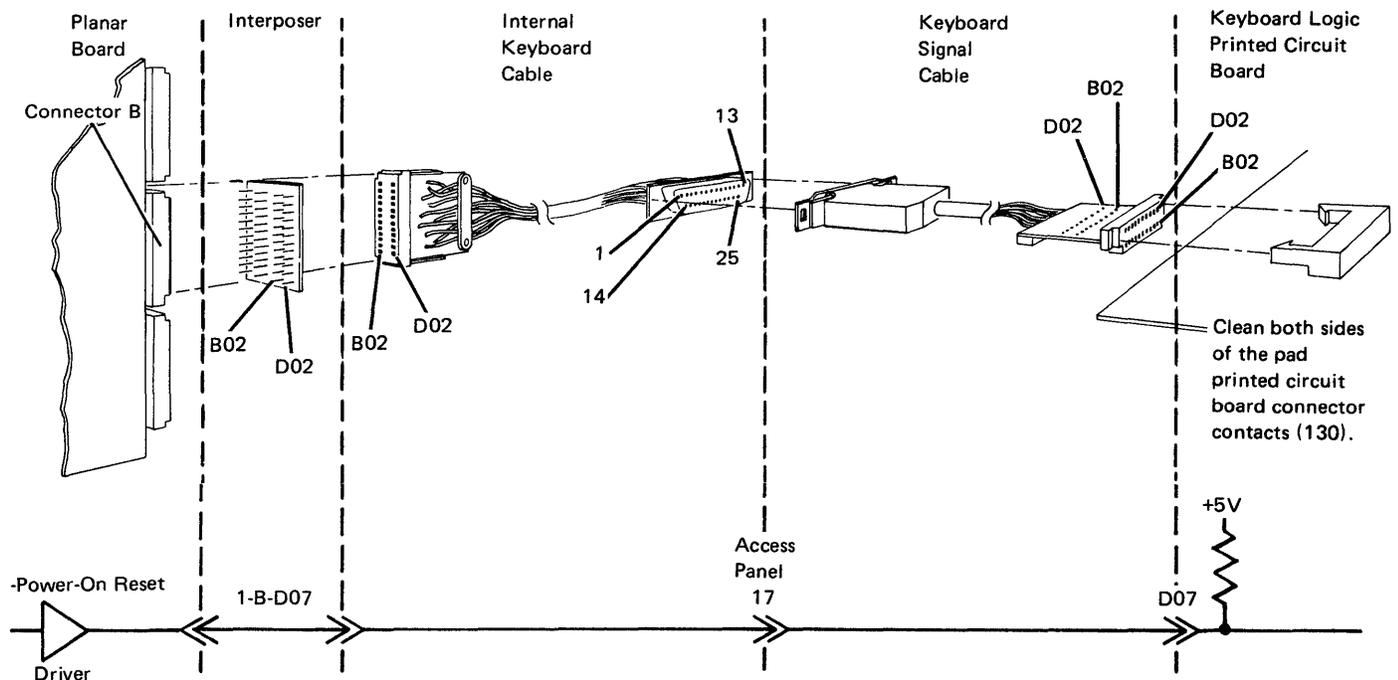
Service Aids

- 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 it is powered on after the keyboard cable has been disconnected.

Tools

Connect the CE probe as follows:

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



141 (continued)

- 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 0100 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:

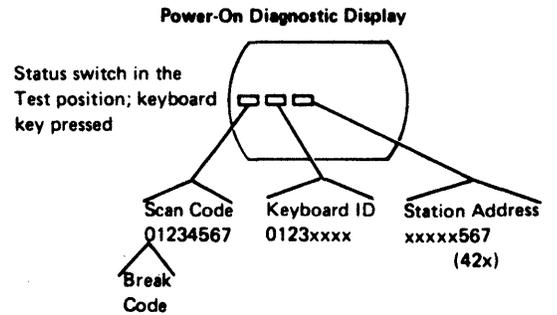
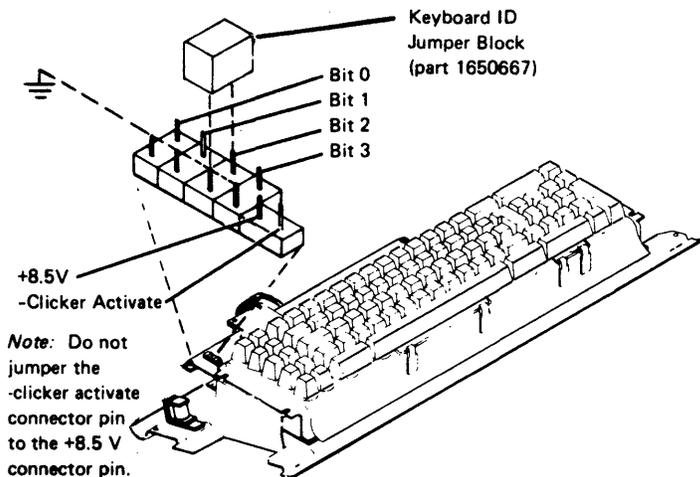
- Analyze the suspected line; inspect all the connector contacts.
- Clean the pad PC board contacts.
- Replacement sequence:
 - Logic PC board
 - Planar
 - Keyboard cables

142 KEYBOARD IDENTIFICATION

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

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

* 1 = Jumpered
0 = Not jumpered



143 KEYBOARD ARRANGEMENT

The keyboard arrangement section shows the key numbers for the keyboards. The key numbers are the same as the key-position numbers in the scan code table (144).

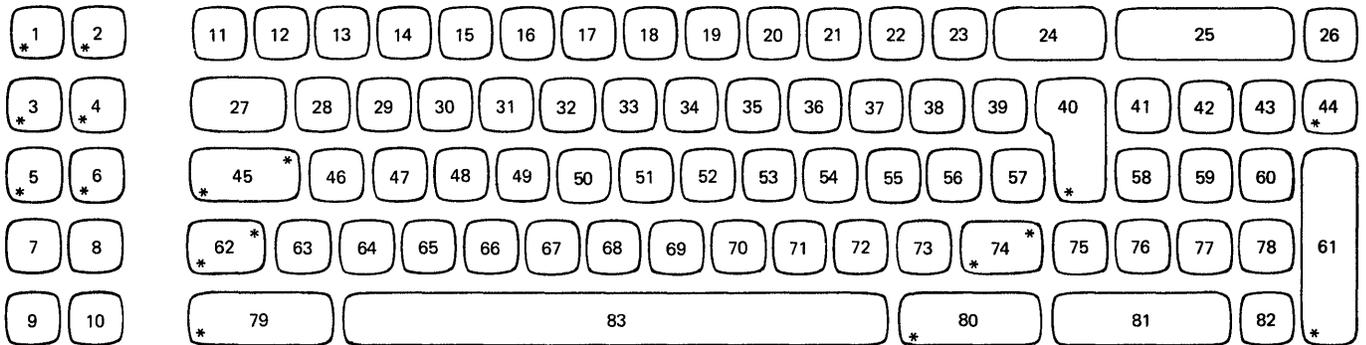
Keyboard Template (GX21-9266)

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

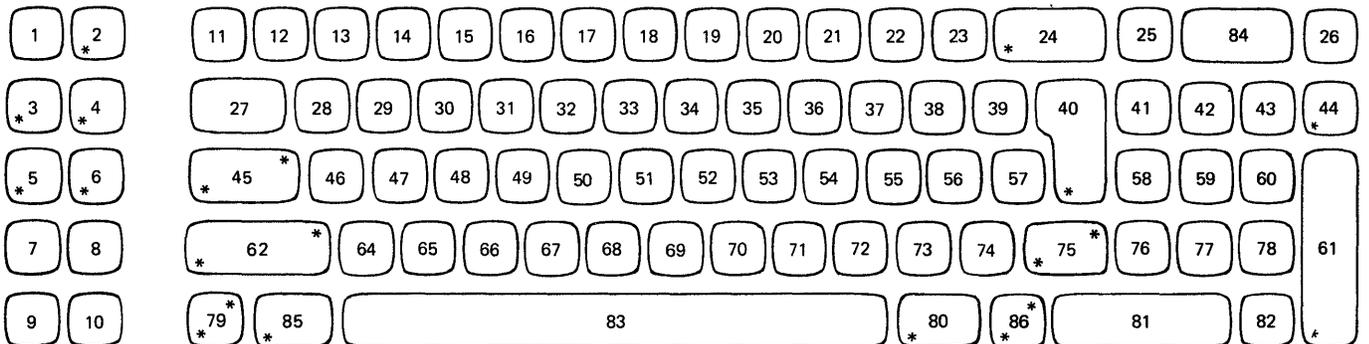
The keys in the top row on the keyboard allow you to use the command functions. When you press the Cmd (command) key and then one of the top row keys, you select command functions 1 through 12 or Test Request. When you press the Cmd key, then hold down the Shift key and press one of the top row keys, you select the 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 so that the names of the command functions on the template are the same as the names of the commands performed by the top row of keys.

Standard Keyboard Layout



Standard Keyboard Layout (Katakana)

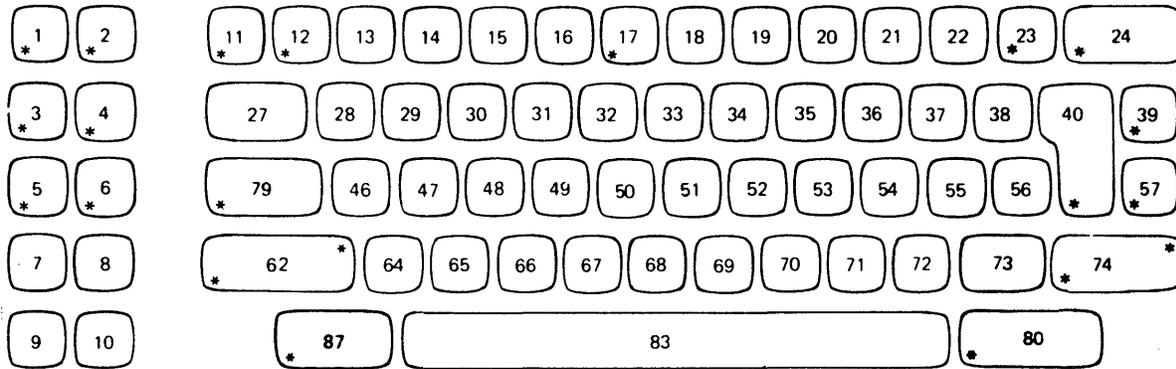


Not a typamatic key

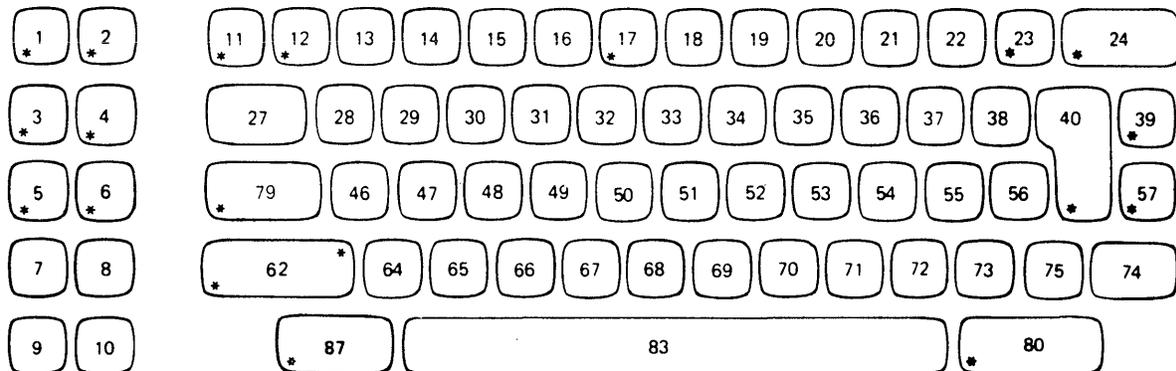
A make/break key

143 (continued)

Data-Entry Keyboard Layout (66 Keys)



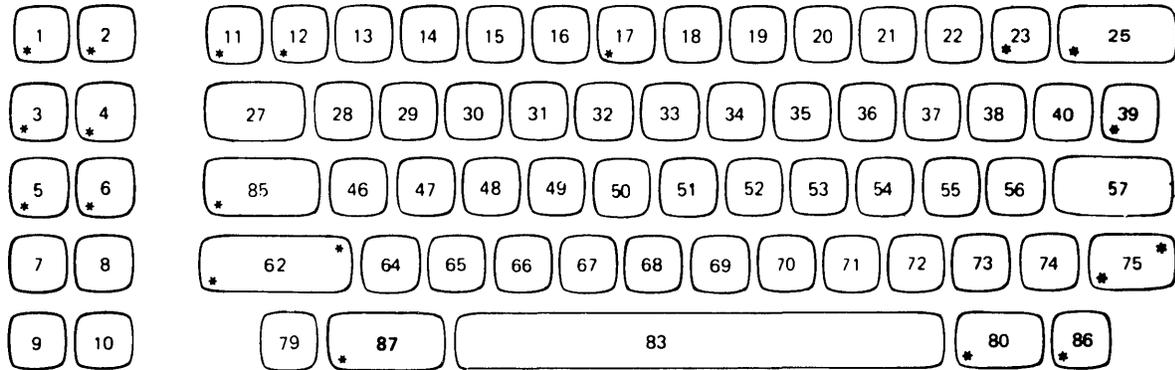
Data-Entry Keyboard Layout (67 Keys)



-  Not a typamatic key
-  A make/break key

143 (continued)

Katakana Data-Entry Keyboard Layout (69 Keys)



Not a typamatic key



A make/break key

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144 SCAN CODE TABLE

Scan codes are a function of the physical position of the keyboard keys. The following table shows the 8-bit scan code, the hexadecimal code, and the key position for the keyboards. The * (asterisk) in scan code position 0 indicates that the key is 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. When the US and the Katakana scan codes are different, the Katakana code is listed below the US code for that key position.

144 (continued)

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
24 Katakana	61	01100001	68	05	00000101
25	4B	01001011	69	06	00000110
25 Katakana	3D	00111101	70	07	00000111
26	4C	01001100	71	08	00001000
27	20	00100000	72	09	00001001
28	21	00100001	73	0A	00001010
29	22	00100010	74	56	*1010110
30	23	00100011	74 Katakana	0C	00001100
31	24	00100100	75	0C	00001100
32	25	00100101	75 Katakana	56	*1010110
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	79 Katakana	53	*1010011
38	2B	00101011	80	68	01101000
39	2C	00101100	81	40	01000000
40	2D	00101101	82	4A	01001010
41	47	01000111	83	0F	00001111
42	48	01001000	84	4B	01001011
43	49	01001001	85	7E	01111110
			86	52	*1010010
			87	69	01101001

150 DISPLAY ASSEMBLY LOCATIONS

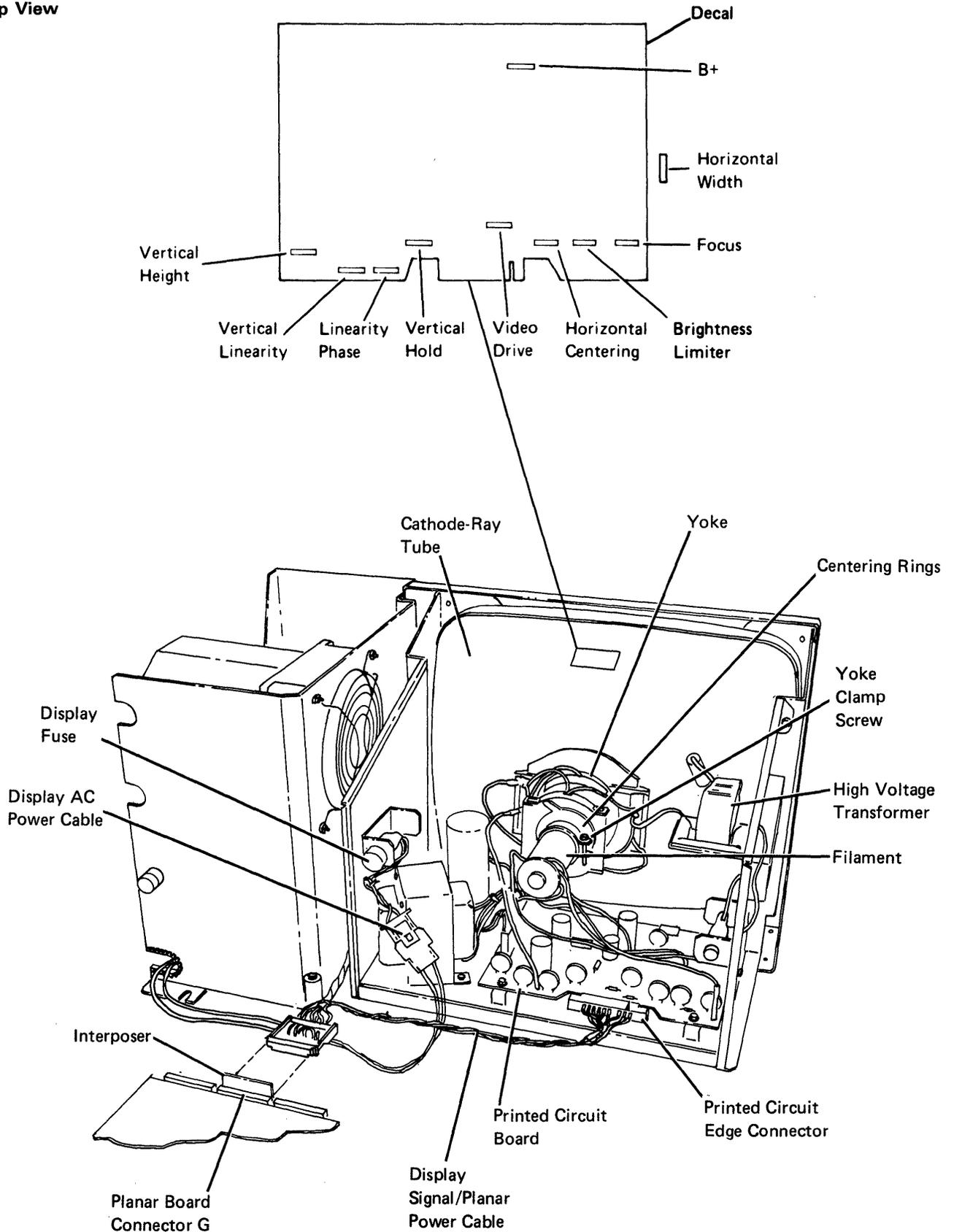
The display assembly installed in your machine might not be the same as the one shown here, because several manufacturers supply the display assemblies. Although the display assemblies might look different, they are similar and generate the same signals and displays.

Always refer to the decal on the CRT to locate the adjustments on the printed circuit board. If the adjustment does not appear on the decal, it is not required on your machine.

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

150 (continued)

Top View



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.

Removal

1. Power off and remove the line cord from the wall outlet.
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 two base mounting screws and the four front mounting screws or screws and nuts.

DANGER

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

6. Lift the display assembly from the display station housing.
7. Place the used display assembly in the shipping container so it can be returned to the branch office.

Replacement

1. Move the rubber shock mounts to the location needed for the type of display you are installing.
2. Set the new display assembly in the display station.
3. Fasten the display assembly with six mounting screws or screws and nuts.
4. Connect the printed circuit edge connector. Align the pointer on the connector with the notch in the printed circuit board (157).
5. Connect the display ac power cable (150).
6. If necessary, make the display adjustments (152 through 155).
7. Align the display assembly to allow the front cover to close properly.
8. Close the front and rear covers (108).
9. Check the gap between the bezel and the display assembly to ensure that the gap is not too much (100).
10. If the gap is too much, return to step 7.

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 limiter potentiometer on the display assembly.
- The Contrast control on the control panel.
- The Brightness control on the control panel.

Some displays also have a video gain/video drive adjustment.

Brightness Limiter Potentiometer Adjustment

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

Note: Too much brightness might cause poor focus.

Contrast Control and Brightness Control Adjustments

1. Run the online tests (206).
2. Select option 1 (display attributes) from the Display Verification Menu.
3. The Hs on 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/Video Drive Potentiometer Adjustment

On some display assemblies, the video gain/video drive potentiometer is used to limit the brightness of the characters. Normally, use the Brightness control on the control panel for getting the best display screen image. The video gain can also correct differences between the intensity of the horizontal and vertical lines of a character.

153 VERTICAL AND HORIZONTAL ADJUSTMENTS

Perform the appropriate vertical adjustment if:

- The characters have rapid vertical movement (hold).
- The display rolls vertically (hold).
- The display is too short (height).
- The character height is not correct (linearity or phase).

Perform the proper horizontal adjustment if:

- The screen is too narrow (width).
- The right or left margin is incorrect (centering).
- The screen shows horizontal motion (centering).

If the problem is not corrected after you have made the adjustments, replace the display assembly.

Vertical Adjustments

Each vertical adjustment could affect the others. Anytime the screen image rolls, you should adjust the vertical hold potentiometer before you continue with the other vertical adjustments.

Vertical Hold Potentiometer Adjustment

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

1. Set the Status switch to the Test position to display the scan code, address, and ID fields.
2. Observe the display screen while you turn the vertical hold potentiometer in each direction until the screen image rolls. Note each roll position.
3. Turn the vertical hold potentiometer to the center of its range. Do *not* allow the picture to roll. If a small adjustment causes the picture to roll up and then down, replace the display assembly.

Vertical Height Potentiometer Adjustment

This potentiometer is used to adjust the overall display screen height. The nominal height for the Model 1 is 166 mm \pm 6 mm (6.53 inches \pm 0.24 inch). The nominal height for the Model 11 is 190 mm \pm 6 mm (7.48 inches \pm 0.24 inch).

Vertical Linearity Potentiometer Adjustment

This potentiometer is used to control the balanced height of the characters.

The vertical height potentiometer and vertical linearity potentiometer can affect each other. Adjust them until you get the desired result.

Linearity Phase Potentiometer Adjustment

This potentiometer is used to adjust the balanced character height between the top of the screen and the bottom of the screen.

Horizontal Adjustments

Horizontal Width Potentiometer Adjustment

The horizontal width potentiometer is used to control the width of a display. This potentiometer is adjusted at the factory to 205 mm \pm 6 mm (8.06 inches \pm 0.24 inch) for the Model 1 and 252 mm \pm 6 mm (9.93 inches \pm 0.24 inch) for the Model 11. If there is a horizontal position problem, correct the problem by adjusting the centering rings.

Horizontal Centering, Horizontal Set, or Horizontal Oscillator Potentiometer Adjustment

Adjust the horizontal centering potentiometer to center the video within the raster.

1. Turn the brightness limiter potentiometer on the display assembly until a raster appears.
2. Ensure that the raster margins are equal. See reference 155.
3. Adjust the horizontal centering, horizontal set, or horizontal oscillator to center the data within the raster.
4. Turn the brightness limiter potentiometer until the raster disappears.

154 YOKE ADJUSTMENT (150)

Adjust the yoke until the display is the correct size and is aligned horizontally.

1. Loosen the yoke clamp screw on the yoke collar.
2. Place the yoke as far forward as possible against the bell part of the cathode-ray tube.
3. Turn the yoke to correct the tilted display.
4. Tighten the yoke clamp screw on the yoke collar.

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

155 CENTERING ADJUSTMENT (150)

The centering rings, are used to determine the horizontal and vertical positions of a display. If the display is tilted, do *not* adjust the centering rings; turn the yoke (154). The following adjustments will affect each other. Adjust both rings to get the best results.

1. Adjust the rear centering ring for horizontal centering. The space on the left and right margins of the display should be equal.
2. Adjust the front centering ring for vertical centering.
3. If the adjustment cannot be made, replace the display assembly (151).

FACTORY ADJUSTMENTS

CAUTION

The following factory adjustments should *not* be attempted; they are described for your information only:

Focus Potentiometer Adjustment

The focus potentiometer is used to obtain a desired display focus. The factory adjusts the potentiometer to provide the best complete screen definition.

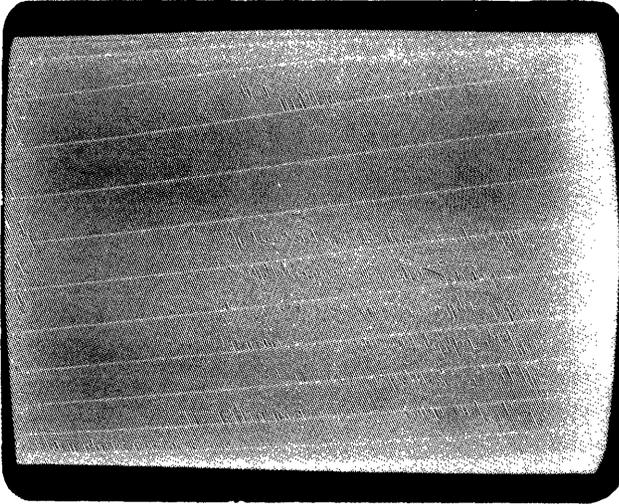
B+ Potentiometer Adjustment

The B+ voltage is set at the factory with a precision meter. No attempt should be made to adjust this voltage. If the B+ voltage is out of adjustment, there is a loss of display image. Because many other parts in the display assembly can cause the same symptom, the display assembly should be replaced.

156 RASTER

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

Note: A reverse image display could look like a raster display. However, when you use reverse image, the indicator area is not within the lighted area of the display screen. When a raster is displayed, the lighted area of the display screen includes the indicator area.

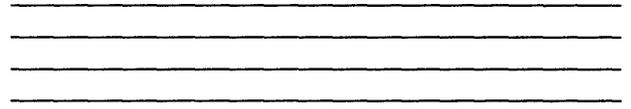


If there is a raster condition on the display screen, ensure that the raster check jumper is removed; then perform the *Video Adjustments* (152).

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 main planar board (105). This jumper places a solid high level voltage on the video signal line. A complete raster will check the display assembly and display signal cable.

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157 DISPLAY ASSEMBLY CABLE MINI-MAP

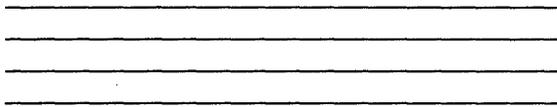
- Use this mini-MAP to locate problems with the '+horizontal sync', '-vertical sync', and '+video' lines.
- For mini-MAP example, see *Troubleshooting Aids* (212).

Conditions After Power On

Each line is pulsing.

CAUTION

Do not power on the display station while the display signal/planar power cable is 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).
- The power supply supplies power through connector G on the planar.
- The planar supplies signals to the display assembly. (The display assembly has its own power supply.)

