# 5280

IBM

SY31-0600-1

# IBM 5280 Distributed Data System

## IBM 5285 Programmable Data Station Maintenance Information Manual

**Second Edition (December 1980)**

This is a major revision of and makes obsolete SY31-0600-0 and TNL SN31-6328. Because the changes and additions are extensive, this publication should be reviewed in its entirety. Changes are periodically made to the information herein; these changes will be reported in technical newsletters or in new editions of this publication.

This MIM (maintenance information manual) is to be used for servicing the IBM 5285 Programmable Data Station. Customer engineers using this manual are assumed to have completed the IBM 5280 Distributed Data System hardware education course.

This MIM has four major sections: maintenance, diagnostic aids, tools and test equipment, and theory. Maintenance includes locations and procedures. Diagnostic aids includes information about diagnostic techniques. Tools and test equipment lists all the items needed to service the IBM 5285. 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*.

There are several DANGER and CAUTION notices in this manual. You can use the blank lines below each notice to translate it into your own words. The locations of these notices are listed under Safety.

The following trademarks are referred to in this manual:

Tektronix – Trademark of Tektronix, Inc.

Sony – Trademark of Sony Corporation of America

Nu Data – Trademark of Nu Data

**Related Publications**

Related information can be found in the following manuals:

- *IBM 5285 Programmable Data Station Maintenance Analysis Procedures*, SY31-0623
- *IBM 5285 System Logic Manual*, SY31-0632
- *IBM 5281 Data Station Maintenance Information Manual*, SY31-0596
- *IBM 5282 Dual Data Station Maintenance Information Manual*, SY31-0597
- *IBM 5286 Dual Programmable Data Station Maintenance Information Manual*, SY31-0599
- *IBM 5288 Programmable Control Unit Maintenance Information Manual*, SY31-0601
- *IBM 5280 Diskette Drive Maintenance Information Manual*, SY31-0602
- *IBM 5280 Data Areas and Diagnostic Aids Handbook*, SY31-0595
- *IBM 5280 Communications Reference Manual*, SC34-0247
- *IBM 5280 Message Manual*, GA21-9354

# Contents

**DIAGNOSTIC AIDS**



**TOOLS AND TEST EQUIPMENT**



**THEORY**

The information in this MIM is to be used as reference material when you are diagnosing machine failures. This MIM contains maintenance procedures, diagnostic aids, tools and test equipment information, and theory.

The format for page numbering is XXX.Z. The XXX is the number of the page and the Z (although not normally used) is for expansion when it is not practical to renumber all pages.

Three-digit reference numbers are assigned to location drawings and maintenance procedures that are referenced from the MAPs (maintenance analysis procedures).

## MAINTENANCE PROCEDURES

The maintenance procedures section contains location drawings and maintenance procedures for repairing, installing, removing, or diagnosing the failing field-replaceable units (FRUs).

## DIAGNOSTIC AIDS

The diagnostic aids section provides information about the testing of the data station by the diagnostic programs. The use of some specialized tools is described. The use of the cable diagrams and tables is described. The diagnostic aids section is common to all controllers and might contain some features that do not apply to the IBM 5285.

## TOOLS AND TEST EQUIPMENT

The tools and test equipment section contains information about the tools and test equipment needed to service the data station.

## THEORY

The theory section contains descriptions of the functional units and features. These descriptions are preceded by a view of the system that gives you a general idea of the complete operation and how each function or feature is associated with the operation.

## DANGER AND CAUTION NOTICES

Throughout this manual, the word DANGER is used to inform the CE of an action that could cause a personal injury. The word CAUTION is used to inform the CE of an action that could damage the machine, or affect the running of a customer program.

The IBM 5285 Programmable Data Station has the following specific DANGERs:

- Voltage is present at the power supply and the display assembly, when the power cord is connected to the service outlet.

- 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.

### Danger Notices

Danger notices appear in the following maintenance procedures:

031 Cover Removal and Replacement
071 Control Panel Removal and Replacement
073 Power Switch Removal and Replacement
075 Keylock Switch Removal and Replacement
077 Screen Controls Removal and Replacement
141 Display Assembly Locations
161 Video Adjustments
163 Vertical Adjustments
165 Horizontal Adjustments
167 Yoke Adjustment
169 Centering Adjustment
181 Display Assembly Removal and Replacement
301 Diskette Drive Removal and Replacement
451 Power Supply Locations
453 AC Distribution
457 Power Supply Wiring Diagram
461 Voltage Level Checks
463 Ripple Voltage Level Check
470 Power Supply Removal and Replacement
471 Communications Feature Power Supply Card Removal and Replacement
474 Board Assembly Removal and Replacement
476 Resonant Capacitor C7 Removal and Replacement
480 Power Cord and Line Filter Removal and Replacement
715 Station Protector Service Check

### Caution Notices

Caution notices appear in the following maintenance procedures:

031 Cover Removal and Replacement
115 Keyboard Cleaning
121 Key Module Removal and Replacement
127 Pad Printed Circuit Board Removal and Replacement
171 Factory Adjustments
301 Diskette Drive Removal and Replacement
463 Ripple Voltage Level Checks
513 Logic Card Cover Removal and Replacement
515 Fan Shroud Removal and Replacement
521 Logic Board Removal and Replacement
523 Logic Card Removal and Replacement
563 ROS Patch Card Removal and Replacement
825 DDSA
905 General Logic Probe

## 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

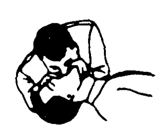
### General Considerations

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

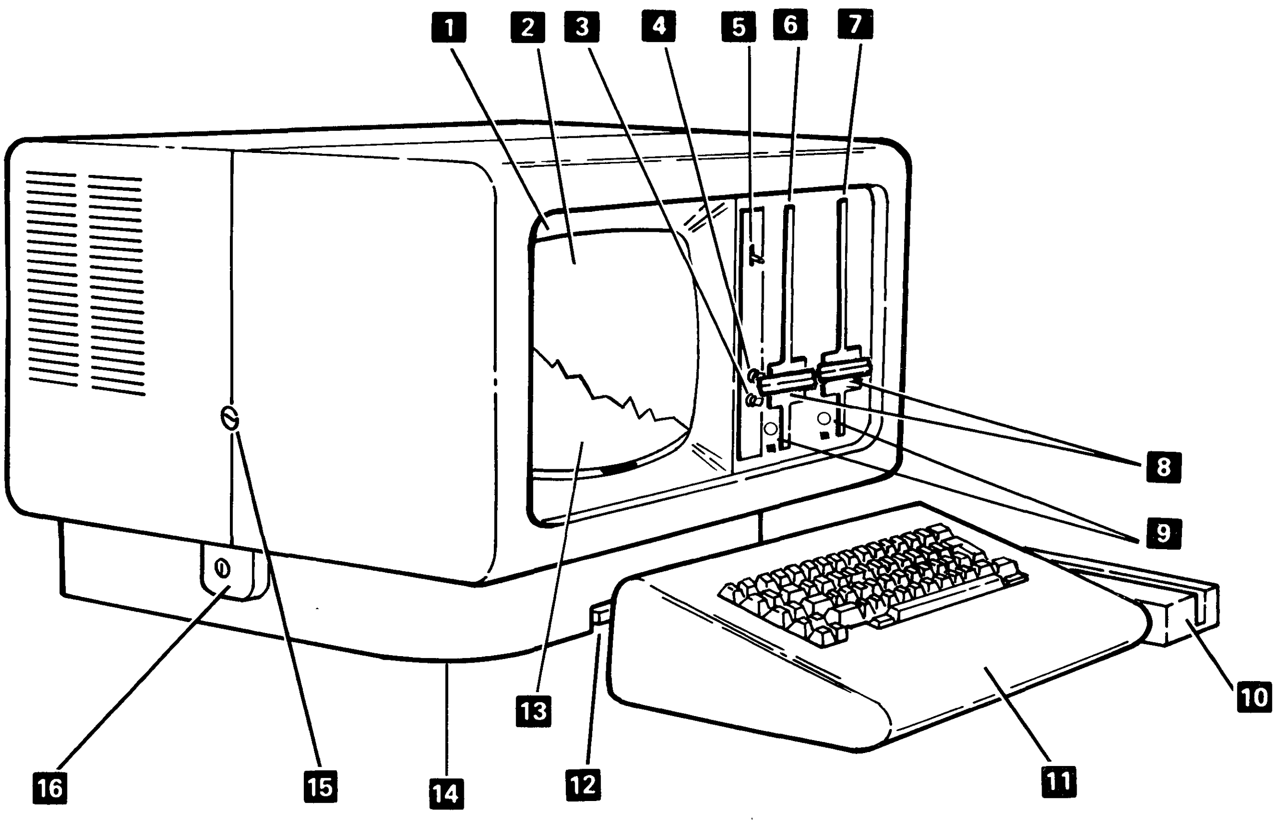


Final mouth-to-mouth position

## Base Machine Locations

### 001 FRONT VIEW

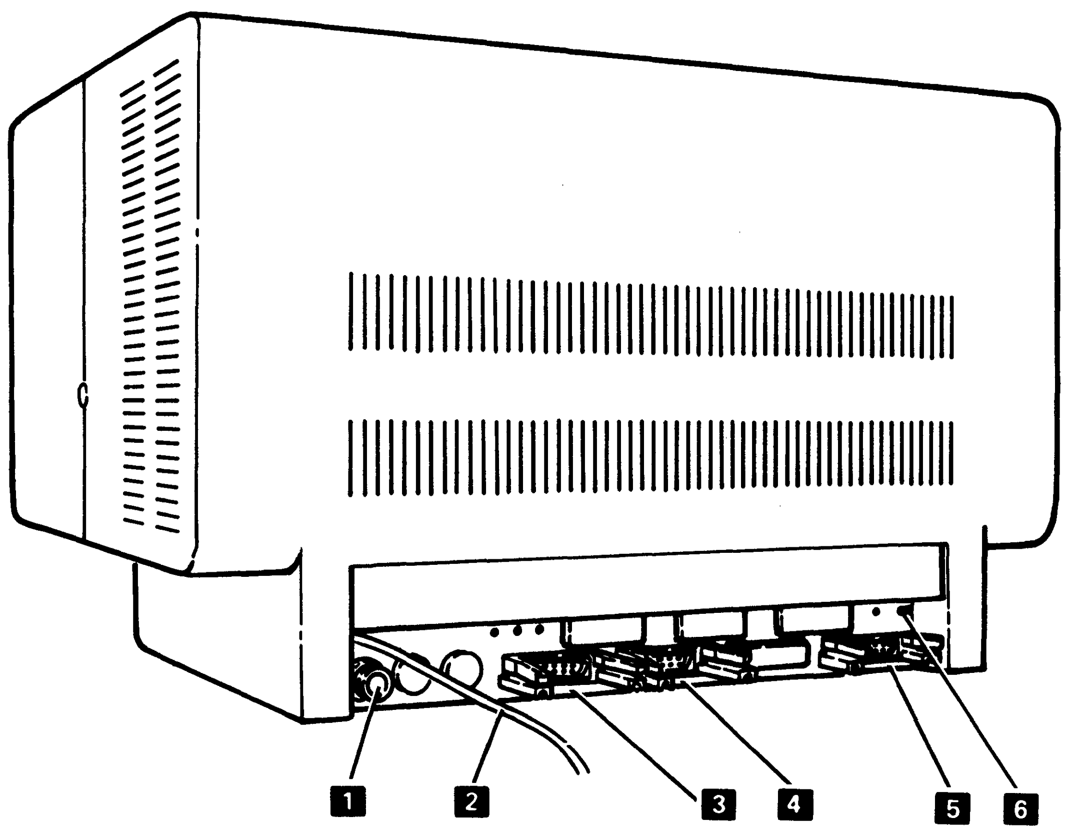
1 Bezel
2 Display screen
3 Contrast control
4 Brightness control
5 Power switch
6 Diskette drive A
7 Diskette drive B
8 Diskette locking levers (shown in the closed position)
9 Drive-in-use indicators
10 Magnetic stripe reader
11 Keyboard
12 Keyboard cable connector J101
13 Glare shield
14 Stamped serial number (located underneath)
15 Cover screws (one on each side)
16 Keylock



## 011 REAR VIEW

**With Covers**

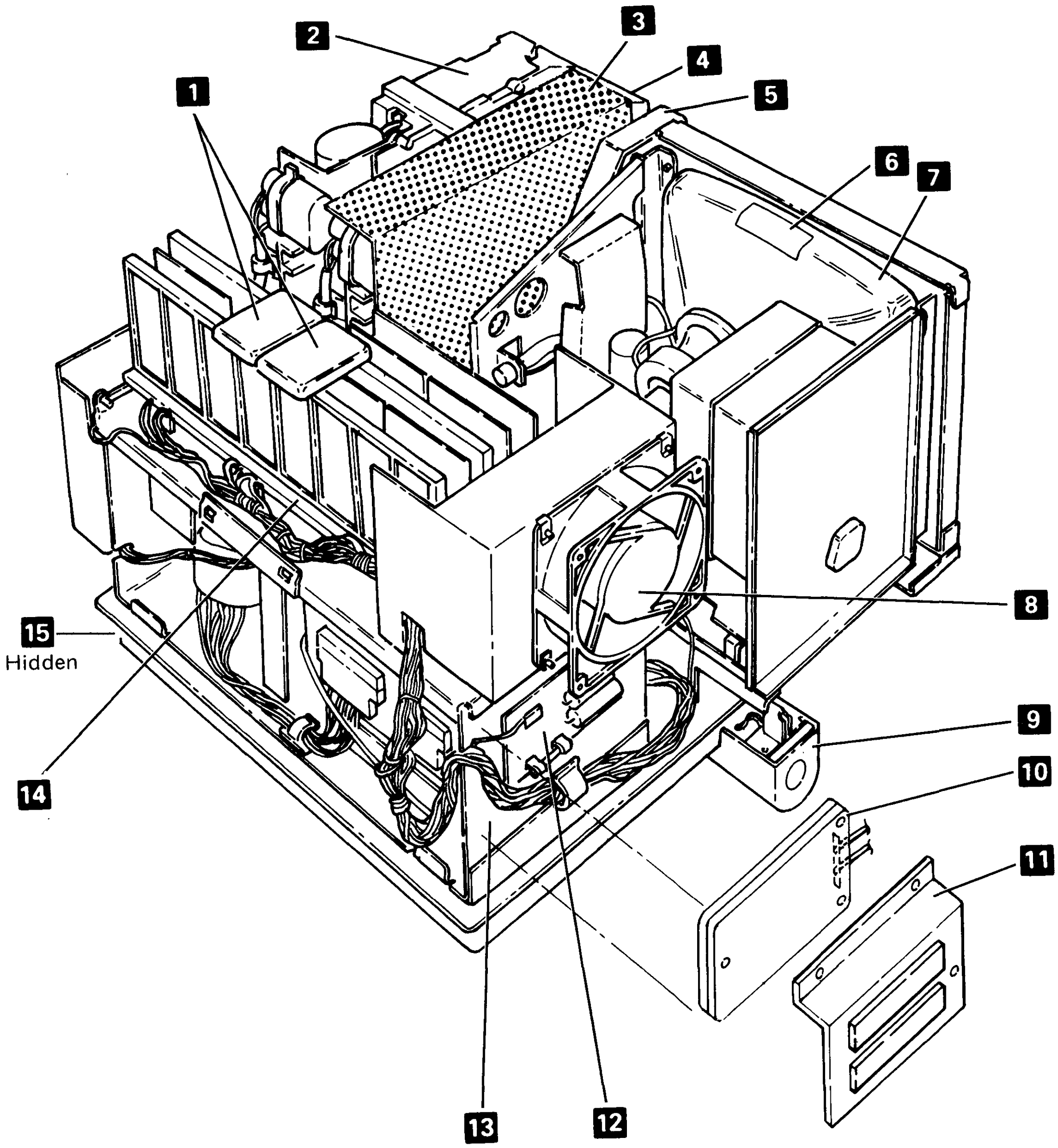
1 Printer twinaxial cable connector
2 Power cord
3 Remote keyboard/display connector J103
4 Remote diskette drive connector J111
5 Communications support connector J140
6 Magnetic stripe reader cable access hole



## 011 REAR VIEW (continued)

**Without Covers**

1. Card insertion tools
2. Diskette drive B
3. Diskette drive magnetic shield
4. Diskette drive A
5. Operator control panel
6. Display assembly service information label
7. CRT
8. Fan
9. Keylock
10. Line plate (World Trade)
11. Surge protector (World Trade)
12. -8.5 Vdc communications power supply
13. Power supply
14. Logic board assembly
15. Serial number plate



## Covers

### 031 REMOVAL AND REPLACEMENT

**Data Station**

*Removal*

**DANGER**
Voltage is present in the data station when the power cord is connected to the service outlet.

1. Power off.

2. Close the diskette locking levers **4**.

3. Loosen the screws **3**. (One on each side of the data station.)

**CAUTION**
Too much pressure on the drive-in-use indicator cables will damage the cables.

4. Slide the covers apart until the drive-in-use indicator cables **5** can be disconnected.

5. Disconnect the drive-in-use indicator cables.

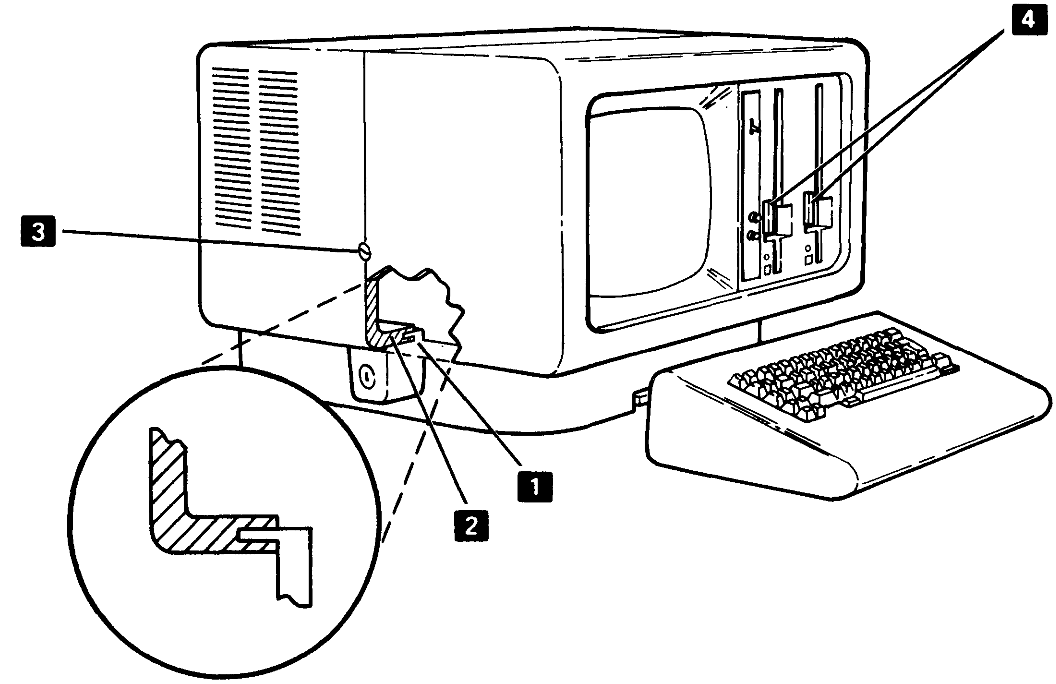
6. Continue to slide the covers apart until the grooves **2** in the covers clear the flanges **1** on the base of the data station.

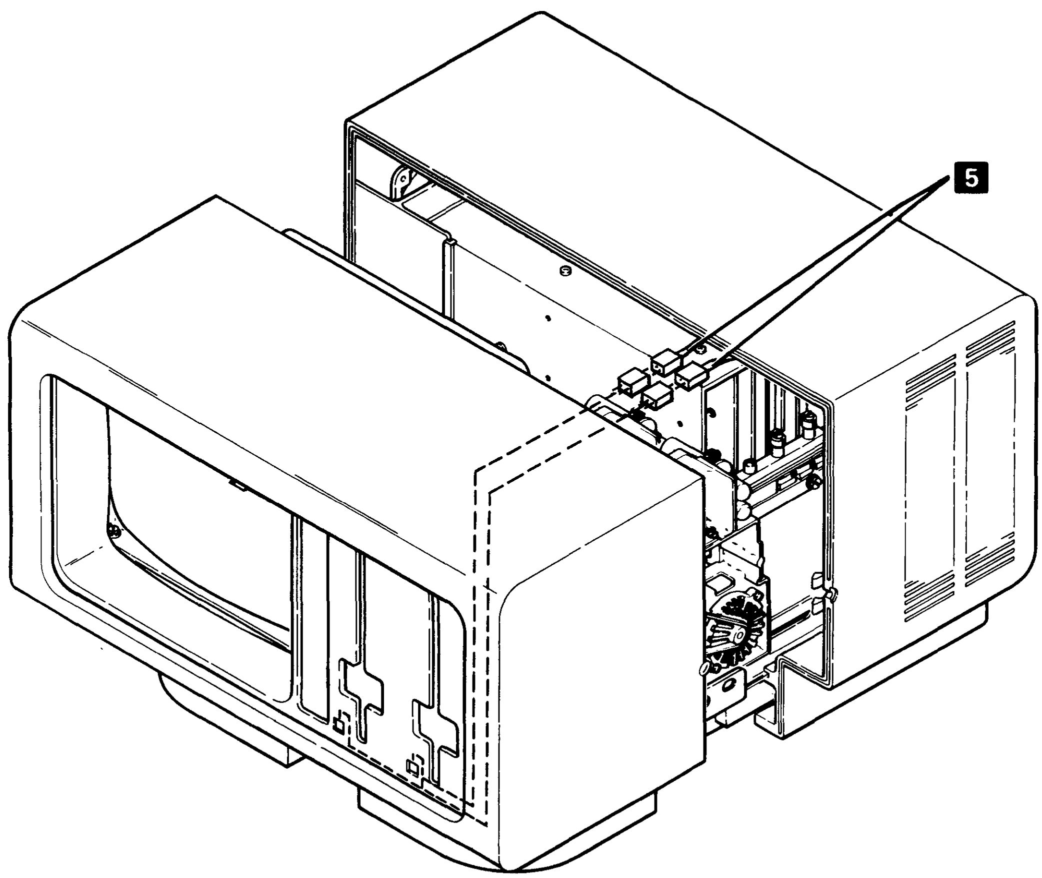
*Replacement*

For replacement of the covers, observe the following CAUTIONs and reverse the steps in the removal procedure.