Dark Screen

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

Vertical Rolling, Overlapped Lines of Data, or Unstable Display

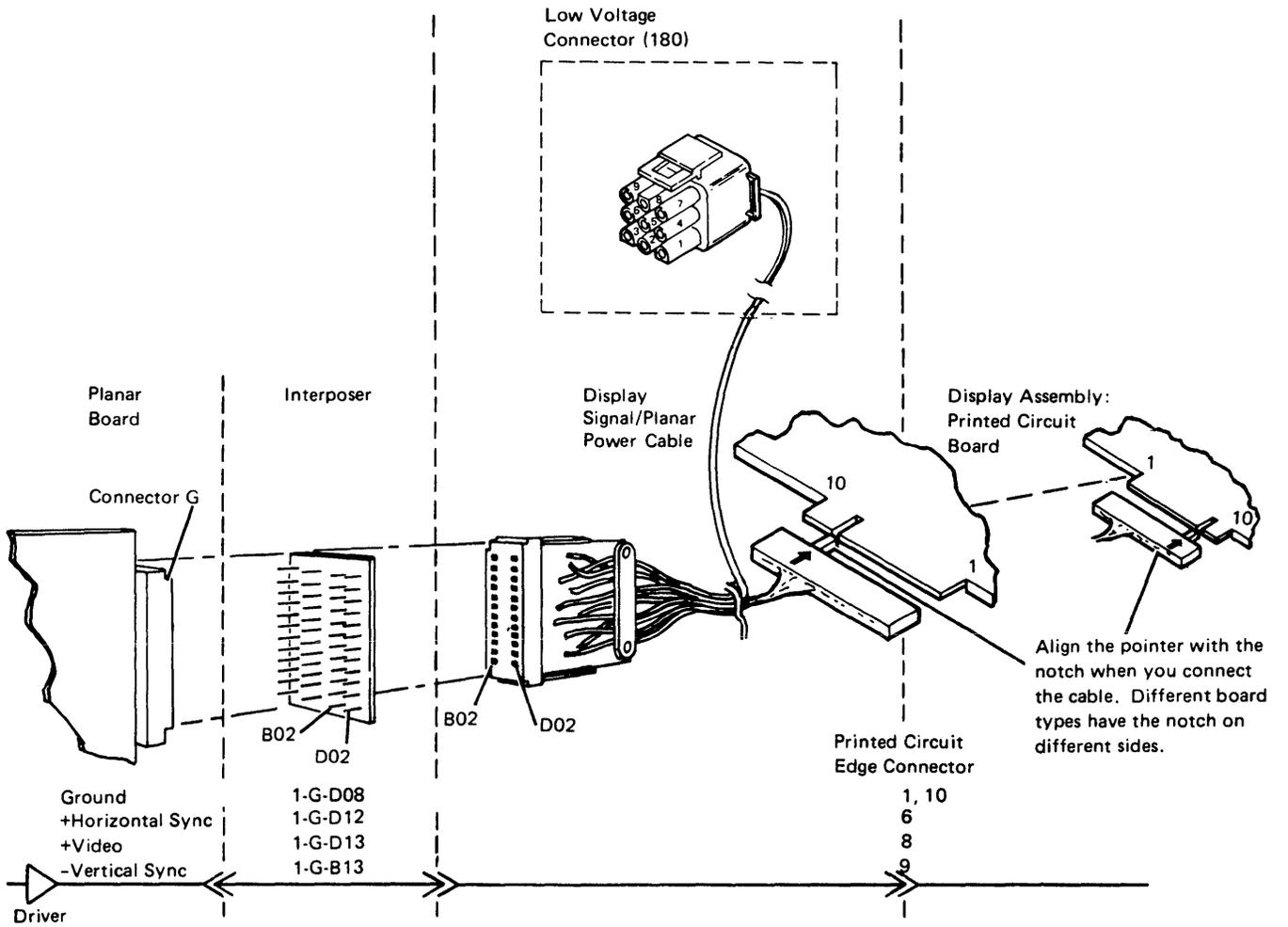
- Check the horizontal and vertical lines for an open.
- Check the adjustments (153).

Tools

Connect the CE probe as follows:

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

157 (continued)



157 (continued)

- 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?

Y N

- Power off.
- Disconnect the cable at the display.
- Power on.

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.

Does the MAP call out any other line that has not been checked?

Y N

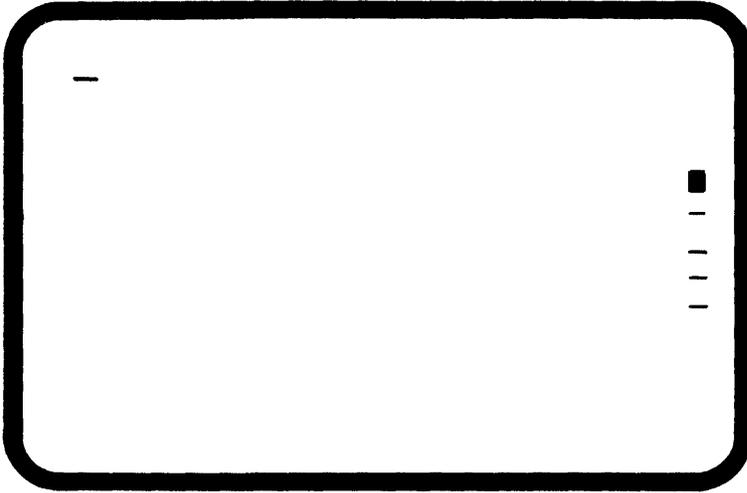
- Reconnect the display AC power connector (150).
- Make adjustments if applicable (153).
- Replace the display assembly.
- Repeat this procedure for the other line.

Suggested action for an intermittent problem:

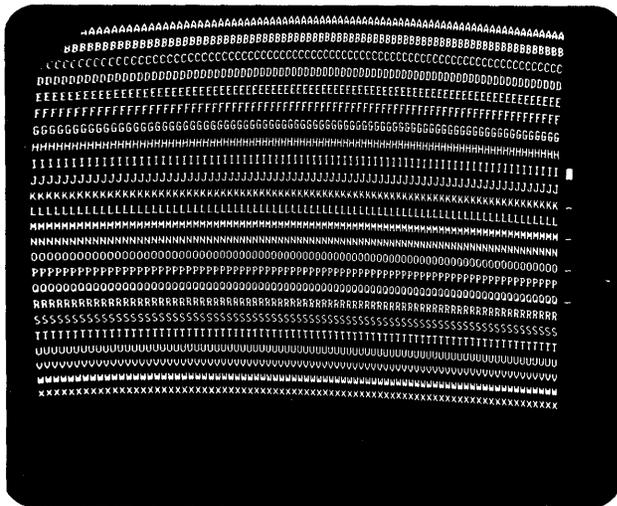
- Analyze the suspected line; inspect all the connector contacts.
- Replacement sequence:
 - Display assembly
 - Planar
 - Display signal/planar power cable

158 DISPLAY SCREEN EXAMPLES

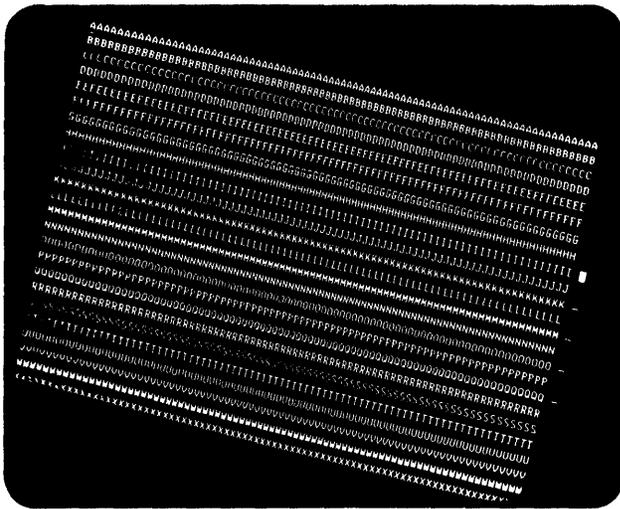
Normal screen (free key mode):



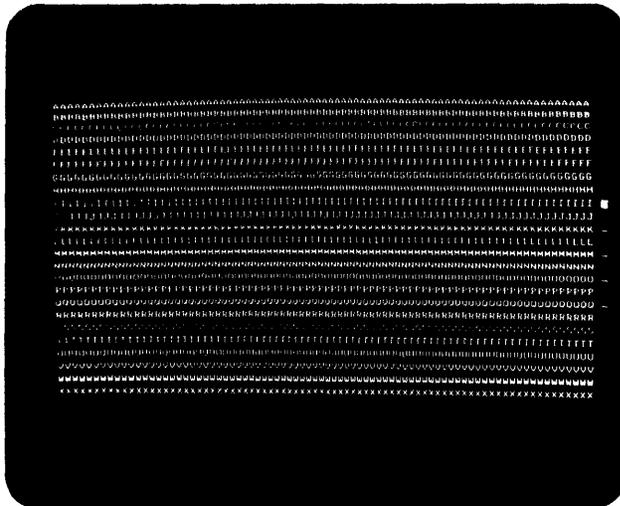
Display not centered



Tilted display

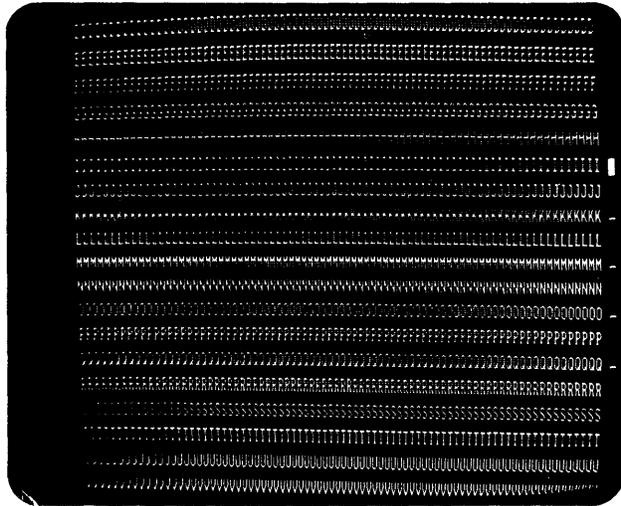


Display size not correct (too small)

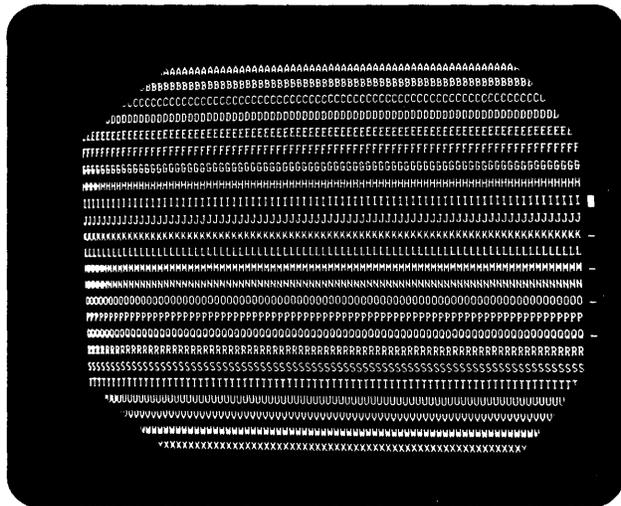


158 (continued)

Display size not correct (expanded vertically)



Characters missing only in the corners



System Cable

170 CUSTOMER SYSTEM CABLE SIGNAL QUALITY CHECK

CAUTION

All of the work stations will be taken off line while the customer system cable signal quality check is being performed.

The customer system cable signal quality check is a controller diagnostic procedure. Information on this signal quality check is located in the controller documents. If you are not trained on the controller, call for a service representative who is trained on the system.

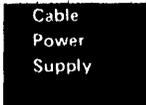
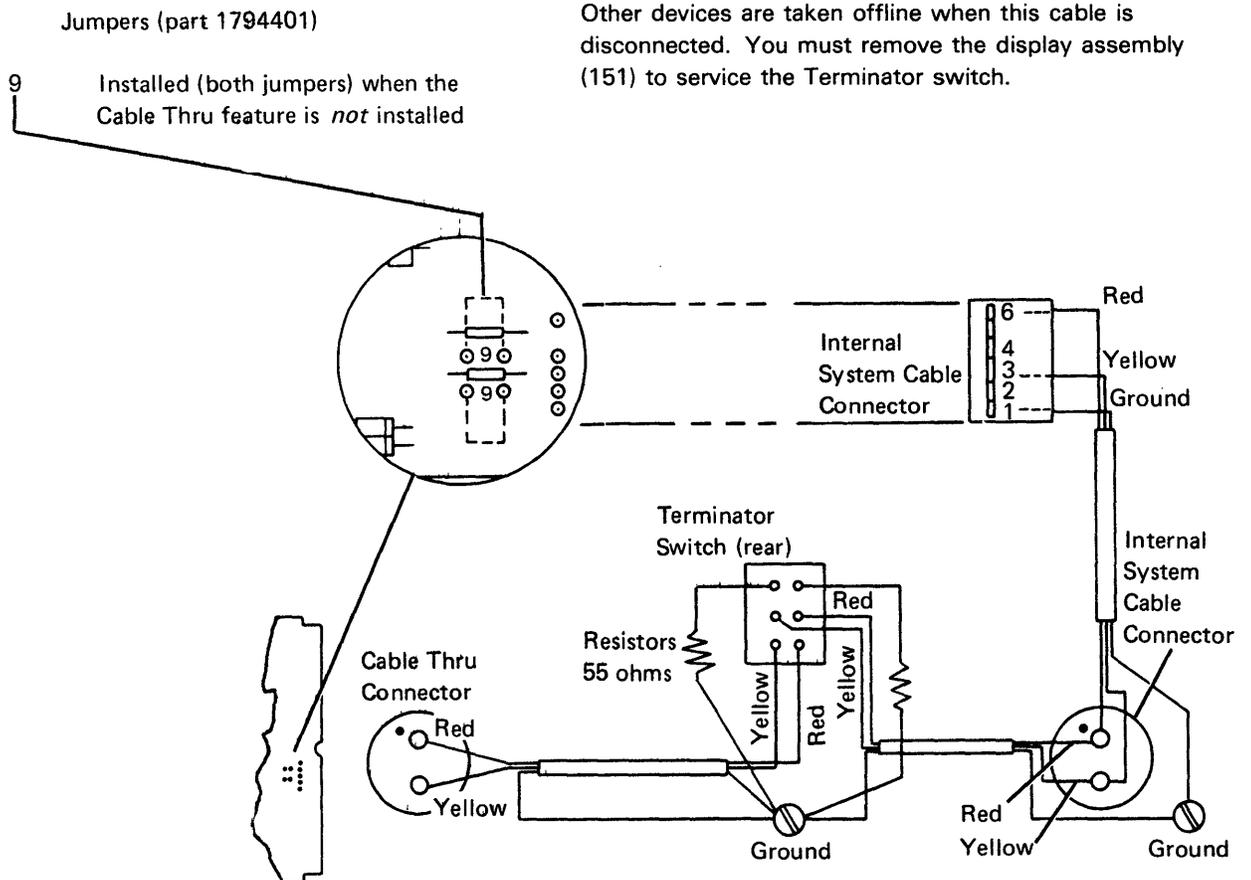
171 INTERNAL SYSTEM CABLE AND TERMINATOR SWITCH

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

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.

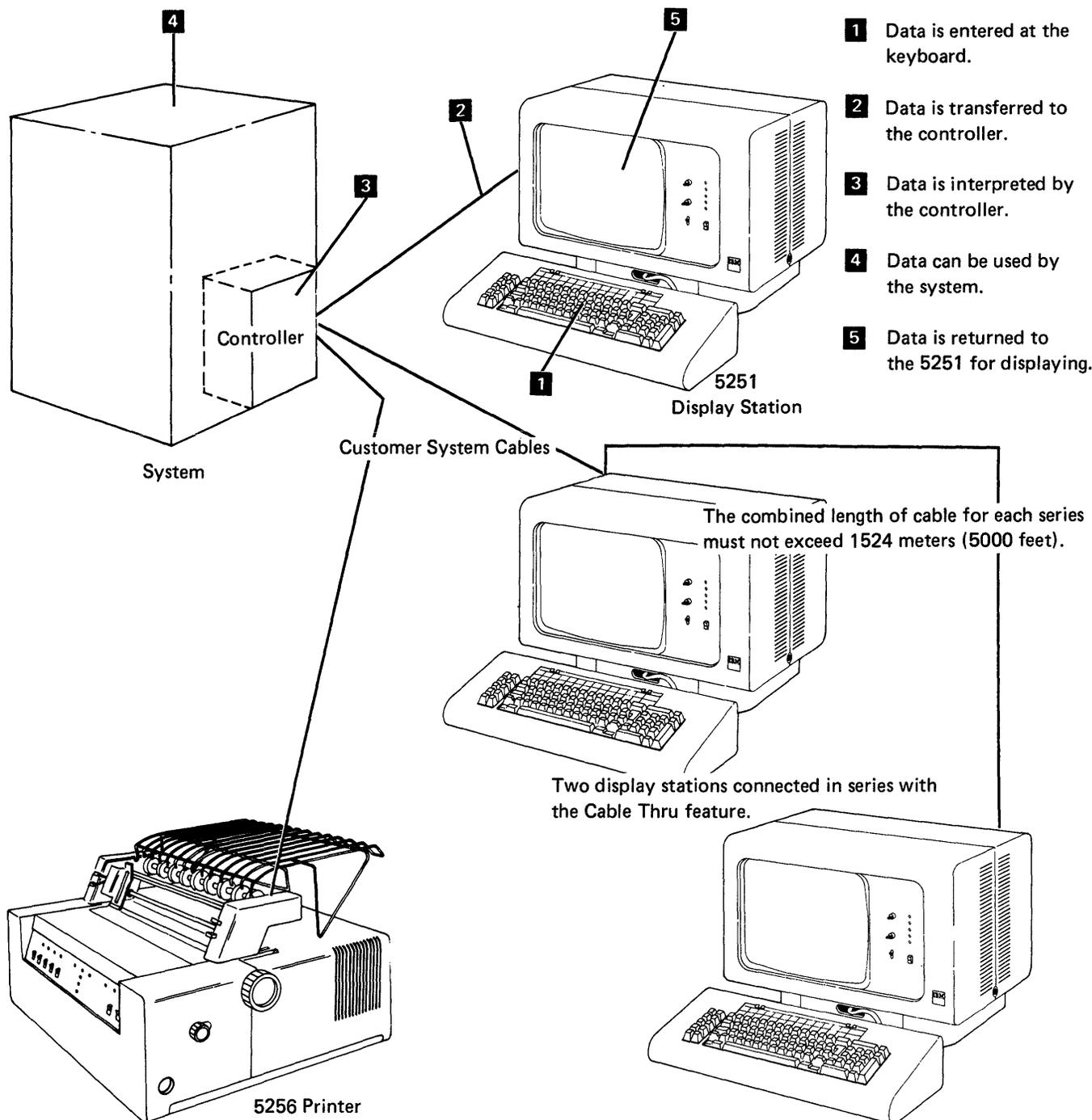
The Terminator switch (Cable Thru feature only) on the access panel has a position 1 and position 2. *Position 1* stops the communications signal and completes the circuit. The last work station on the line must have the Terminator switch set to position 1; all other stations on the line must have the Terminator switch set to position 2. *Position 2* permits the communications signal to flow through the display station to the next work station.

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



172 TYPICAL DISPLAY STATION CONFIGURATION

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



173 STATION PROTECTOR AND LIGHTNING PROTECTOR

Station Protector

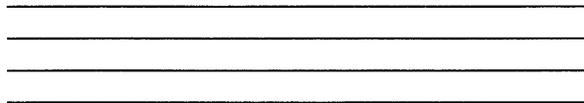
See *IBM 5250 Information Display System Planning and Site Preparation Guide, GA21-9337* for detailed information.

The station protector is owned and maintained by the customer. Only 2 station protectors should be connected to any one port.

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

DANGER

Never handle cables or connectors during an electrical storm.

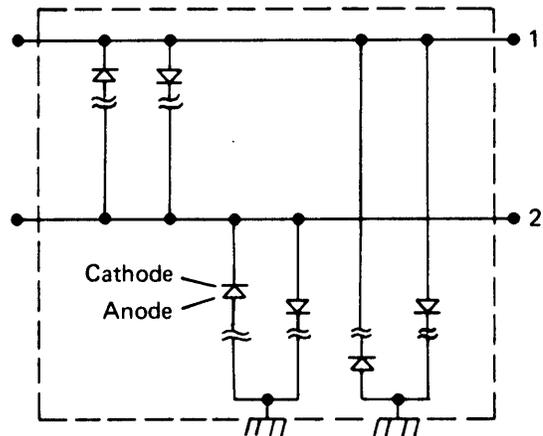


The following procedure can be used to check a station protector that is supplied by IBM:

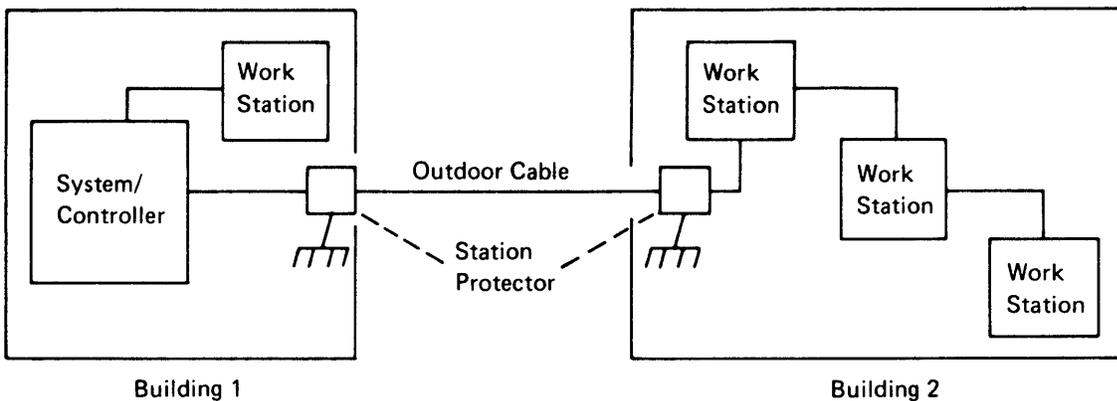
1. Check each diode with the black lead connected to the anode and the red lead connected to the cathode. The resistance should be less than 2,000 ohms.
2. Check each diode with the black lead connected to the cathode and the red lead connected to the anode. The resistance should exceed 10,000 ohms.

Note: Use only CE meter (part 1749231). Use the RX 100 scale.

Typical Station Protector Board



Typical Installation



Lightning Protector

The lightning protector protects the planar from voltage peaks induced by electrical discharges, including lightning, and electrical noise within factories or offices. The following procedure can be used to check the lightning protector.

Note: Ensure that a lightning protector is installed on the new planar if a lightning protector was on the planar being replaced.

The cables to the lightning protector (both at the planar board and the internal system cable) must be disconnected before the checks are made. This will disconnect the display station from the system but will not disconnect other work stations in a cable thru string.

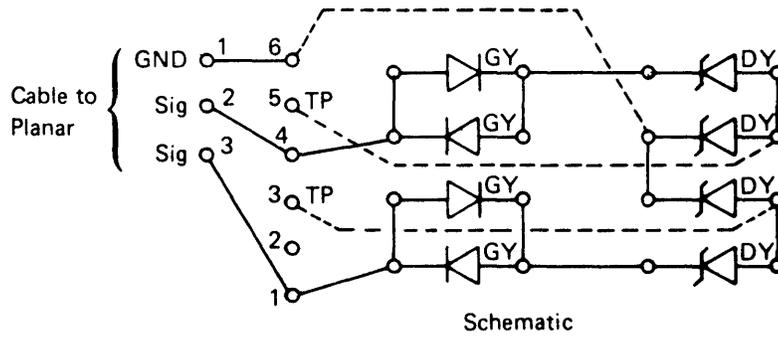
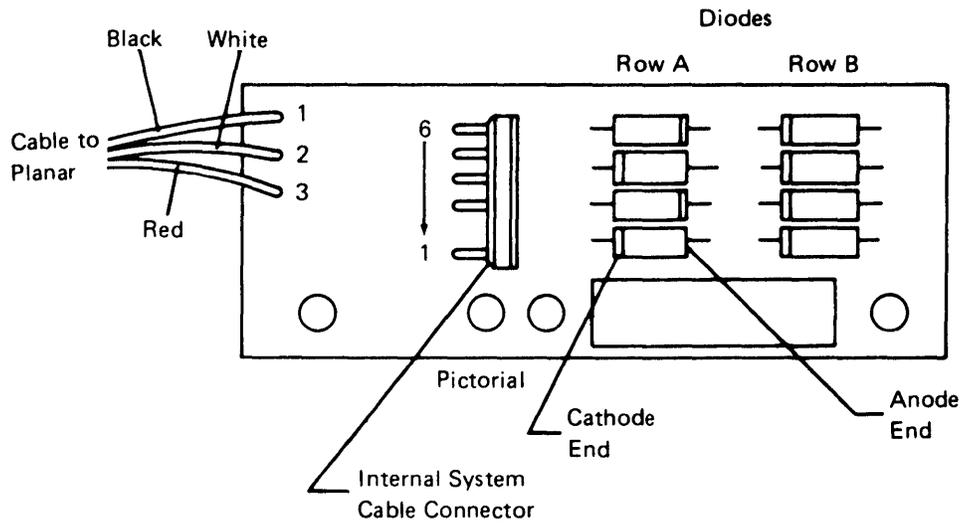
DANGER

Never hold or touch cables or connectors during an electrical storm.

1. Visually check the lightning protector for broken wires or land patterns.
2. Use only CE meter part 1749231. Use the R x 100 scale.
 - a. Check row A.
 - Check both the top and bottom diodes with the black lead connected to the anode and the red lead connected to the cathode. The resistance should be 1K to 4K.*
 - Check both the top and bottom diodes with the black lead connected to the cathode and the red lead connected to the anode. The resistance should be 1K to 4K.*
 - b. Check row B.
 - Check each diode with the black lead connected to the anode and the red lead connected to the cathode. The resistance should be 1K to 4K.*
 - Check each diode with the black lead connected to the cathode and the red lead connected to the anode. The CE meter should indicate an open circuit.

* If either diode in the pair is open, the resistance will indicate an open circuit in one direction.

Lightning Protector



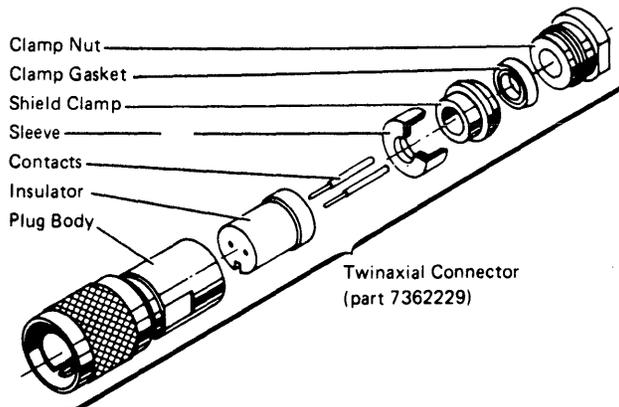
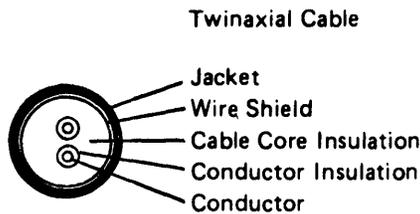
The dotted lines show land patterns on the back of the PC board.

174 CABLE ASSEMBLY PROCEDURES

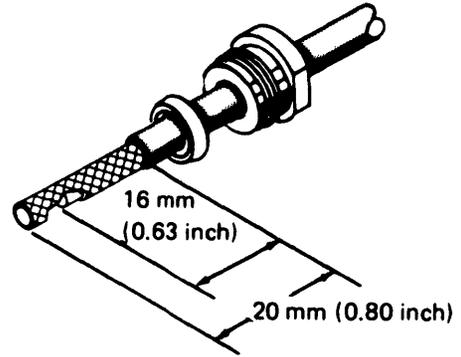
Assembling and maintaining the customer system cable should be done by the customer. However, if aid is requested, use the following procedures the assemble the cables.

Assembly of Twinaxial Cable

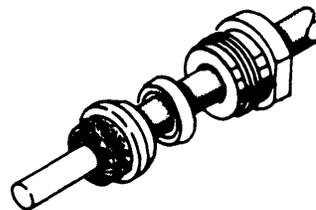
1. Ensure that all parts are present. Look at the figure below for location of the cable layers.



2. Cut the end of the cable squarely. Then slide a clamp nut and clamp gasket over the cable jacket and trim the jacket to the dimensions given. Push the wire shield back to expose the inner insulation core, and cut the core and conductors to the dimension shown (16 mm [0.63 inch]). Slide the wire shield back over the core, and taper it to a point for ease of shield clamp assembly in step 3.



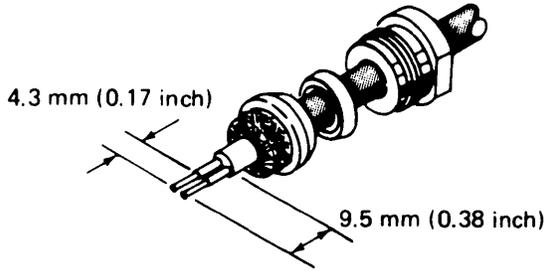
3. Slide the shield clamp over the shield so that its inner shoulder touches the cable jacket. Then, fold the shield back over the shield clamp and trim the shield as shown.



Note: Place the shield wires over the shield clamp uniformly to ensure a good radio frequency connection of the shield, and to prevent breaking the strands or the shield.

174 (continued)

4. Cut the cable core and the conductor insulation to the dimensions shown. *Do not notch the conductors or the insulation.* If the braid is separated, trim the shield again as in step 2.