**CAUTION**
Ensure that the cables are not in the way of the cover.

**CAUTION**
Ensure that the cover screws fit over the cover correctly to prevent damage to the cover and to ensure that the cover is tightly fastened down.


4
3
1
2


5

## 031 REMOVAL AND REPLACEMENT (continued)

### Keyboard

*Removal*

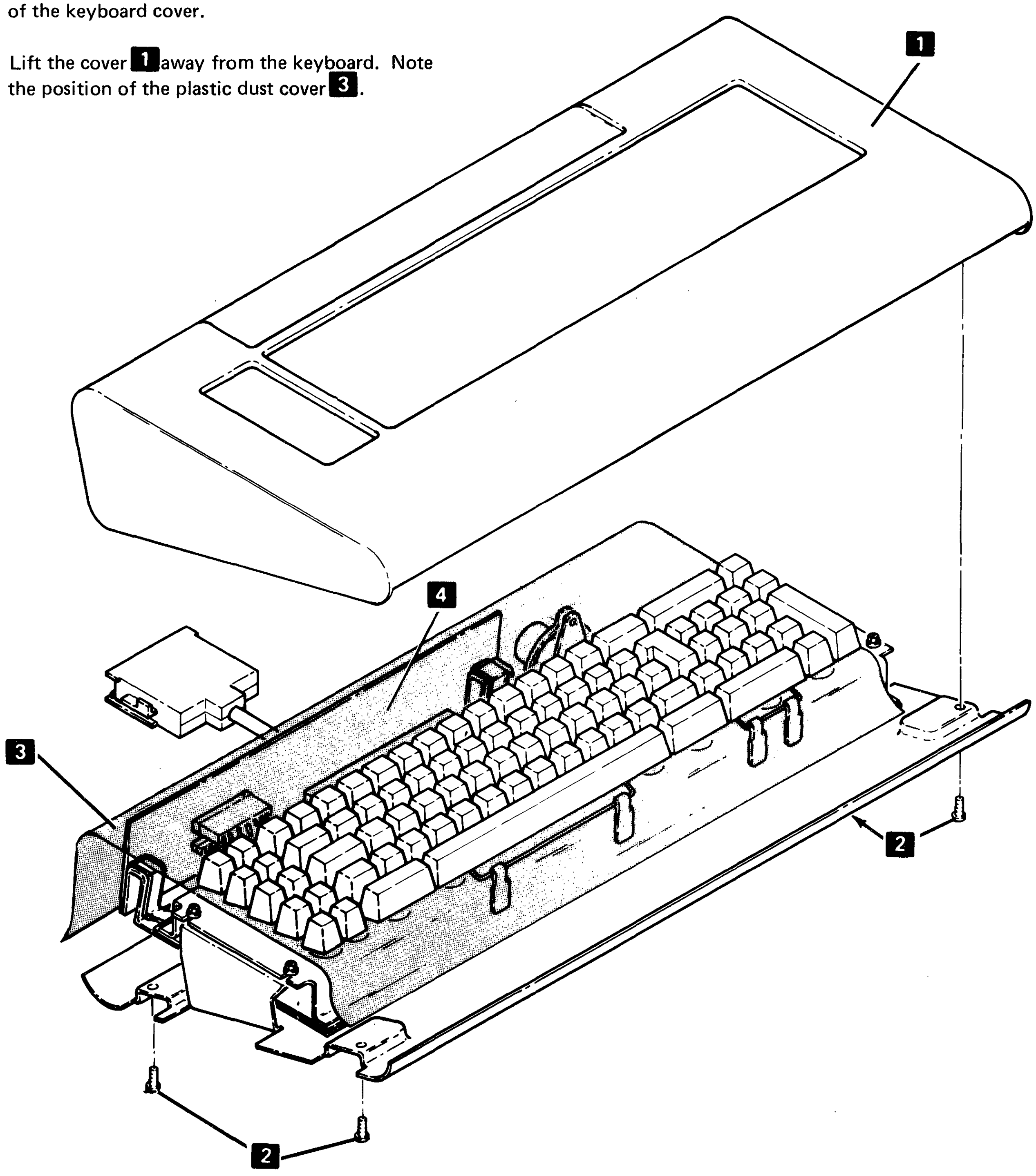
1. Power off.

2. Loosen the four corner screws **2** on the bottom of the keyboard cover.

3. Lift the cover **1** away from the keyboard. Note the position of the plastic dust cover **3**.

*Replacement*

For replacement of the keyboard cover, reverse the steps of the removal procedure. Ensure that the keys do not rub against the cover and that the dust cover is placed over the logic card **4**.



## Operator Controls

### 071 CONTROL PANEL REMOVAL AND REPLACEMENT

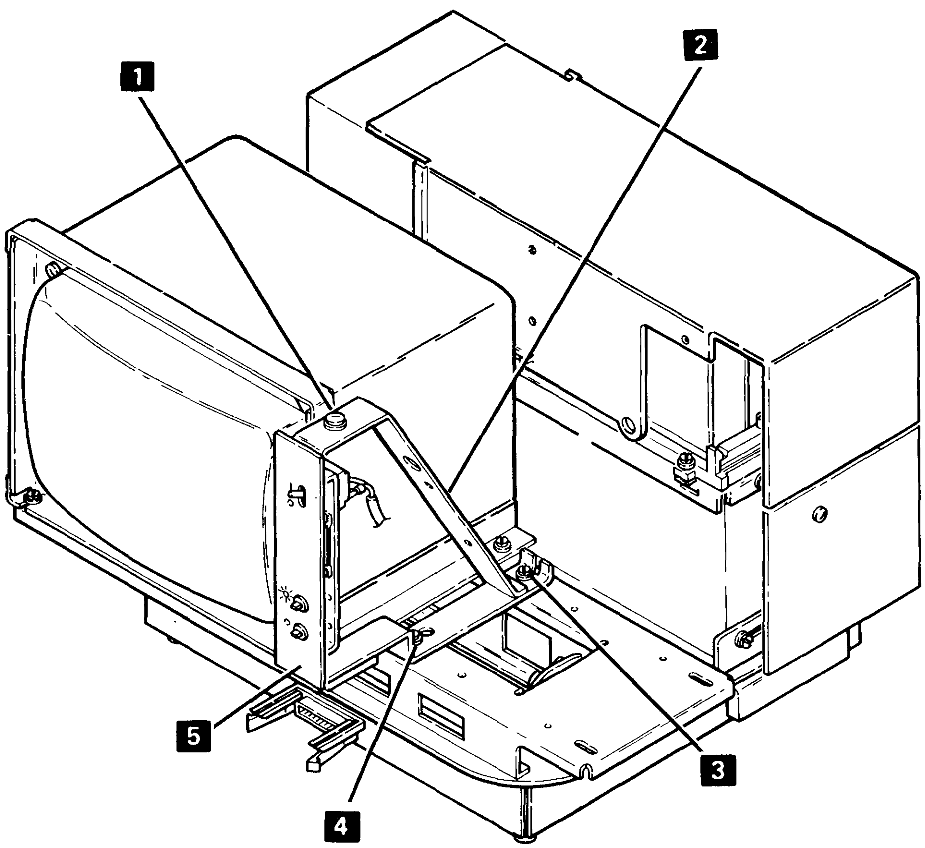
**DANGER**
Voltage is present at the operator controls when the power cord is connected to the service outlet.

**Removal**

1. Power off.
2. Disconnect the power cord from the service outlet.
3. Remove the data station covers (031).
4. Remove the top mounting bracket screw **1**.
5. Loosen the two bottom mounting bracket screws **3** and **4**.
6. Lift the mounting bracket **2** and the bezel **5** out of the data station.

**Replacement**

For replacement of the operator panel, reverse the steps in the removal procedure.



## 073 POWER SWITCH REMOVAL AND REPLACEMENT

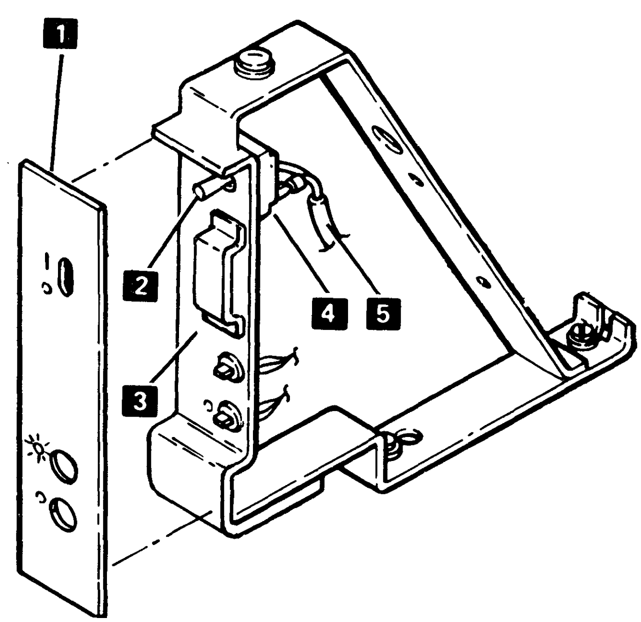
### Removal

**DANGER**
Voltage is present at the power switch when the power cord is connected to the service outlet.

1. Power off.
2. Disconnect the power cord from the service outlet.
3. Remove the data station covers (031).
4. Remove the control panel (071).
5. Remove the four wires 5 from the Power switch 4. (Note the positions of the wires for the replacement procedure.)
6. Remove the control panel bezel 1 by prying gently with a screwdriver.
7. Remove the nut 2 and lift the Power switch from the mounting bracket 3.

### Replacement

For replacement of the Power switch, reverse the steps in the removal procedure.




## 075 KEYLOCK SWITCH REMOVAL AND REPLACEMENT

### Removal

**DANGER**
Voltage is present at the keylock switch when the power cord is connected to the service outlet.

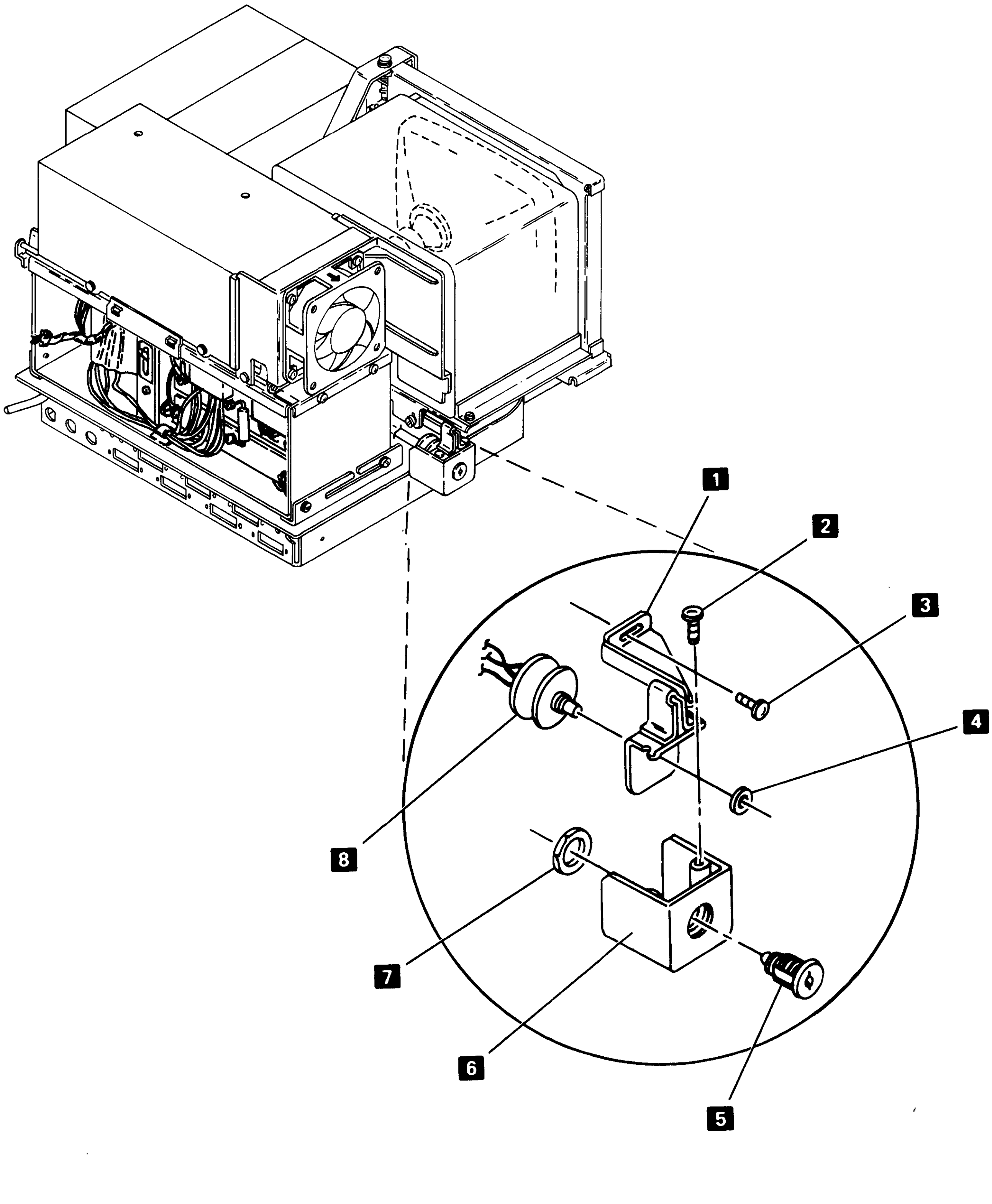
1. Power off.
2. Disconnect the power cord from the service outlet.
3. Remove the data station covers (031).
4. Remove the two screws 3 holding the switch bracket 1 to the data station base.
5. Remove the two screws 2 holding the switch bracket 1 to the switch box 6.
6. Remove the nut 4 and remove the switch 8.
7. Remove the nut 7 and remove the lock 5.

### Replacement

For replacement of the keylock switch, observe the following and reverse the steps in the removal procedure.

When you reinstall the switch and the lock, ensure that the key goes into the lock with the teeth of the key facing up and that one of the keys turns counterclockwise and the other key turns clockwise.

## 075 KEYLOCK SWITCH REMOVAL AND REPLACEMENT (continued)



## 077 SCREEN CONTROLS REMOVAL AND REPLACEMENT

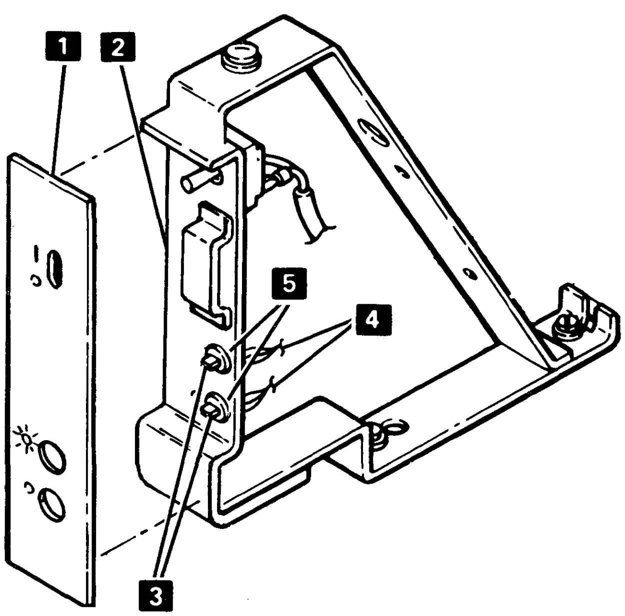
### Removal

**DANGER**
Voltage is present at the screen controls when the power cord is connected to the service outlet.

1. Power off.
2. Disconnect the power cord from the service outlet.
3. Remove the data station covers (031).
4. Remove the control panel (071).
5. Remove the three wires 4 from the control to be removed. (Note the positions of the wires for the replacement procedure [217].)
6. Remove the control panel bezel 1 by prying gently with a screwdriver.
7. Pull the knob 3 off the shaft of the control to be removed.
8. Remove the nut 5 and lift the control from the mounting bracket 2.

### Replacement

For replacement of the control, reverse the steps in the removal procedure.



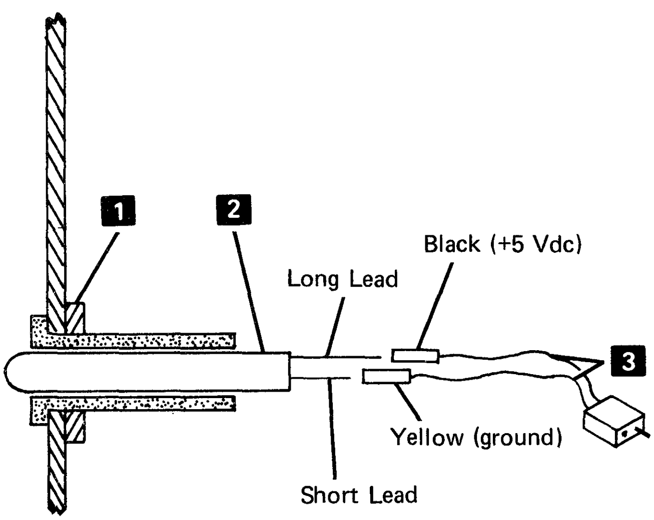
## 079 DRIVE-IN-USE INDICATOR REMOVAL AND REPLACEMENT

**Removal**

1. Power off.
2. Remove the data station covers (031).
3. Disconnect the drive-in-use indicator cable 3 from the drive-in-use indicator 2.
4. Remove the retaining collar 1.
5. Push on the drive-in-use indicator from the outside of the cover and remove the drive-in-use indicator through the inside of the cover.

**Replacement**

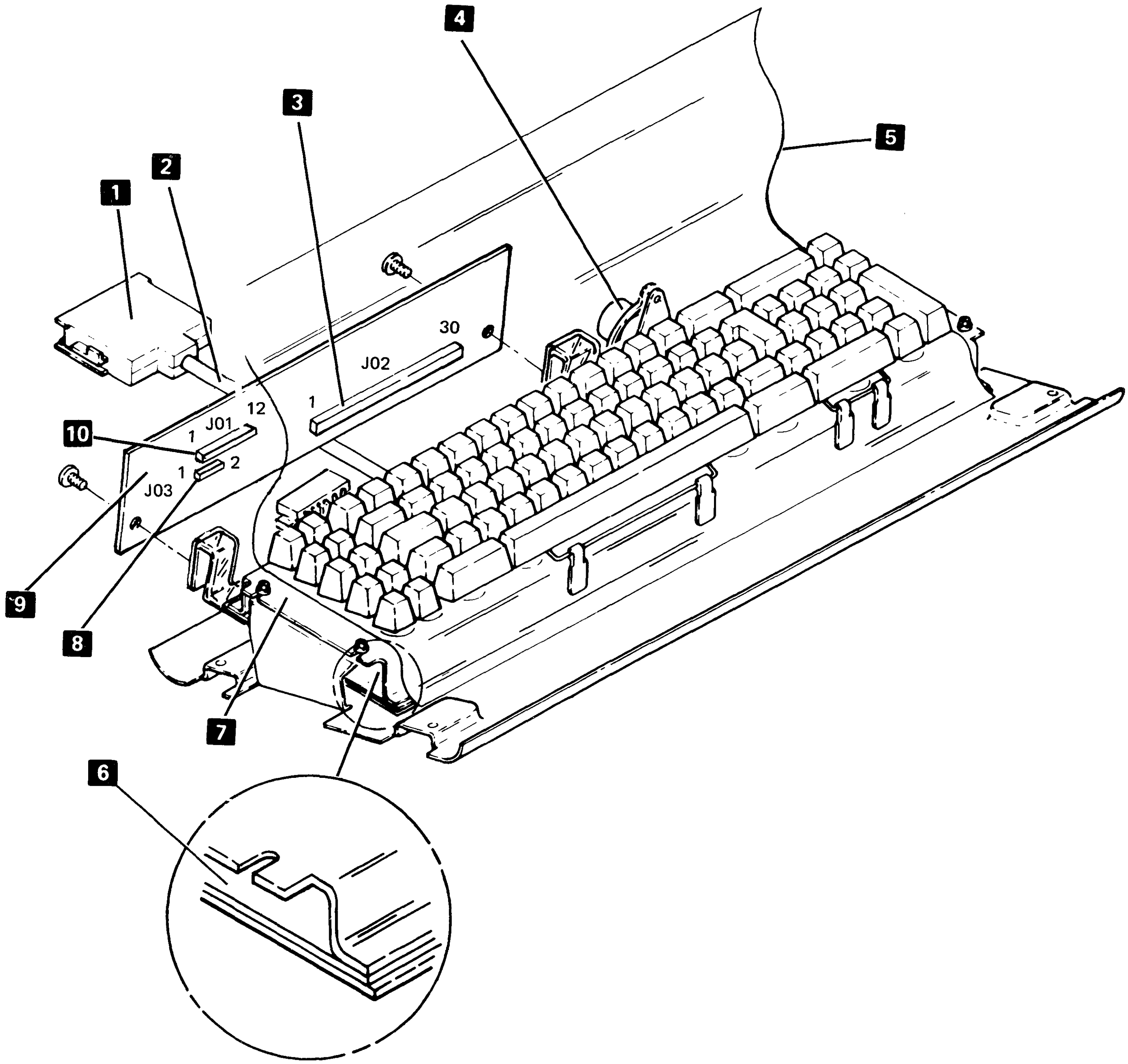
For replacement of the drive-in-use indicator, reverse the steps in the removal procedure.



## Keyboard

### 101 LOCATIONS

1 Connector P101
2 Keyboard signal cable
3 Connector J02
4 Speaker
5 Dust cover
6 Pad printed circuit board
7 Key unit
8 Connector J03
9 Keyboard logic card
10 Connector J01



## 111 BREAK CODE SERVICE CHECK

Use this service check to determine if the break code is working properly.

This service check uses the Up or Down condition of the '-strobe A' line and the '-break code A' line to determine if the scan code of the key being pressed is being sent to the controller.