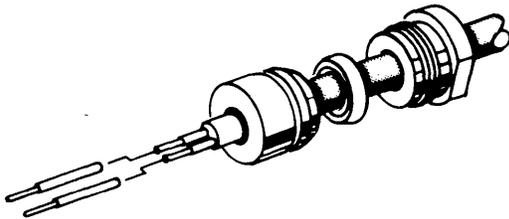
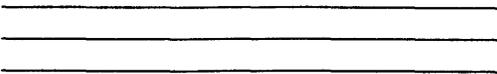


5. Slide the sleeve over the cable core and press the sleeve against the shield wires.

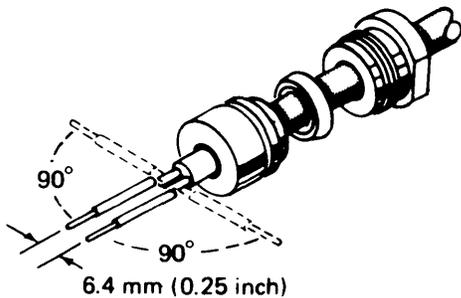
Using minimum heat, solder the contacts to the conductors.

CAUTION

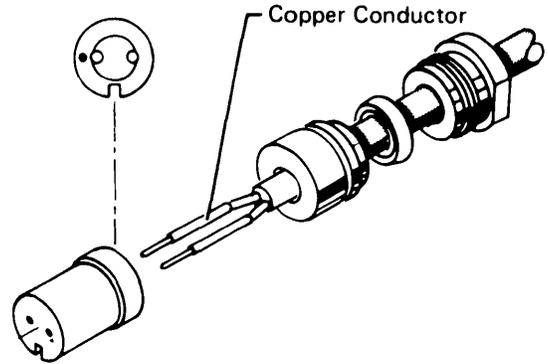
Clean off any excess solder.



6. Bend the conductors and the contacts out at 90° to the cable. Then bend the conductors back to parallel (approximately 6.4 millimeters [0.25 inch] between conductors).



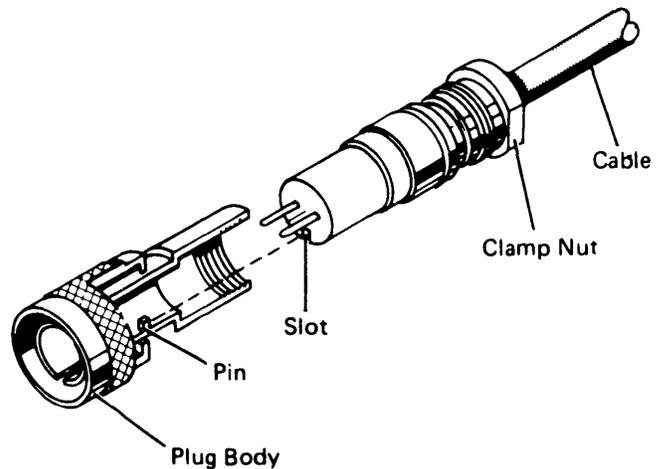
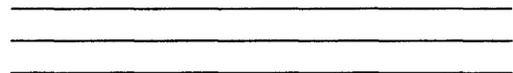
7. Slide the insulator over the contacts and the cable so that the insulator touches the sleeve. Press all the parts together. To ensure correct polarity, the contact on the bare copper conductor of the cable must go into the insulator hole that has a dot next to it.



8. Align the slot in the insulator with the pin inside the plug body. Insert the assembly into the plug body. Tighten the clamp nut with 5.7 to 6.8 N·m (50 to 60 inch lbs) torque.

CAUTION

Do not allow the cable and plug body to twist as the clamp nut is tightened.



9. Check for shorts between the conductors and between each conductor and the plug body.

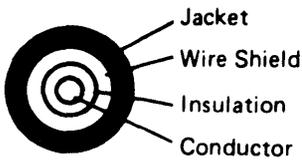
174 (continued)

Assembly of Coaxial Cable

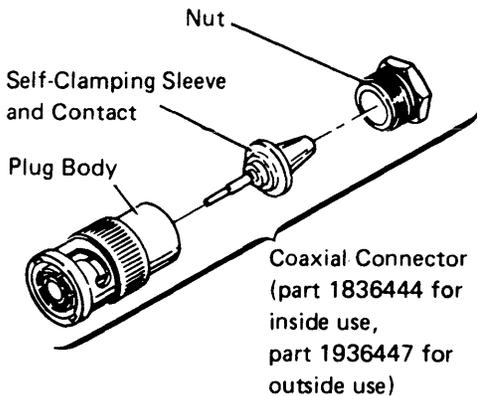
If your installation has coaxial cable (part 323921 for inside use or part 5252750 for outside use), use the following procedures to attach it to the connectors.

1. Ensure that the connector has all of the parts needed. Look at the Figure below for location of the cable layers.

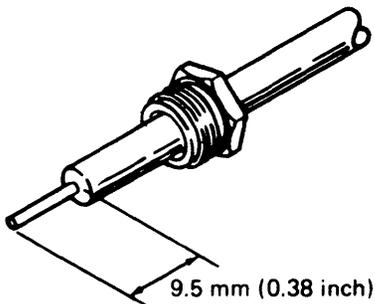
Coaxial Cable



Coaxial Connector



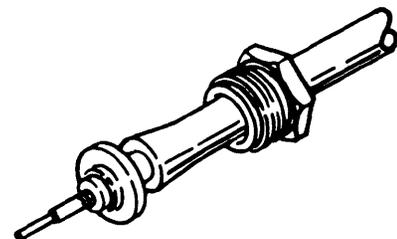
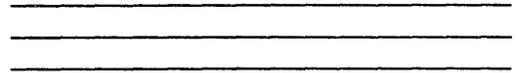
2. Cut squarely through the jacket, shield, and insulation, to show 9.5 millimeters (0.38 inch) of the conductor. Slide the nut onto the cable.



3. Insert the conductor into the tapered, self-clamping sleeve and contact; force the edge of the self-clamping sleeve between the insulator and shield until insulation is well onto the taper. Solder the conductor to the contact at the solder hole.

CAUTION

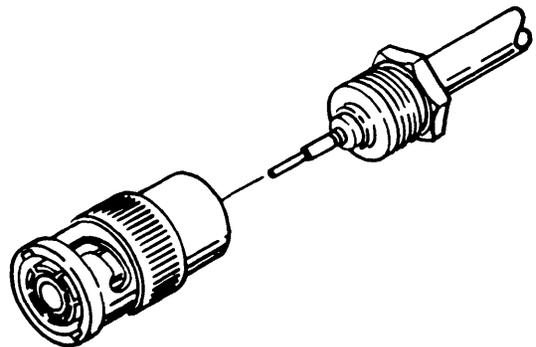
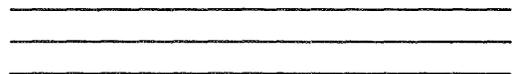
Remove the extra solder from the outside of the contact.



4. Fit the contact into the plug body; screw the nut into the body, to bind the jacket and shield tightly against the self-clamping sleeve.

CAUTION

Do not let the cable twist as the nut is tightened.



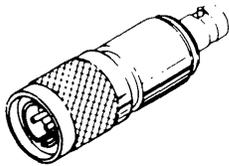
5. Check for short circuits between the plug body and the conductor.

Twinaxial-Coaxial Adapter

The twinaxial-coaxial cable adapter is available to give the customer (who has coax cables installed for a different system) a way to use coax cables with IBM 5250 work stations and a host system. The adapter must be used at both ends of each coaxial cable. Some systems may not support the use of coaxial cable with the adapter. Consult the *Installation Manual—Physical Planning* or *Planning and Site Preparation Guide* for the host system.

When the adapter is used the following restrictions apply:

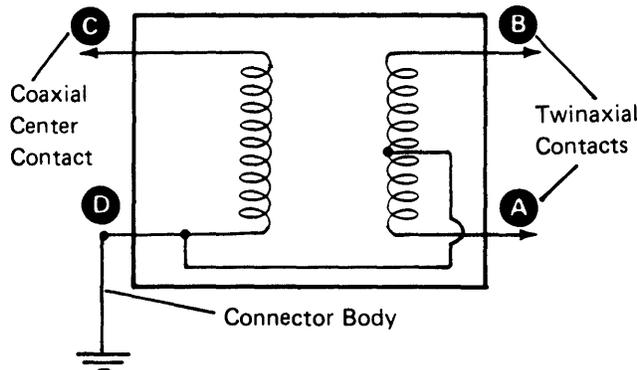
- The cable length between the controller and the first attached work station must not exceed 610 meters (2000 feet).
- When using the CableThru feature, no more than two work stations may be attached to a single port, and the second attached work station must be connected to the first by twinaxial cable. The cable length between the first and second work station must not exceed 30 meters (100 feet).



Twinaxial-Coaxial Adapter (part 7363102)

Adapter Service Check

Below is a table and Figure showing the maximum permissible dc resistances in the twinaxial coaxial adapter.



Cable Labeling

To assist in installation and to avoid confusion, label each end of the cable. Each label should include information that identifies:

1. The unit to which the end being labeled is to be connected.
2. The unit to which the other end is to be connected.
3. The location of the other end of the cable.
4. The port into which you will plug the cable.

Also, it is often an aid to supply the telephone extension number located near the other end of the cable.

Tests of Cabling After Installation

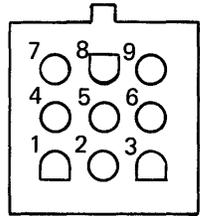
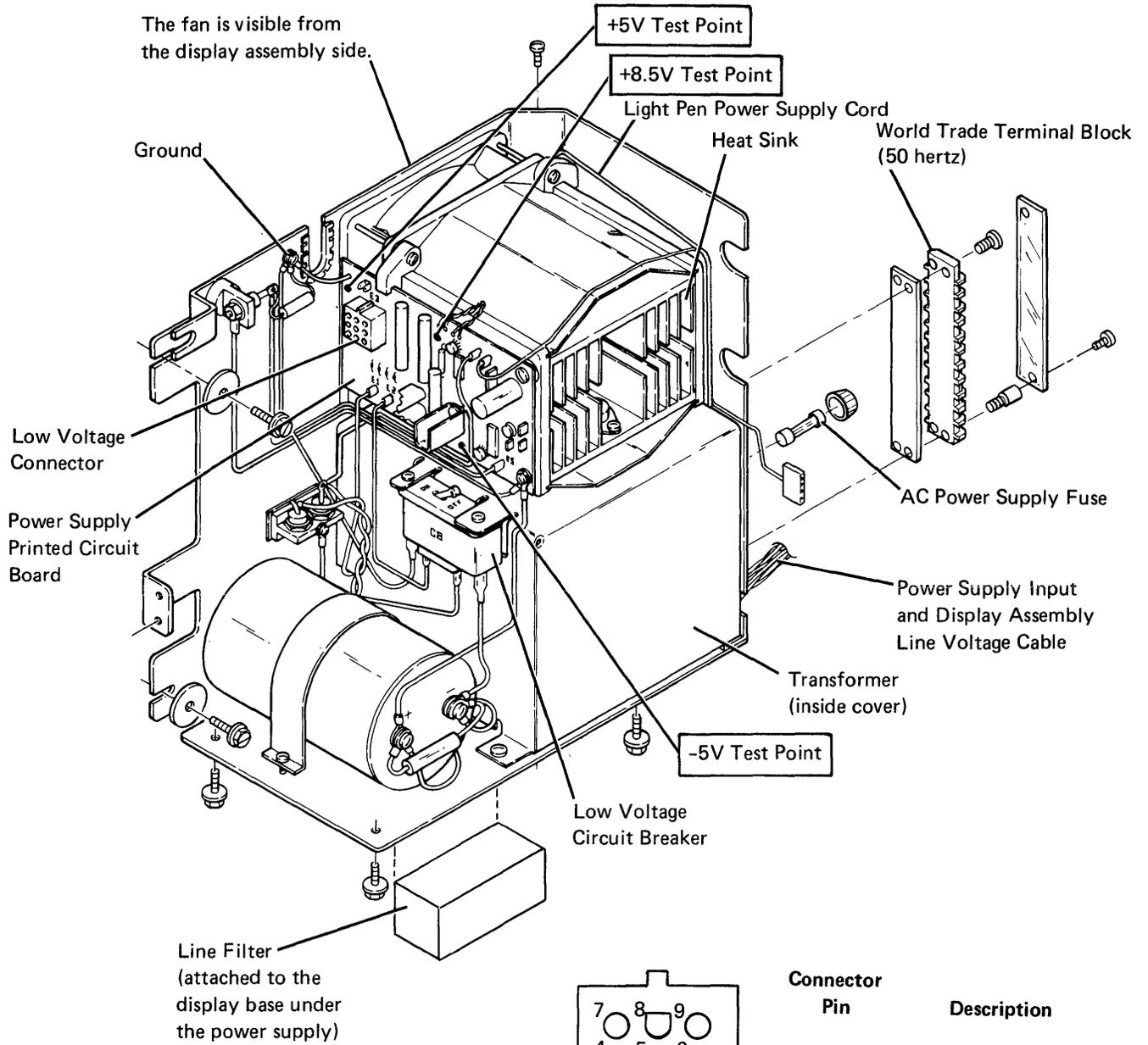
Installation of cabling should include tests after installation to ensure that there are no problems, no high-resistance connections, and that the circuit is in balance should ensure there are no:

1. Open circuits in each conductor or shield.
2. Short circuits between conductors of the same pair.
3. Grounds on each conductor, either between a conductor and a shield or between a conductor and a grounded object.
4. Reversed polarities (twinaxial cable only).

Measure	Maximum ohms
A to B	1.0
A to D	0.5
B to D	0.5
C to D	0.8

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

Removal

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.

1. Power off.
2. Disconnect the line cord from the wall outlet.
3. Open the front and rear covers.
4. Disconnect the cables to the display assembly, the Power switch, and the main planar board.
5. Disconnect the low voltage connector from the power supply PC board (180).
6. Disconnect the display AC power cable (150).
7. Remove the ground wire that connects the rear of the power supply to the base.
8. Disconnect the top two wires from the Power switch (remember the position of the wires for reassembly).
9. Remove the Power switch bracket (two screws) and the rear cover strain relief cable from the power supply.
10. Using a socket tool, remove the six mounting screws from the power supply.
11. Lift the power supply from the display station housing.
12. Place the used power supply in the shipping container, so it can be returned to the branch office.

180-181

Replacement

1. Set the new power supply in the display station.
2. Fasten the mounting screws on the power supply.
3. Reconnect the cables.
4. Align the Power switch with the hole in the front bezel.
5. Check the World Trade transformer connections (184).

182 VOLTAGE LEVEL CHECKS

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

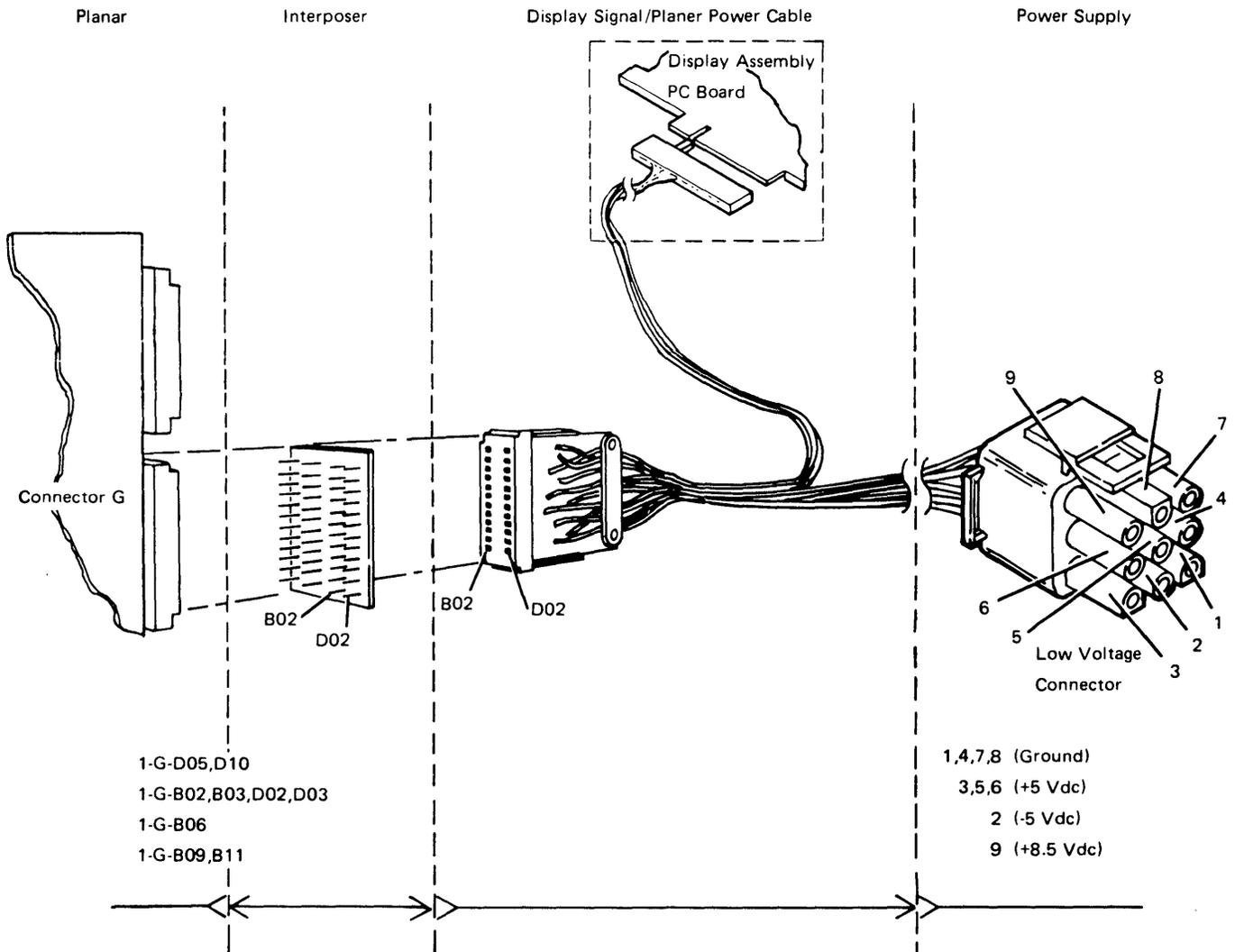
DANGER

Line voltage is present at the power supply.

Low Voltage 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

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

- The power supply supplies power to connector G on the planar by way of the low voltage connector.
- The planar supplies signals to the display assembly. (The display assembly has its own power supply.)



183 POWER SUPPLY RIPPLE LEVEL CHECK

The peak-to-peak output ripple level should be less than 4% of the respective dc voltages when measured with an oscilloscope.

When an oscilloscope is not available, ripple voltage can be observed by using the multimeter with the dB adapter as follows:

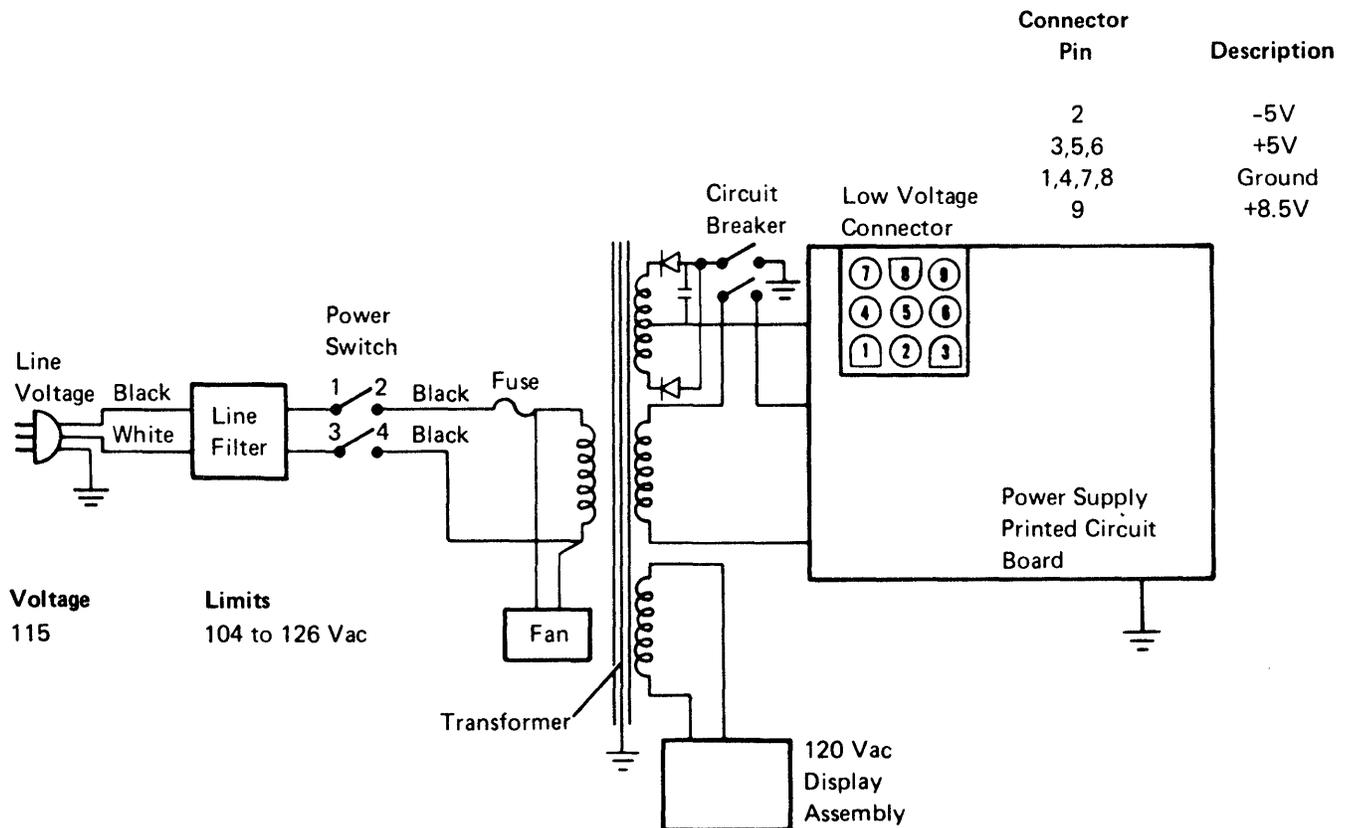
1. Set the dB adapter to Bridge mode.
2. Set the Range switch to 0 dB.
3. Connect one of the dB adapter leads to frame ground and the other lead to the DC voltage in question.

4. Change the setting on the Range switch until the meter needle is as close as possible to the medium range.
5. Use the following table to determine if your supply has an acceptable ripple level:

Power Supply Voltage	Acceptable Ripple Level
±5 V	-21 dB to -60 dB
+8.5 V	-17 dB to -60 dB

184 POWER SUPPLY CHARTS

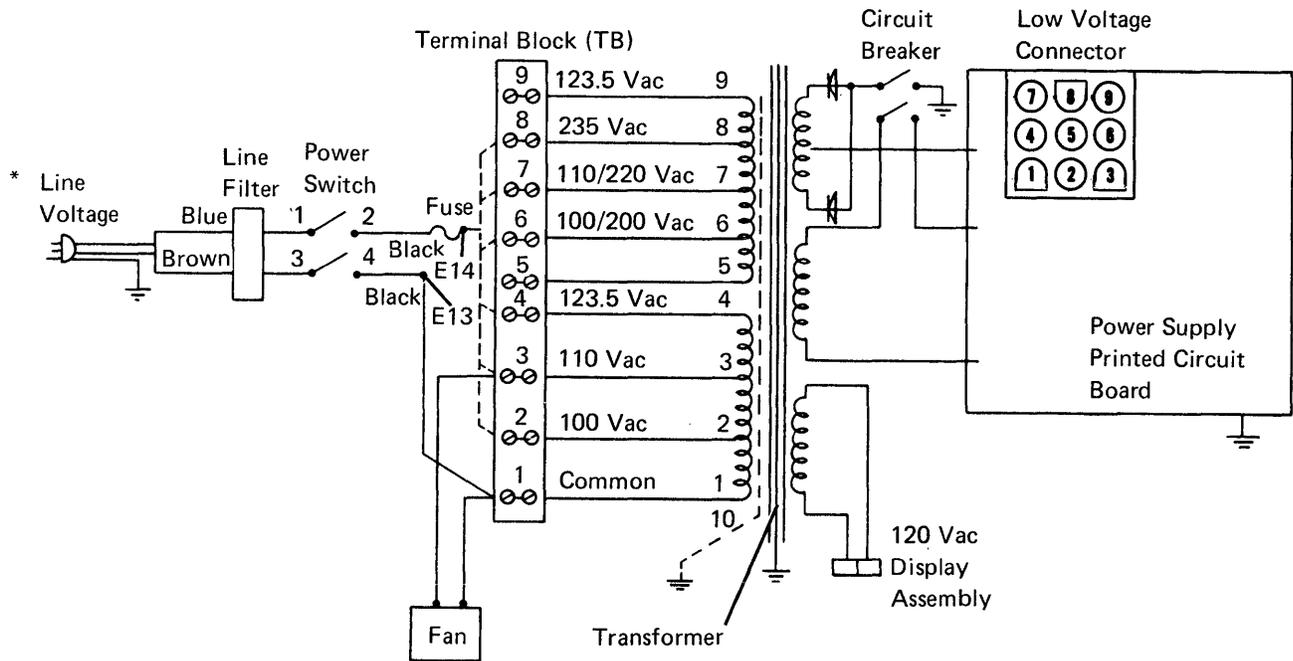
US Power Supply



184 (continued)

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).

186 NOT USED

187 POWER SUPPLY FAN REMOVAL AND REPLACEMENT

Removal

1. Open the front and rear covers.
2. If a fan guard is present, remove the nuts holding the fan guard to the power supply frame.
3. Remove the remaining nuts holding the fan assembly to the power supply frame.
4. Remove the two wires that connect the fan to the power supply.
5. Lift up the heat sink assembly and the fan assembly.
6. Remove the four screws and four nuts that hold the fan assembly to the heat sink assembly.

Replacement

CAUTION

Do not crimp or pinch the two voltage wires between the fan and the power supply frame.

To replace the fan assembly, reverse the preceding steps.

188 LIGHT PEN POWER SUPPLY CARD REMOVAL AND REPLACEMENT

Removal

1. Open the front and rear covers.
2. Disconnect the ground wire from the power supply frame.
3. Disconnect the power input wire from the power supply printed circuit board.
4. Remove the light pen power supply card mounting screws.
5. Disconnect the cable at the light pen card.
6. Remove the card and cable assembly.

Replacement

1. Replace the light pen power supply card in the reverse order of the removal.

Diagnostic Aids

200 CONTROL PANEL LEDs

The following five lights (LEDs) are located on the control panel of the display station: Line Sync, Line Check, Internal Check, Storage Check, and Ready. These lights are used by the operator and the customer engineer. All five lights are on briefly during power on to test the LEDs. After power on, use the following descriptions.

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 there are more than 160 ms between recognized characters.

Line Check

When on, this light indicates that the display station has sensed a parity error in the poll or data that 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 particular work station. The addressed work station returns an error response to the controller. The controller resends the information that caused the error until the display station receives the information without any errors; at this time, the light turns off.

Internal Check

When on, this light indicates that a parity error has been found in the data bus while the display station is getting data from read/write storage. You can reset the Internal Check light 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 and as a problem determination aid for the operator.

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.

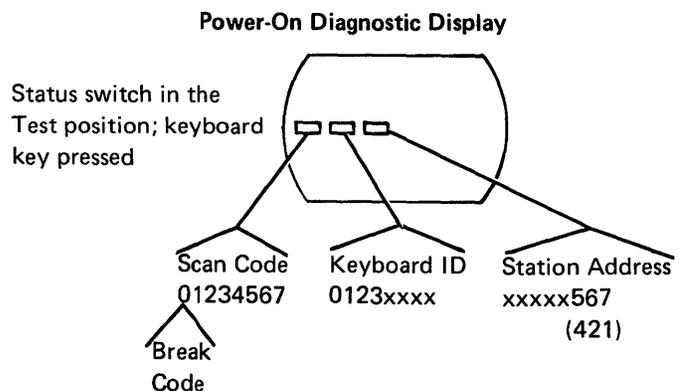
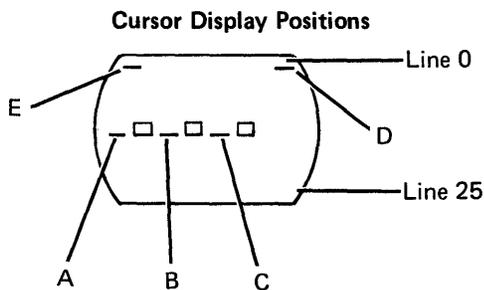
The settings of the Address switches (Cable Thru feature only) should not be changed while the power-on diagnostic is looping unless a keyboard data key is pressed and held down. Release the key to permit the power-on diagnostic to loop after the settings of the Address switches have been changed so that the changes can be seen in the address field of the display screen.

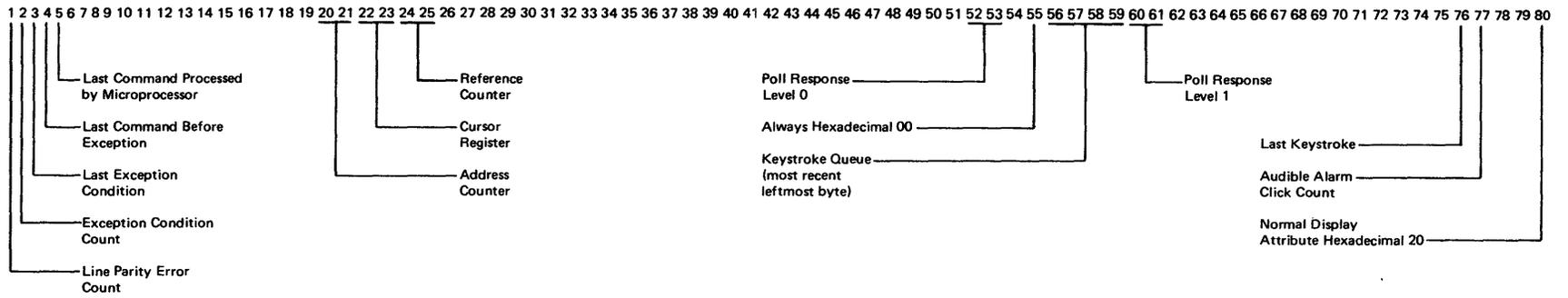
If the cursor is in position D and the Status switch is in the Normal position, the clicker will sound only for the first four keys pressed. Additional keys can be pressed, but the clicker will not sound. If the Status switch is now set to the Test position, lines 0 and 25 will be displayed for approximately 5 seconds. During this 5 seconds, the hexadecimal code of the last key pressed will be displayed in position 76 of line 25.

Lines 0 and 25 are displayed when the Status switch is set to the Test position while a customer job is being run 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.

You can reset the Storage Check light and Internal Check light by setting the Status switch to the Test position. The operator must sign on and restart the customer job after the Status switch has been set to the Normal position.

The field attribute will be displayed when the Status switch is in the Test position.





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 (not used)
- 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 above illustration shows the most commonly used information. The table indicates all the information displayed on line 25 while the Status switch is set to the Test position. An alternative display of line 25 occurs whenever 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.

Line 25 description is as follows:

202 FIELD ATTRIBUTE CHARACTERS

You can display field attribute characters by setting the Status switch to the Test position. The hexadecimal code is displayed to the left of the field that it converts.

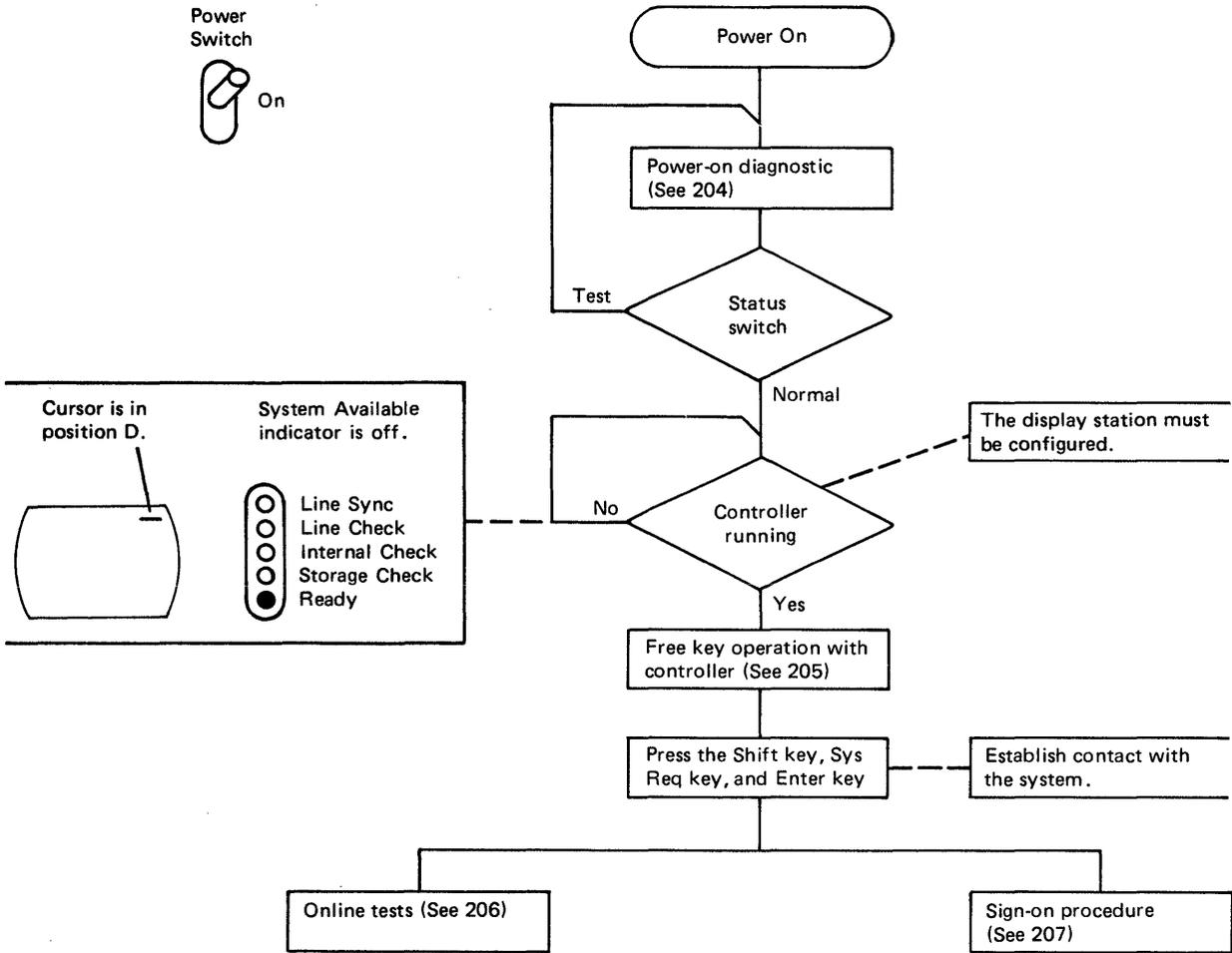
A description of each code follows:

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; however, codes 30 through 3F contain 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 verification test.

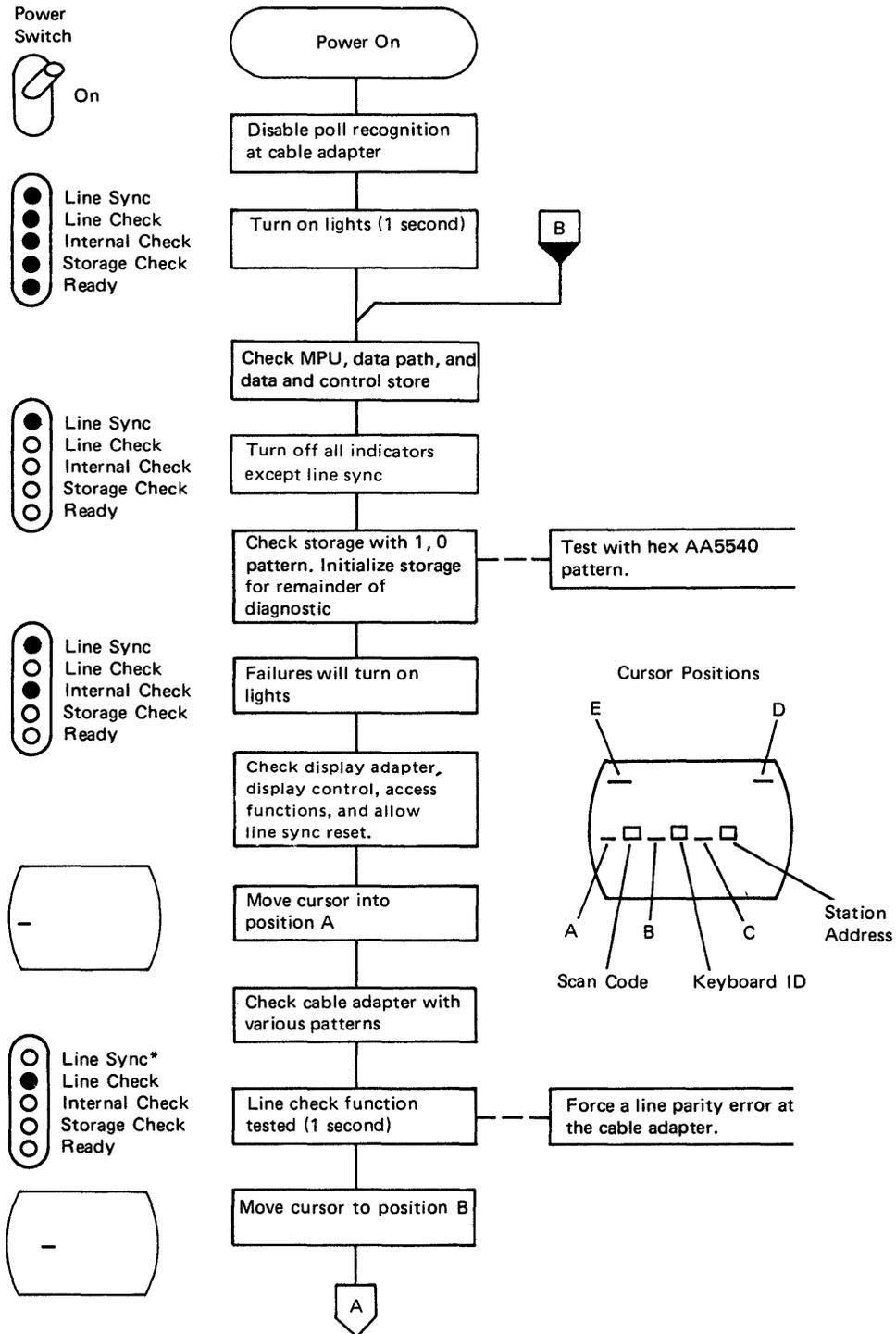


204 POWER-ON DIAGNOSTIC

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

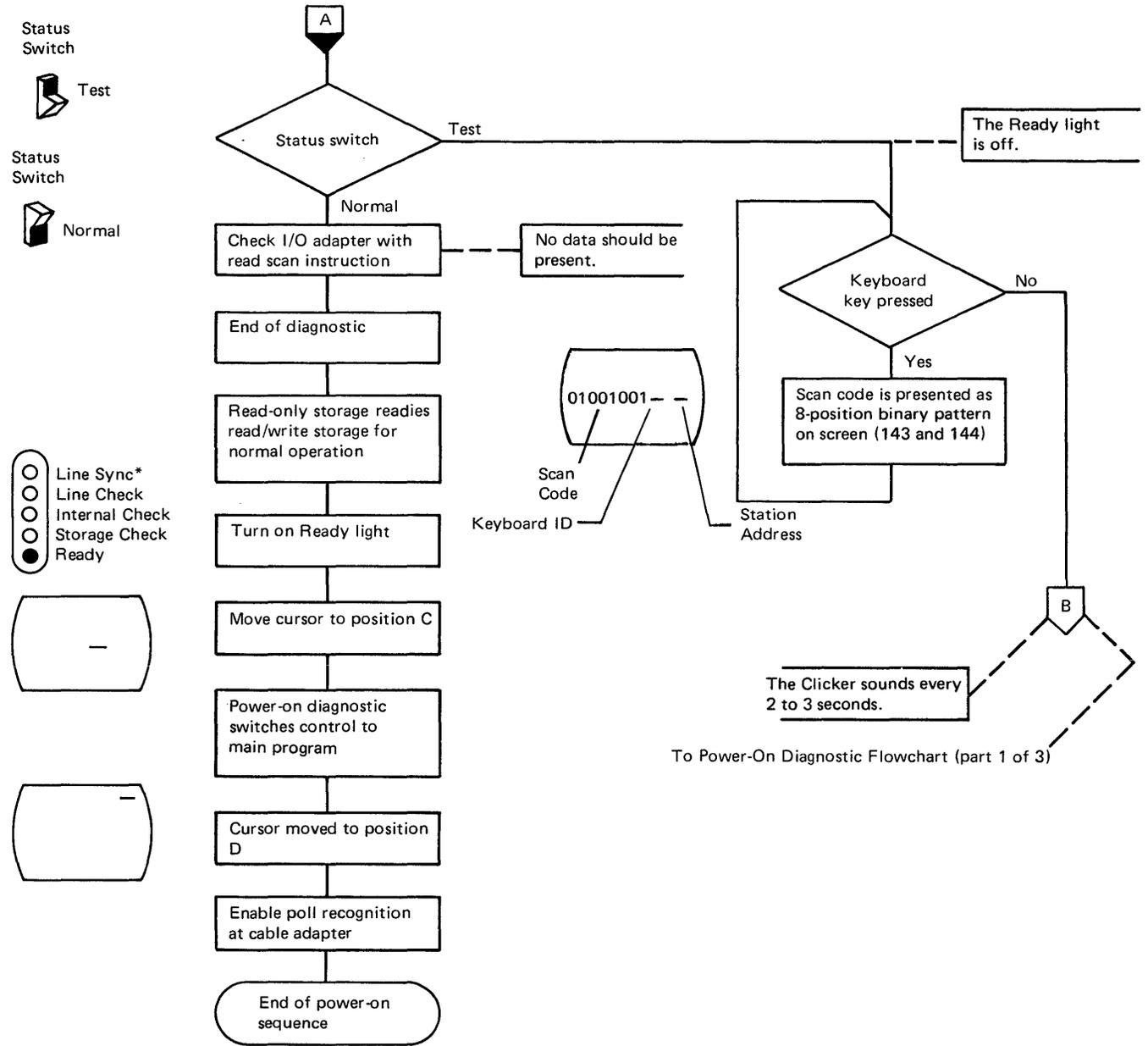
At the end of this diagnostic, you can perform more tests using the free key mode or the verification test, or you can sign on using the sign-on procedure.

Power-On Diagnostic Flowchart (Part 1 of 3)



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

Power-On Diagnostic Flowchart (Part 2 of 3)

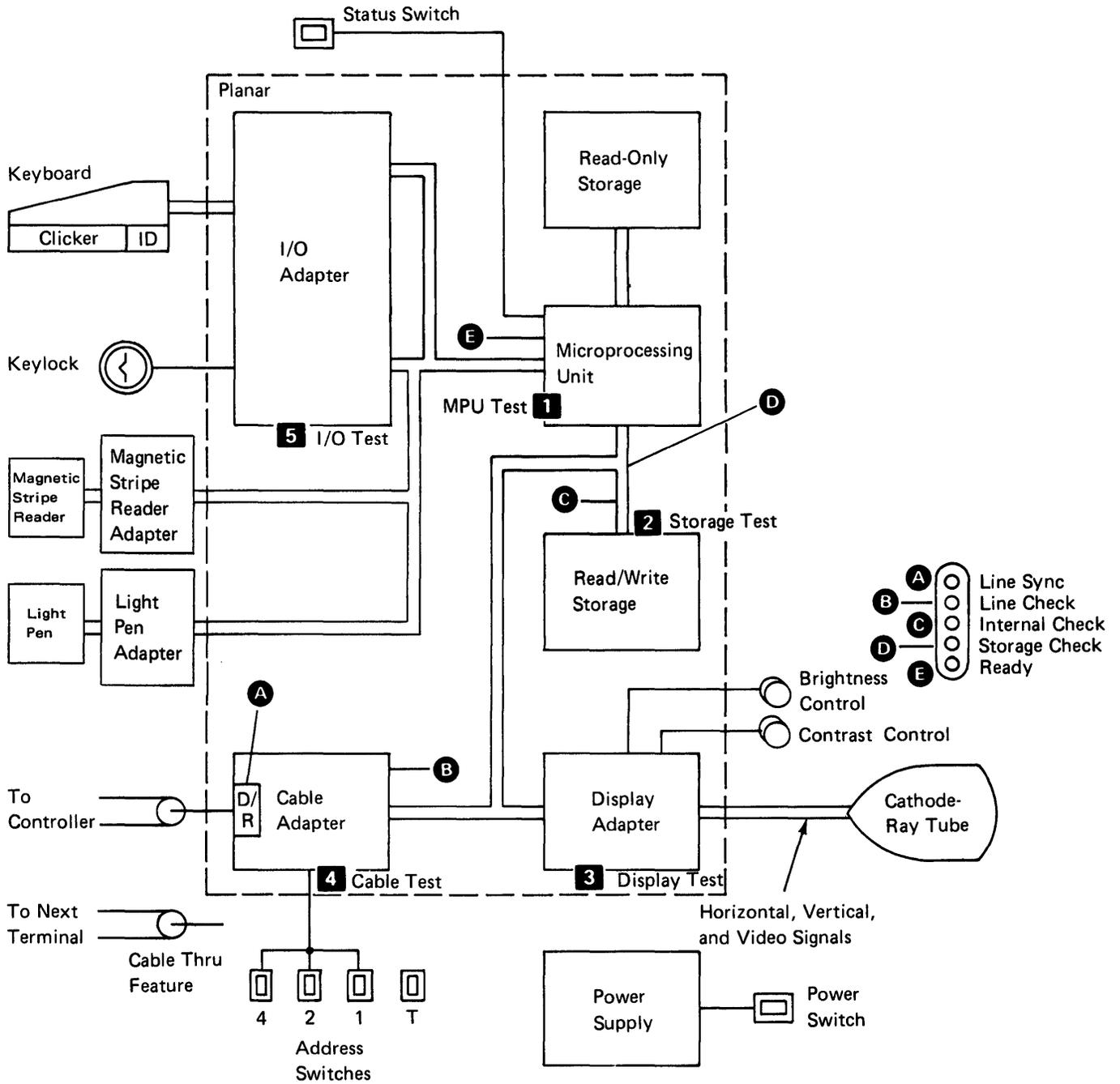


To Power-On Diagnostic Flowchart (part 1 of 3)

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

Power-On Diagnostic Flowchart (Part 3 of 3)

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



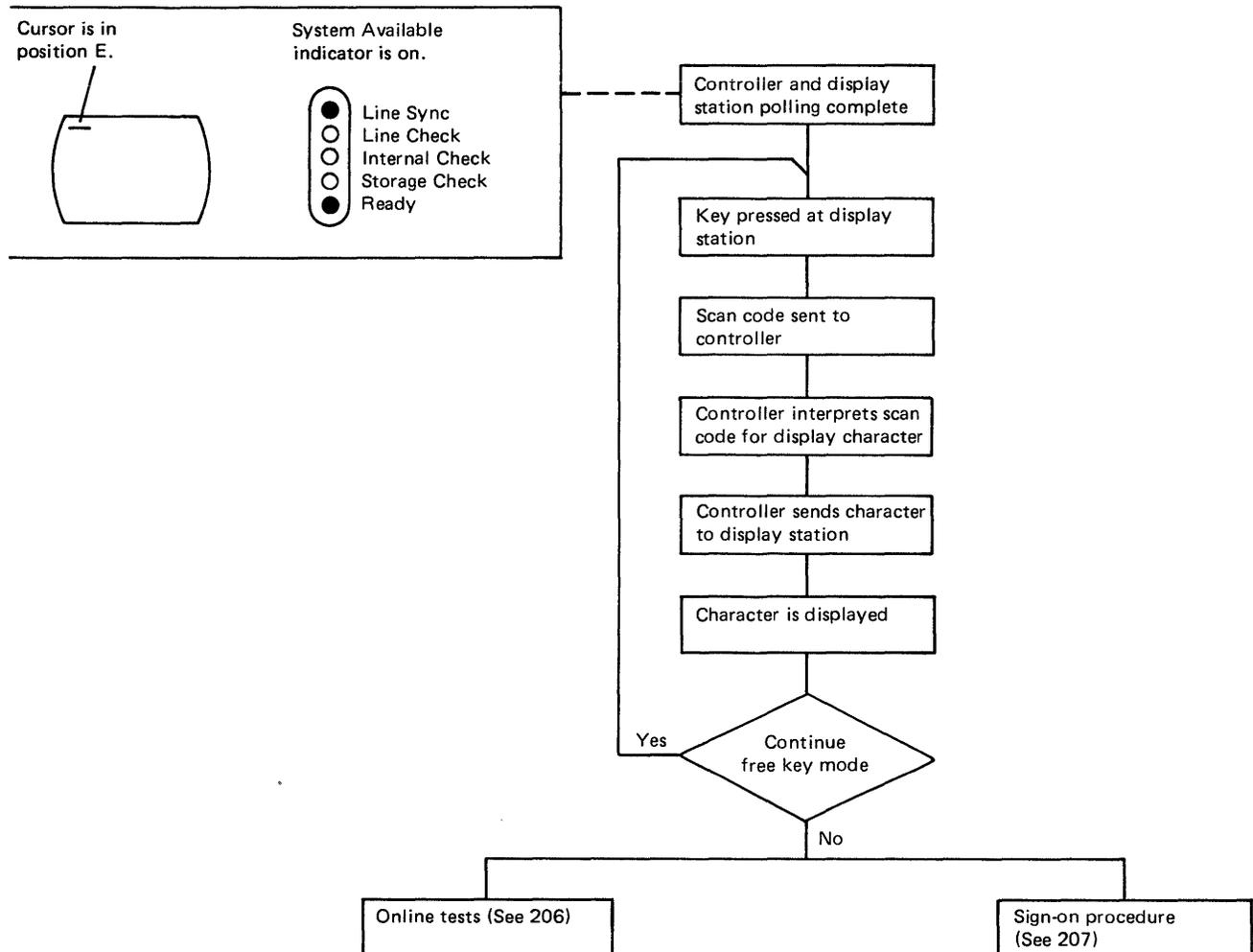
205 FREE KEY OPERATION

The display station is in the free key mode after the power-on diagnostic has been completed and before the customer signs on. While in the free key mode, the display station communicates with the controller and permits keyed characters to be displayed; because keyed characters are displayed you can check the alphameric keys and most of the function keys. If the following function keys are pressed while the display station is in the free key mode, error code 0099 will be returned:

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

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

Free Key Mode Flowchart

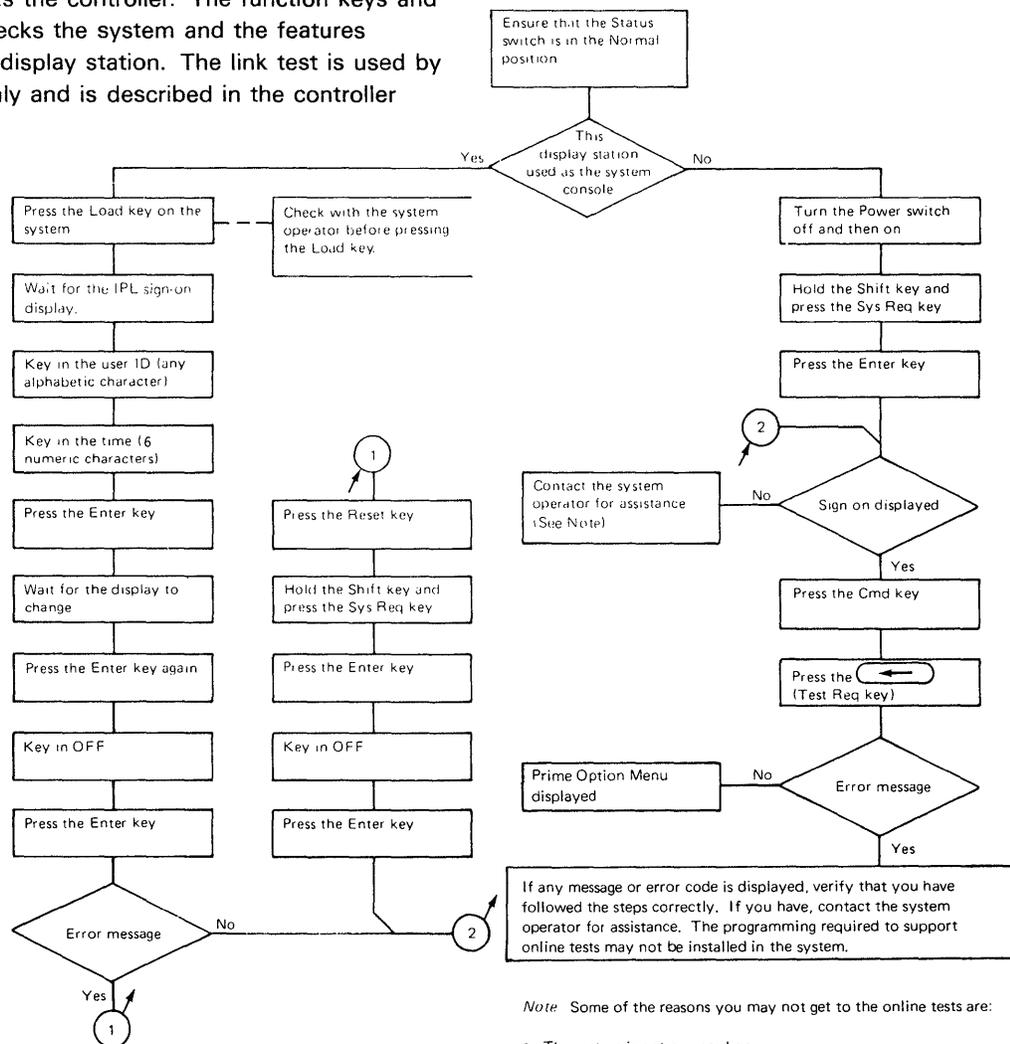


206 ONLINE TESTS

If the 5251 Model 1 or 11 does not connect to a 5251 Model 2 or 12, a System/38, a System/34, or a Series 1 processor, see your controller documentation for details to start the online test. Online test include work station exerciser routines that are contained in the system. The Prime Option Menu is displayed; this menu permits the selection of the following: display verification, matrix printer verification, configuration data, and ERAP (error recording analysis procedures), and link test (this test is used by the controller only).