- Connect the general logic probe as follows:
  - +lead (red) to power supply pin E2 (+5 VDC) 3
  - -lead (black) to power supply pin E3 (ground) 2
  - Ground to A-A1-TP18 1

- Set the general logic probe switches as follows:
  - Technology switch to the Multi position
  - Latch switch to the None position
  - Gate Ref switch to the +1.4 V position

**Note:** Do not use the probe tip extender. Use of the probe tip extender could cause erroneous readings on the probe.

1. Connect the probe tip to the '-break code A' line at A-A1-TP4. Both the Up light and the Down light should be on.

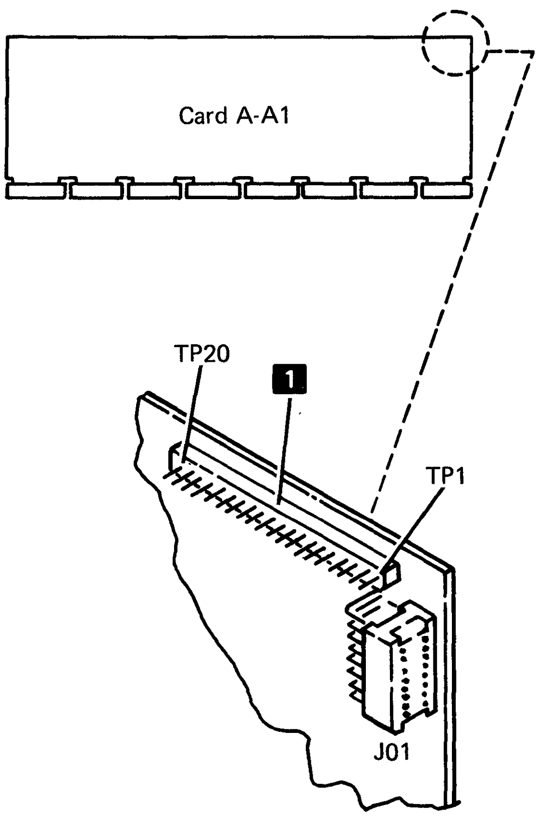
2. Connect the negative gating lead to the '-strobe A' line at A-A1-TP2. Both the Up light and the Down light should be off.

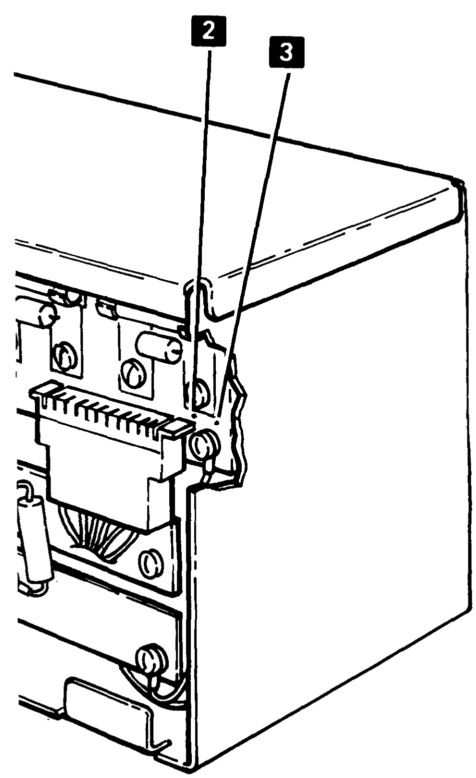
3. Press and hold a make/break key (113). The Down light should be off. When the key is pressed, the UP light should pulse.

4. Release the make/break key. The Up light should be off. When the key is released, the Down light should pulse.

5. Press and release all other keys. The Down light should be off. When each key is pressed, the Up light should pulse.

6. Press and hold any typamatic key (113). When the key is pressed, the Up light should pulse. After a short delay, the Up light should be off and the Down light should pulse at the typamatic rate.

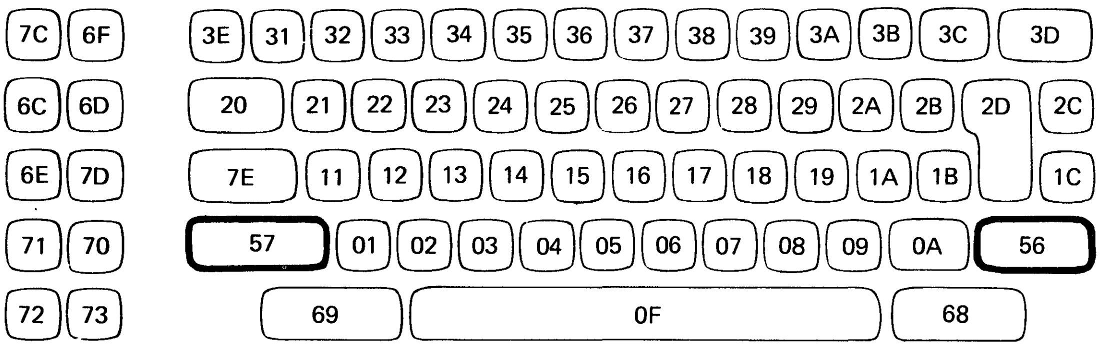


## 113 KEYBOARD LAYOUT AND SCAN CODES

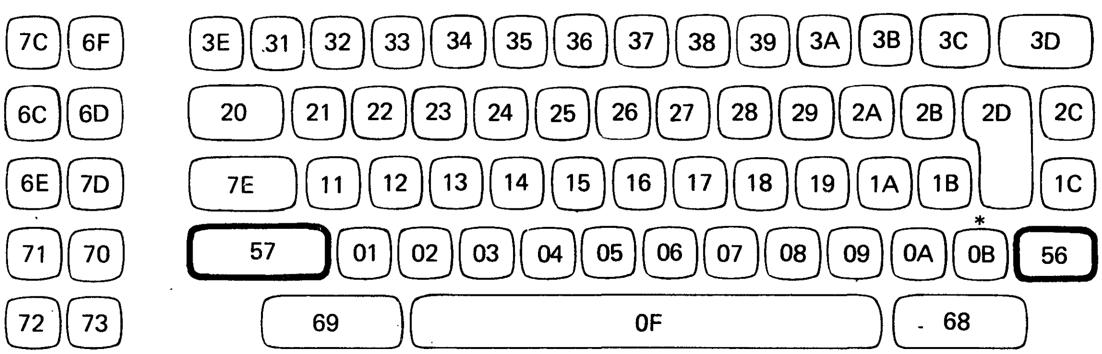
The keyboard scan codes for the different keyboards are shown on the individual keytops in the following figures. The make/break keys will generate a scan code of hexadecimal 5x when they are pressed and will generate a scan code of hexadecimal Dx when they are released. For example, when the Shift key or Num key shown on the left side of the 66-key keyboard is pressed, it will generate a scan code of hexadecimal 57. When it is released, it will generate a scan code of hexadecimal D7. All of the keys except the make/break keys are typamatic.

**66-Key Keyboard (Data Entry)**




— A make/break key

**67-Key Keyboard (Data Entry)**

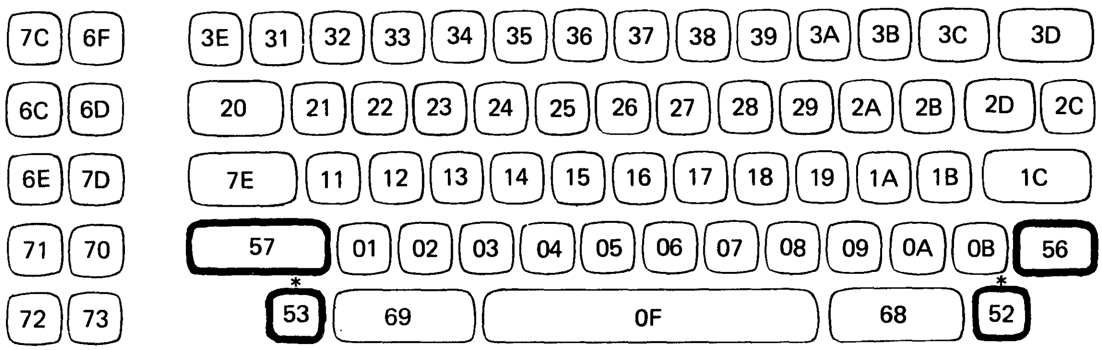



* — Not present on the 66-key keyboard

— A make/break key

## 113 KEYBOARD LAYOUT AND SCAN CODES
(continued)

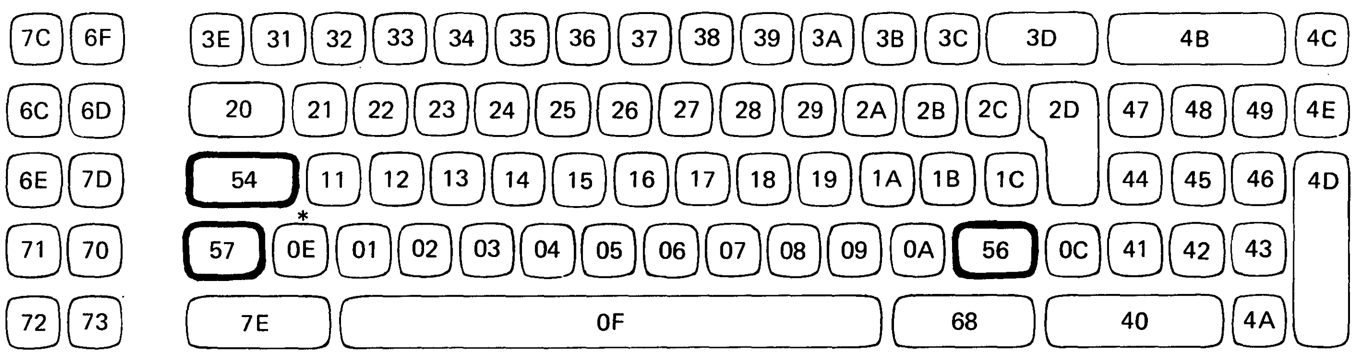
### 69-Key Keyboard (Data Entry)




* — Not present on the 67-key keyboard

— A make/break key

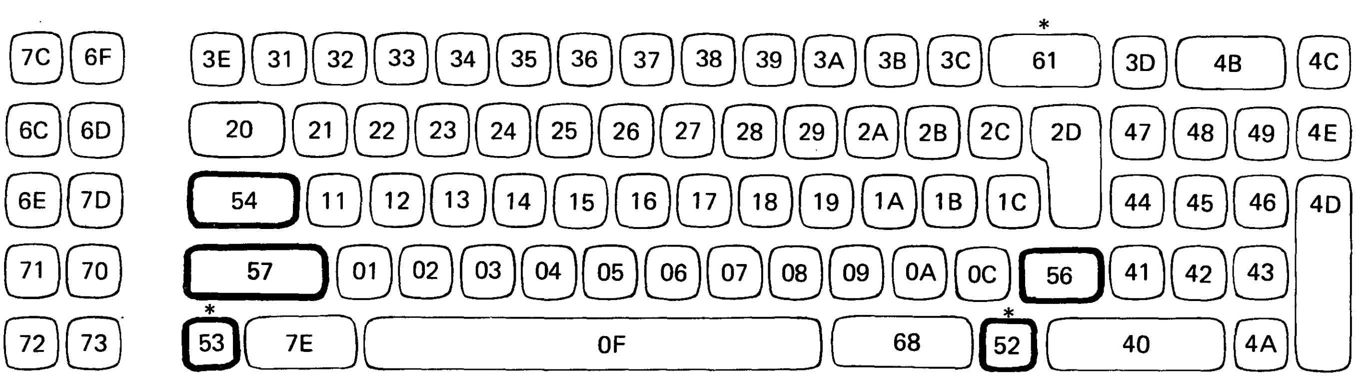
### 83-Key Keyboard (Typewriter)




* — Not present on the 85-key keyboard

— A make/break key

### 85-Key Keyboard (Typewriter)




* — Not present on the 83-key keyboard

— A make/break key

## 115 KEYBOARD CLEANING

1. Power off.

2. Disconnect the keyboard cable connector J101 (001).

3. Remove the keyboard cover (031).

4. Remove the pad printed circuit board (127).

5. Clean the pad printed circuit board with a lint-free cloth moistened with isopropyl-alcohol solvent.

**CAUTION**
If you use too much pressure when cleaning the flyplates, you could cause them to become disengaged from the spring.

6. Check the flyplates for dirt; clean only those flyplates that are dirty or are causing failures.

If the keys are binding because of contamination, clean the keyboard in the following way:

1. Wash the pad printed circuit board and affected flyplates with a lint-free cloth moistened with water and hand soap.

2. Wash the pad printed circuit board and affected flyplates with a lint-free cloth moistened with water.

3. Wash the pad printed circuit board and affected flyplates with a lint-free cloth moistened with isopropyl-alcohol solvent.

If the contamination is severe, you might have to install a new keyboard. If the key modules are sticking, replacement modules must be installed (121). Plastic parts and covers can be cleaned with IBM cover cleaner.

## 121 KEY MODULE REMOVAL AND REPLACEMENT

**Removal**

1. Power off.

2. Disconnect the keyboard cable connector J101 (001)

3. Remove the keyboard cover (031).

**CAUTION**
To avoid damaging the keystem, do not rock the keybutton side to side.

4. Lift the keybutton from the keystem. Use the keybutton removal tool to rock the keybutton from front to back.

5. Remove the pad printed circuit board (127).

6. Reach under the keyboard and push up the key module until it is released.

**Replacement**

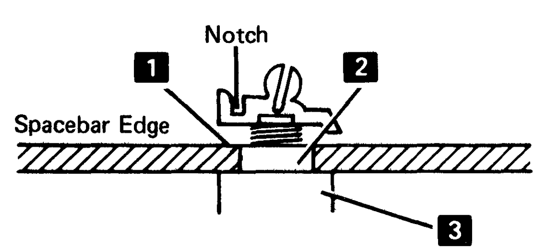
1. Insert the key module **3**. Align the opening in the key module with the location tab in the mounting hole **2**. The keystem must be placed so the notch is facing the Spacebar edge of the keyboard **1**.

2. Reinstall the pad printed circuit board (127).

3. Turn the keyboard over and, if necessary, place the dust cover in the correct position.

4. Reinstall the keybutton on the keystem.

5. Reinstall the keyboard cover (031).



## 123 SPACEBAR REMOVAL AND REPLACEMENT

### Removal

1. Power off.

2. Disconnect the keyboard cable connector J101 (001).

3. Remove the keyboard cover (031).

4. Hold the ends of the Spacebar **2** and pull up to slide the Spacebar off the keystems. Do not let the stabilizer **3** fall out of the assembly.

5. If the pivots **4** need to be removed, insert a screwdriver tip in the opening in the side of the frame **1** ; then twist the screwdriver slightly until the pivot can be removed.

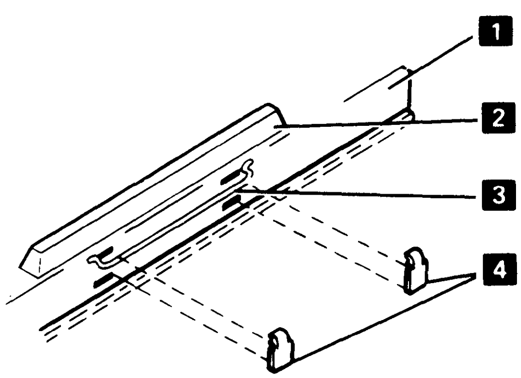
### Replacement

1. Press the pivots into place in the frame.

2. Put the Spacebar into place over the key modules.

3. Guide the stabilizer into the openings in the pivots.

4. Press the Spacebar down on the keystems.



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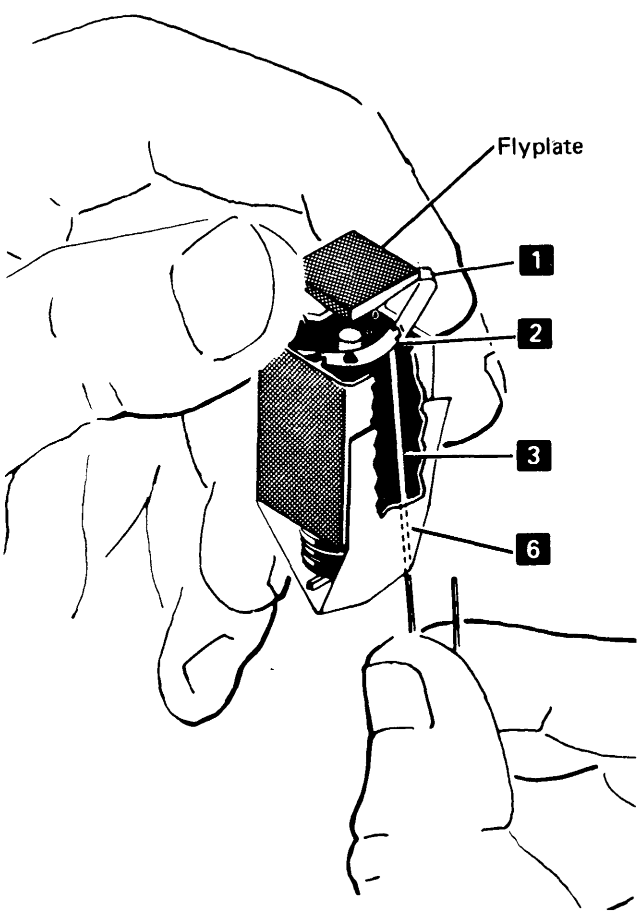
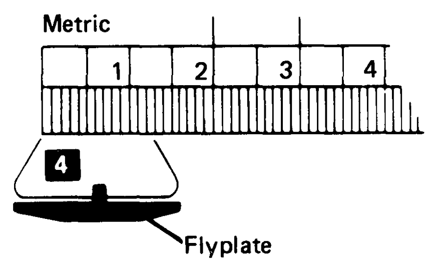
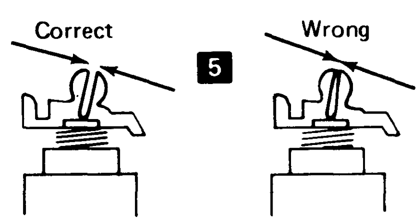
## 125 FLYPLATE REPLACEMENT

It is not recommended that you reinstall a disconnected flyplate in a key module. 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. Power off.
2. Remove the key module (121).
3. Bend the spring on the flyplate so that there is 12.7 millimeters (0.5 inch) between the ends of the spring **4**.
4. Tape the keystem down **6**.
5. Hold the key module and the flyplate as shown and line up the ends of the flyplate spring **1** with the tips of the flat spring **2** attached to the keystem.
6. Insert a small stylus or a straight paper clip into 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 of the flat spring drops into the opening of the flyplate spring.
9. Attach the other end of the flat spring in the same way.
10. Remove the tape holding the keystem.
11. Check the keystem for the correct shape **5** in the opening and bend the keystem if necessary.
12. Reinstall the key module in the key assembly.



## 127 PAD PRINTED CIRCUIT BOARD REMOVAL AND REPLACEMENT

### Removal

1. Power off.

2. Disconnect the keyboard cable connector J101 (001).

3. Remove the keyboard cover (031).

**CAUTION**
Pressure applied to the keyboard logic card can cause the keyboard logic card to crack.

---

4. Remove the two screws **1** and, applying pressure to J02, disconnect J02 to remove the keyboard logic card **5**.

**CAUTION**

The keyboard must be kept free of dirt and contamination.

---

5. Disconnect cable connectors J01 and J03.

6. Remove the four screws **2** (two on each side of the keyboard).

7. Lift the keyboard **4** out of the keyboard base **3**.

8. Invert the key assembly **6** and reinstall it on the original mounts; use a screw on each side **11** to hold the keyboard in place.

**CAUTION**
Do not remove the pad printed circuit board while a key is pressed; this will cause the flyplate to jump out of the key module.

---

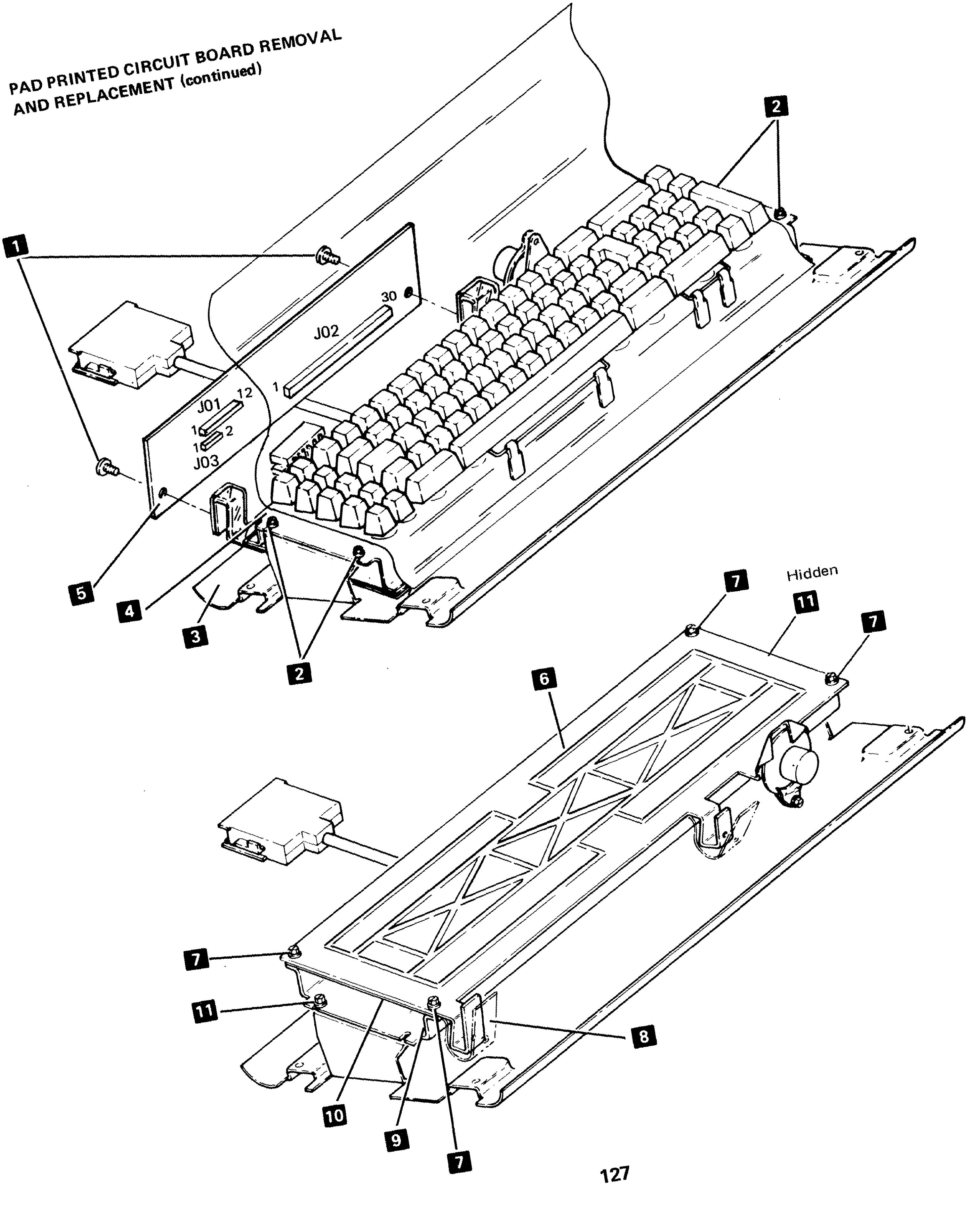
9. Remove the four screws **7** from the pad printed circuit board and base plate.