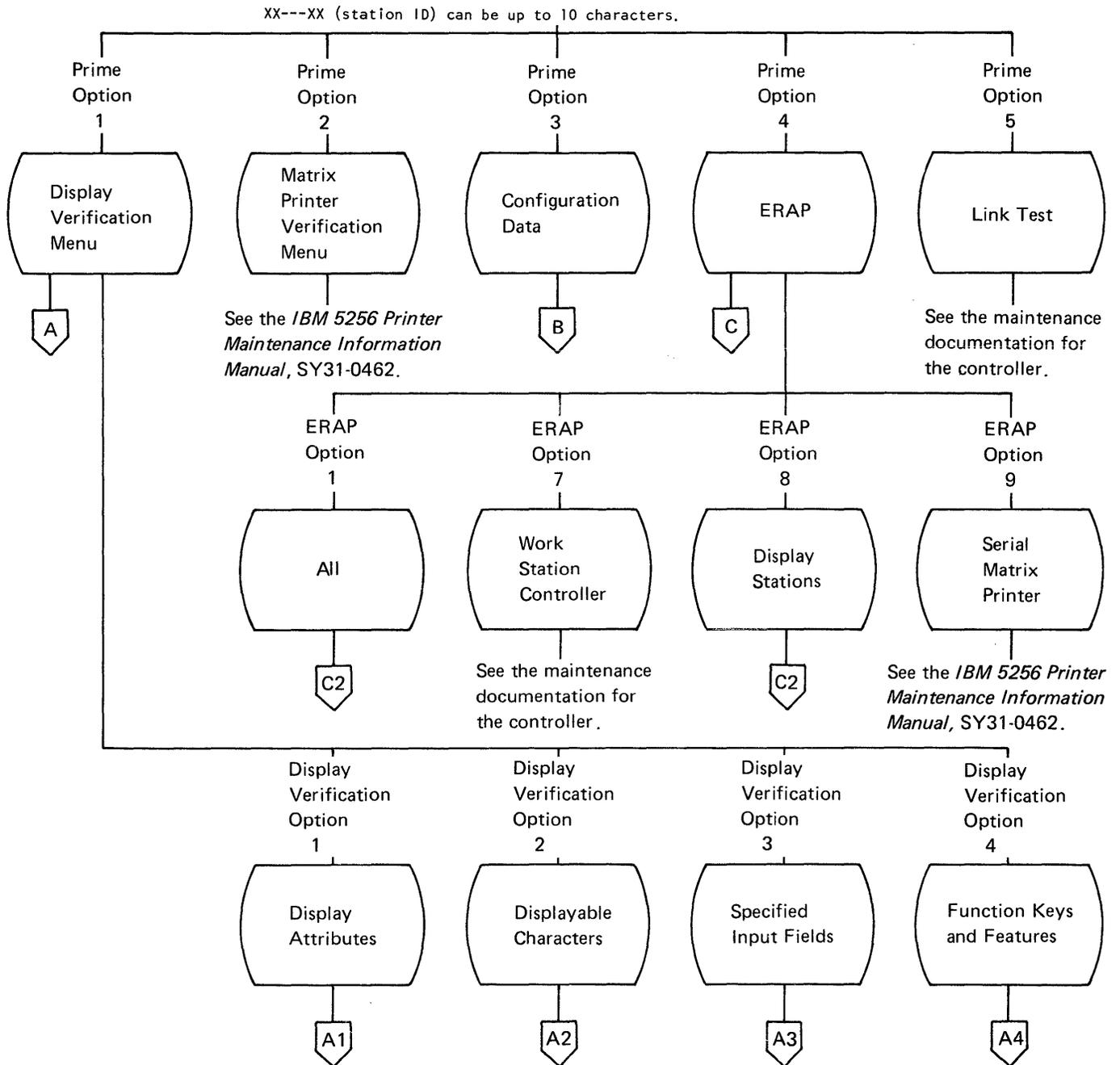
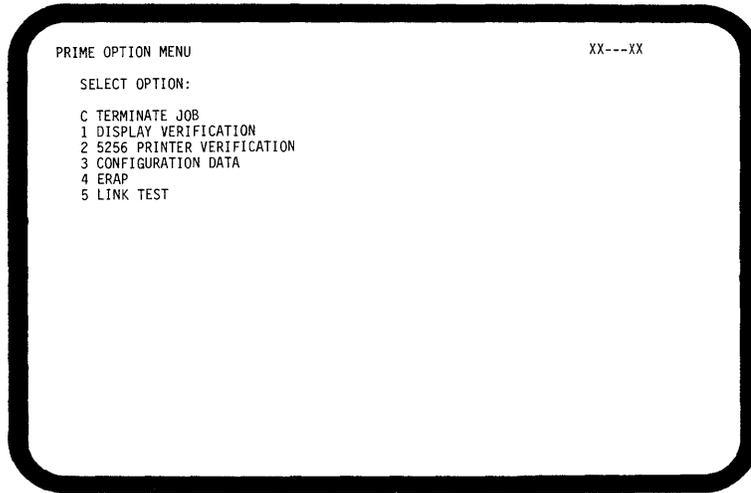
The Display Verification Menu permits the selection of the following tests: the display attributes test, the displayable characters test, the specified input fields test, the function keys and features test, and the link test. The display attributes test and the displayable characters test check the planar. The specified input fields test checks the controller. The function keys and features test checks the system and the features installed on the display station. The link test is used by the controller only and is described in the controller documentation.

Online tests can be run on the work station while 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 methods that can be used to terminate or sign off a job. These methods are not described in this manual because they are system operating procedures. If you do not know the procedure to use with the system, use the procedure in the following flowchart:

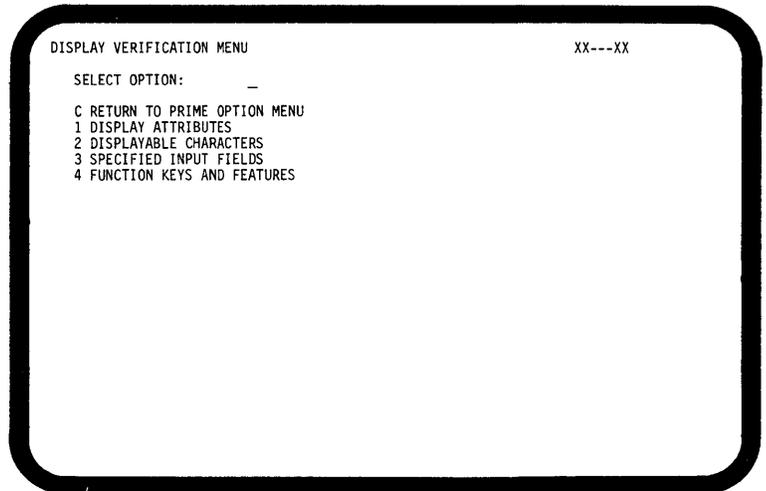


Note: Some of the reasons you may not get to the online tests are:

- The system is not powered on.
- The MS IPL has not been successfully completed.
- This station is not configured in the system.
- A message is waiting on the system console for this station, and the operator has taken no action.



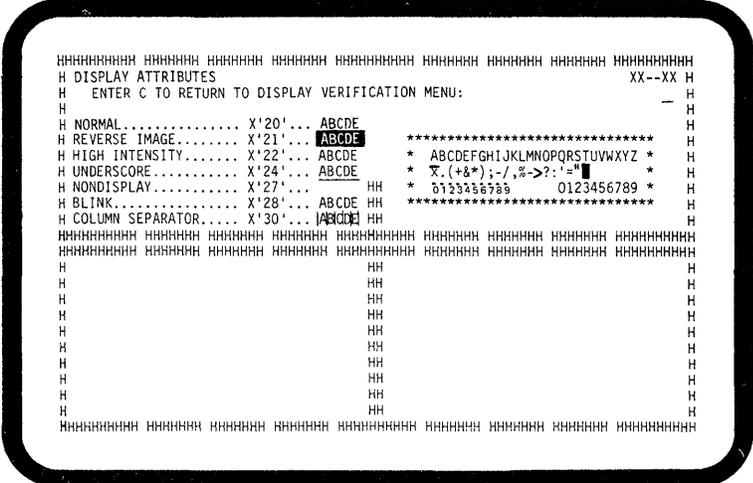
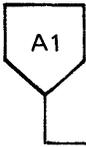
Online Tests Displays



Select the Display Verification Menu by:

XX---XX (station ID) can be up to 10 characters.

1. Pressing the 1 key.
2. Pressing the Enter key.



Select the display attributes option by:

1. Pressing the 1 key.
2. Pressing the Enter key.

XX---XX (station ID) can be up to 10 characters.

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

How to use this display:

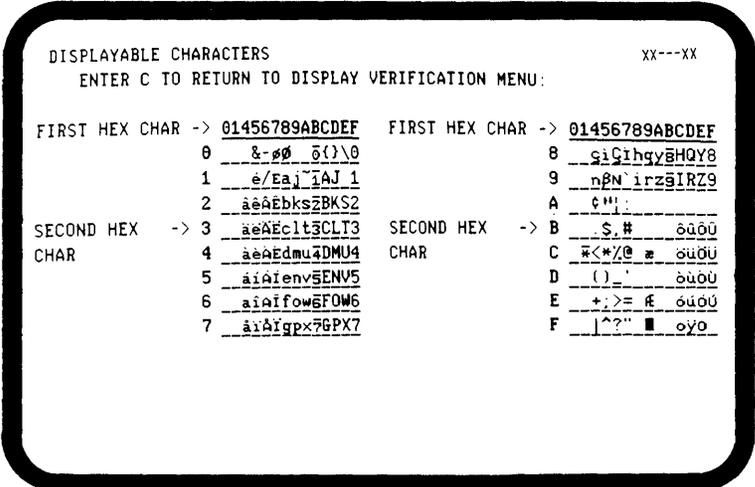
1. Turn the Contrast control fully clockwise and slowly decrease the Brightness control; observe the pattern of H's that alternate in intensity.
2. Adjust the Brightness control to obtain the best character image.
3. Press the Spacebar once to position the cursor on the right side of the display screen.
4. Key in one of the hexadecimal numbers shown on the left side of the display screen; press the Enter key. Observe the results that take place on the right side of the display screen. Compare these results with the attribute description on the left. A wrong 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.

Return to the Display Verification Menu by:

1. Pressing the C key.
2. Pressing the Enter key.

A2



XX---XX (station ID) can be up to 10 characters.

Select the displayable characters option by:

1. Pressing the 2 key.
2. Pressing the Enter key.

This display shows the characters that are represented by the characters on the keyboard.

If you have the planar with the country jumpers 105, the following characters will be displayed when you set the Status switch to the Test position:

First Hex Char-	0	1	4	5	6	7	8	9	A	B	C	D	E	F
	·	̄		&	-	ó	ø	°	μ	¢	{	}	\	0
1	⁰ 1	1̄	⁴ 1	é	/	É	a	j	~	£	A	J	É	1
2	⁰ 2	2̄	â	ê	Â	Ê	b	k	s	¥	B	K	S	2
3	⁰ 3	3̄	ä	ë	Ä	Ë	c	l	t	₹	C	L	T	3
4	⁰ 4	4̄	ä	è	Ä	È	d	m	u	f	D	M	U	4
5	⁰ 5	5̄	á	í	Á	Í	e	n	v	§	E	N	V	5
6	⁰ 6	6̄	ã	î	Ã	Î	f	o	w	₹	F	O	W	6
7	⁰ 7	7̄	ã	ï	Ã	Ï	g	p	x	¼	G	P	X	7

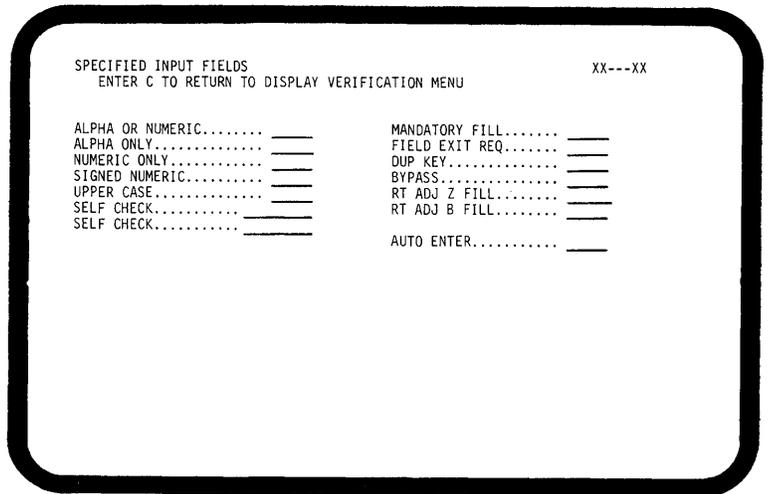
First Hex Char-	0	1	4	5	6	7	8	9	A	B	C	D	E	F
8	⁰ 8	8̄	ç	ì	Ç	Ì	h	q	y	½	H	Q	Y	8
9	⁰ 9	9̄	ñ	β	Ñ	'	i	r	z	¾	I	R	Z	9
A	⁰ A	Ā	[]		:	≤	ā	ī	ı̇	≥	2	3	
B	⁰ B	Ĭ	.	\$,	#	≥	ı̇						
C	⁰ C	̄	<	*	%	@	đ	æ	Đ	≠	ö	ü	Ö	Ü
D	⁰ D	ı̇	D	()	-	ı̇	≤	b	↑	ı̇	ı̇	ı̇	ı̇
E	⁰ E	ı̇	-	+	;	>	=	P	ƒ	ƒ	'	ı̇	ı̇	ı̇
F	⁰ F	ı̇												

The following chart shows the characters that will change when you set the Status switch back to the Normal position. The characters will change according to the country and per the country jumpers (108).

	Hex: 4A	4C	4F	5A	5B	5F	6A	79	7B	7C	A1	C0	D0	E0
U S and Canada	¢			!		¬								
ASCII/Intl														
Austria/Germany	Ä			Ü		ö			§	β	ä	ü	Ö	
Belgium						ù			à	¨	é	è	ç	
Brazil	É			§	Ç	ç	ã	Õ	Ã		õ	é		
Canada (French)	à			'		ù				¨	é	è	ç	
Denmark/Norway	#			×	Å	ø		ƒ	Ø	ü	æ	å		
Finland/Sweden	§			×	Å	ö	é	Ä	Ö	ü	ä	å	É	
France	°			§		ù		£	à	¨	é	è	ç	
Italy	°			é		ò	ù	£	§	ì	à	è	ç	
Japan (English)	£			!	¥	¬					—			\$
Portugal		Ç				õ		Ã	Õ	ç	ã	'	ç	
Spain					ƒ	¬	ñ		Ñ		¨			
Spanish-Speaking						¬	ñ		Ñ		¨			
United Kingdom	\$!	£	¬								

Return to the Display Verification Menu by:

1. Pressing the C key
2. Pressing the Enter key



XX---XX (station ID) can be up to 10 characters.

Select the specified input fields option by:

1. Pressing the 3 key.
2. 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 place the cursor at the start 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 is entered.
2. Enter information in the fields described on the display screen. If an error is made, press the Error Reset key and correct the error.

The field descriptions are:

Alpha or Numeric: Key in five alphabetic or numeric characters.

Mandatory Fill: This field must be filled with five alphabetic or numeric characters.

Alpha Only: Key in five alphabetic characters.

Field Exit Req: Key in five alphabetic or numeric characters and then press the Field Exit key.

Numeric Only: Key in five numeric characters.

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

Signed Numeric: Key in four 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 five alphabetic characters.

Rt Adj Z Fill: Key in one alphabetic or numeric character. Press the Field Exit key. The character keyed will be moved to the right of the field, and the left four positions will be filled with zeros.

Self-Check: Key in the example for Modulus 10 as shown in *Appendix C*. Include the self-check digit.

Rt Adj B Fill: Key in one alphabetic or numeric character. Press the Field Exit key. The character keyed will be moved to the right of the field, and the left four positions will be filled with blanks.

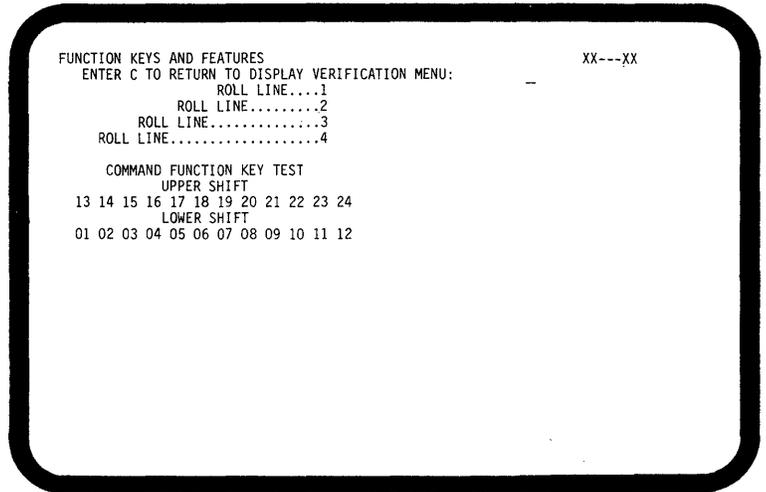
Self-Check: Key in the example for Modulus 11 as shown in *Appendix C*. Include the self-check digit.

Auto Enter: Key in five alphabetic or numeric characters. As soon as the last character has been keyed, the controller reads all the input fields, sends the information to the system, and writes it back to the display screen next to the input fields.

Return to the Display Verification Menu by:

1. Pressing the C key.
2. Pressing the Enter key.

A4



XX---XX (station ID) can be up to 10 characters.

Select the function keys and features option by:

1. Pressing the 4 key.
2. 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 while you press either the Roll↑ or Roll↓ key.
2. Observe roll lines 1, 2, 3, and 4. You can return lines that have rolled off the display screen by pressing the Enter key.
3. Observe the intensity of the numbers on the display screen while you perform step 4.

4. Press the Cmd key; then press command function key 1. Repeat until command function keys 1 through 12 have been pressed. Press the Cmd key again; then press and hold the Upper Shift key while pressing command function key 13. Release both keys. Repeat until command function keys 13 through 24 have been pressed.
5. Repeat step 4 to obtain a normal display of the numbers.

Return to the Display Verification Menu by:

1. Pressing the C key.
2. Pressing the Enter key.

Return to the Prime Option Menu by:

1. Pressing the C key.
2. Pressing the Enter key.



```
CONFIGURATION DATA - REMOTE STATIONS                                XX---XX
ENTER C TO RETURN TO PRIME MENU:
-
LINE STATION ADDR  LSID LOGICAL ID  DESCRIPTION  M/S
1     OA          01   XX---XX   DISPLAY      960
1     OA          03   XX---XX   PRINTER      960
1     OA          04   XX---XX   DISPLAY      1920
1     OB
*** END OF REMOTE DATA ***
```

XX---XX (station ID) can be up to 10 characters.

Note: Controller OB is shown, but all stations attached to OB are not shown. It is a system option to show the stations.

Press the Enter key

```
CONFIGURATION DATA - LOCAL STATIONS                                XX---XX
ENTER C TO RETURN TO PRIME MENU:
-
DEVICE ADDR  UNIT ADDR  LOGICAL ID  DESCRIPTION  M/S
CO           *       XX---XX   DISPLAY      960
CO           *       XX---XX   DISPLAY      960
CO           *       XX---XX   PRINTER      960
CO           *       XX---XX   DISPLAY      1920
*** END OF LOCAL DATA ***  SYSTEM CONFIGURATION SEE CNFIGSCP@ ***
```

XX---XX (station ID) can be up to 10 characters.

* Unit address can be up to three characters. The units position is the physical station address; the two high order positions are the physical port/cable.

@ This is a system message area. A sample message is shown.

Select the configuration data option by:

1. Pressing the 3 key.
2. Pressing the Enter key.

Descriptions of the configuration data headings are:

- Device Addr is the address of the controller.
- Unit Addr is the station(s) assigned to the controller.
The first 2 digits are the physical port/cable number,
and the third digit is the station address.
- Logical ID is the name the system uses to address
the station(s) assigned to the controller.

Return to the Prime Option Menu by:

1. Pressing the C key.
2. Pressing the Enter key.



```
ERROR RECORDING ANALYSIS PROCEDURE                                XX---XX
SELECT OPTION:  _
C RETURN TO PRIME OPTION MENU
1 DISPLAYS
2 PRINTERS
3 WORKSTATION CONTROLLER AND LINE
4 ALL
```

OR

```
ERROR RECORDING ANALYSIS PROCEDURE.  SELECT DESIRED OPTION  _
0 END                                7 WORKSTATION CONTROLLER
1 ALL                                8 DISPLAY STATIONS
2                                     9 5256 PRINTERS
3                                     10
4                                     11
5                                     12 SDLC
6
```

XX---XX (station ID) can be up to 10 characters.

Either format is appropriate. The top format is a work-station-only ERAP menu. The bottom format is a shared (system/work station) ERAP menu.

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

1. Pressing the 4 key.
2. Pressing the Enter key.

Note: For a detailed ERAP description, see the system documents. For display station problem identification, see *208 Error History Table* in this section.

Descriptions of the ERAP options are:

- If you select the END option, the ERAP function will be terminated. If you select this option and press the Field Exit key, the display returns to the sign-on menu.
- If you select the ALL option, the ERAP tables will be displayed one at a time for all devices on the line. 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 the error history table for the last device on the line is displayed.
- If you select the workstation controller option, the display stations option, or the 5256 printers option, you must also select a particular device. The I/O counter table, the error counter table, and the error history table will be displayed for the selected device only.

This manual describes only the display stations option.

C2

```

ERROR RECORDING ANALYSIS PROCEDURE.  SELECT DESIRED OPTION 08
ENTER ID OF DESIRED DEVICE  _
XX---XX  XX---XX  XX---XX
  
```

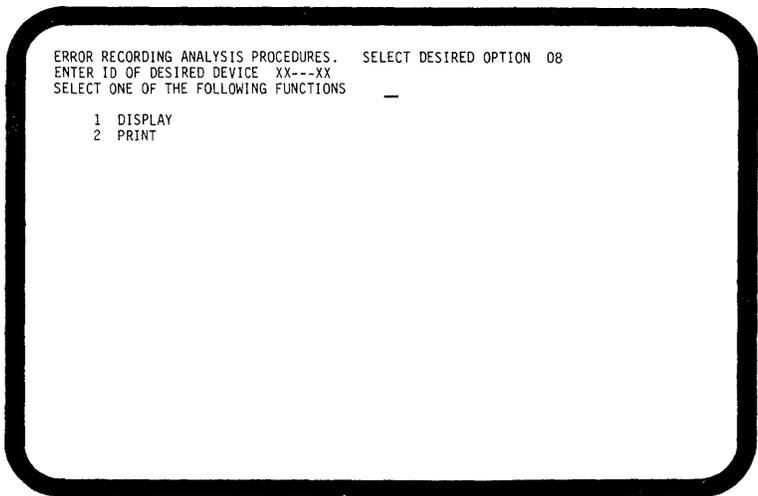
XX---XX (station ID) can be up to 10 characters.

Select the display stations option by:

1. Pressing either the 1 key or the 8 key, depending on the displayed menu.
2. Pressing the Field Exit key.

How to use this display:

1. Enter the ID of the desired device.
2. Press the Enter key.



XX---XX (station ID) can be up to 10 characters.

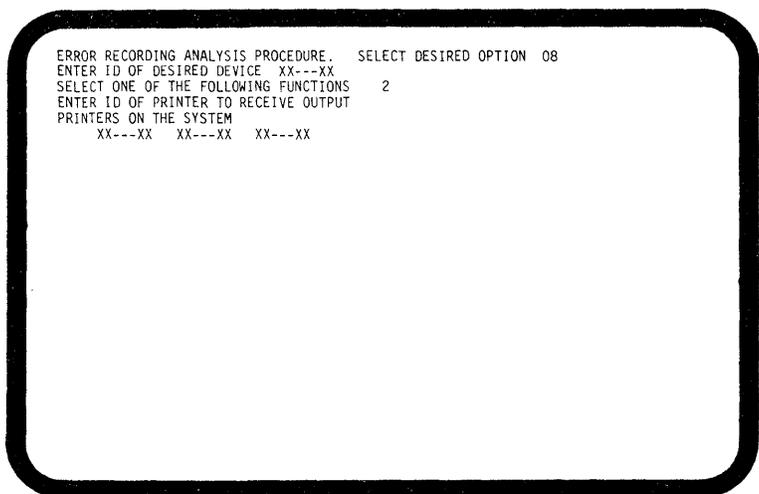
How to use this display:

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

1. Press the 1 key.
2. Press the Enter key.

If you want a printout of the error tables:

1. Press the 2 key.
2. Press the Enter key.



XX---XX (station ID) can be up to 10 characters.

Note: This screen will be seen only if you select the print option

The following three tables may be displayed again or printed again (in order) as many times as desired; you must press the Enter key after each table has been displayed or printed.

```

PRESS ENTER TO VIEW NEXT DISPLAY.  ENTER C TO RETURN TO MAIN MENU  _
I/O COUNTER TABLE FOR DISPLAY STATION      W2/ C011
DATE LAST RESET          00/00/00
NUMBER OF SVCS          6414
***** END OF TABLE *****

```

Press the Enter key.

```

PRESS ENTER TO VIEW NEXT DISPLAY.  ENTER C TO RETURN TO MAIN MENU  _
ERROR COUNTER TABLE FOR DISPLAY STATION    /    DATE LAST RESET 76/07/31
RECEIVE PARITY CHECKS..... 0
LINE PARITY CHECKS..... 0
***** END OF TABLE *****

```

Optional Screen

Press the Enter key.

```

PRESS ENTER TO VIEW NEXT DISPLAY.  ENTER C TO RETURN TO MAIN MENU  _
ERROR HISTORY TABLE FOR DISPLAY STATION  /  _
ERROR  CONT/HOST  CABLE STATUS  DEVICE STATUS  DATE  TIME
CODE   STATUS     CONT      DEVICE     0       1       *YY/MM/DD HH:MM:SS
-----
0104   0000 0000   0000 0000  0100 0001  0000 0000  0000 0000  76/08/24  04:46:19
0120   0000 0000   0000 0000  0000 1001  0000 0000  0000 0000  76/07/24  02:32:06
***** END OF TABLE *****

```

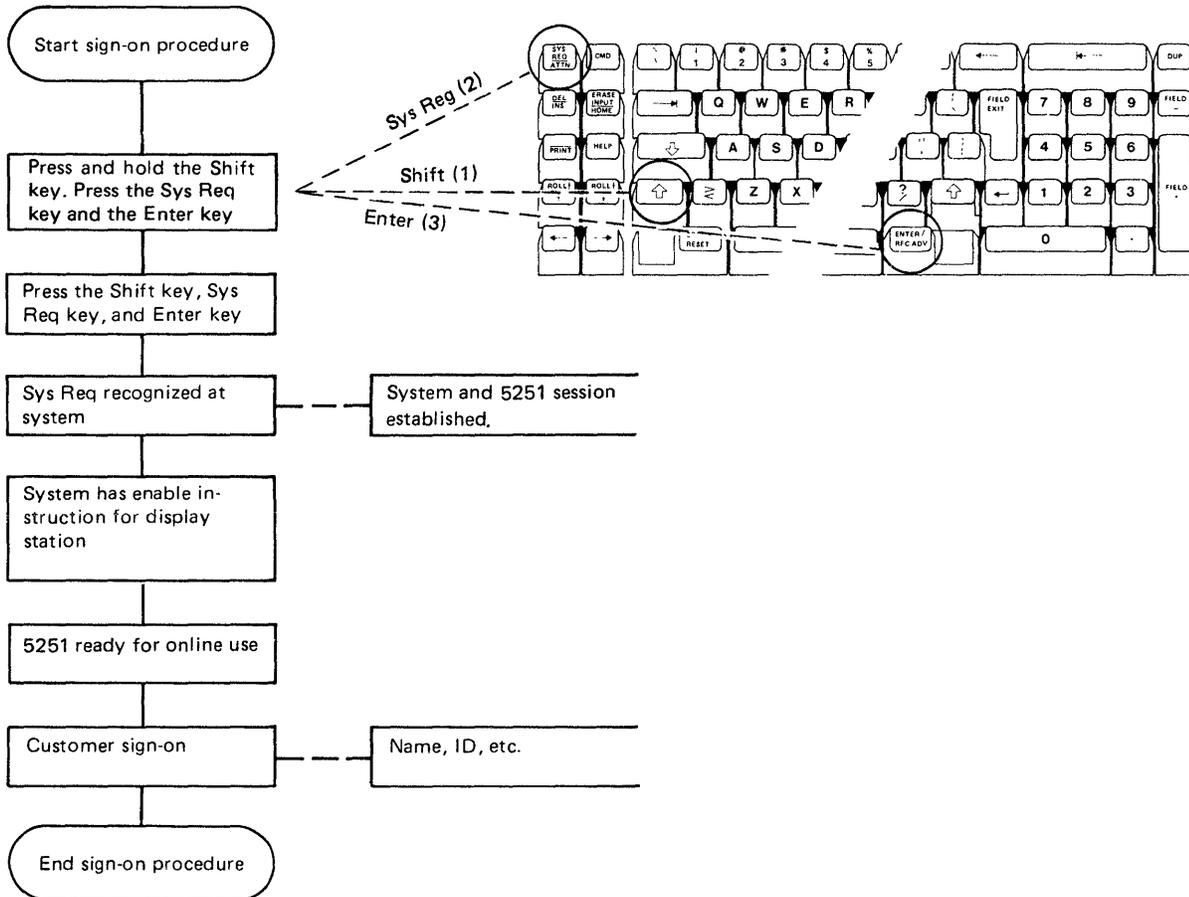
* Acceptable formats: YY/MM/DD
MM/DD/YY
DD/MM/YY

For the identification of display station problems, see reference 208 *Error History Table*.

207 SIGN-ON PROCEDURE

This is the procedure that the operator and customer engineer use to sign on to use the display station. It is also a diagnostic in that all parts of the display station, customer system 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 figure is an example of an error history table that describes the fields that can be displayed on the display station or that can be printed on a printer.

	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 = Display
Error type

Controller defined. If any error bit is present, see the 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

Modify Data Tag (MDT)

Defines status byte 0
0010 = Keyboard scan code

Scan code or command

Even/odd response level
0 = Even
1 = Odd

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

209 ERROR CODES

Two types of error codes are described in this section: display station error codes and operator error codes.