10. Lift the base plate, insulator, and the pad printed circuit board **10** from the key assembly **9**.

### Replacement

For replacement of the pad printed circuit board, reverse the steps in the removal procedure. Be sure to place the plastic insulator **8** over the pad printed circuit board before reinstalling the base plate. The insulator tabs must be between the logic card and the mounting brackets.

# 127 PAD PRINTED CIRCUIT BOARD REMOVAL AND REPLACEMENT (continued)



## Display Assembly

### 141 LOCATIONS

**DANGER**

The display assembly contains high voltages. For all internal adjustments, use only the fiber screwdriver.

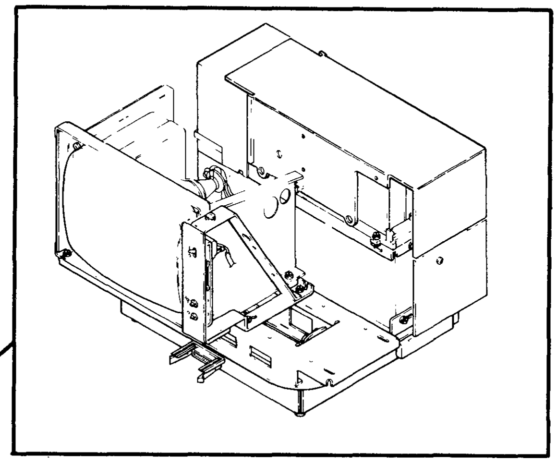
**DANGER**

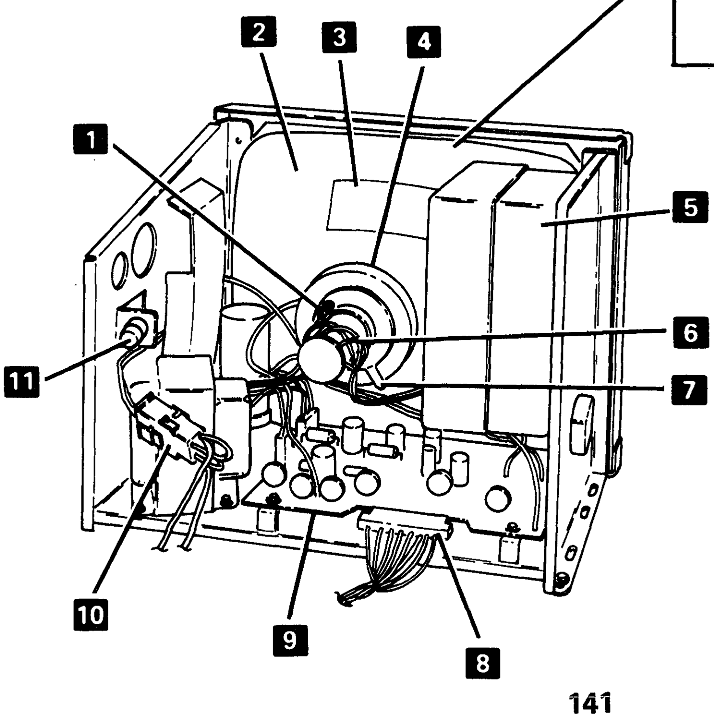
The green wire in the display assembly is not at ground voltage.

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

See the service information label on the cathode-ray tube to locate the adjustments on the printed circuit board.

1 Yoke clamp screw
2 Cathode-ray tube
3 Display assembly service information label
4 Yoke
5 High voltage transformer shield
6 Filament
7 Centering rings
8 Display signal connector P20
9 Printed circuit board
10 Display AC power connector J5/P5 (451 and 457)
11 Display fuse (If the fuse is not in this location, see the display assembly service information label for the correct location)





## 161 VIDEO ADJUSTMENTS

**DANGER**
The display assembly contains high voltage. For all internal adjustments, use only the fiber screwdriver.

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

### Brightness Limiter Potentiometer

Refer to the service information label on the cathode-ray tube for the location of the Brightness Limiter potentiometer.

1. Turn the Brightness control on the control panel fully clockwise.

2. Turn the Brightness Limiter potentiometer on the display assembly printed circuit board until the retrace lines just disappear.

**Note:** Too much brightness could cause poor focus.

### Contrast Control and Brightness Control

1. Display a test pattern of both normal and high-intensity characters (see 971 for the display exerciser test CRTTEST).

2. Adjust the Brightness control on the control panel for the best display image of the normal-intensity characters.

3. Adjust the Contrast control on the control panel for the best display image of the high-intensity characters.

### Video Gain/Video Drive Potentiometer

Refer to the service information label on the cathode-ray tube for the location of the Video Gain/Video Drive potentiometer.

1. Adjust the Brightness control on the control panel for the best display image.

2. Adjust the Video Gain/Video Drive potentiometer on the display assembly printed circuit board to correct the intensity of the horizontal and vertical lines of the characters.

## 163 VERTICAL ADJUSTMENTS

**DANGER**
The display assembly contains high voltages. For all internal adjustments, use the fiber screwdriver.

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

If the character height or the margin on top or bottom of the display screen is wrong, the display image rolls vertically, or the characters appear to have a vertical movement, perform the vertical adjustments. Also check the centering adjustment (169).

If the problem is not corrected after you have made the adjustments, install a new display assembly (181).

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

### Vertical Hold Potentiometer

Refer to the service information label on the cathode-ray tube for the location of the Vertical Hold potentiometer.

Adjust the Vertical Hold potentiometer to obtain a stable (not rolling) display image and to minimize character distortion.

1. Display a test pattern (see 971 for the display exerciser test CRTTEST).

2. Observe the display image while you turn the Vertical Hold potentiometer clockwise until the display image starts to roll. Note the position of the Vertical Hold potentiometer.

3. Observe the display image while you turn the Vertical Hold potentiometer counterclockwise until the display image starts to roll. Note the position of the Vertical Hold potentiometer.

4. Turn the Vertical Hold potentiometer to the center of the range observed in steps 2 and 3. If the display image continues to roll, install a new display assembly (181).

### Vertical Height Potentiometer

Refer to the service information label on the cathode-ray tube for the location of the Vertical Height potentiometer.

The Vertical Height potentiometer and the Vertical Linearity potentiometer can affect each other. Adjust them both until you get the desired result.

Use the Vertical Height potentiometer to adjust the display image height. The height for the 1920-character screen and the 960-character screen is adjusted at the factory to 166 millimeters ± 6 millimeters (6.53 inches ± 0.24 inch). The height of the 480-character screen is adjusted at the factory to 83 millimeters ± 3 millimeters (3.25 inches ± 0.12 inch).

### Vertical Linearity Potentiometer

Refer to the service information label on the cathode-ray tube for the location of the Vertical Linearity potentiometer.

The Vertical Height potentiometer and the Vertical Linearity potentiometer can affect each other. Adjust them both until you get the desired result.

Use the Vertical Linearity potentiometer to control the balanced height of the characters. The characters in the top row should be the same height as the characters in the bottom row. Normal character height is 3.58 millimeters (0.141 inch).

### Linearity Phase Potentiometer

Refer to the service information label on the cathode-ray tube for the location of the Linearity Phase potentiometer.

The Linearity Phase potentiometer, as with the Vertical Linearity potentiometer, controls the balanced height of the characters between the top of the display screen and the bottom of the display screen.

## 165 HORIZONTAL ADJUSTMENTS

**DANGER**
The display assembly contains high voltages. For all internal adjustment, use the fiber screwdriver.

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

If the display image appears too narrow, the margins on the left or right are wrong, or the display image appears to have a horizontal motion, perform the horizontal adjustments.

If the problem is not corrected after you have made the adjustments, install a new display assembly (181).

### Horizontal Width Potentiometer

Refer to the service information label on the cathode-ray tube for the location of the Horizontal Width potentiometer.

The Horizontal Width potentiometer is used to control the width of the display image. This potentiometer is adjusted at the factory to 205 millimeters ± 6 millimeters (8.06 inches ± 0.24 inch). If there is a horizontal positioning problem, correct the problem by adjusting the centering rings (169).

### Horizontal Centering Potentiometer

Refer to the service information label on the cathode-ray tube for the location of the Horizontal Centering potentiometer.

Adjust the Horizontal Centering potentiometer to center the display image within the raster.

1. Turn the Brightness Limiter potentiometer until a raster appears.
2. Adjust the Horizontal Centering potentiometer to center the data within the raster.
3. Turn the Brightness Limiter potentiometer until the raster disappears.

## 167 YOKE ADJUSTMENT

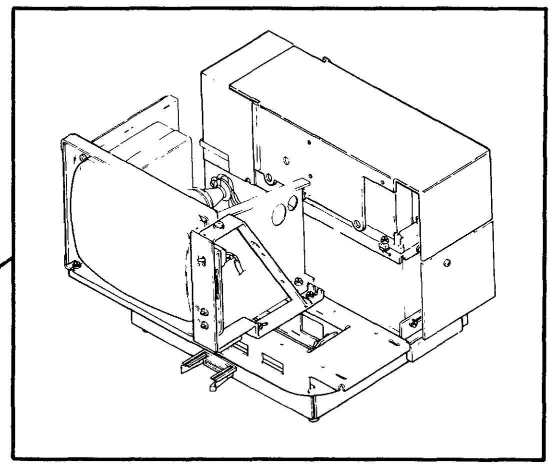
**DANGER**
The display assembly contains high voltages. For all internal adjustments, use the fiber screwdriver.

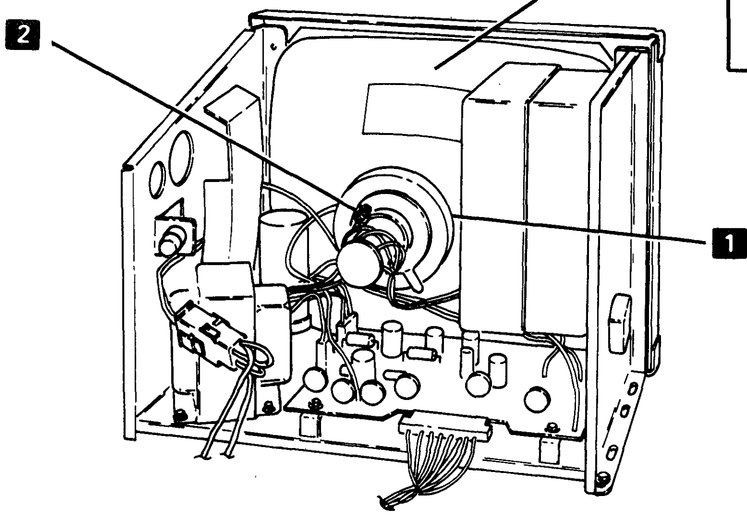
**DANGER**
The green wire in the display assembly is not at ground voltage.

If the display image is not the correct size or is tilted, adjust the yoke (also see 165 Horizontal Adjustments and 169 Centering Adjustment).

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

**Note:** If this adjustment does not correct the problem, install a new display assembly (181).





## 169 CENTERING ADJUSTMENT

**DANGER**
The display assembly contains high voltages. For all internal adjustments, use the fiber screwdriver.

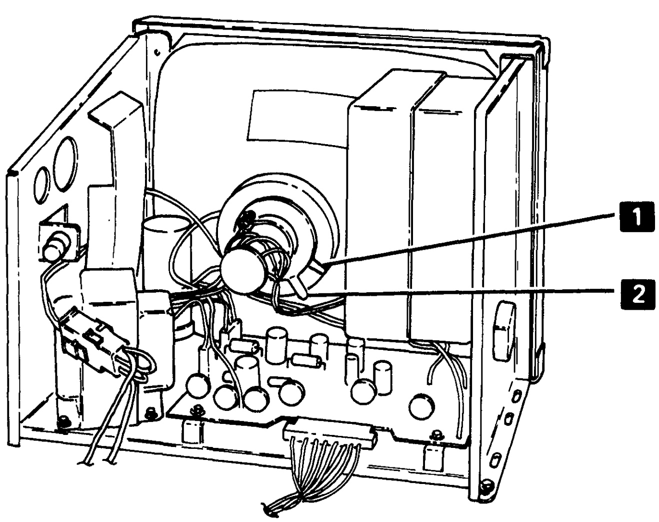
**DANGER**
The green wire in the display assembly is not at ground voltage.

Ring magnets, which are attached to the centering rings, are used to determine the horizontal and vertical placement of the display image. If the image is tilted, do not adjust the centering rings; adjust the yoke (167). The following adjustments will affect each other. Adjust both centering rings to get the best results.

1. Adjust the rear centering ring **1** for horizontal centering. The space on the left and right margins of the display screen should be equal.

2. Adjust the front centering ring **2** for vertical centering. The space on the top and the bottom of the display screen should be equal.

**Note:** If this adjustment does not correct the problem, install a new display assembly (181).




## 171 FACTORY ADJUSTMENTS

**CAUTION**
The following adjustments should not be attempted. They are described here for your information only.

### Focus Potentiometer

The Focus potentiometer is used to focus the display image. The factory adjusts this potentiometer for the best display image.

### B+ Potentiometer

The B+ potentiometer is set at the factory with a precision meter. If the B+ potentiometer is out of adjustment, there is a loss of the display image.

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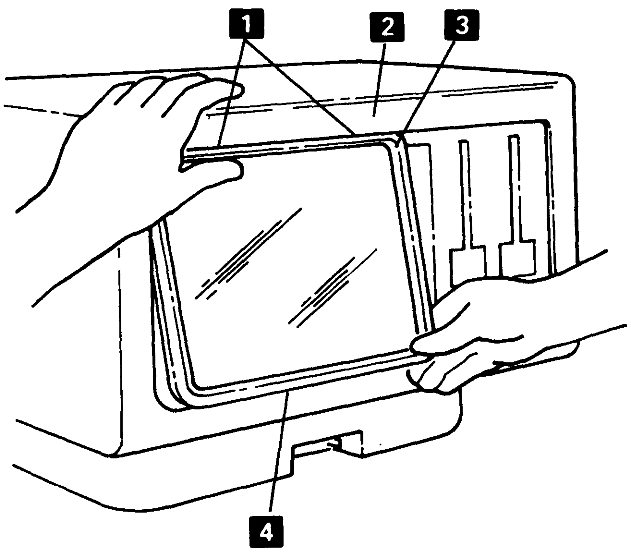
## 180 GLARE SHIELD REMOVAL AND REPLACEMENT

### Removal

1. Push up on the top of the glare shield 3 until the bottom of the glare shield clears the clip 4.

2. Pull the bottom of the glare shield away from the face of the CRT; then lower the glare shield until the tabs 1 clear the bezel 2.

3. Remove the clip 4 from between the bezel and the outside cover.

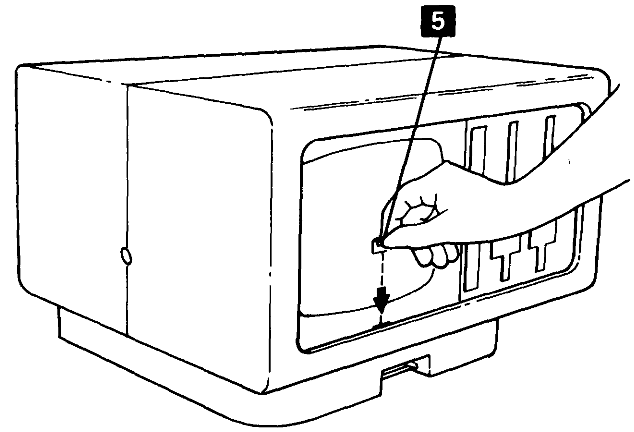


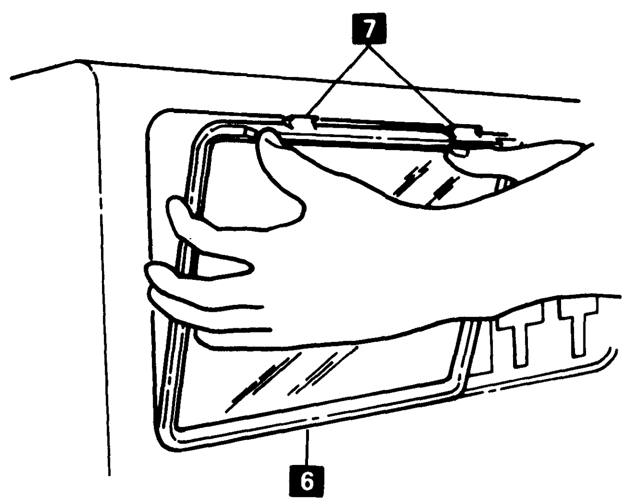

### Replacement

1. Insert the clip 5 between the outside cover and the bezel approximately in the center.

2. Insert the bottom of the glare shield 6 into the clip. Move the clip if necessary to fit the slot on the glare shield.

3. Push in on the top of the glare shield until the tabs 7 snap into place between the bezel and the outside cover.



## 181 DISPLAY ASSEMBLY REMOVAL AND REPLACEMENT

**DANGER**
The display assembly contains high voltages. For all internal adjustments, use only the fiber screwdriver.

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

### Removal

1. Power off.

2. Disconnect the power cord from the service outlet.

3. Remove the data station covers (031).

4. Disconnect the display signal connector P20 **12**.

5. Disconnect the display AC power connector J5/P5 **11**.

6. Scribe a line on the base of the data station at both sides of the display assembly mounting bracket **8**. These lines will be used to reposition the bracket when the display assembly is replaced.

7. Remove the top mounting bracket screw **1** from the control panel.

**DANGER**
The cathode-ray tube can implode if it is hit or if it falls.

8. Remove the four screws **2**, **4**, **6**, and **10**.

9. Lift the display assembly from the data station base.

10. If a new display assembly is not to be installed, the removal procedure is complete. If a new display assembly is to be installed, proceed to step 11.

11. Place the display assembly face up on a convenient work surface.

12. Remove the four screws **3**, **5**, **7**, and **9** from the display assembly mounting bracket **8**.

13. Remove the display assembly mounting bracket from the display assembly.

14. Reinstall the four screws **3**, **5**, **7**, and **9** into the display assembly.

15. Place the used display assembly into the shipping container so that it can be returned as instructed by local procedures.

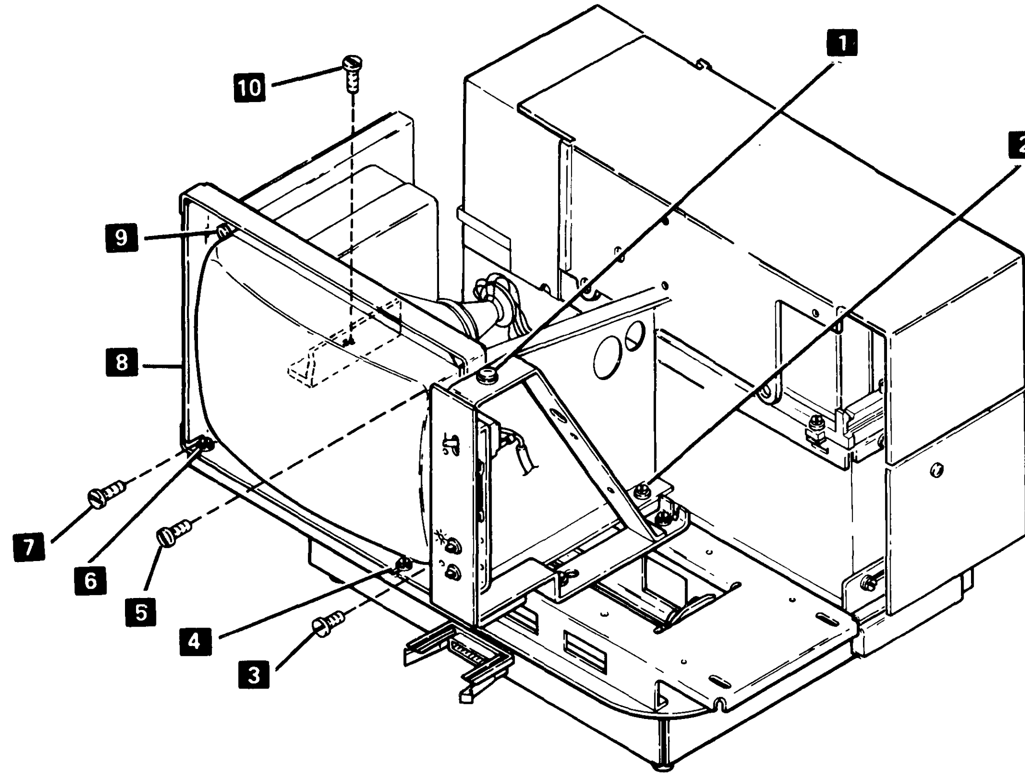
### Replacement

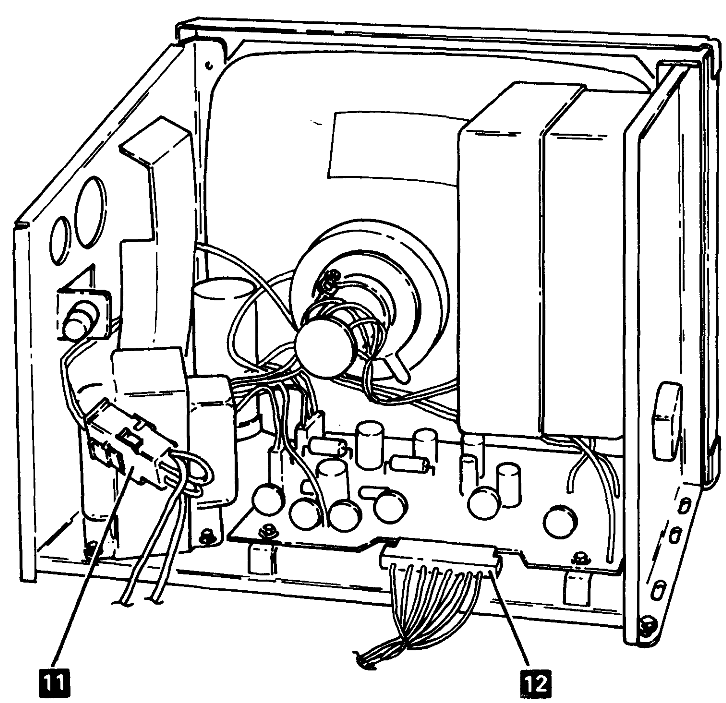
For replacement of the display assembly, reverse the steps in the removal procedure while observing the following:

1. If you are installing a new display assembly, remove the four screws **3**, **5**, **7**, and **9** from the new display assembly and use the screws to install the display assembly mounting bracket to the new display assembly.

2. Align the display assembly mounting bracket to the lines scribed in step 6 of the removal procedure.

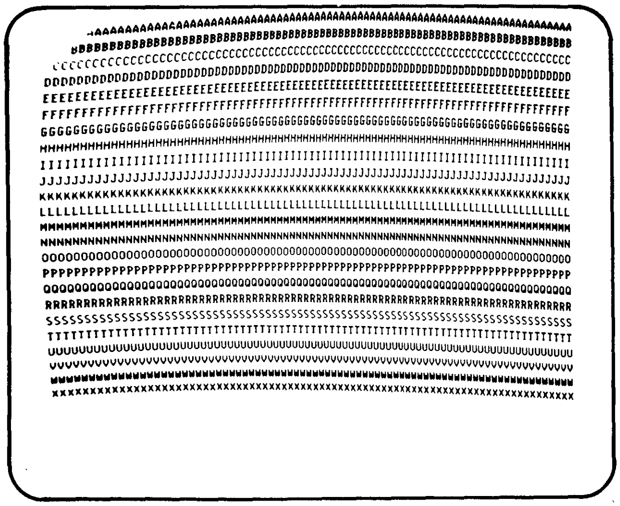
## 181 DISPLAY ASSEMBLY REMOVAL AND REPLACEMENT (continued)



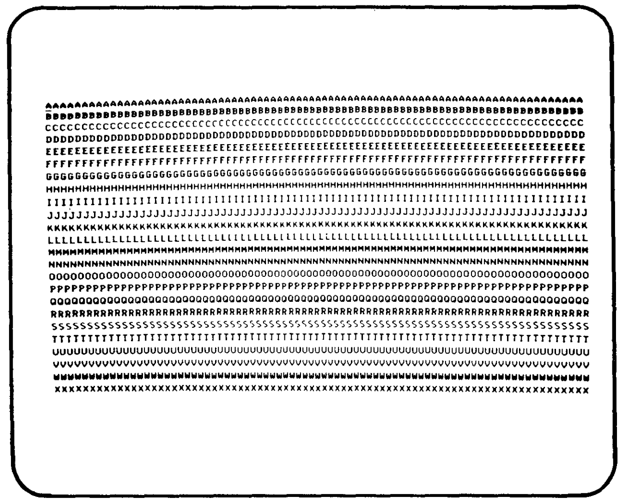



## 183 DISPLAY SCREEN EXAMPLES

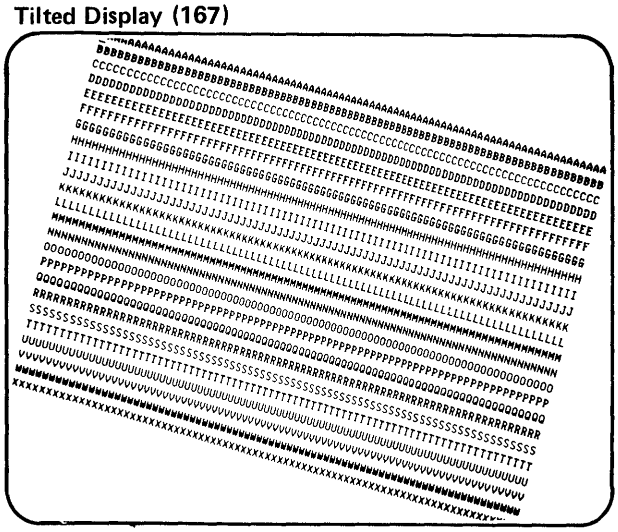
Display Not Centered (169)



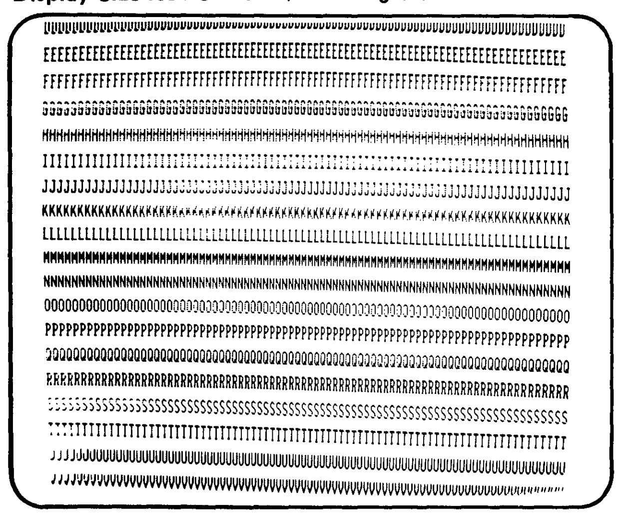
Display Size Not Correct (Too Small) (167)



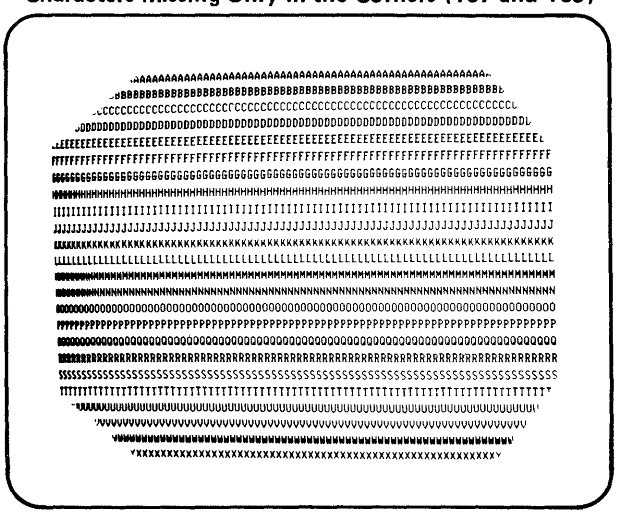
Tilted Display (167)



Display Size Not Correct (Too Large) (167)



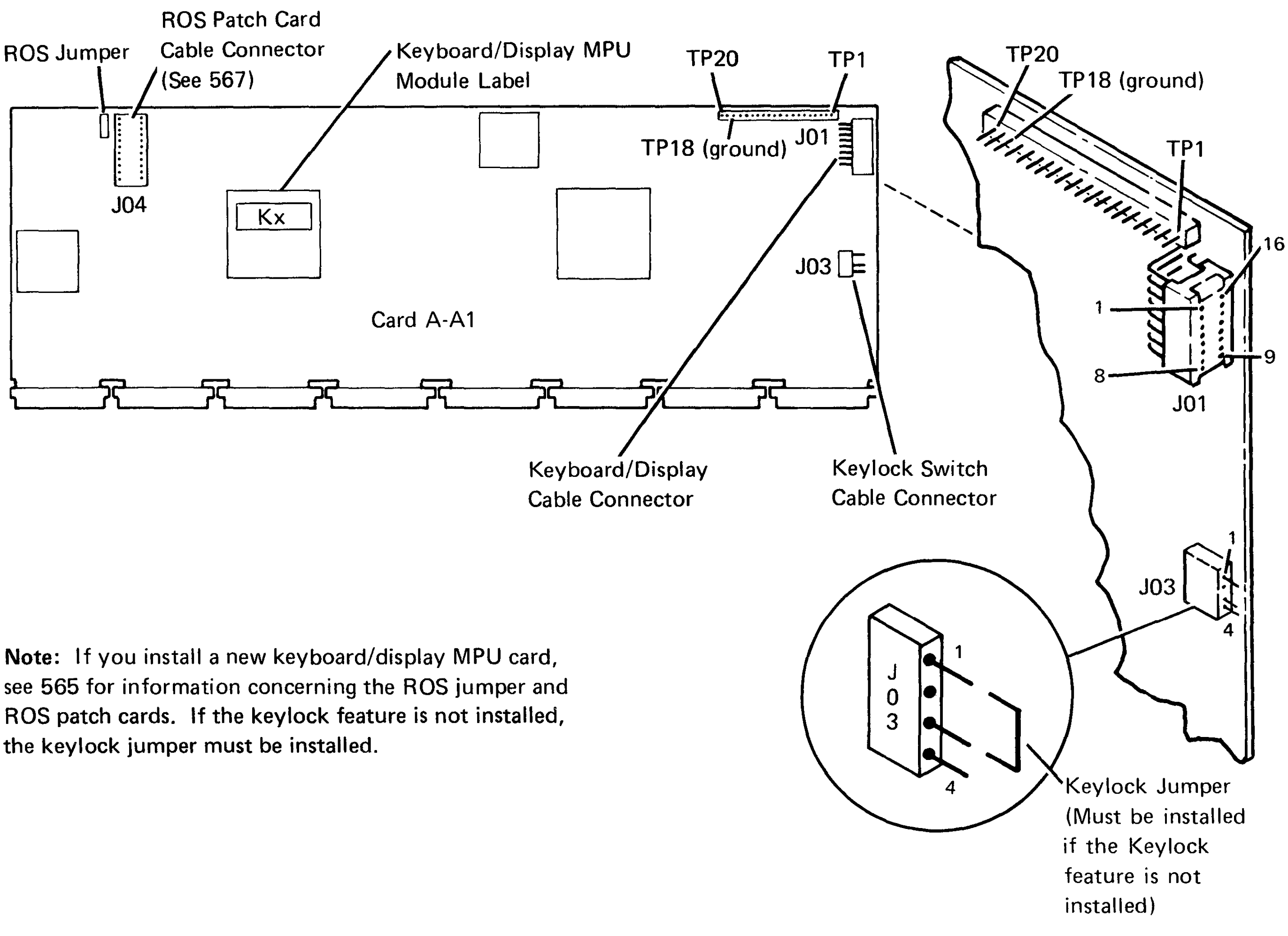
Characters Missing Only in the Corners (167 and 169)



## Keyboard/Display Cards

### 200 KEYBOARD/DISPLAY MPU CARD (A-A1)

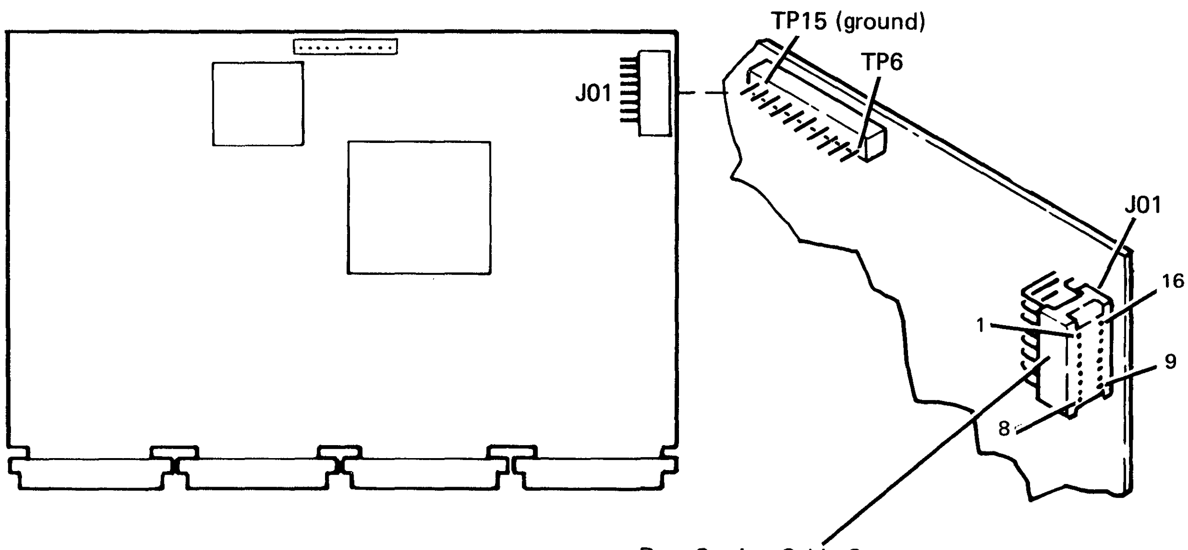
The keyboard/display MPU card diagram shows the location of the test pins, cable connectors, jumpers, and the module label. This card contains one keyboard/display MPU (for up to four keyboard/displays), and the logic needed to control the local keyboard/display.




**Note:** If you install a new keyboard/display MPU card, see 565 for information concerning the ROS jumper and ROS patch cards. If the keylock feature is not installed, the keylock jumper must be installed.

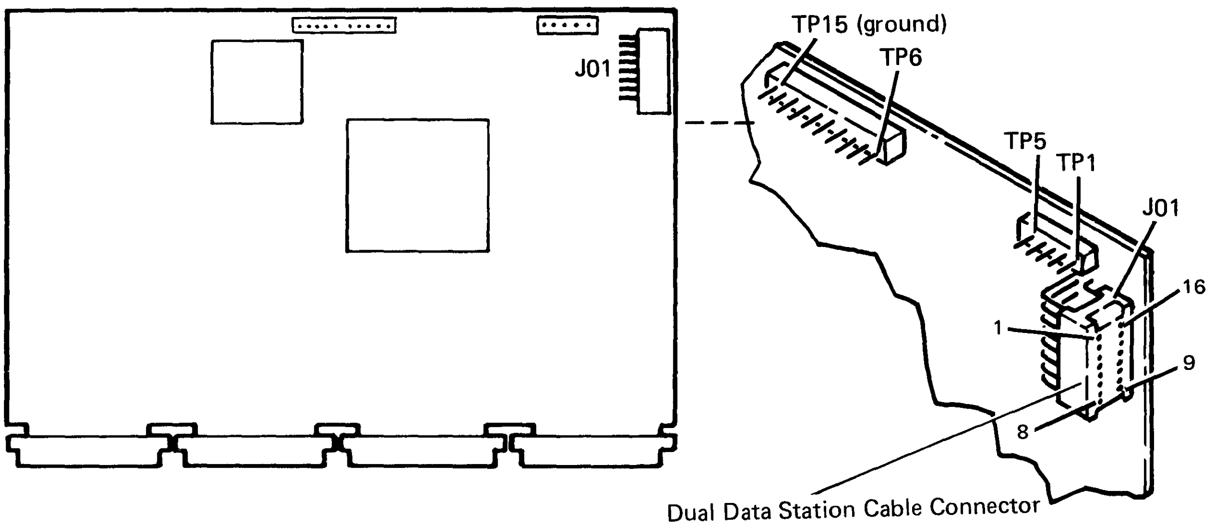
## 201 DATA STATION ADAPTER CARD (A-E1).

The data station adapter card contains the logic needed to control the display and keyboard in an auxiliary data station. The following figure shows the location of the components on the card. See 503 to determine when to use this card.



## 203 DUAL DATA STATION ADAPTER CARD (A-E1)

The dual data station adapter card contains the logic needed to control the display and keyboards in an auxiliary dual data station. The following figure shows the location of the components on the card. See 503 to determine when to use this card.



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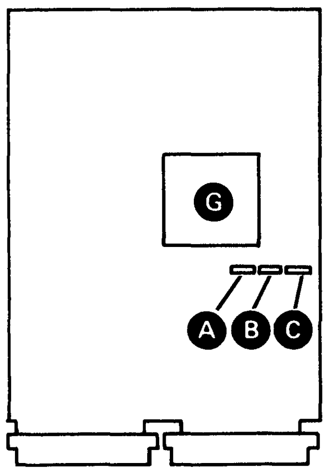
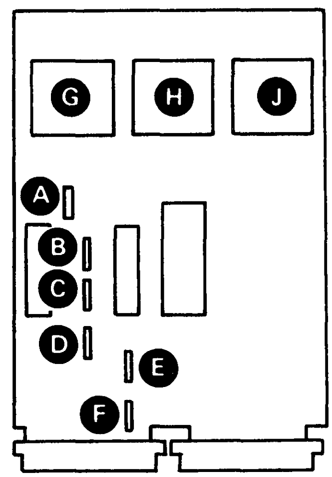
## 207 KEYBOARD/DISPLAY STORAGE CARDS (A-B7)

The IBM 5285 Programmable Data Station uses two types of keyboard/display storage cards: type B and type C. The following figure and Table shows the location of the jumpers and modules on the two cards, which card to use for each configuration, and the total storage available with each configuration.




**Type B**

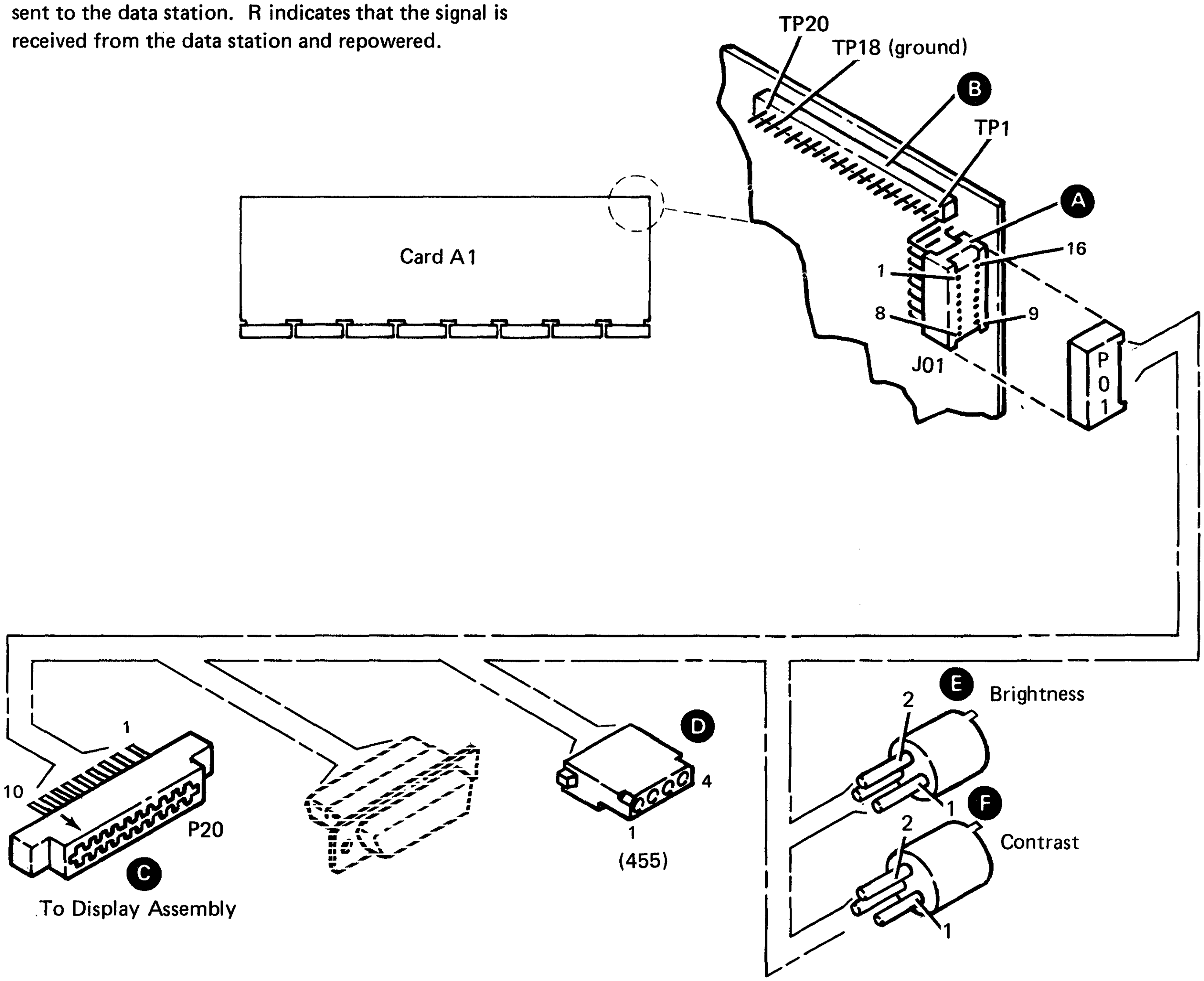



**Type C**

| Configuration | | Keyboard/Display Storage Card | | | | |
|---|---|---|---|---|---|---|
| **Display Size** | **Auxiliary Data Station Attached** | **Type** | **Size** | **Modules Installed** | **Jumpers Installed** | **Total Keyboard/ Display Storage** |
| 6 lines 480 characters | | | | | | |
| | None | | | | | 2 K |
| | IBM 5281 | C | 2 K | G | | 4 K |
| | IBM 5282 | C | 3 K | G and H | D and E | 5 K |
| 12 lines 960 characters | None | B | 1 K | G | A and B | 3 K |
| | IBM 5281 | C | 3 K | G and H | D and E | 5 K |
| | IBM 5282 | C | 4 K | G and H | B, C, and D | 6 K |
| 24 lines 1920 characters | None | B | 2 K | G | C | 4 K |
| | IBM 5281 | C | 5 K | G, H, and J | A, B, C, D, and F | 7 K |

## 217 DISPLAY CABLE DIAGRAM

The following cable diagram and table shows the physical cable connections, each line name, and all of the associated connecting points. See 901 on how to use the cable diagram. The arrow (→) indicates the logical direction of the signal. D indicates that the signal is repowered and sent to the data station. R indicates that the signal is received from the data station and repowered.