Display Station Error Codes

Errors that are relative to hardware failures or the servicing of a display station are listed first. The controller detects these errors by sensing the status sent from the display station or by sensing either no response or a wrong response. Errors are stored in the order in which they are received; they are listed here in groups. The error codes appear on the display screen in the bottom left corner; error code 01xx identifies a display station error. (These numbers blink.)

Line/Interface Errors

0100 No Response

This error is reported if the display station did not respond to a poll when the display station and controller were in session. This error is not normally logged.

0101 Transmit Activity Check

This error is detected by the controller when a poll or command is executed by the controller.

0103 Receive Parity Error

The controller reports this error if the wrong parity was received in response to a poll or command.

0104 Line Parity Check

The display station reports this error if the wrong parity was received in a poll or command.

0106 Receive Length Check

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

0107 Wrong Station Responded

An incorrect station address was returned in response to a poll from the controller.

0108 Power On-Transistion

The status bit was set when the display station was powered on. This error is reported 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 had been sent.

Keyboard Errors

0111 Scan Code Not Valid

The 8-bit code sent in the keyboard response frame could not be translated to an assigned character or function that was specified by the controller.

Command/Function Errors

0120 Command Not Valid

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

0121 Register Value Not Valid

This condition indicates that the address counter value was not within the user accessible limits.

0122 Storage or Input Queue Overrun

This condition occurs if more than 16 commands and associated data frames are sent to the display station by the controller, or if an attempt is made to store data in storage that is not accessible to the user.

0123 Null or Attribute Exception

This condition indicates that no attribute was found or that the address counter pointed to an attribute.

0124 Activate Not Valid

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

0125 Undefined Exception Status

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

0149 Undefined Error Status

This condition indicates that the controller found an error but the cause of the error could not be determined.

0181 Magnetic Stripe Reader Error

This error is indicated if no device word was received by the controller while bit 10 was on.

0182 Device Type Error

This condition indicates that an unsupported device responded to a poll.

0183 Wrong Size Display Assembly

The CRT image size does not match the CRT image size set in the ID word sent by the display station.

0184 Incorrect Keyboard ID

The keyboard ID received by the controller was invalid.

0185 Incorrect Keyboard Specified

The keyboard ID received by the controller does not match the ID in the keyboard table in use for the display station.

0189 Invalid Outstanding Status

An outstanding status was presented in the poll response, and no outstanding status information was available.

Time-Out Errors

0190 Even/Odd Change in Status

This condition indicates that the status sent to the controller from the display station did not change within 225 ms after the controller sent a positive acknowledgment and received a not busy response.

0191 Busy

This condition indicates that the controller found that the busy bit had been on for a period of more than 400 ms.

Operator Error Codes

These errors are caused when you press the wrong key, press a key that is not recognized by the controller, or enter the wrong data in a specified input field. The error codes appear on the display screen in the bottom left corner; these error codes have a format of 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 the controller. See the system documents for the cause of the error.

However, you can check the error conditions by using the online test (206). For example, the specified input fields display (selected from the Display Verification Menu) contains specific data fields. You can intentionally make errors by entering the wrong data in a field and checking 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.

0000 HELP KEY NOT ALLOWED NOW

You 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.

0001 LAST KEYSTROKE NOT RECOGNIZED

You keyed information faster than the controller could receive it; therefore, the last character you entered was not recognized. This is a keyboard overrun.

0002 LAST KEYSTROKE NOT RECOGNIZED

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

0003 INVALID KEY FOLLOWED CMD KEY

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

0005 CURSOR IN PROTECTED AREA OF DISPLAY

You attempted to enter data; however, the cursor was 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 in which the data can be entered and enter the data.

0006 INVALID KEY FOLLOWED SYS REQ KEY

You pressed the Sys Req key but failed to press either the Enter key or the Error Reset key.

0007 MANDATORY ENTER FIELD—MUST ENTER DATA

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

0008 THIS FIELD REQUIRES ALPHABETIC CHARACTERS

The field into which you are now attempting to enter data requires alphabetic data, and you pressed a key that was not an alphabetic 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.

0009 THIS FIELD REQUIRES NUMERIC CHARACTERS

The field into which you are now attempting to enter data requires numeric data, and you 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.

0010 ONLY CHARACTERS 0 THROUGH 9 ALLOWED

The field into which you are now attempting to enter data requires signed numeric data, and you pressed some other key.

Valid characters are 0 through 9. The Dup key can be used to duplicate these characters into this field.

0011 INVALID KEY FOR SIGN POSITION OF FIELD

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

0012 INSERT MODE—NO ROOM TO INSERT DATA

Either there is no room in this field for additional data, or the cursor is in the last position of the field.

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

0013 INSERT MODE—ONLY DATA KEYS ALLOWED

You are now in the Insert mode; however, you pressed a key that is not a data key. Only data keys are valid after you have pressed the Ins key.

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

0014 MANDATORY FILL FIELD—MUST FILL TO EXIT

You pressed a function key that is supposed to 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 from the first position in the field before data has been 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.

0015 CHECK DIGIT ERROR

The number and the check digit you entered did not compare.

If the number you entered matches the input, continue without using that input.

0016 FIELD MINUS KEY INVALID WITH THIS FIELD

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

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

0017 MANDATORY FILL FIELD—KEY USED INVALIDLY

You pressed the Field -, Field +, or Field Exit key; however, the cursor was not in the first or last position of this mandatory fill field. A mandatory fill field must be completely filled unless you exit from the first position in the field before data has been 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.

0018 INVALID KEY USED TO EXIT THIS FIELD

The cursor is in the last position of this field. You must use a key that is not a data key to leave this field; for example, you can use the Field Exit key.

0019 DUP KEY NOT ALLOWED IN THIS FIELD

You pressed the Dup key; however, the Dup key is not permitted to be used in this field.

0020 ENTER KEY NOT ALLOWED IN THIS FIELD

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

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

0021 MANDATORY ENTER FIELD—MUST ENTER DATA

The cursor is located in a mandatory enter field, and you attempted to exit from the field without entering data. A mandatory enter field must have data entered in it before you can exit from the field.

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.

Clear the error and continue without using the undefined key.

0027 KEY NOT DEFINED—KEY CANNOT BE USED

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

0031 WSC BUFFER OVERFLOW

The data on the MSR card was not within the specified length for MSR.

Continue without using that MSR card.

0032 DATA ERRORS ON COAX LINE

A 16-byte block of data was not transferred.

Retry the MSR card. If the error reoccurs, continue without using that MSR card.

0033 SECURE DATA NOT AUTHORIZED

The MSR data received was secured data; however, this field was not specified for secured data in the FCW.

Ensure that you are in the correct field. Retry the MSR card. If the error reoccurs, continue without using that MSR card.

0034 MSR WILL NOT FIT IN ACTIVE INPUT FIELD

The data received from the MSR by the controller will not fit in the field.

Retry the MSR card. If the error reoccurs, continue without using that MSR card.

0035 MSR ERROR

Bit 8 of the MSR data is on.

Retry the MSR card. If the error reoccurs, continue without using that MSR card.

0036 LIGHT PEN USAGE IS NOT ALLOWED

The operator has started entering data into a field (can be any field on the display) but has not gone from the field (finished entering data) before attempting to use the light pen.

0037 TIP SWITCH ERROR

The light pen tip switch is operated when the light pen is not in a light pen field (the light pen is pointed at a character in a field and the field does not have a light pen control word).

0097 TEST REQUEST NOT AVAILABLE

The programming required for the test request function is not installed in the host system.

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 the key that caused the error. If you have not yet used the system request functions, the Sys Req key is the only valid function key at this time.

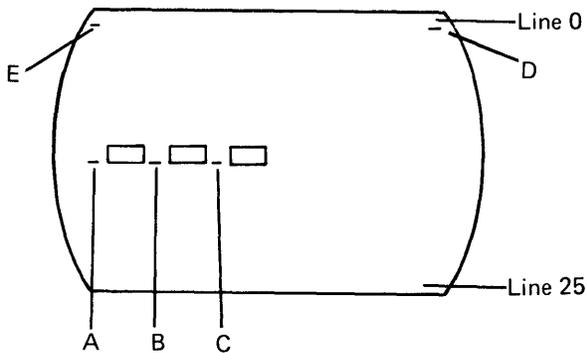
Note: When this error occurs, the display station is in the free key mode. The free key mode is described in reference 205.

210 DIAGNOSTIC DISPLAY LOCATIONS

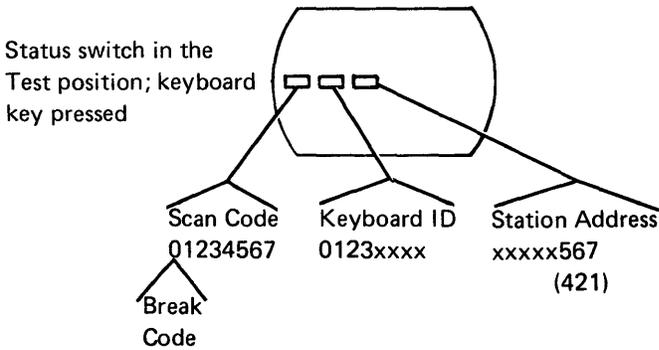
211 (NOT USED)

This figure shows the possible positions of the cursor during the power-on sequence. If the cursor is in position A, B, or C, the power-on diagnostic did not finish. If the cursor is in position D, the power-on diagnostic finished; however, the display station is not in session with the host system. If the cursor is in position E, the power-on diagnostic is finished, and the display station is in session with the host system.

Cursor Display Positions



Power-On Diagnostic Display



212 TROUBLESHOOTING AIDS

Mini-MAPs provide you with three levels of information. These levels are:

1. A description of the circuit and how it can be tested.
2. A figure showing the circuit line names and pin numbers.
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 for the symptoms to change or disappear while you are probing 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

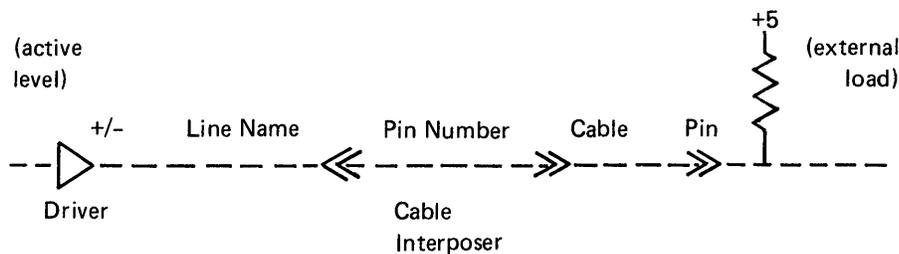
Lists suggestions as to how the circuit may be tested and additional information about the circuit.

Tools

Suggests which tools to use.

SOURCE
(Driver)

SINK (Receiver)
(pull up resistor)



212 (continued)

Mini-MAP example

Is the signal present at the driver?

Y N

Is the line at a Down level?

Y N

- Replace the driver.

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

- Check for a ground.

Is the line grounded?

Y N

- Replace the driver.
- Replace the FRU that caused the ground.

Note: A pull-up resistor at the receiver will cause an Up level at the receiver if the cable is open.

Is the signal present at the 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 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 in which they should be replaced.

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Preventive Maintenance

Preventive maintenance is not needed on the display station.

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Tools and Test Equipment

The following tools and test equipment are needed to service the 5251 Display Stations Models 1 and 11:

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

This kit contains tools that are normally used by the customer engineer.

3. Metric tool kit

You can order a kit of metric tools from Mechanicsburg by ordering bill of material 1749235.

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

4. Fiber screwdriver

You need a fiber screwdriver to adjust the potentiometers on the cathode-ray tube. You can order this screwdriver by ordering part 460811. (This tool is now being supplied in the standard tool kit.)

5. Keytop removal tool (part 9900373)

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 the probe.)

Test Terminal

The line being probed is connected to this terminal.

Note: To avoid improper indications, this lead should not be placed near the high-voltage transformer or near 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.

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

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

Logic Selector (TECHNOLOGY)

Use the Multi setting for the display station.

Latch Switch

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

Gate Ref Volts Switch

Set the Gate Ref Switch to ground (GND).

Gating Terminals

You do not need to use these terminals to probe within the display station.

Indicator Lights

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

A pulsing line is indicated by both lights being on or flashing at any rate.

Power Leads

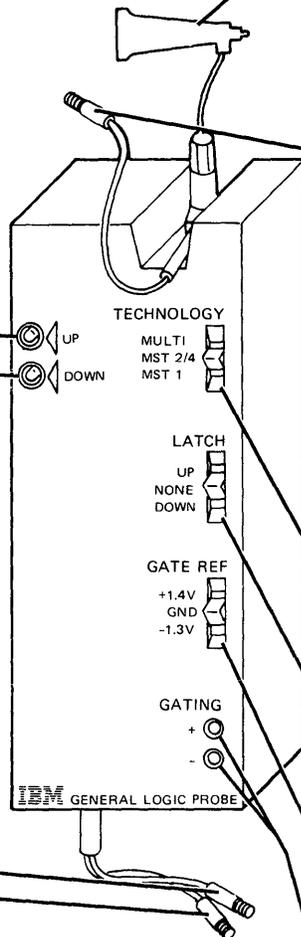
+Red
-Black

CAUTION

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

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

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



Introduction

The IBM 5251 Display Stations Models 1 and 11 are tabletop, online work stations that are used for data entry or interactive display functions. The display station contains a display screen that displays data, a keyboard that is used to enter data, a control unit that contains storage, and a cable adapter that handles the communications between the controller and the display station.

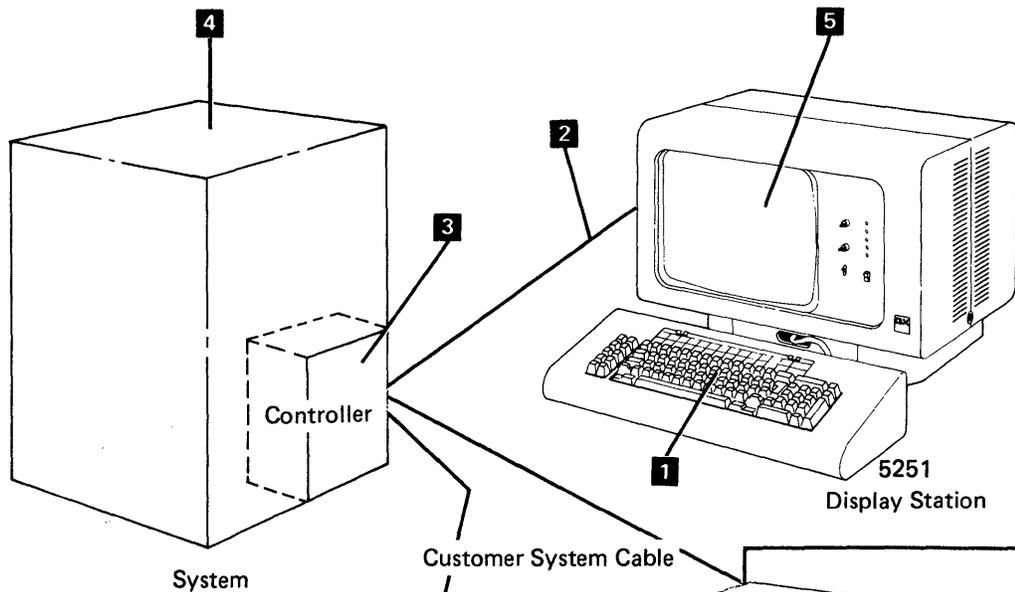
The Model 1 displays up to 960 characters in 12 rows of 80 characters each. These 12 rows are interspersed by 12 blank rows that improve readability.

The Model 11 displays up to 1920 characters in 24 rows of 80 characters each.

SYSTEM CONFIGURATION

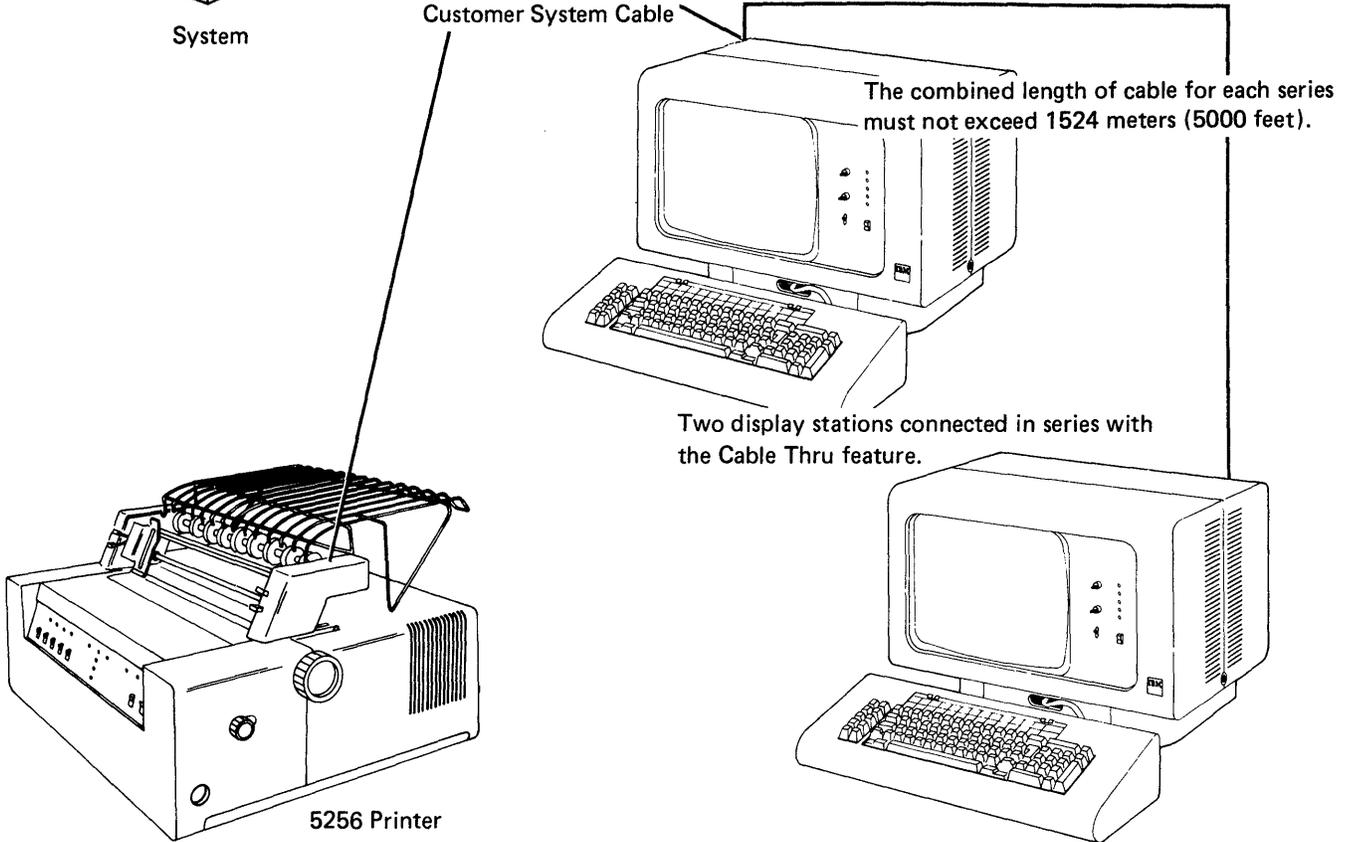
The following figure shows a configuration of a 5251 Display Station Model 1 or 11 attached to a controller at a system location. The number of display stations that are attached to the system is specified during system configuration. Display stations and printers can be attached in a point-to-point configuration, or they can be attached in a series configuration by means of a Cable Thru feature that is installed on each work station in the configuration.

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



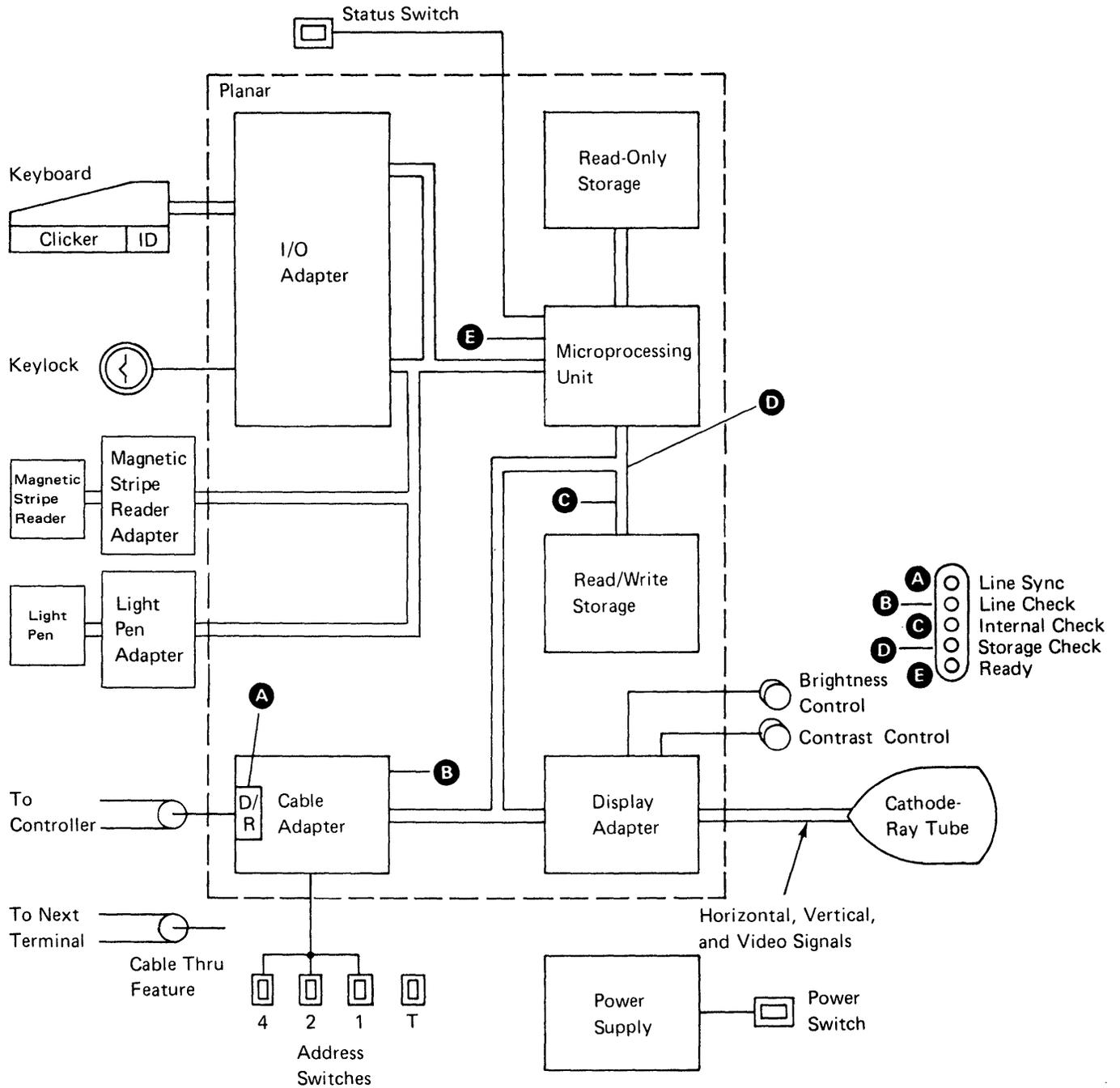
Data Flow

- 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

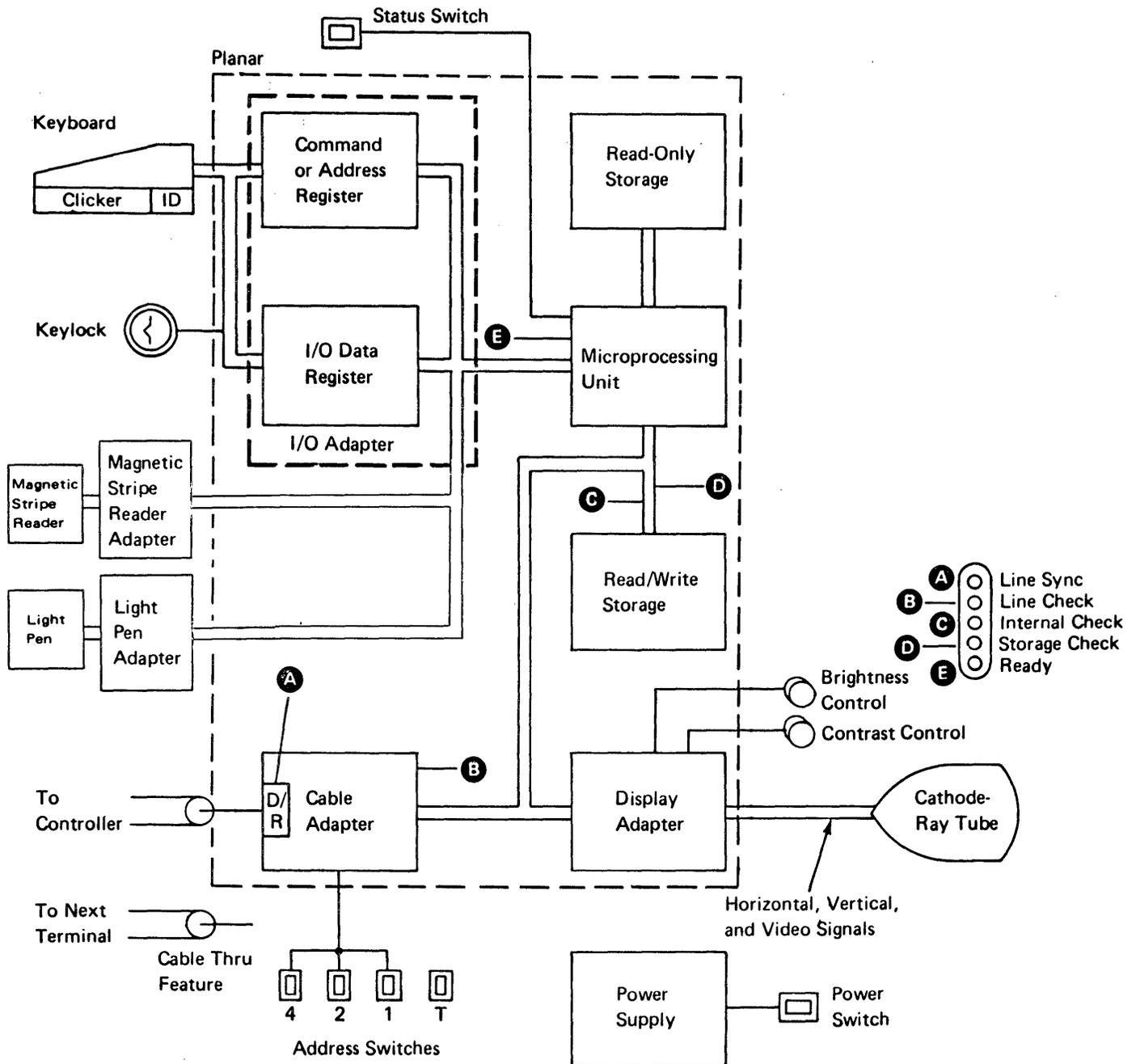
The next figure shows the data flow of the display station. The following pages of this section describe functions performed in each of the major sections of the display station. Gating and parity checking are not shown in the data flow; nor are counters and parity generation shown.



Functional Units

I/O ADAPTER CONTROL

The I/O adapter control is composed of a group of registers that control the interface and address functions of the I/O devices. These registers are controlled by the MPU (microprocessing unit) and are loaded with data from the I/O devices. The data is moved to 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 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, which is attached to the pad printed circuit board, contains the scan counter; this converts the pressed key to a scan code.

The scan code is loaded into an eight-position buffer on the logic printed circuit board when the keyboard signals the keyboard adapter control that a keystroke is ready to be sent. A strobe pulse 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 appropriate character indicated on the keyboard. The keyboard identification specifies how the scan code is interpreted.

Typamatic keys load the character buffer with a scan code for each scan code cycle. The typamatic key operates 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 tells the controller that there is a change in shift status.

Clicker

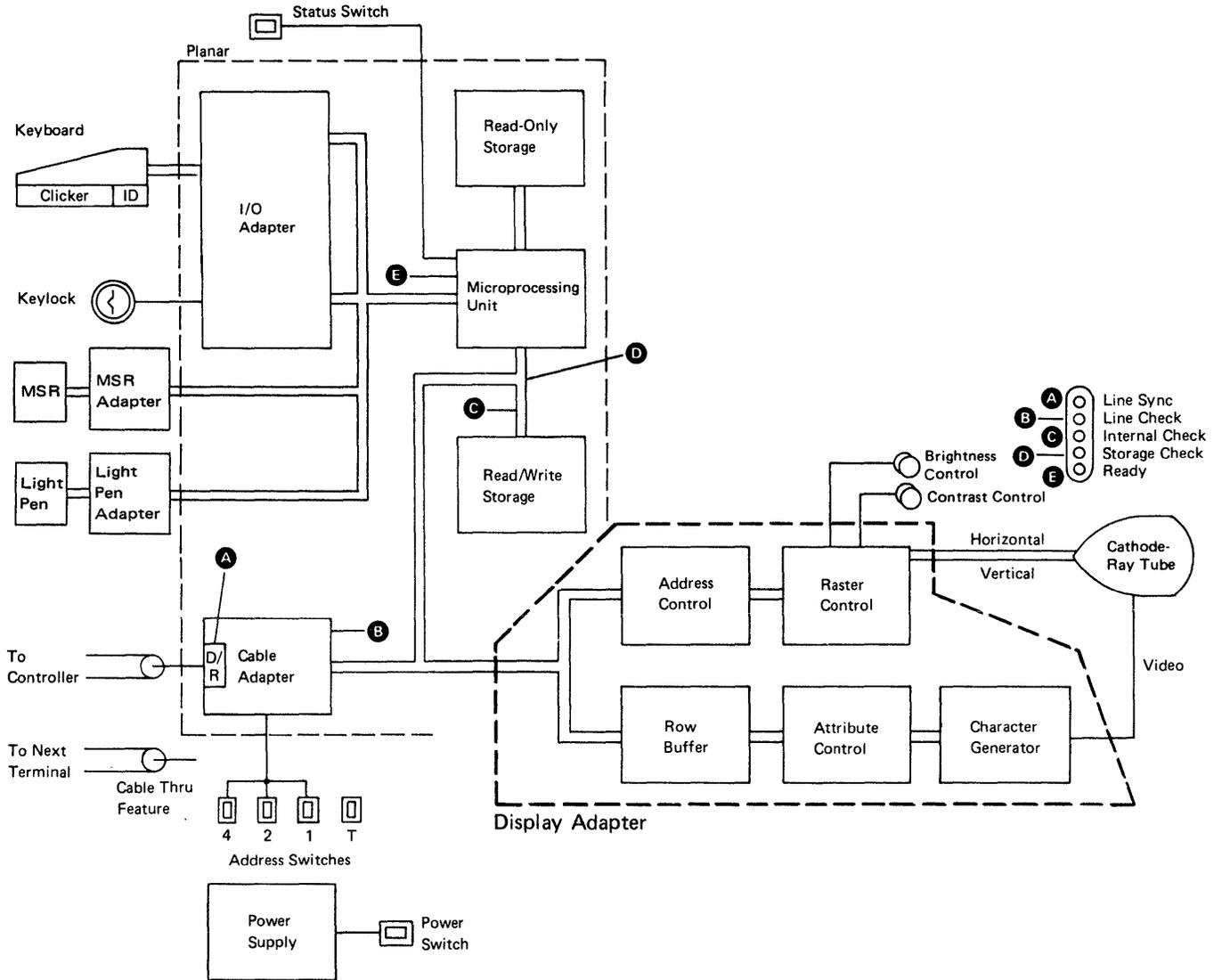
A solenoid attached to the keyboard is activated after the data has been sent from the logic printed circuit board and has been stored by the MPU. The sound of the solenoid is an aid to the operator because it indicates that the next key may be pressed. Also, an alarm function can be performed by this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

Keyboard Identification

When requested, a 4-bit ID code is sent to the controller. The ID code tells the controller which keyboard is being used. The ID code is set up when pins are jumpered on a plug board on the keyboard logic printed circuit board.

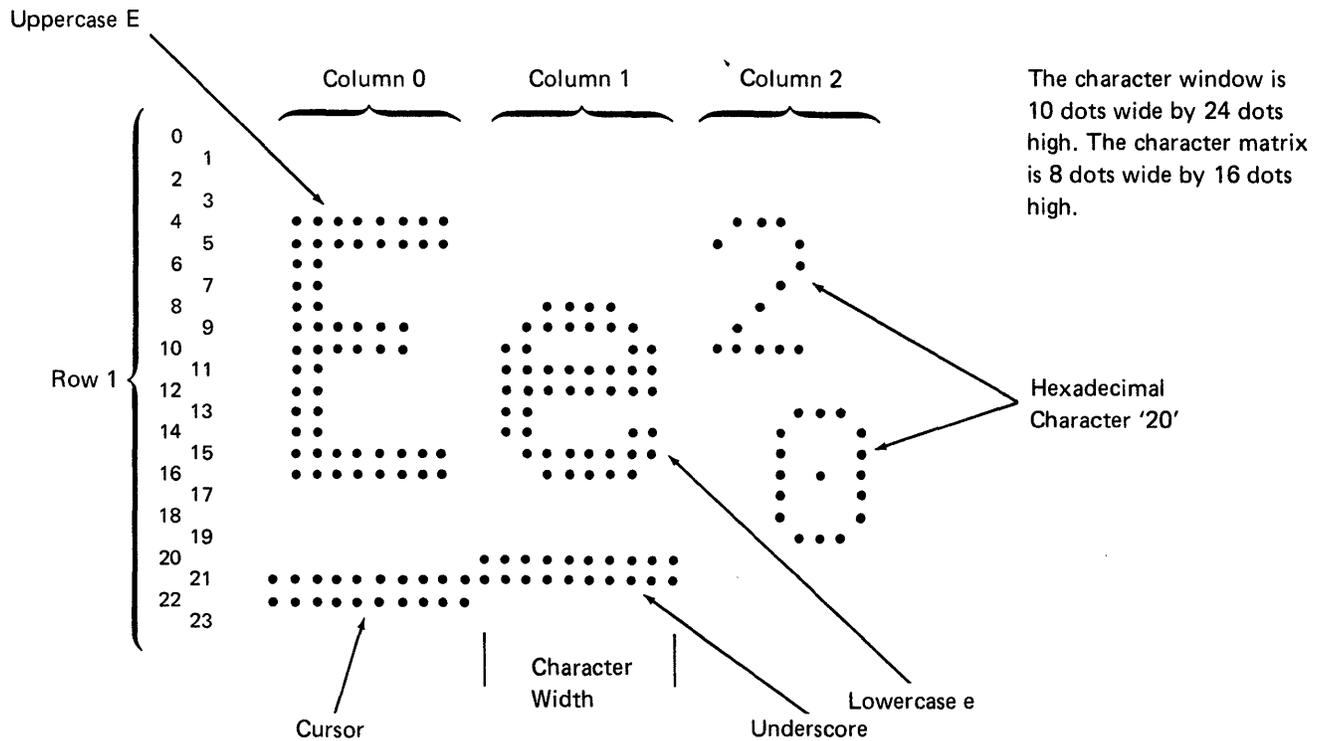
DISPLAY ADAPTER

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



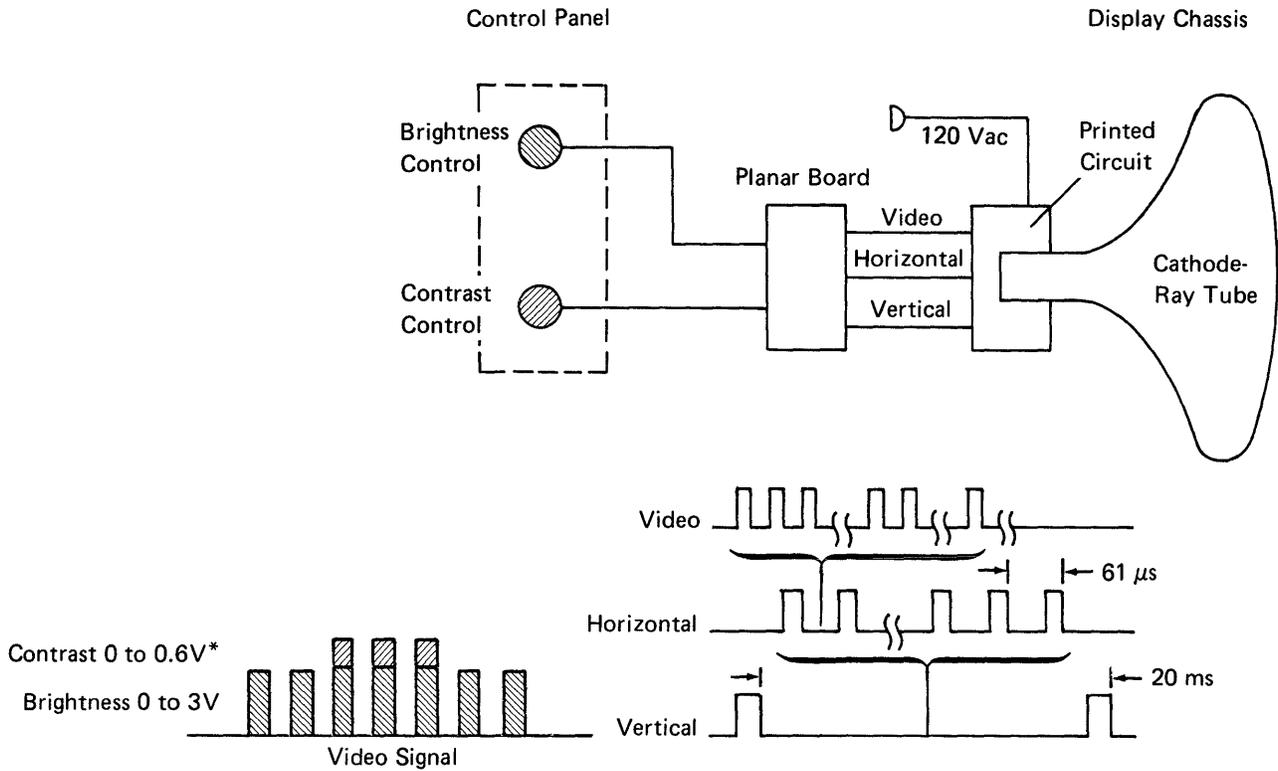
Buffering and Displaying

Data that is to be displayed is contained in read/write storage. The display adapter addresses the read/write storage area for this data, moves the data to one of the 2-row buffers in the display adapter, converts the data into a dot pattern by means of a character generator, and shifts the pattern by means of a video signal line to the cathode-ray tube. At the same time, the display adapter determines the display position and converts the position into the vertical and horizontal drive signals needed for the cathode-ray tube. This routine is constantly repeated to refresh the display. The generated character matrix is 8 dots wide by 16 dots high.



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 a 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/or no reverse image when the screen is refreshed. Field attributes occupy one character space position; this position 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 line indicates the *off* condition. The controller controls all the indicators except the System Available indicator. Power on resets all the indicators.

When the display screen indicators are on, they 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 within 200 ms.
- Message Waiting – indicates that a message is waiting for the operator.
- Keyboard Shift – indicates that the display station is in upper (numeric) shift.
- Insert Mode – indicates that the Ins key has started an operation.
- Input Inhibited – indicates that the system cannot process a keyboard scan code.

A cursor, which is controlled by the MPU or controller, indicates where the next keyboard character will be shown on the display screen.

CABLE ADAPTER

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

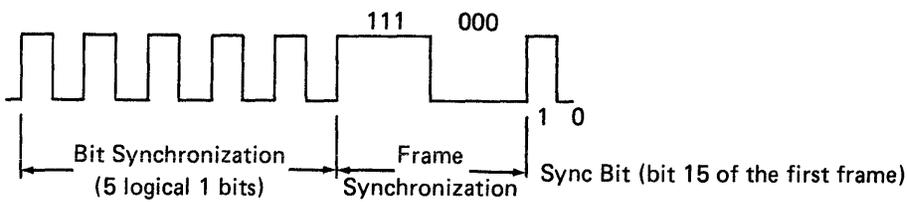
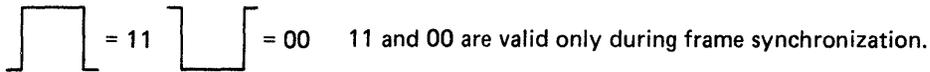
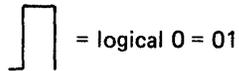
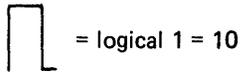
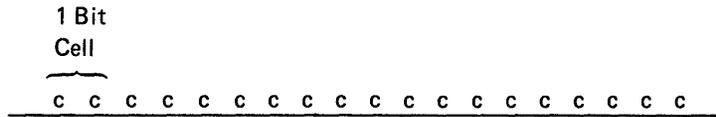
Note: A system cable connects the display station to the controller. See the *System Cable* section in the *Maintenance Procedures* section of this manual and the *Cable Thru* section in the *Features* section.

The 16-Bit Frame

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 as needed. The system cable carries no signal between frames.

To understand what is to follow, it is necessary to describe 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 is used for a 0 and a 1 to 0 transition is used for a 1). Because the transition divides the bit into two parts, the term *half bit* will be used in the description that follows. (The data is sent through the system cable in the form of a four-level signal. Refer to the system documents for more information on the phase encoding process.)

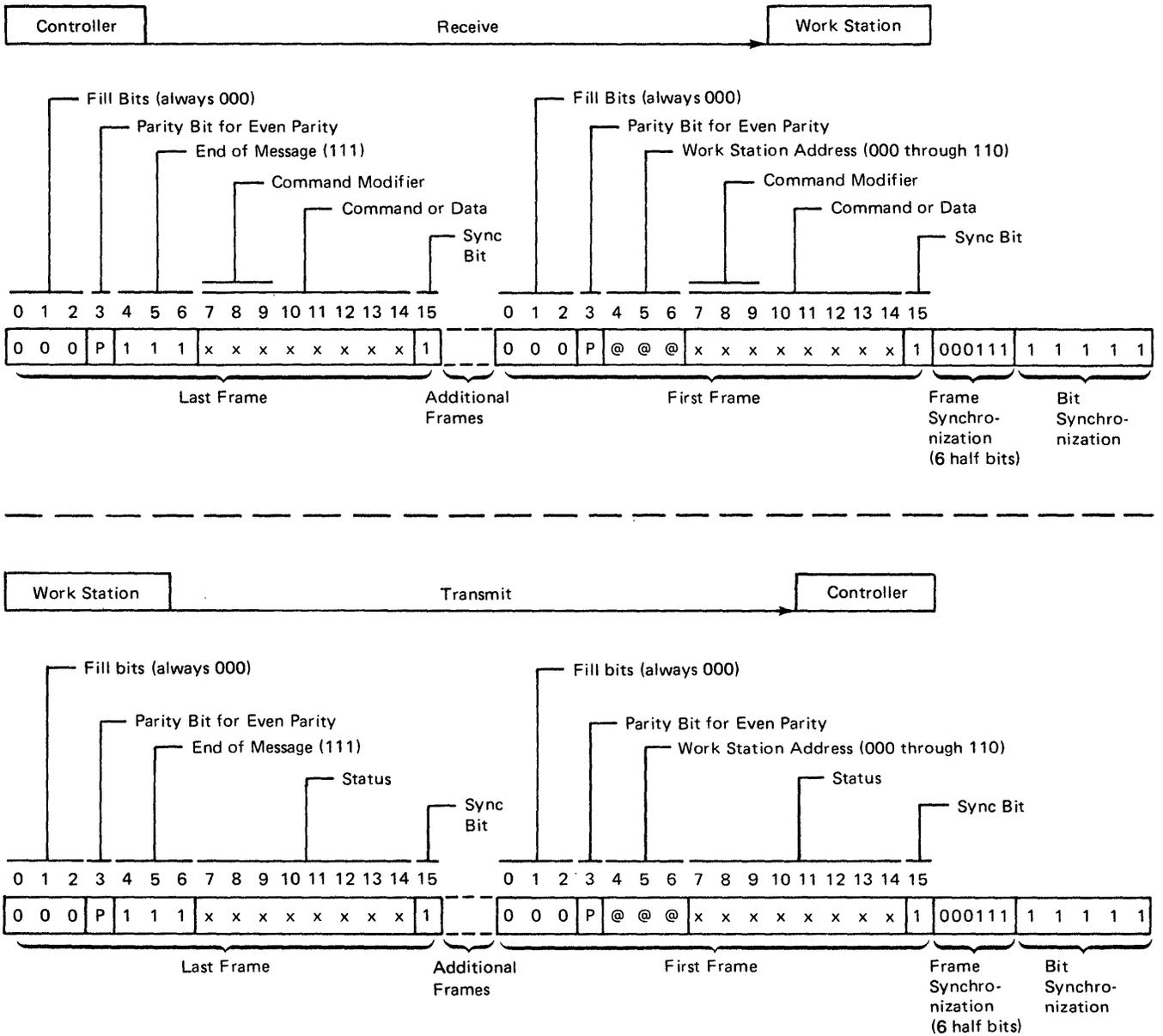
When information is to be sent on the cable, a group of five 1 bits (1010101010 half bits) is sent to establish bit synchronization. Immediately after the 1 bits have been sent, a group of three half bit 1's and three half bit 0's is sent to establish frame synchronization. After the frame synchronization half bits have been sent, the frame is sent; the sync bit is sent first.



← To line

The maximum transmission rate is 1.0 MHz (16 microseconds per frame). The meaning of each bit of the frame during transmit and receive is shown in the following figure:

Transmission Sequences



The 16-bit frame carries 13 bits of information in each direction. The fill bits, which are 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) has been received until the time the same work station starts sending bit and frame synchronization patterns. Bits 7 through 14 contain the data or commands used by the display station and storage. Bit 15, which is 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 combined in bits 10 through 14 of the command frame.

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

EOQ (00010): indicates the end of the command queue. Bits 8 and 9 of the command frame must be on (1). Only polls will be recognized 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 followed by two data words and causes bits 7 through 14 of the data words to be written in the cursor register.

Load Reference Counter (00111): is followed by two data words and causes bits 7 through 14 of the data words to be written in the reference counter.

Move Data (00110): moves data, to the reference counter address, 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 responds to and resets a line parity error from the display station. It also responds to the last status transmission from the display station.

Read Activate (00000): this command is sent after the setup specified by a read command is completed and starts the transmission of requested data.

Write Activate (00001): this command immediately precedes the data transmitted by the controller after the work station has been set up by a write command and causes the work station to start receiving the data from the controller.

Read Base ID¹ (0000 1100): request the retransmission of one ID word to the Model 2 or 12. This command can be used by the Models 2 and 12 to determine the characteristics of attached work stations.

Read Between Limits¹ (11010): causes data to be returned from an area in read/write storage; this area is inside 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 Field Immediate¹ (11001): is followed by 2 data bytes that contain the starting address of the read. Data is transferred from that address until the next screen attribute is reached.

Read Keyboard ID¹ (101100): determines the type of keyboard and country.

Read Light Pen Data (10101000): request the transfer of 16 frames of light pen data.

Read MSR¹ (10011000): request the transfer of the next 16 frames of magnetic stripe reader data.

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; this response consists of one display line of data from the read/write storage.

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

Reset (00010): sets the attributes to normal and moves the cursor to the upper left corner. A specific address feature can reset selected portions of the display station, or the controller can send the display station address for a complete station reset.

Reset Light Pen (10100010): resets the light pen hardware.

Reset MSR (10010010): resets the magnetic stripe reader hardware.

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

Search Next Null (10100): causes the display station to search 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 Data¹ (00101): followed by 1 data byte, which controls the display screen to conditionally reset the exception status, control the keyboard clicker during input inhibit, control the audible alarm, input cursor display, blink the cursor, and reverse image.

Write Data and Load Cursor¹ (10001): followed by 1 to 14 data frames. Data is written to the location address counter, the address counter is incremented, and the cursor register is updated to the new value in the address counter.

Write Data and Load Cursor to the Indicators and Switches¹ (1010001): followed by 1 data byte, which contains the control information for the display screen indicators.

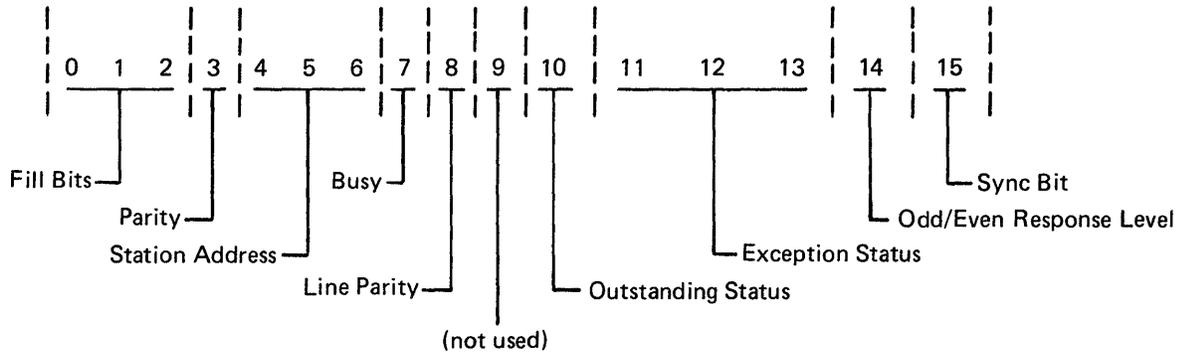
Write Immediate Data¹ (11101): causes the display station to store all the data the controller sends. If there is more data than the storage area can contain, a storage overrun error occurs.

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

Response Frame

A response frame is returned to the controller after the display station has been 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 has been executed. The second frame contains a station address, which consists of all 1's (indicating the last message frame), and the scan code, which is contained in bits 7 through 14. The first frame in the response contains the following status information:



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 to be sent or status data from an I/O device to the controller.

Bits 11, 12, and 13

These three bits are encoded to indicate the following exception status:

Bit	11	12	13	Description
	0	0	0	No exception status
	0	0	1	Null or attribute error
	0	1	0	Activate command 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

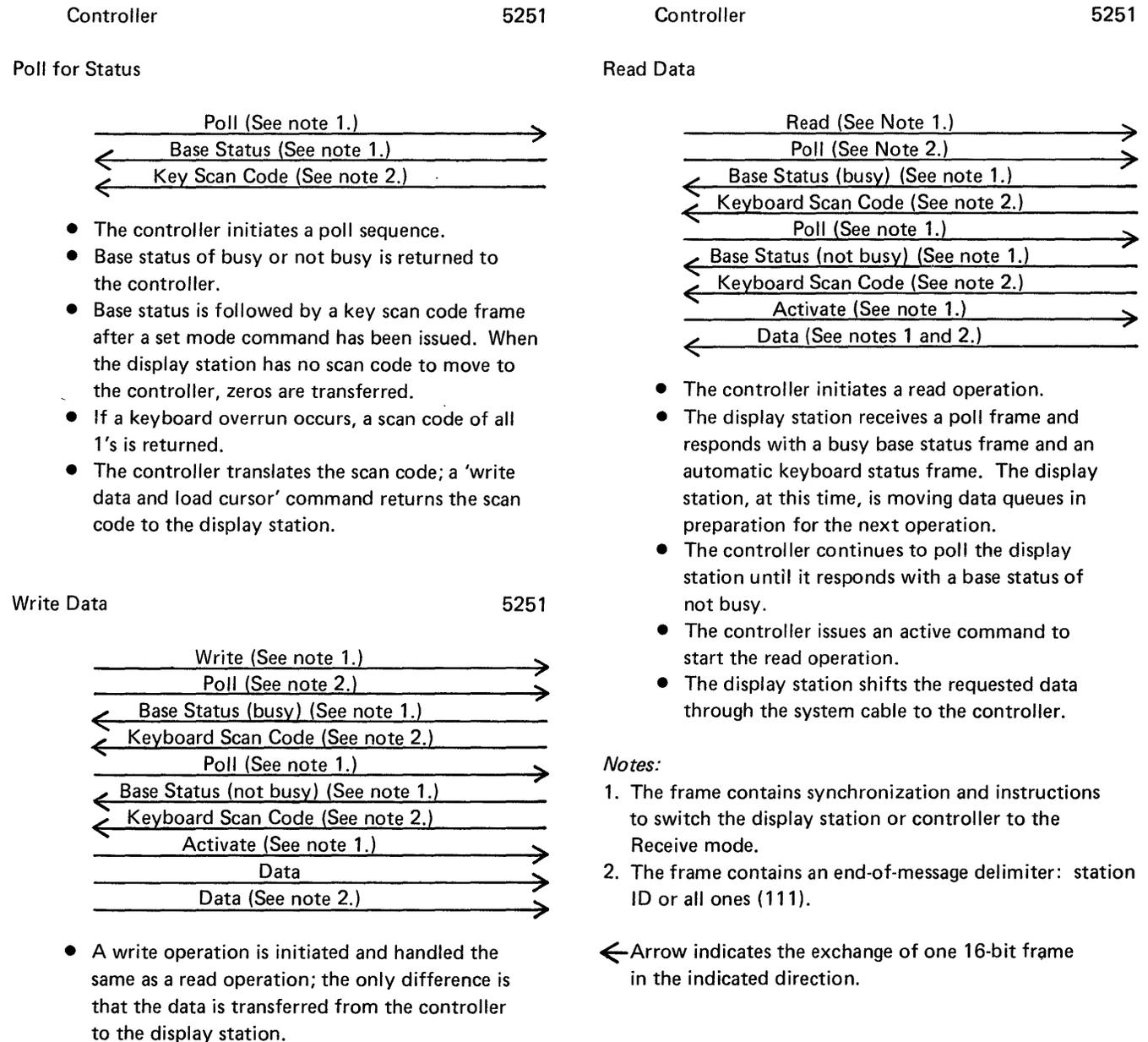
Bit 14

By analyzing bit 14, the controller can determine if the information in the received response frame is the same as the information in the preceding 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 preceding condition.



Interface

The following figure shows the 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

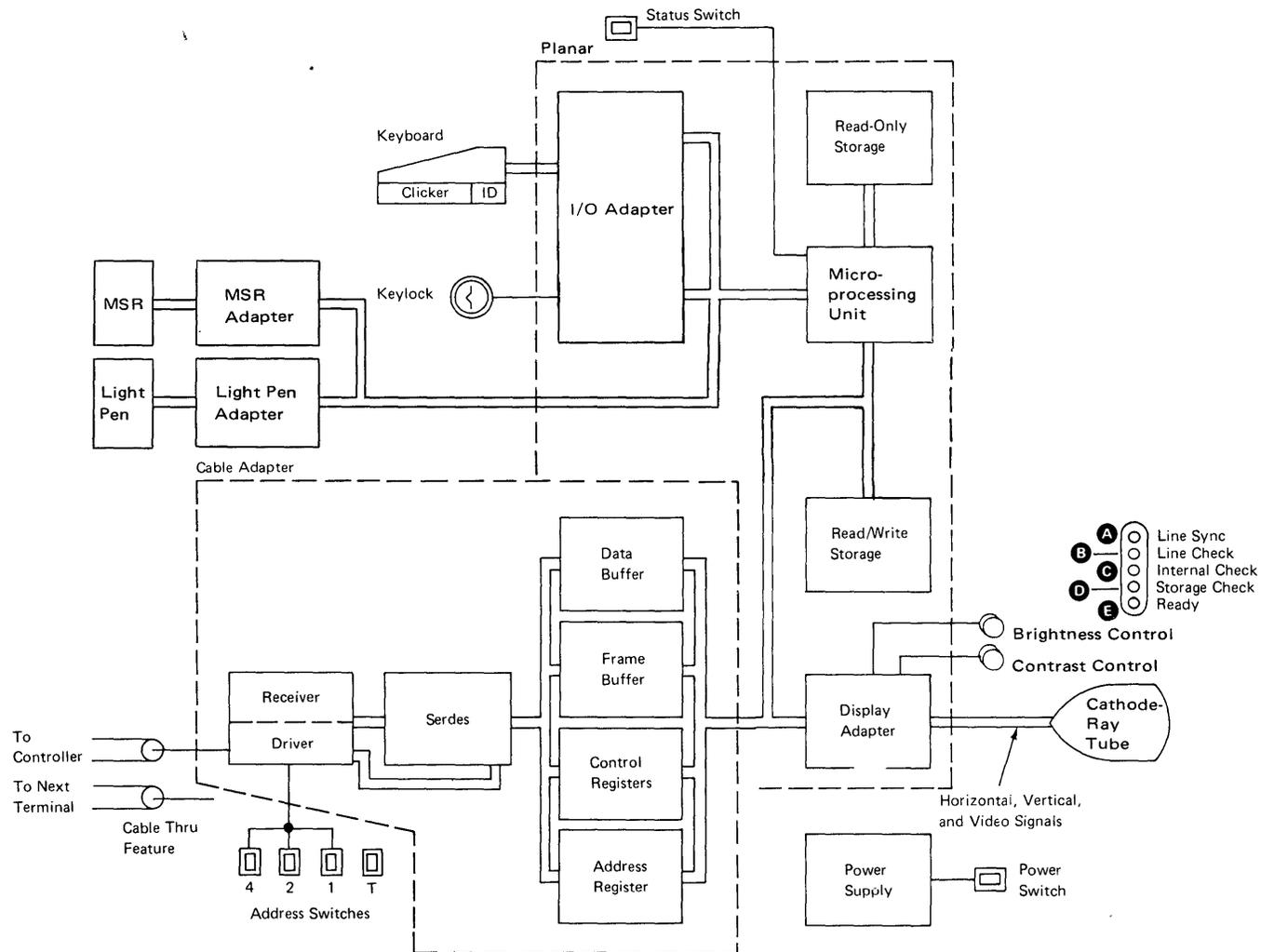
During data transfer, the cable adapter has the three following major functions:

1. To respond to polling
2. To shift data to the customer system cable for transmission to the controller
3. To receive frames from the cable and decode the frames to determine whether they contain commands or data

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

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

Received data is moved into the serdes until the sync bit is in the high-order position. The serdes is stopped; this stoppage allows 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 controlled by a microprogram. It 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 read/write storage.