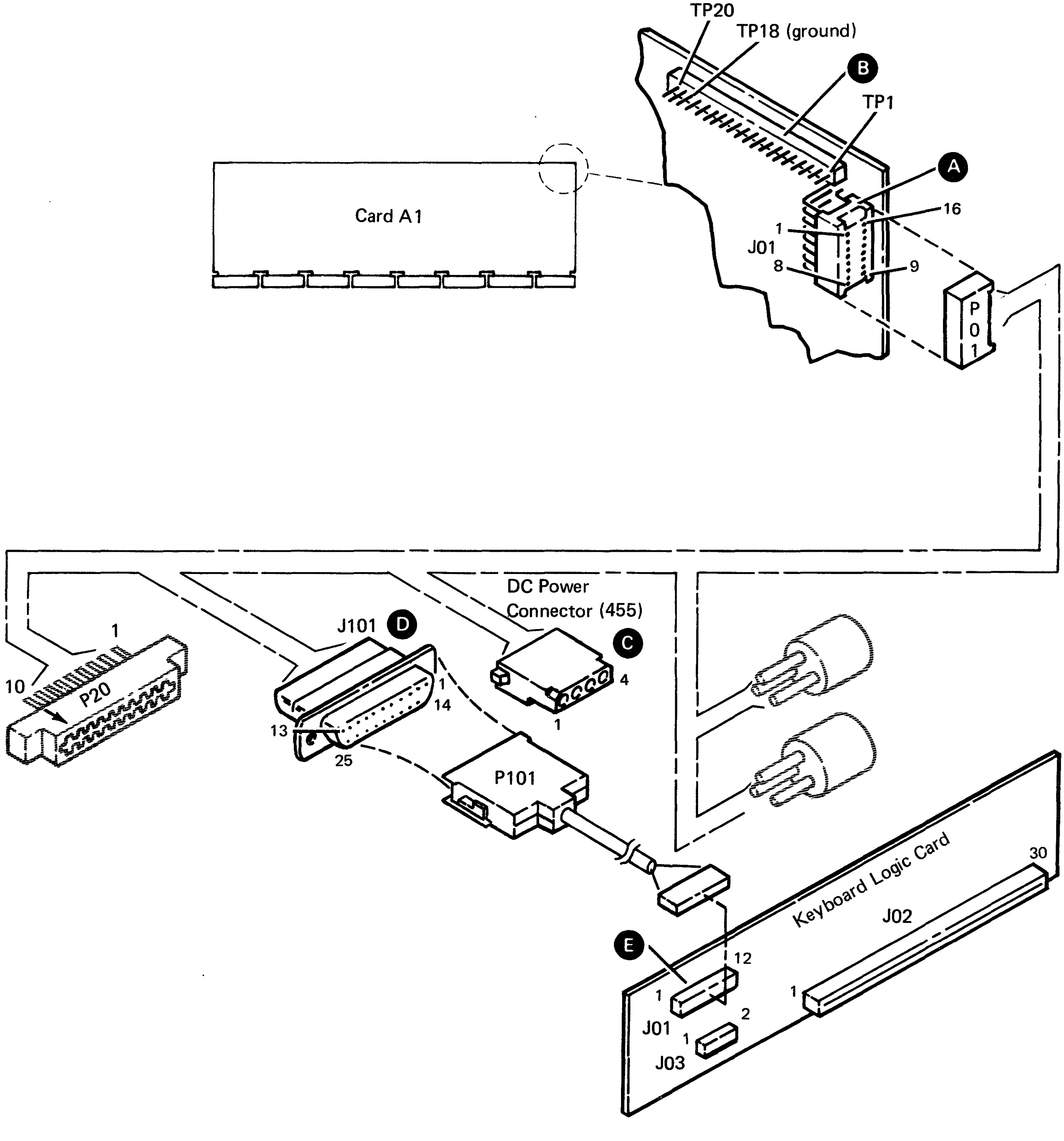


## 217 DISPLAY CABLE DIAGRAM (continued)

| | Card A1 | | Display P20 | KBD/CRT DC Connector | Control Panel | | |
|---|---|---|---|---|---|---|---|
| | TP B | J01 A | C | D | Brightness E | Contrast F | Line Name |
| D → | 10 | 6 | 8 | | | | +video drive |
| D → | 13 | 7 | 9 | | | | -vertical drive |
| D → | 16 | 8 | 6 | | | | +horizontal drive |
| ← | 12 | 14 | | | 2 | | Brightness control |
| ← | 11 | 13 | | | | 2 | Contrast control |
| | | 12 | | | 1 | 1 | ground (controls) |
| | | | | 1 | 3 | 3 | +5 Vdc (controls) |
| | | 9 | 1 | | | | ground (logic) |
| | | 10 | 10 | | | | ground (logic) |
| | | 11 | 10 | | | | ground (logic) |

## 219 KEYBOARD CABLE DIAGRAM

The following cable diagram shows the physical cable connections, each line name, and all associated connecting points. See 901 on how to use the cable diagram. The arrow (→) indicates the logical direction of the signal. D indicates that the signal is repowered and sent to the data station. R indicates that the signal is received from the data station and repowered.



## 219 KEYBOARD CABLE DIAGRAM (continued)

| | Card A1 | | KBD/CRT DC Power Connector C | Cable Connector Panel | KBD Logic Card | |
|---|---|---|---|---|---|---|
| | TP B | J01 A | | J101 D | J01 E | Line Name |
| R ← | 1 | 1 | | 1 | 5 | -serial data A |
| R ← | 2 | 2 | | 3 | 4 | -strobe A |
| D → | 15 | 3 | | 5 | 1 | -POR |
| D → | 6 | 5 | | 6 | 3 | -click |
| R ← | 4 | 15 | | 4 | 7 | -break code A |
| ← | 3 | 16 | | 2 | 6 | +serial data clock A |
| | | | 1 | 21 | 12 | +5 Vdc (speaker) |
| | 18 | | 2 | 22 | 9 | ground |
| | | | 3 | 23 | 11 | +5 Vdc (logic) |
| | | | 4 | 24 | 10 | -5 Vdc (logic) |

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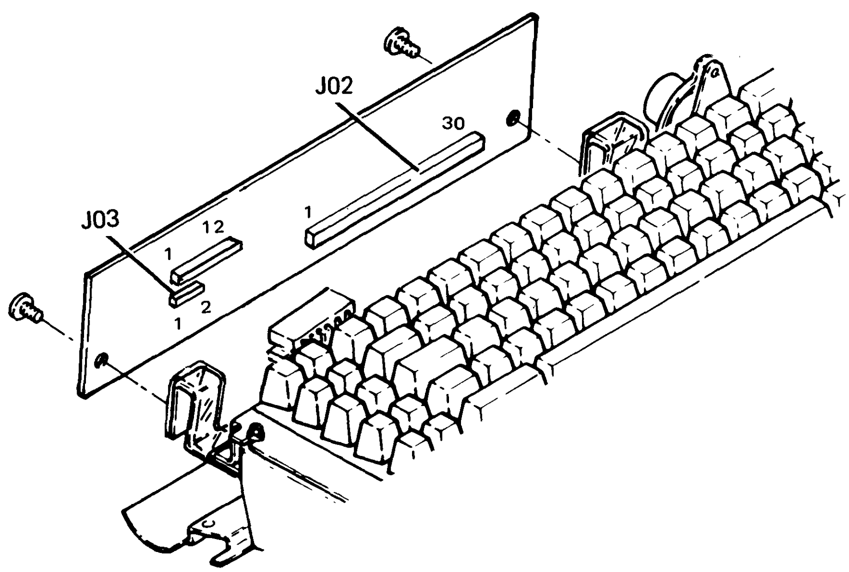
## 220 KEYBOARD LOGIC CARD J02 AND J03 CONNECTOR

The J02 connector carries the signals from the keyboard pad printed circuit board to the keyboard logic card. The J03 connector carries the signal and drive voltage to the speaker.

**J02 Signal Lines**

| | |
|---|---|
| 1 | ground |
| 2 | +drive 22 |
| 3 | +drive 21 |
| 4 | +drive 20 |
| 5 | +drive 19 |
| 6 | +drive 18 |
| 7 | +drive 17 |
| 8 | +drive 16 |
| 9 | +drive 15 |
| 10 | +drive 14 |
| 11 | +drive 13 |
| 12 | +drive 12 |
| 13 | +drive 11 |
| 14 | +drive 10 |
| 15 | +drive 09 |
| 16 | unused |
| 17 | +drive 08 |
| 18 | +drive 07 |
| 19 | +drive 06 |
| 20 | +drive 05 |
| 21 | +drive 04 |
| 22 | +drive 03 |
| 23 | +drive 02 |
| 24 | +drive 01 |
| 25 | +drive 00 |
| 26 | matrix shield ground |
| 27 | -sense A |
| 28 | -sense B |
| 29 | -sense C |
| 30 | -sense D |




**J03 Signal Lines**

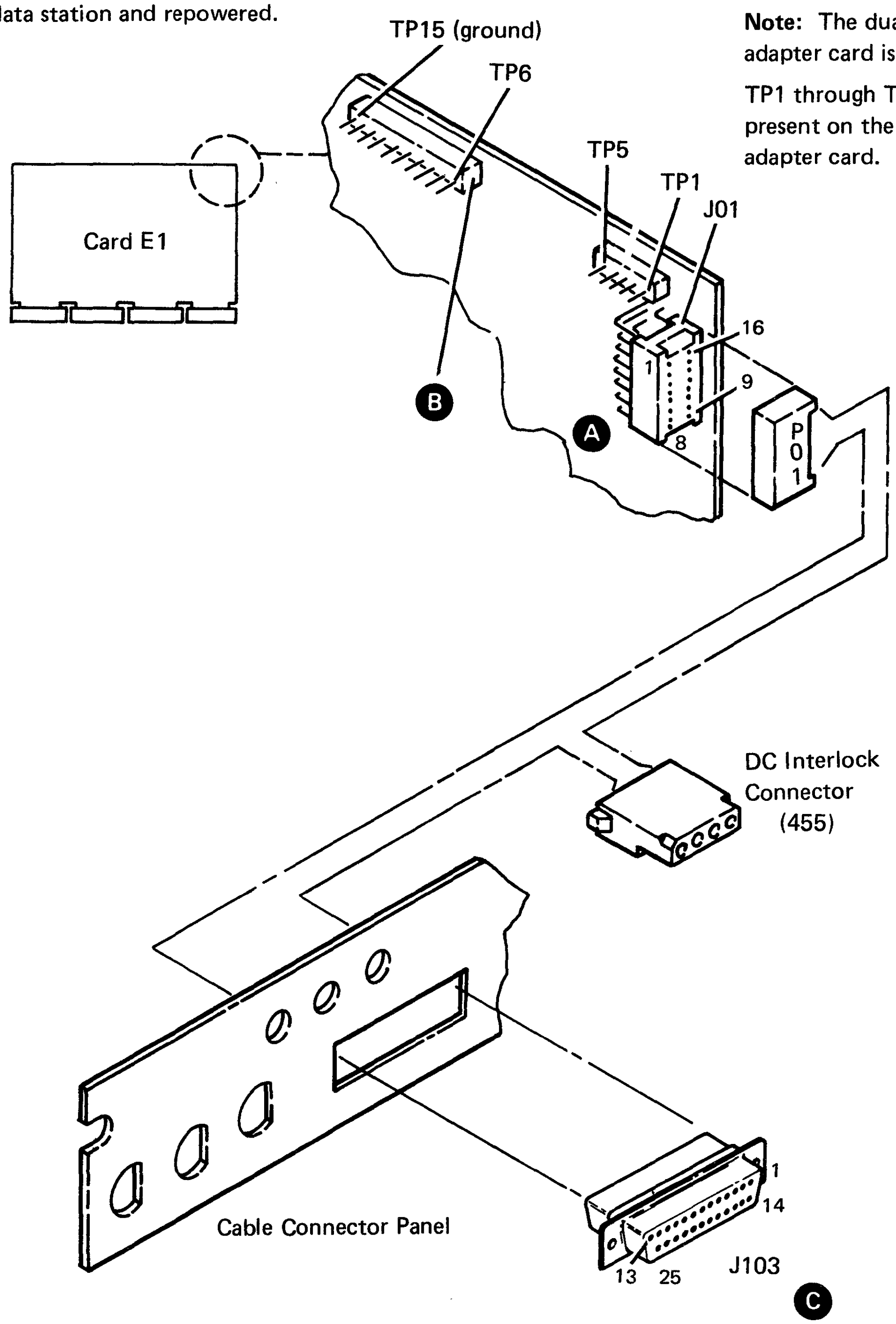
| | |
|---|---|
| 1 | -click |
| 2 | +5 volt |

## 227 IBM 5285 TO IBM 5281 OR IBM 5282 CABLE DIAGRAM

The following cable diagram and table shows the physical cable connections, each line name, and all associated connecting points. See 901 on how to use the cable diagram. The (→) indicates the logical direction of the signal. D indicates that the signal is repowered and sent to the data station. R indicates that the signal is received from the data station and repowered.

**Note:** The dual data station adapter card is shown.

TP1 through TP5 are not present on the data station adapter card.



## 227 IBM 5285 TO IBM 5281 OR IBM 5285 CABLE DIAGRAM (continued)

### KEYBOARD

| | Card E1 | | Connector | |
|---|---|---|---|---|
| | TP B | J01 A | J103 C | Line Name |
| R ← | 12 | 1 | 13 | +serial data A |
| R ← | 13 | 2 | 11 | +break code A |
| D → | 7 | 3 | 9 | -clicker A |
| R ← | 1 | 6 | 3 | +serial data B* |
| R ← | 5 | 7 | 1 | +break code B* |
| R ← | 4 | 10 | 14 | +strobe B* |
| R ← | 2 | 11 | 2 | -serial data clock B* |
| D → | 3 | 14 | 5 | +clicker B* |
| R ← | 14 | 15 | 10 | +strobe A |
| R ← | 6 | 16 | 12 | -serial data clock A |

### DISPLAY

| Card E1 | | Connector | |
|---|---|---|---|
| TP B | J01 A | J103 C | Line Name |
| 8 | 5 | 4 | -vertical drive |
| 9 | 12 | 6 | -high intensity drive |
| 11 | 4 | 7 | +video drive |
| 10 | 8 | 8 | +horizontal drive |

### VOLTAGE

| Card E1 | | DC | | |
|---|---|---|---|---|
| TP B | J01 A | Interlock Connector C | Connector J103 D | Line Name |
| 15 | 9 | 2 | 25 | ground (logic) |
| 15 | 13 | 2 | 25 | ground (logic) |
| | | | 24 | ground (frame) |
| | | 1 | 15 | +24 Vdc interlock |

*The keyboard B lines are not present when an IBM 5281 is the attached device.

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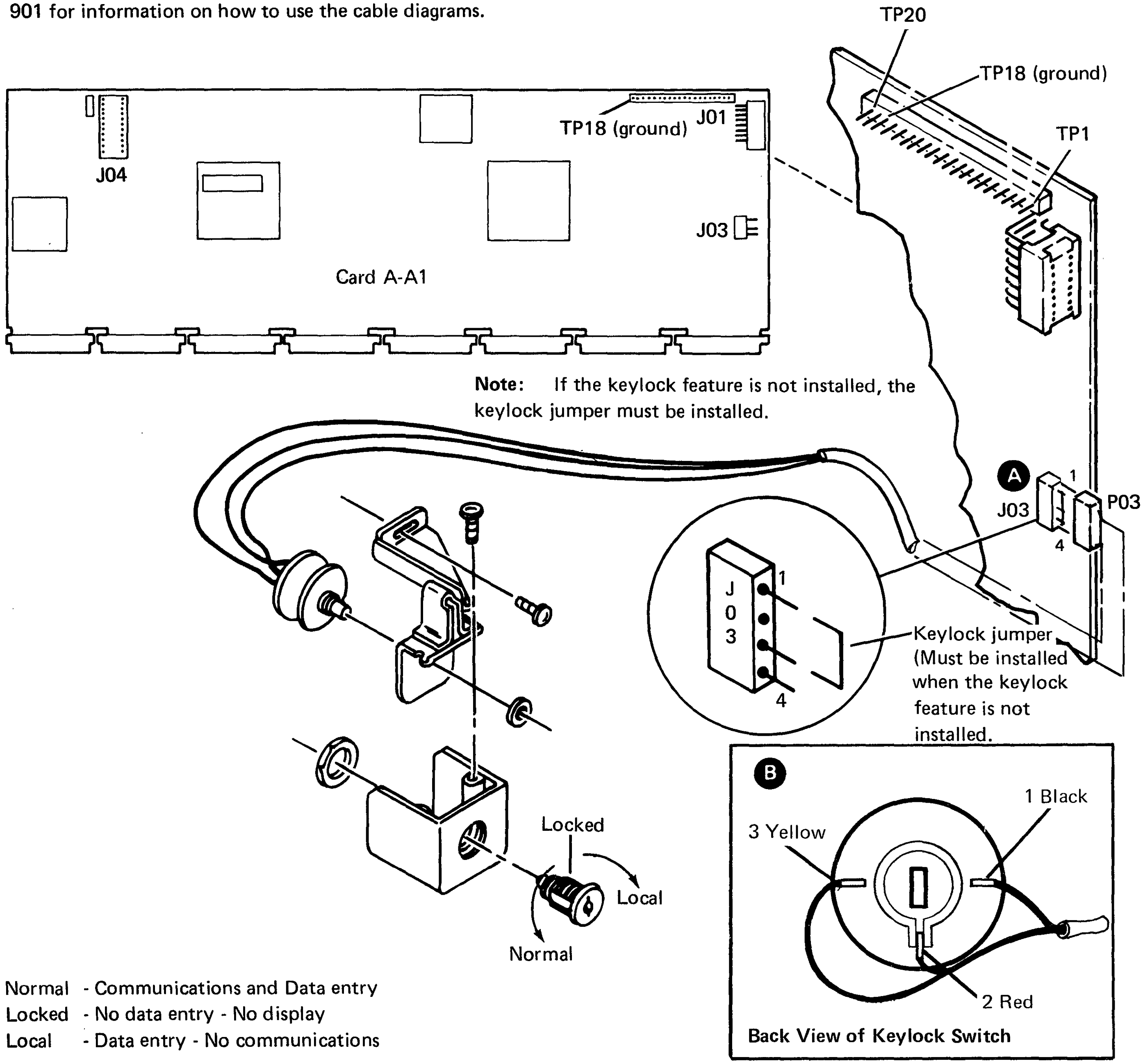
## 229 KEYLOCK CABLE DIAGRAM

This diagram and table shows the cable connections and identification, the line names and the probe points. See 901 for information on how to use the cable diagrams.




**Note:** If the keylock feature is not installed, the keylock jumper must be installed.

**Back View of Keylock Switch**

Normal - Communications and Data entry
Locked - No data entry - No display
Local - Data entry - No communications

| Card A-A1 J03 (A) | Keylock Switch (B) | Line Name | Switch Position |
|---|---|---|---|
| 1 | 1 | keylock position 1 | Normal |
| 3 | 2 | ground | Locked |
| 4 | 3 | keylock position 3 | Local |

## Diskette Drive

### 301 DISKETTE DRIVE REMOVAL AND REPLACEMENT

The following procedure is only for the removal and replacement of the diskette drive assembly. For locations in the diskette drive assembly and for all maintenance procedures for the assembly, see *IBM 5280 Diskette Drive Maintenance Information Manual,* SY31-0602.

**DANGER**
Line voltage is present on the diskette drive(s) when the power cord is connected to the service outlet.

#### Removal

*With One Diskette Drive Installed*

1. Power off.
2. Remove the power cord from the service outlet.
3. Remove the data station covers (031).
4. Ensure that there is a cleared work area next to the data station.
5. Remove the screw **1**, then remove the magnetic shield **2**.
6. Loosen the two diskette drive mounting bracket screws **3**; then slide the mounting bracket **4** far enough away from the diskette drive to clear the locating tabs.
7. Slide the diskette drive away from the left mounting bracket **6**.
8. Place the diskette drive on the work area.
9. Remove the diskette drive signal cable **5**.
10. Disconnect the AC connector **7**.

*With Two Diskette Drives Installed*

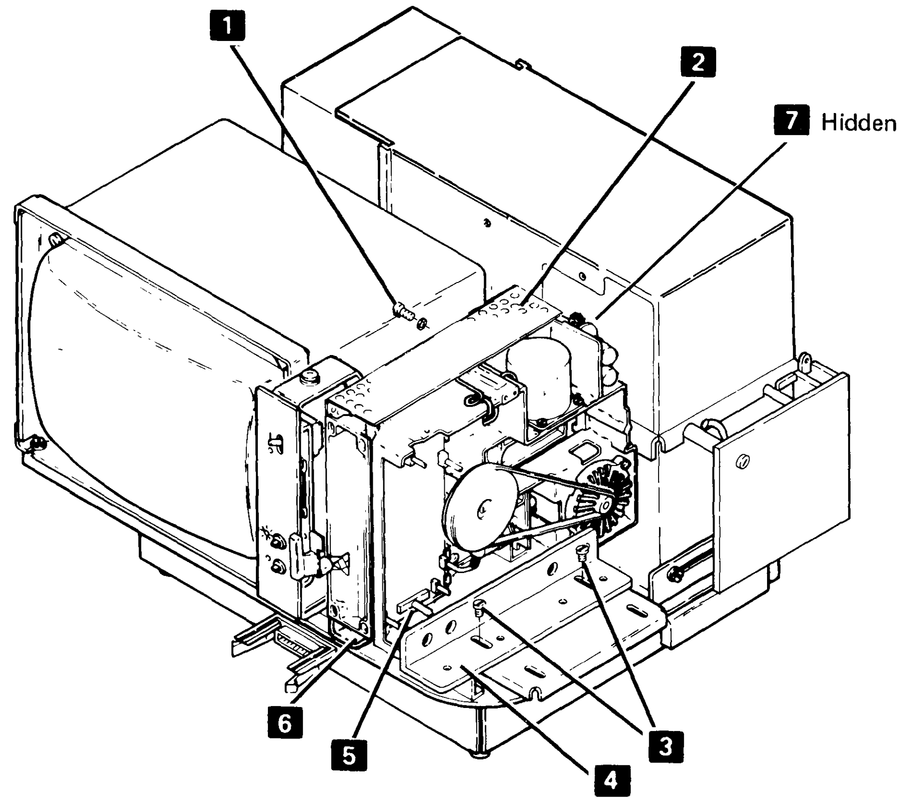
1. Power off.
2. Remove the power cord from the service outlet.
3. Remove the data station covers (031).
4. Ensure that there is a cleared work area next to the data station.
5. Remove the screw **16**; then remove the magnetic shield **8**.
6. Loosen the two diskette mounting bracket screws **10**; then slide the mounting bracket **9** away from the diskette drive to clear the locating tabs.
7. Slide the two diskette drive assemblies away from the left mounting bracket **14**; then lift the two diskette drive assemblies out of the data station.
8. Place the diskette drive assemblies on the work area.
9. To separate the diskette drives, remove the top spring clip **12** and the two bottom spring clips **13**.
10. Remove the diskette drive signal cables **11**.
11. Disconnect the AC connectors **15**.