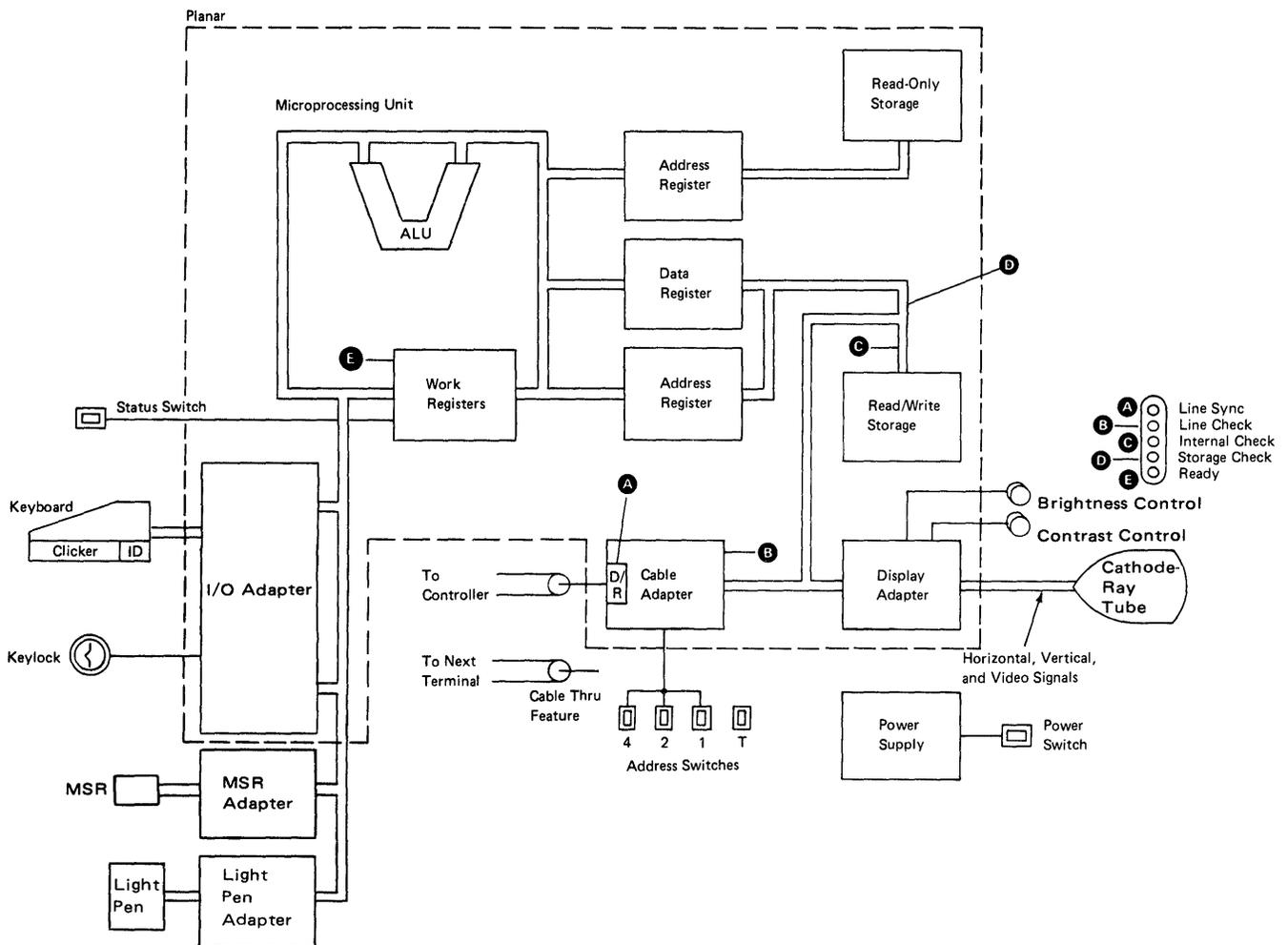
The major parts of the MPU are read/write storage and read-only storage, storage registers, work registers, and ALU (arithmetic and logic unit).

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 divided into three parts: display control area, cable adapter control area, and microprocessing unit work area.

Internal Processing Queue

Each display station has a work area in Read/write storage large enough to hold up to 16 frames of commands or associated data. Commands and associated data are executed from this work area; the commands and data that were placed in the work area first are the first to be used.



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 to read and write data. The reference counter register is used for moving data from one display area to another.

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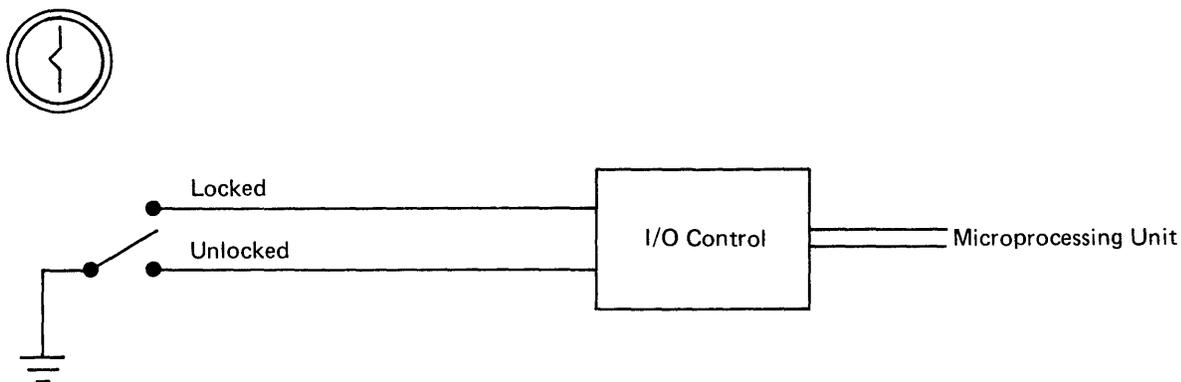
KEYLOCK FEATURE

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

When the Keylock is in the locked position while the Status switch is set to 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 the unlocked position, and the power-on diagnostic still functions the same.

Keylock



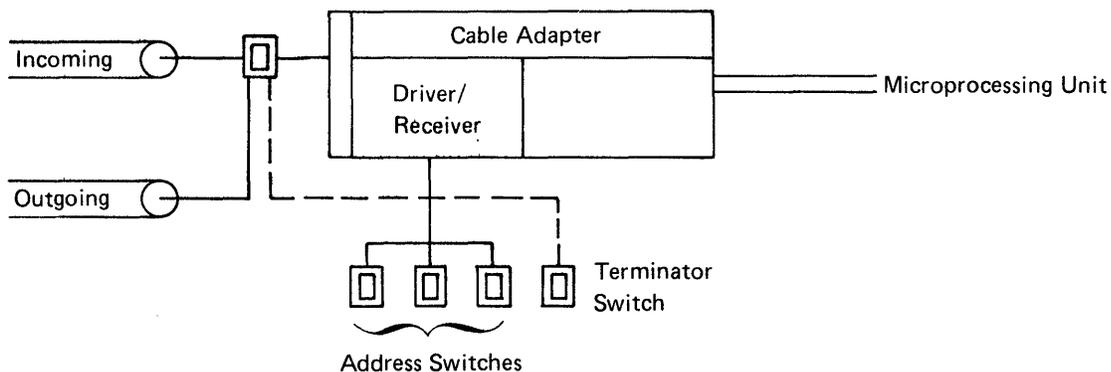
CABLE THRU FEATURE

If more than one work station (either a display station or a printer) is connected in series on the customer system cable, this feature must be installed on each of those work stations to supply connectors for the customer system cable to the next work station in the series. A maximum of seven work stations can be connected in this series. The last work station in a series does not require the Cable Thru feature. (A machine without the Cable Thru feature has a built-in termination and has a station address of 000.)

This feature has four switches. Three of the switches permit a unique address for the work station (addresses range from 000 through 110). The fourth switch permits termination for the last work station in the series.

See the *Customer System Cable* section in the *Preventative Maintenance* section of this manual.

Note: Do not leave the system cable disconnected when servicing the display station with the Cable Thru feature. When this cable is disconnected, other devices are taken offline. A quick-disconnect adapter (IBM part 7362230 or an equivalent part) can be used to connect the system's incoming and outgoing cables; in this way, the display station is bypassed.



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

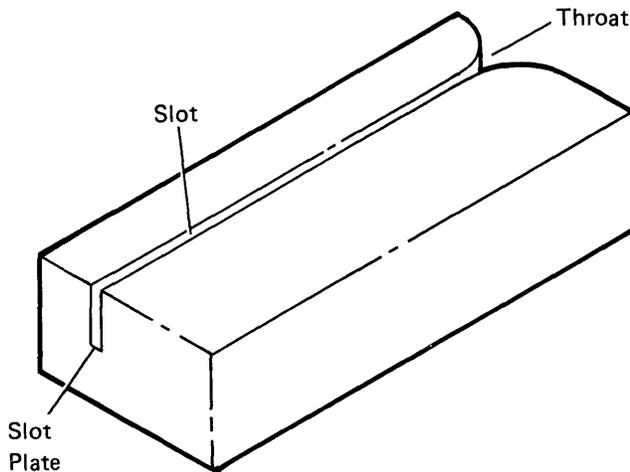
0 = Off; 1 = On

MAGNETIC STRIPE READER FEATURE

The Magnetic Stripe Reader (MSR) reads magnetic stripes on documents such as credit cards or identification cards. Reading of the magnetic stripe document is accomplished as follows:

Note: The MSR is positioned with the open portion (throat) of the slot towards the right.

1. The operator positions the document so that the magnetic stripe is at the bottom of the document and is facing the operator.
2. The document is inserted into the throat so that the bottom of the document is flush against the bottom surface of the slot plate.
3. The document is moved smoothly and continuously through the slot from right to left. The document must remain against the bottom surface of the slot.



The MSR can read documents from 0.178 to 1.143 mm (.007 inches to .045 inches) thick at a speed of 127.0 to 1016.0 mm (5 to 40 inches) per second. The MSR can read at any speed within this range; therefore, a constant speed through the slot is not necessary.

The MSR contains a document-sensing photocell, a reading head, and an amplifier. The photocell detects a document and readies the MSR adapter to receive the 5 bit (4 data bits and 1 parity bit) numeric data from the MSR. As the data is read from the document, it is stored in a buffer on the MSR card. Up to 128 bytes (125 data bytes plus the SOM, EOM, and LRC characters) can be stored. The MSR card circuits checks for an error condition and sets the error bit on in all data bytes if an error is found. Error conditions checked are:

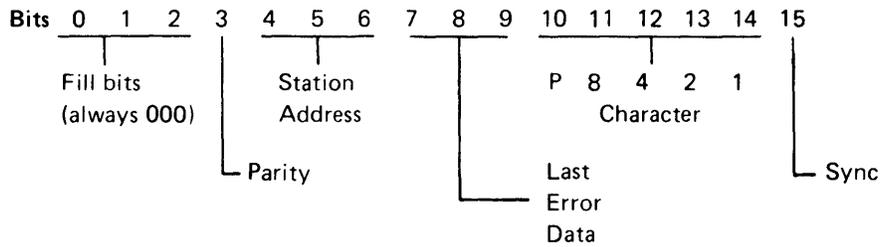
- No SOM, EOM, or LRC characters
- A parity error
- A speed check or LRC check error

The MSR card circuits then sets the service request bit on. The MPU in the 5251 Display Station Models 1 or 11 or the 5252 Dual Display Station sets the OS (outstanding status) bit on in the next poll response frame. The controller then issues a 'read MSR data' command to read 16 bytes of MSR data. If no error bit is on in the data received, the above ready sequence continues until all MSR data has been transferred to the controller. The MSR card circuits are automatically reset when the last data is read.

The controller then checks for a missing SOM, EOM, or LRC character, a parity error, or an LRC error. The MSR controller also checks to ensure the field is large enough to accept the data and that an operator ID is not being read into a field that is not specified for an operator ID.

When all the checking is complete and the MSR data is valid, the controller uses a 'write data and load cursor' command to transmit each byte of data to the 5251 Display Station Models 1 or 11 or the 5252 Dual Display Station. The display station loads the data into the regen storage area ready for the display. If an error bit is on in any data bytes received, the controller stops reading the data, resets the MSR card circuits, and displays the appropriate error code. If the controller detects an error after all data has been received, it discards the data and displays the appropriate error code.

Read Data Word



Bit 7
 0 = Reader not installed
 1 = Reader installed

Bit 8
 0 = No error
 1 = Reader error

Bit 9
 0 = Not last character
 1 = Last character

The first character sent in the read data/activate read command sequence is the SOM; it is followed by up to 15 data characters. If one of the read data words in this sequence does not contain EOM in the character field, the controller sends another read data command/activate read command sequence. After this command sequence has been received at the MSR, another 16 read data words are sent to the adapter. This sequence continues until the EOM occupies the character field of one of the read data words. When the EOM is sent to the adapter, an LRC (longitudinal redundancy check) character is sent in the next read data word to check the validity of the data transfer.

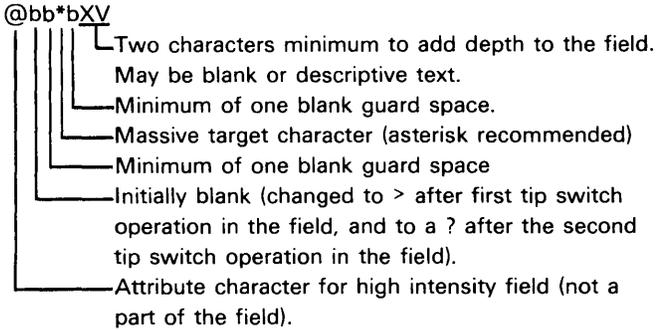
Valid Codes for the Character Field

Hex Code	P	8	4	2	1	Character
0	1	0	0	0	0	0
1	0	0	0	0	1	1
2	0	0	0	1	0	2
3	1	0	0	1	1	3
4	0	0	1	0	0	4
5	1	0	1	0	1	5
6	1	0	1	1	0	6
7	0	0	1	1	1	7
8	0	1	0	0	0	8
9	1	1	0	0	1	9
A	1	1	0	1	0	:
B	0	1	0	1	1	% (start of message (SOM))
C	1	1	1	0	0	@
D	0	1	1	0	1	⌋
E	0	1	1	1	0	=
F	1	1	1	1	1	? (end of message (EOM))

Eight read data/activate read command sequences are required to send the maximum of 128 bytes.

SELECTOR LIGHT PEN FEATURE

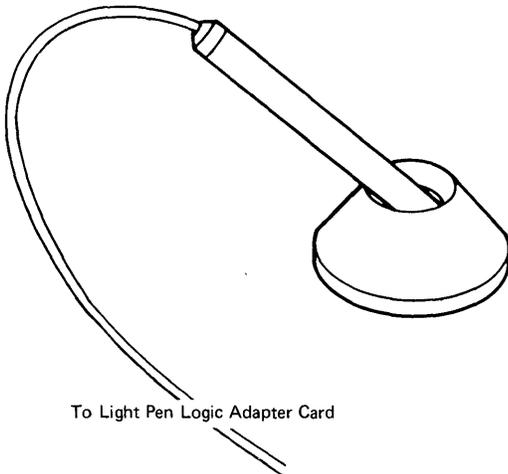
The Selector Light Pen feature allows the operator to select the desired fields displayed on the CRT. By using the light pen, the operator can select the fields without the use of the keyboard. The fields selected by the operator must be designated as light pen input fields by a field control word. For correct operation, the following format and guide lines should be used for designating light pen input fields:



A good guide line is to have only one light pen field per display line. If two or more light pen fields must be on the same display line, place them as far apart as possible. Other input fields or bypass fields may be on the same line.

Theory of Operation

The light pen hardware consists of the light pen wand and the light pen logic card.



Light Pen Feature

When the light pen is pointed at a character on the screen, a photocell in the light pen converts the light emitted by the character into a usable voltage level. The light emitted by the character when it is being written or refreshed is intense enough to be above the threshold value and produce a usable output voltage. The light pen logic card contains buffers which are continuously updated with the row and column address of the character that is being sensed. The service request bit is then sensed by the MPU and sets the outstanding status bit on in the next poll response frame. The controller sends a 'read light pen data' command and then a 'read activate' command to the display station. The MPU in the 5251 Display Station Models 1 or 11 reads the data from the light pen card circuits, formats each of the 16 bytes of data into a 16-bit frame, and sends the 16 frames to the controller. The first two bytes contain the row and column data and the remaining 14 bytes are null (hex FF). When the controller receives the data, it sends a command to update the cursor position in the regen storage and resets the service request.

The above sequence continues as long as the light pen is triggered by the light from a valid character position on the display. The cursor position is updated every 160 milliseconds.

When the tip switch is operated, the sequence just described occurs again but with the following changes:

- The service request bit is set on immediately.
- Bit 2 of byte 1 is set on to indicate that the tip switch has been operated.

This time, when the controller receives the 16 data bytes, it checks to ensure the light pen is in a valid light pen field and then places a mark character > in the first position of the light pen field to show that an entry has been made.

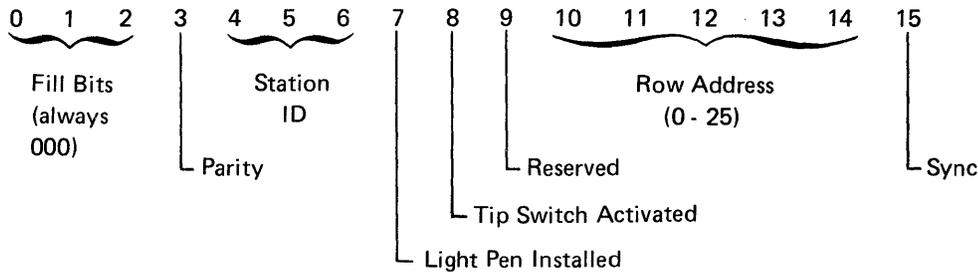
- Updates the cursor position.
- Resets the service request.

If the tip switch is operated a second time in the same light pen field, the controller places a different mark character ? in the first position of the light pen field.

When updating the cursor, the controller actually places the cursor three positions to the left of the column address it received. This is to compensate for an average three position delay in the sensing of the character.

The contents of the first two frames are as follows:

Frame one (data byte and control bits)



Bits 0 through 15 are used to send light pen data from the 5251 Models 1 or 11.

Bits 7 through 14 are used internally on the 5251 Models 1 or 11 as a data byte.

Bit 7

0 = Light Pen is not installed

1 = Light Pen is installed

Note: If bit 7 is 0, all remaining bits of this frame (except bit 15) will also be 0.

Bit 8

0 = Tip switch is not activated

1 = Tip switch is activated

Bits 10 through 14

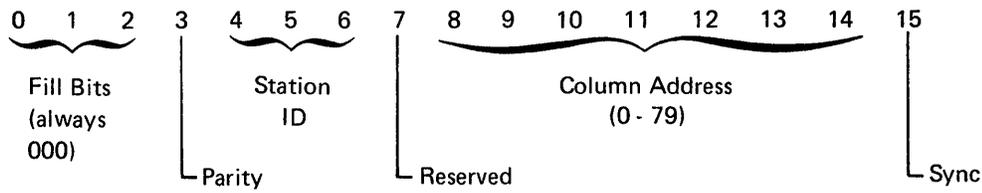
The binary value of bits 10 through 14 is the row address of the selected field. The decimal values of the bits are:

16 8 4 2 1

Example:

1 0 0 1 0 = a row address of 18.

Frame two (data byte and control bits)



Bits 0 through 15 are used to send light pen data from the 5251 Models 1 or 11.

Bits 7 through 14 is the data byte from the light pen card.

The binary value of bits 8 through 14 is the column address of the selected field. The decimal values of these bits are:

64 32 16 8 4 2 1

Example:

0 1 1 0 1 0 1 = a column address of 53.

The remaining frames of the 16-frame response (16 bytes of data) are not used with the Light Pen feature. They are null and contain hex FF in the data field (bits 7 through 14).

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Appendix A. Display Station Setup Instructions

It is the customer's responsibility to set up the display station. If the customer requests setup aid, use these instructions.

Before the display station is shipped from the factory, it is fully tested and adjusted.

This setup procedure should be used after the display station has been located where it is to be used; this procedure should also be used whenever the display station is disconnected and moved.

DANGER

The display station has a weight of approximately 34 kilograms (75 pounds). NEVER LIFT IT WITHOUT AID.

If the display station has the Keylock feature, a small envelope containing 2 keys is fastened 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: for the US, use 115 Vac; for World Trade, see the installation planning representative.

If problems occur while you are following these instructions, go to the *Start of Call MAP*.

The setup instructions are written in two sections:

- You can complete Section 1 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 (horizontal) position.
7. Set the Power switch to the On position and turn the Brightness control fully clockwise.
8. When the display station warms up (about 20 to 30 seconds), slowly turn the Brightness control counterclockwise to an acceptable brightness.

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

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

Setup Instructions - Section 2

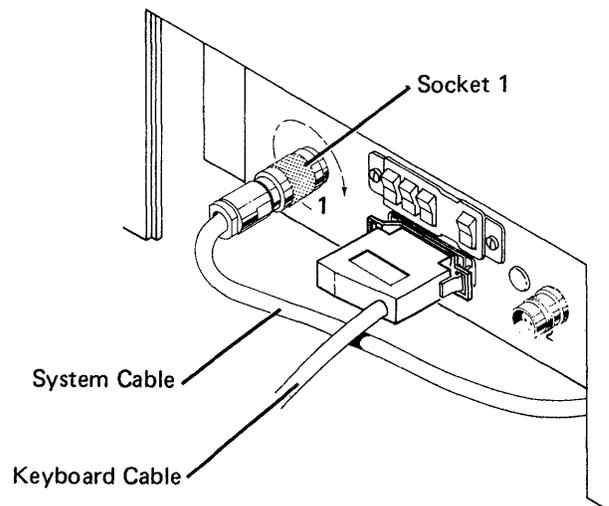
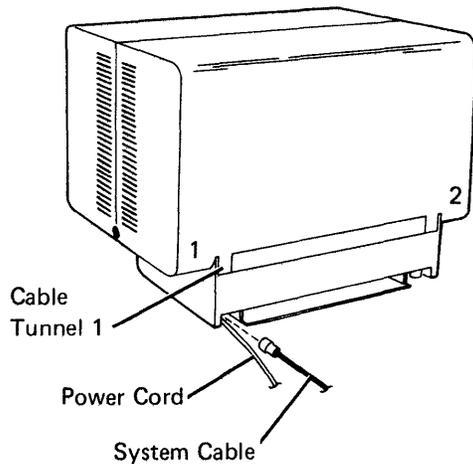
Before you start connecting the display station to the system, ensure that the following is complete:

- The system operator knows that you are going to connect the display station to the system.
- The system cable (with a suitable connector) is installed and ready to use.
- The system cable is connected to the system.
- If the display station is to be connected in series by means of the Cable Thru feature to a preceding display station or printer, 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. Connect the system cable as follows:

- 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.



- c. Connect the system cable to the socket 1 connector.

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

11. 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

- 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 work station on the line.

- 2
 1 Position 2 allows communications signals to flow through the display station to the next work station.

12. Reinstall the front access panel cover.
13. Set the Power switch to the On position.

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

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

If the display station has the conditions described in step 8 but does not have the conditions described in this step, the system may not be powered up, running, or working properly, or your display station may not be in session with the system.

14. Press any numeric or alphabetic keys and listen for the clicker sound as each key is pressed. Observe the cursor as each character is displayed; the cursor should move.
15. 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. Self-Check Feature

SELF-CHECK FEATURE

Self-Check is a feature of the host system and is included here only for reference. The Self-Check feature provides a way for the system to check the entry of data in fields that contain a precomputed self-check digit. The self-check digit is the last digit in the field and has been precomputed by either of two algorithms: modulus 10 or modulus 11.

Signed numeric, alpha only, numeric only, and alphanumeric fields can be specified for checking. All data is checked. The four low order bits are used when they are in the 0 through 9 range. If the four low order bits are in the A through F range, they are replaced by 0. Characters such as nulls or blanks are also treated as 0s.

Example:

Character	EBCDIC Representation	Four Low Order Bits Are Equal To	Number Used to Compute Check Digit
0	1111 0000	0	0
1	1111 0001	1	1
5	1111 0101	5	5
8	1111 1000	8	8
A	1100 0001	1	1
C	1100 0011	3	3
X	1110 0111	7	7
%	0110 1100	C	0
	0110 1011	B	0

Computing the Self-Check Digit

Modulus 10

Modulus 10 can be computed for any field that is from 2 to 31 characters long. To compute the modulus 10 check digit, do the following:

1. Multiply the units position of the field (*not* the check digit) by 2. Multiply the tens position of the field by 1. Proceed to the high order position of the field; multiply alternately by 2 and 1.

2. Add the digits of the products.
3. Subtract the sum of the digits from the next higher number ending in 0.

The difference is the self-check digit.

Note: If the difference is 0, the self-check digit is 0. If the difference is 1, the character combination used in the self-check field has no check digit. Ensure that this character combination is not used in a self-check field.

Example:

Self-check field	A F 1 2 7 6 5
Multiplier	2 1 2 1 2 1 2
Product	2 6 2 2 14 6 10
Sum of the digits	2+6+2+2+1+4+6+1+0=24
Next higher number ending in 0	30
Subtract the sum of the digits	30-24=6
Self-check digit	6
Self-check field with check digit	A F 1 2 7 6 5 6

Modulus 11

Modulus 11 can be computed for any field that is from 2 to 31 characters long. To compute the modulus 11 check digit, do the following:

1. Assign a multiplier to each position of the field. Starting in the units position (*not* the check digit position) and proceeding to the high order position of the field, the multipliers are 2, 3, 4, 5, 6, 7, 2, 3, 4, 5, 6, 7, etc.
2. Multiply each character by its assigned multiplier.
3. Add the products.
4. Divide the sum of the products by 11.
5. Subtract the remainder from 11.

The difference is the self-check digit.

Note: If the remainder in step 4 is 0, the self-check digit is 0. If the remainder is 1, the character combination has no self-check digit. Ensure that this character combination is not used in a self-check field.

Example:

Self-check field	A F 1 2 7 6 5
Multiplier	2 7 6 5 4 3 2
Product	2 42 6 10 28 18 10
Sum of the products	$2+42+6+10+28+18+10=116$
Divide the sum by 11	$116 \div 11 = 10$ plus a remainder of 6
Subtract the remainder from 11	$11 - 6 = 5$
Self-check digit	5
Self-check field with check digit	A F 1 2 7 6 5 5

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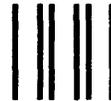
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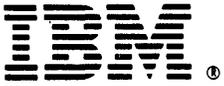
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