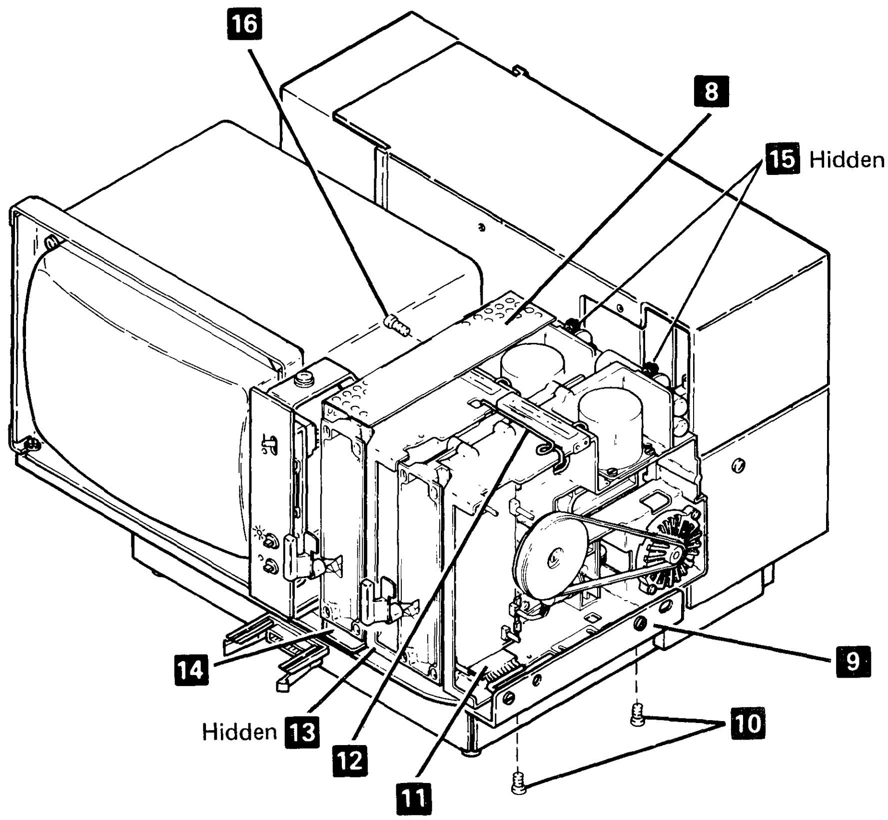
#### Replacement

To install the diskette drives, observe the following CAUTION and reverse the steps in the removal procedure.

**CAUTION**
Ensure that the bottom of the magnetic shield **2** or **8** is hooked over the diskette drive mounting bracket.

## 301 DISKETTE DRIVE REMOVAL AND REPLACEMENT (continued)



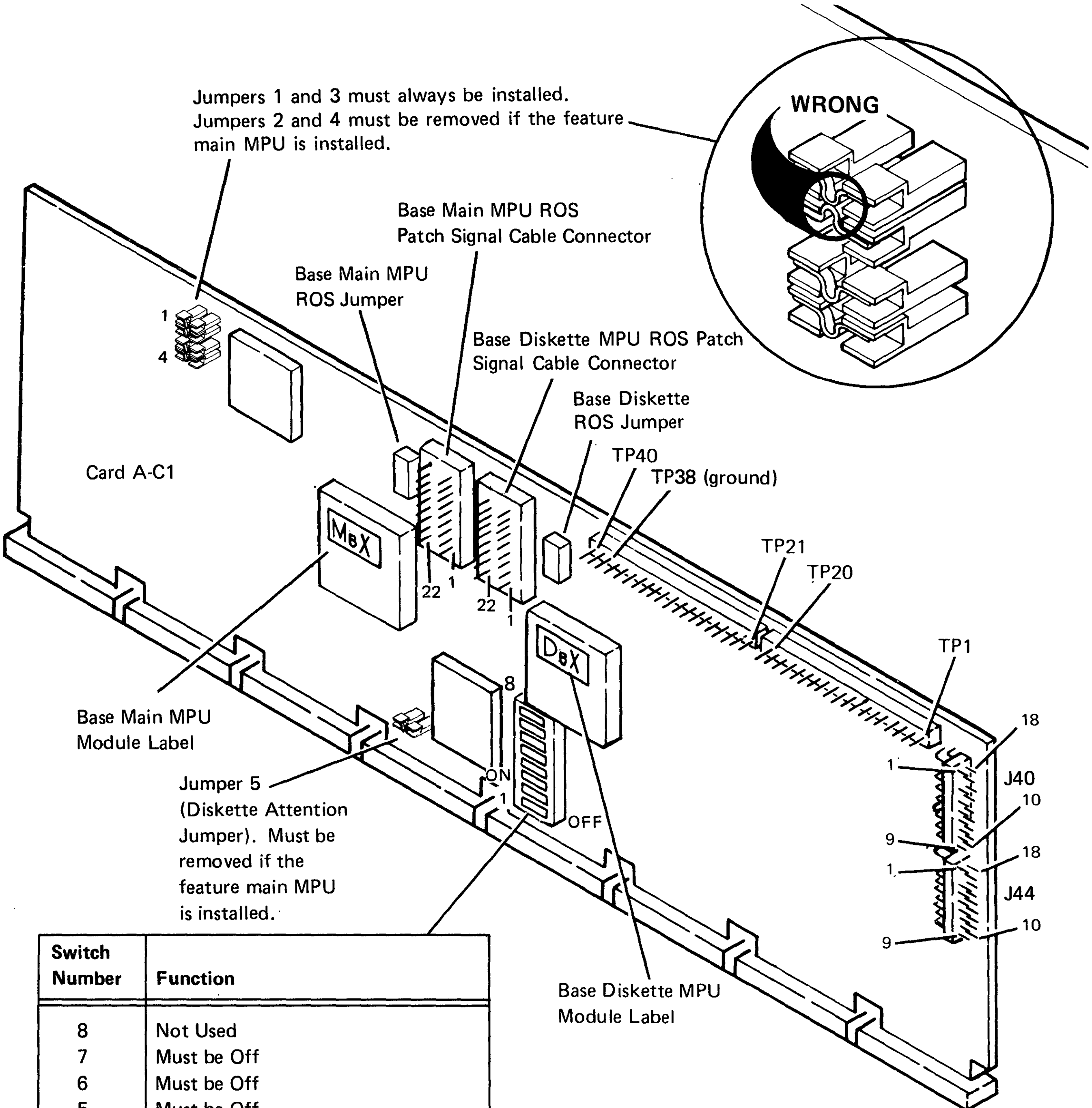
## 303 DISKETTE/MAIN MPU CARD (A-C1)

The diskette/main MPU card figure shows the location of test pins, cable connectors, jumpers, switches, and the module labels. This card contains a diskette MPU and the logic to control four diskette drives.

Two diskette drives are local (addresses 4000 and 4400) and two diskette drives can be remote (addresses 4800 and 4C00) located in a remote data station. Only four drives can be attached at one time. The base main MPU and 32K of main storage are also on this card.

If you install a new diskette/main MPU card, see 565 for information about the ROS jumper and ROS patch card.

## 303 DISKETTE/MAIN MPU CARD (A-C1) (continued)




| Switch Number | Function |
|---|---|
| 8 | Not Used |
| 7 | Must be Off |
| 6 | Must be Off |
| 5 | Must be Off |
| 4 | On if diskette drive 4000 is installed |
| 3 | On if diskette drive 4400 is installed |
| 2 | On if diskette drive 4800 is installed |
| 1 | On if diskette drive 4C00 is installed |

**Note:** Remove the plastic switch cover to change the settings of the switches. After you have changed the settings of the switches, reinstall the switch cover over the switches.

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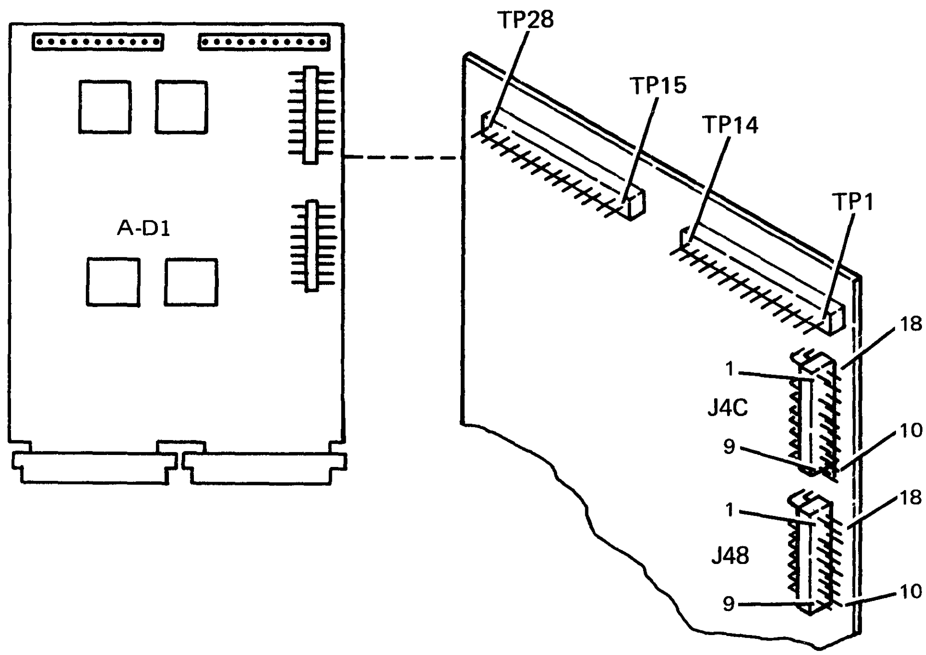
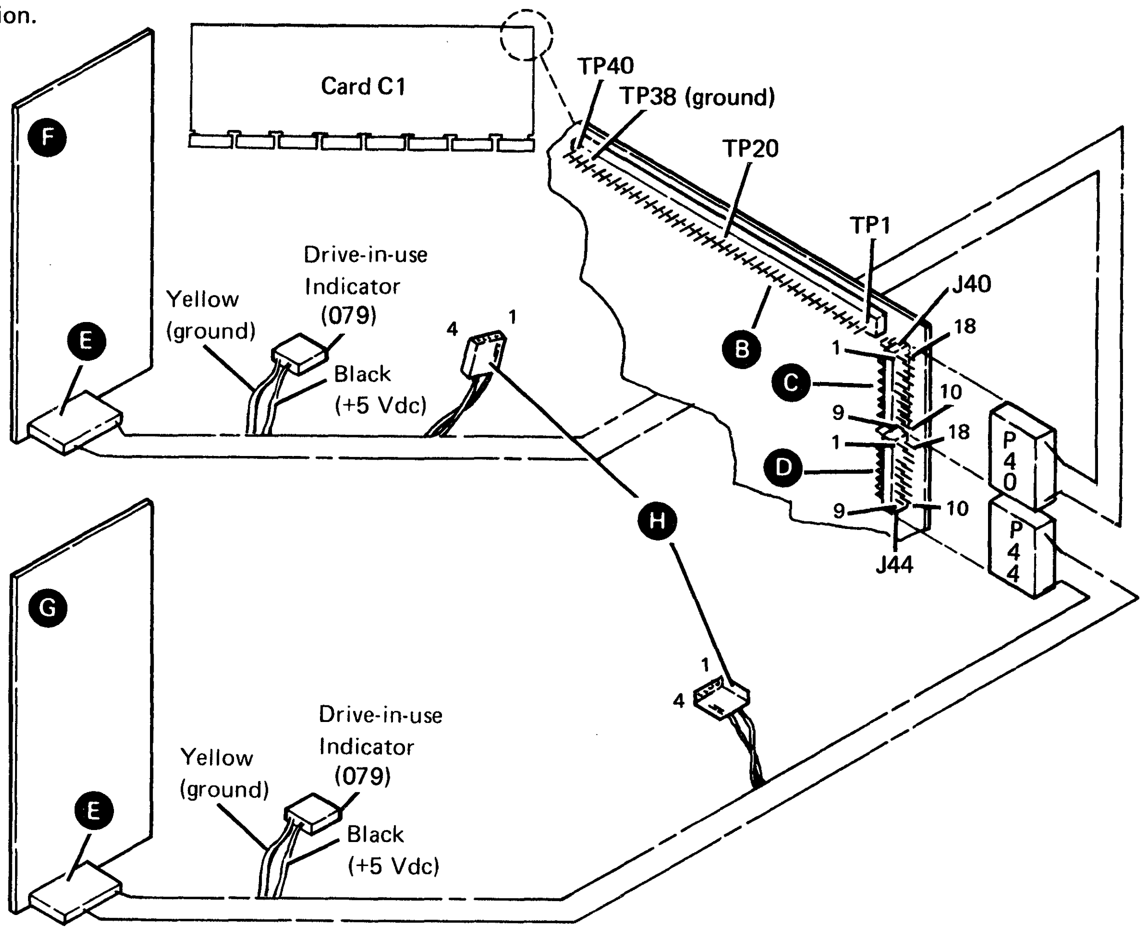
## 305 DISKETTE DRIVER/RECEIVER CARD (A-D1)

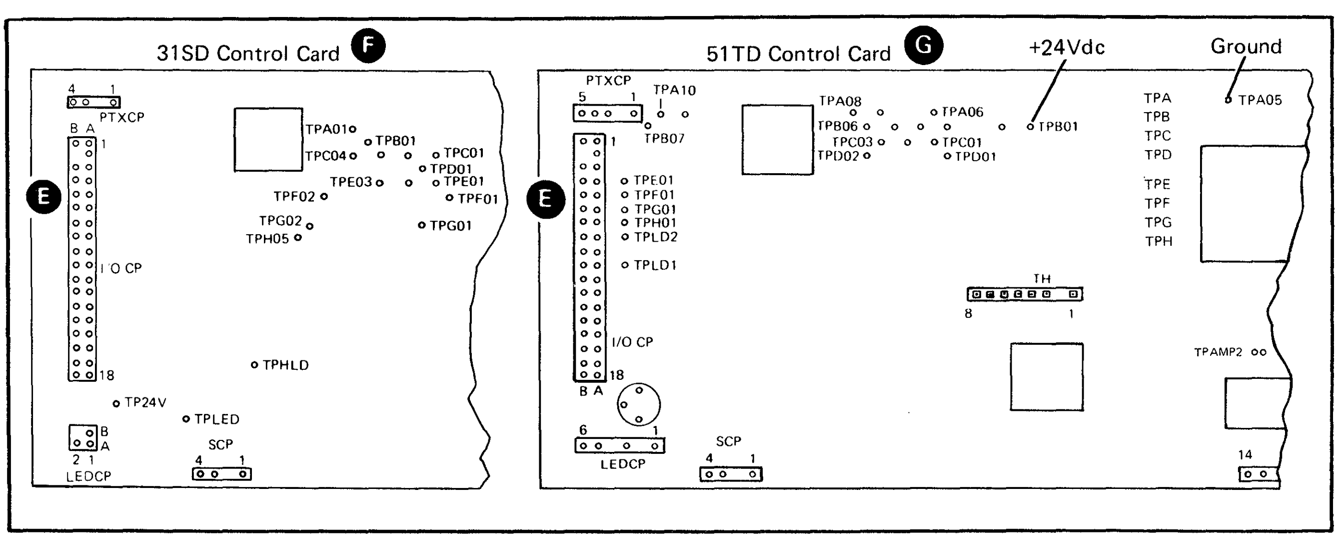
The diskette driver/receiver card figure shows the location of test pins and cable connectors. This card contains the logic to control two remote diskette drives (addresses 4800 and 4C00) located in the remote data station. See 303 for the MPU card used with these diskette drives.



## 313 IBM 5285 LOCAL DISKETTE DRIVES (ADDRESSES 4000 AND 4400)

This diagram and table shows the location of test pins and cable connectors, and calls out various probe points. The arrow indicates the logical direction of the signal.
D indicates that the signal is repowered and sent to the data station.

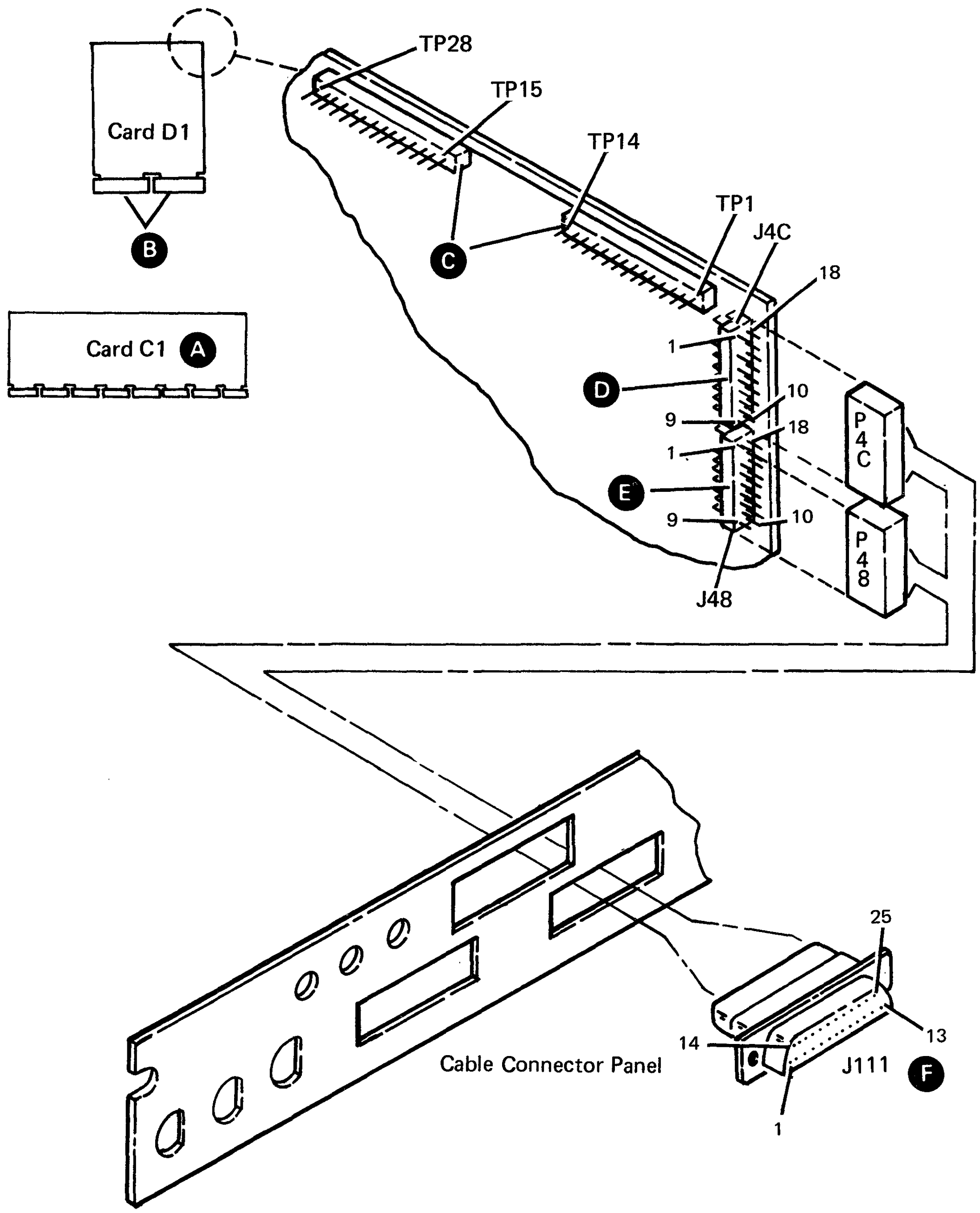


| | Card C1 (Diskette/Main MPU) | | | | | Diskette Drive Control Card | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Diskette | | Test Point | |
| Line Name | | Test Point B | C1J40 C | C1J44 D | Drive DC Connector H | I/O CP Pin E | 31SD F | 51TD G |
| +5 Vdc | | | | | 3 | B01 | TPA01 | TPA09 |
| -5 Vdc | | | | | 4 | A01 | TPB01 | TPC03 |
| +24 Vdc | | | | | 1 | B03 | TP24V | TPB01 |
| ground | | | | | 2 | A02 | TPC04 | TPA07 |
| +access 0 4000 | → | 05 | 07 | | | B10 | TPE01 | TPC01 |
| +access 1 4000 | → | 06 | 17 | | | B13 | TPC01 | TPD01 |
| +diskette 2 sense 4000 | ← | 18 | 12 | | | B05 | | TPF01 |
| +erase gate 4000 | D → | 20 | 06 | | | B09 | TPG02 | TPA06 |
| +file data 4000 | ← | 17 | 04 | | | B07 | TPG01 | TPH01 |
| -file in use 4000 | → | 30 | 11 | | | | | |
| ground 4000 | | 38 | 09 | | | A03 | TPF01 | TPA07 |
| ground 4000 | | 38 | 10 | | | A17 | TPC04 | TPA05 |
| +head engage 4000 | → | 15 | 15 | | | B15 | TPE02 | TPB05 |
| +index 4000 | ← | 03 | 01 | | | B04 | TPE03 | TPE01 |
| +inner tracks 4000 | → | 12 | 05 | | | B08 | TPD01 | TPC02 |
| +select head 1 4000 | → | 01 | 08 | | | B11 | | TPB03 |
| +switch filter 4000 | → | 13 | 14 | | | B16 | | TPD02 |
| +write data 4000 | → | 09 | 13 | | | B17 | TPC03 | TPB06 |
| +write/erase sense 4000 | ← | 16 | 03 | | | B06 | TPF02 | TPG01 |
| +write gate 4000 | D → | 21 | 16 | | | B14 | TPH05 | TPB04 |
| +access 0 4400 | → | 04 | | 07 | | B10 | TPE01 | TPC01 |
| +access 1 4400 | → | 08 | | 17 | | B13 | TPC01 | TPD01 |
| +diskette 2 sense 4400 | ← | 28 | | 12 | | B05 | | TPF01 |
| +erase gate 4400 | D → | 22 | | 06 | | B09 | TPG02 | TPA06 |
| +file gate 4400 | ← | 27 | | 04 | | B07 | TPG01 | TPH01 |
| -file in use 4400 | → | 31 | | 11 | | | | |
| ground 4400 | | 38 | | 09 | | A03 | TPF01 | TPA07 |
| ground 4400 | | 38 | | 10 | | A17 | TPC04 | TPA05 |
| +head engage 4400 | → | 07 | | 15 | | B15 | TPE02 | TPB05 |
| +index 4400 | ← | 19 | | 01 | | B04 | TPE03 | TPE01 |
| +inner tracks 4400 | → | 11 | | 05 | | B08 | TPD01 | TPC02 |
| +select head 1 4400 | → | 02 | | 08 | | B11 | | TPB03 |
| +switch filter 4400 | → | 14 | | 14 | | B16 | | TPD02 |
| +write data 4400 | → | 10 | | 13 | | B17 | TPC03 | TPB06 |
| +write/erase sense 4400 | ← | 26 | | 03 | | B06 | TPF02 | TPG01 |
| +write gate 4400 | D → | 25 | | 16 | | B14 | TPH05 | TPB04 |

### 319 IBM 5285 TO REMOTE DISKETTE DRIVES (ADDRESSES 4800 AND 4C00)

This diagram shows the location of test pins and cable connectors, and calls out various probe points. The arrow (→) indicates the logical direction of the signal. D indicates that the signal is repowered and sent to the data station. R indicates that the signal is received from the data station and repowered.



## 319 IBM 5285 TO REMOTE DISKETTE DRIVES (ADDRESSES 4800 AND 4C00) (continued)

| | Card C1 (Diskette Main MPU) | Card D1 (Diskette Driver/Receiver) | | | | | Cable Connector Panel | |
|---|---|---|---|---|---|---|---|---|
| Line Name | Logic Board Pin A | Logic Board Pin B | | Test Point C | Conn D1J48 E | Conn D1J4C D | J111 F | Line Name |
| -inner tracks* | C1B11 | D1B13 | D → | 26 | 05 | | 05 | +inner tracks* |
| -select head 1* | C1B10 | D1B10 | D → | 23 | 08 | | 08 | +select head 1* |
| -switch filter* | C1D11 | D1D11 | D → | 21 | 14 | | 18 | +switch filter* |
| +write trigger* | C1D10 | D1D10 | D → | 22 | 13 | | 19 | -write trigger* |
| +access 0 4800 | C1D06 | D1D06 | D → | 24 | 07 | | 07 | -access 0 4800 |
| +access 1 4800 | C1B07 | D1B07 | D → | 27 | 17 | | 15 | -access 1 4800 |
| +diskette 2 sense 4800 | C2D06 | D2B04 | R ← | 17 | 12 | | 02 | -diskette 2 sense 4800 |
| +erase gate 4800 | C1B03 | D1B03 | → | 25 | 06 | | 06 | +erase gate 4800 |
| +file data 4800 | C2B06 | D2D05 | R ← | 15 | 04 | | 04 | -file data 4800 |
| -file in use 4800 | C1B08 | D2D09 | → | 28 | 11 | | 14 | -file in use 4800 |
| ground | C1D08 | D1D08 | | | 09 | | 25 | ground |
| ground | C2D08 | D2D08 | | | 10 | | 25 | ground |
| +head engage 4800 | C1D09 | D1D09 | D → | 20 | 15 | | 17 | +head engage 4800 |
| +index 4800 | C1D04 | D1D13 | R ← | 18 | 01 | | 01 | -index 4800 |
| +write/erase sense 4800 | C2B08 | D2B10 | R ← | 16 | 03 | | 03 | -write/erase sense 4800 |
| +write gate 4800 | C1B05 | D1B05 | → | 19 | 16 | | 16 | +write gate 4800 |
| +access 0 4C00 | C1D07 | D1D07 | D → | 13 | | 07 | 20 | -access 0 4C00 |
| +access 1 4C00 | C1D05 | D1D05 | D → | 05 | | 17 | 22 | -access 1 4C00 |
| +diskette 2 sense 4C00 | C2B03 | D2B03 | R ← | 01 | | 12 | 10 | -diskette 2 sense 4C00 |
| +erase gate 4C00 | C1B02 | D1B02 | → | 12 | | 06 | 13 | +erase gate 4C00 |
| +file data 4C00 | C2D07 | D2B05 | R ← | 10 | | 04 | 12 | -file data 4C00 |
| -file in use 4C00 | C2D05 | D2B09 | → | 03 | | 11 | 21 | -file in use 4C00 |
| ground | C1D08 | D1D08 | | | | 09 | 25 | ground |
| ground | C2D08 | D2D08 | | | | 10 | 25 | ground |
| +head engage 4C00 | C1B09 | D1B08 | D → | 07 | | 15 | 24 | +head engage 4C00 |
| +index 4C00 | C1D02 | D1D02 | R ← | 04 | | 01 | 09 | -index 4C00 |
| +write/erase sense 4C00 | C2B07 | D2B07 | R ← | 09 | | 03 | 11 | -write/erase sense 4C00 |
| +write gate 4C00 | C1B04 | D1D04 | → | 06 | | 16 | 23 | +write gate 4C00 |

*These lines are common to drives 4800 and 4C00.

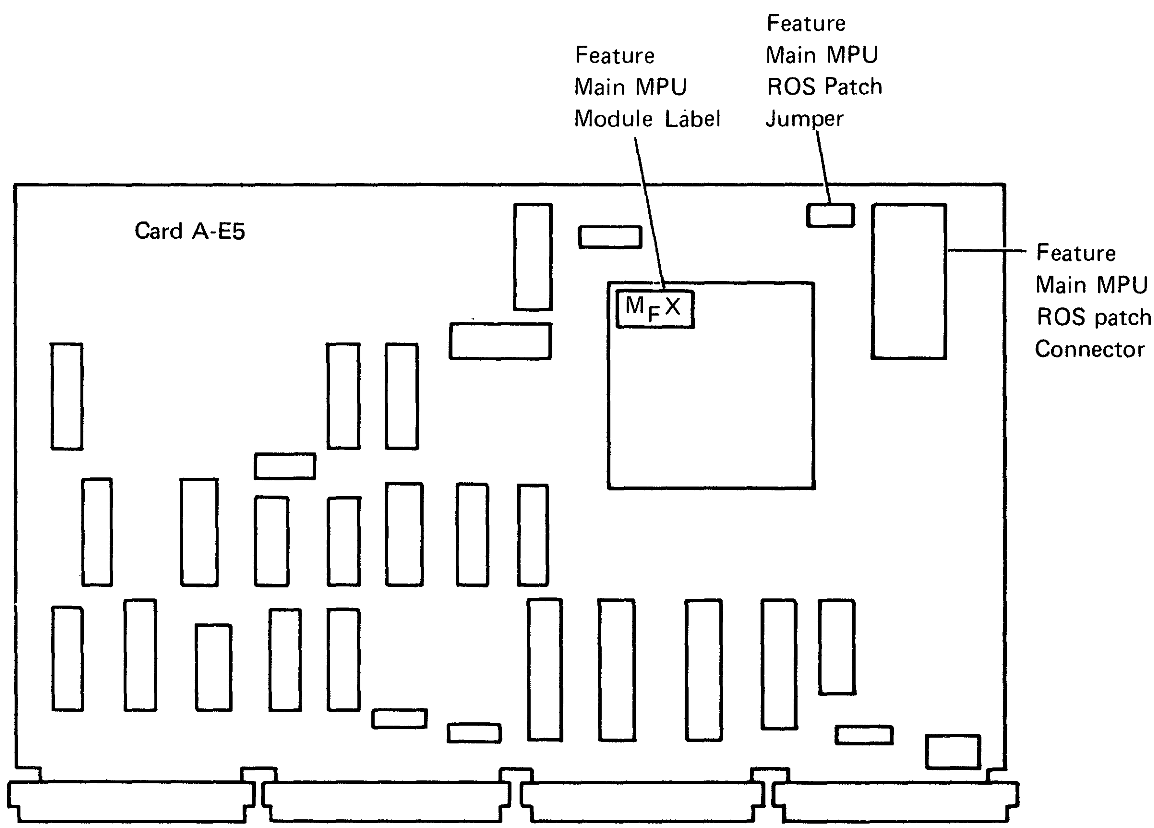
## 402 FEATURE MAIN MPU CARD (A-E5)

The feature main MPU card contains a second main MPU to be used in addition to the base main MPU located on the diskette/main MPU card (303). The following figure shows the location of the components on the card.

If you install a new feature main MPU card, see 565 for information about the ROS patch jumper and ROS patch cards.

If you remove the feature main MPU card, install jumpers 2, 4, and 5 on the diskette/main MPU card (303) and install the following jumpers on the logic board:

E7D09 to E7D10
E7B11 to E7B12
E7D12 to E7D13



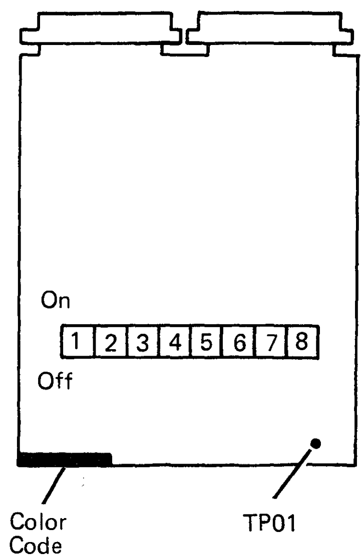
## 403 FEATURE MAIN STORAGE CARD (A-B5)

The diskette/main MPU card (303) contains 32 K bytes of main storage. Additional storage may be located on optional 16 K byte or 32 K byte main storage cards. This optional storage is added in card location B5.

The storage capacity of each feature main storage card is indicated by a color marked on the end of the card. The blue code indicates a 16K byte card and the orange code indicates a 32K byte card.

The switches on the storage card must be set to indicate the starting address of the storage on that card. Because the diskette/main MPU card contains the first 32K bytes of main storage, switch 5 (32K byte) must be set to the On position.

All other switches must be set to the Off position.




**Note:** Remove the plastic switch cover to change the settings of the switches. After you have changed the settings of the switches, reinstall the switch cover over the switches.

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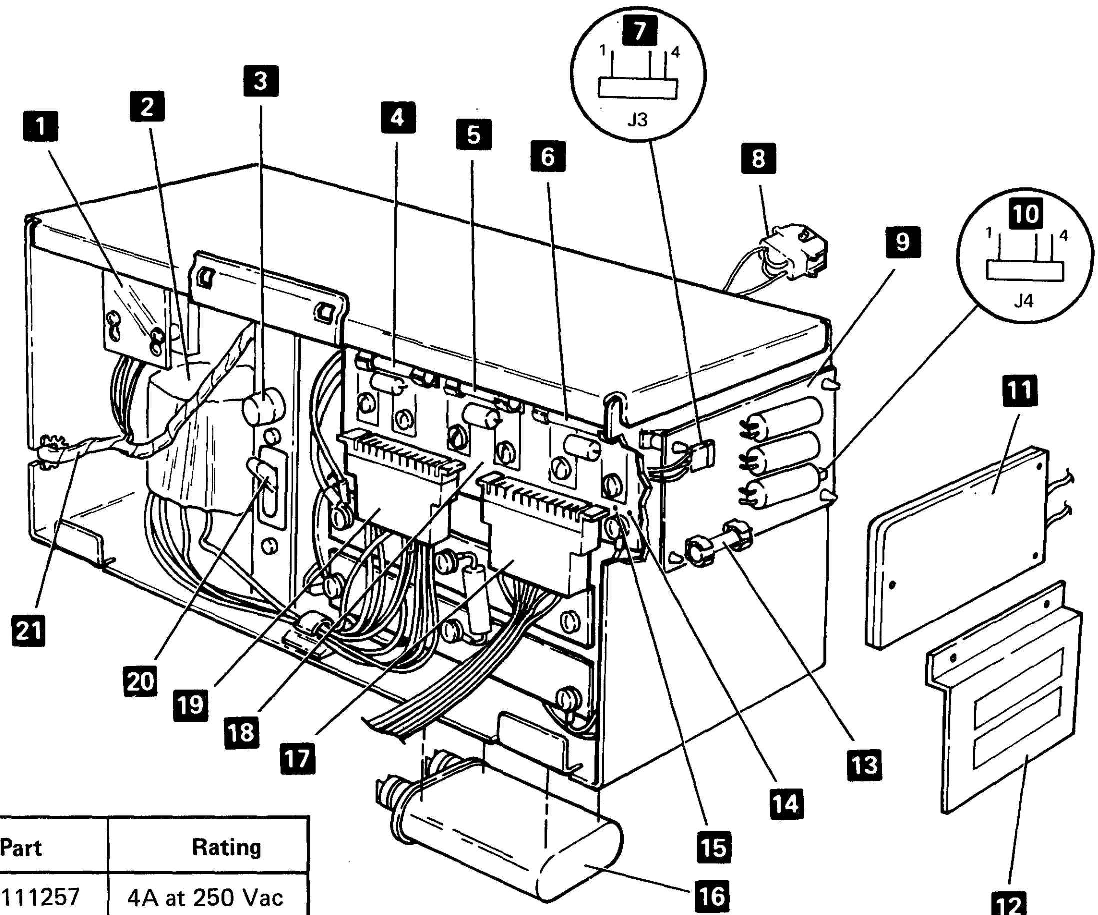
## Power Supply

### 451 LOCATIONS

**DANGER**
Voltage is present at the power supply when the power cord is connected to the service outlet.

1 Terminal block TB1
2 Transformer T1
3 Fuse F4
4 Fuse F3
5 Fuse F2
6 Fuse F1
7 Connectors J3/P3
8 Connector J5/P5 (display AC)
9 Communications feature board (Not installed when World Trade line plate feature is installed)
10 Connector J4/P4
11 Line plate (World Trade)
12 Surge protector (World Trade)
13 Fuse F6
14 Logic probe connector E2 (+5 Vdc)
15 Logic probe connector E3 (ground)
16 Resonant capacitor (located under the power supply)
17 Connector J2/P2
18 Printed circuit board
19 Connector J1/P1
20 Circuit breaker CB1
21 AC distribution cable

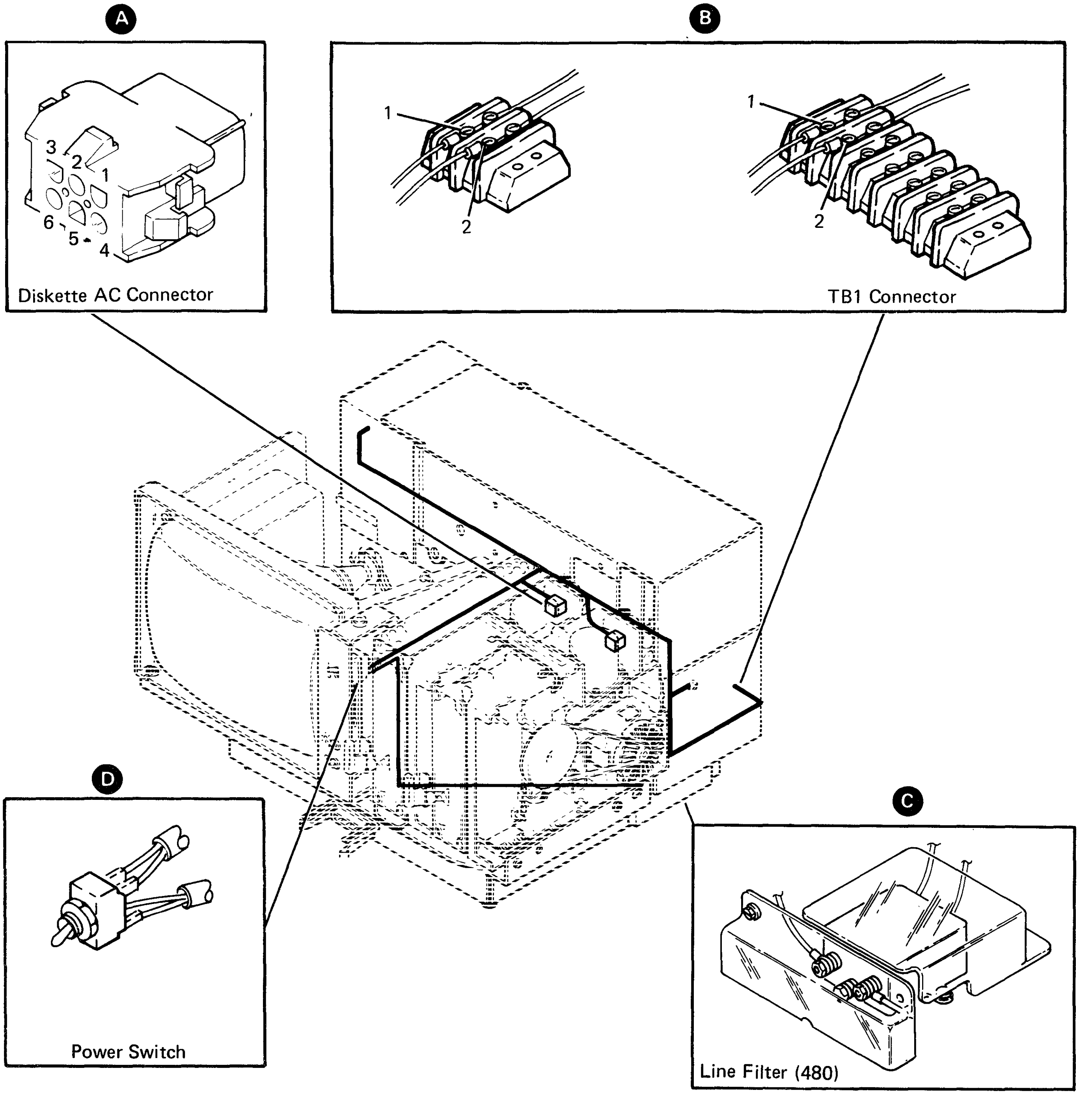


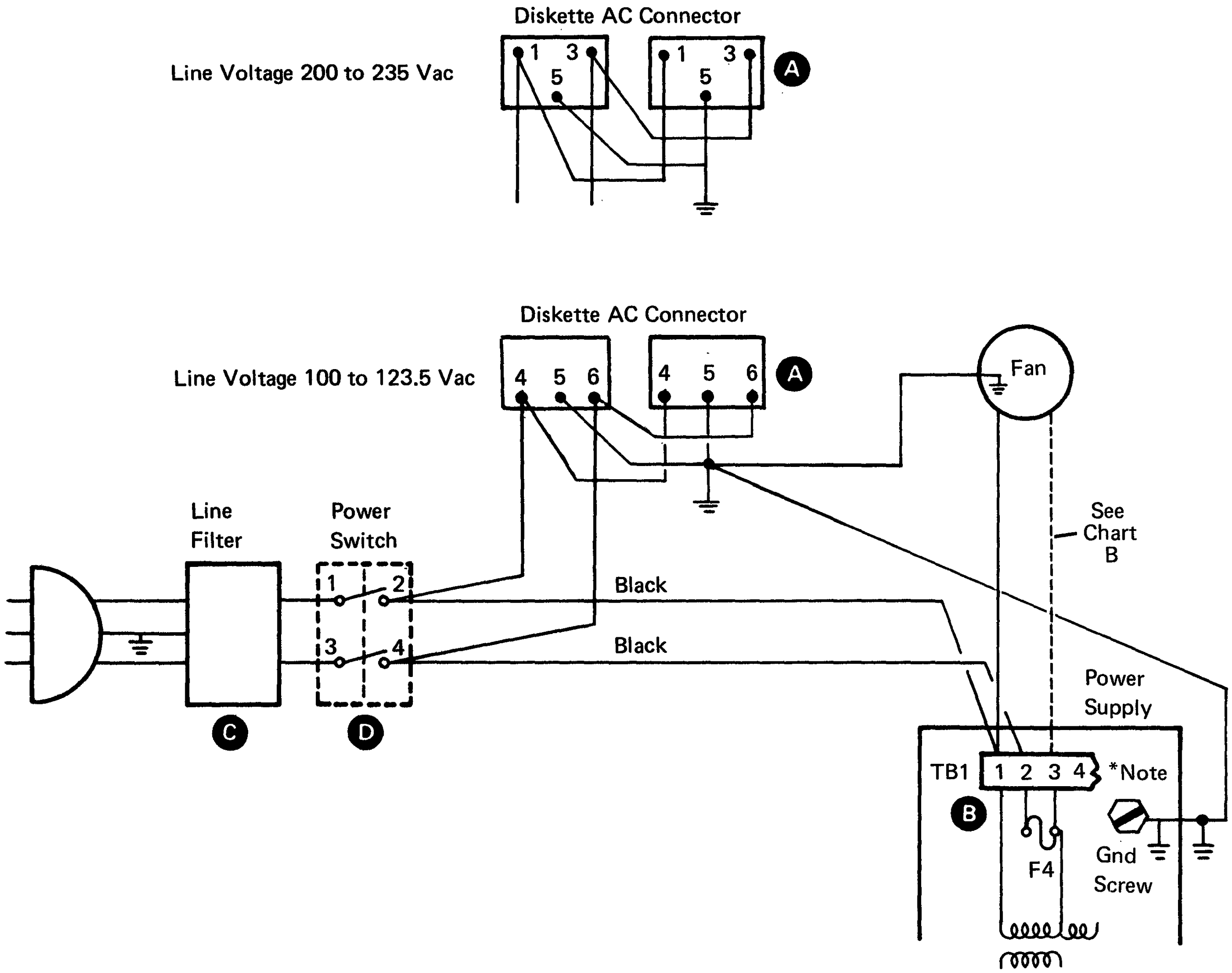

| Fuse | Part | Rating |
|---|---|---|
| F1 | 111257 | 4A at 250 Vac |
| F2 | 855252 | 3A at 250 Vac |
| F3 | 111257 | 4A at 250 Vac |
| F4 | 512137 | 5A at 250 Vac |
| F4 | 2456618 | 3A at 250 Vac |
| F6 | 855253 | 1A at 250 Vac |

## 453 AC DISTRIBUTION

**DANGER**
Voltage is present in the data station when the power cord is connected to the service outlet.

The following figure shows the distribution and the connection points of the AC voltage in the IBM 5285.





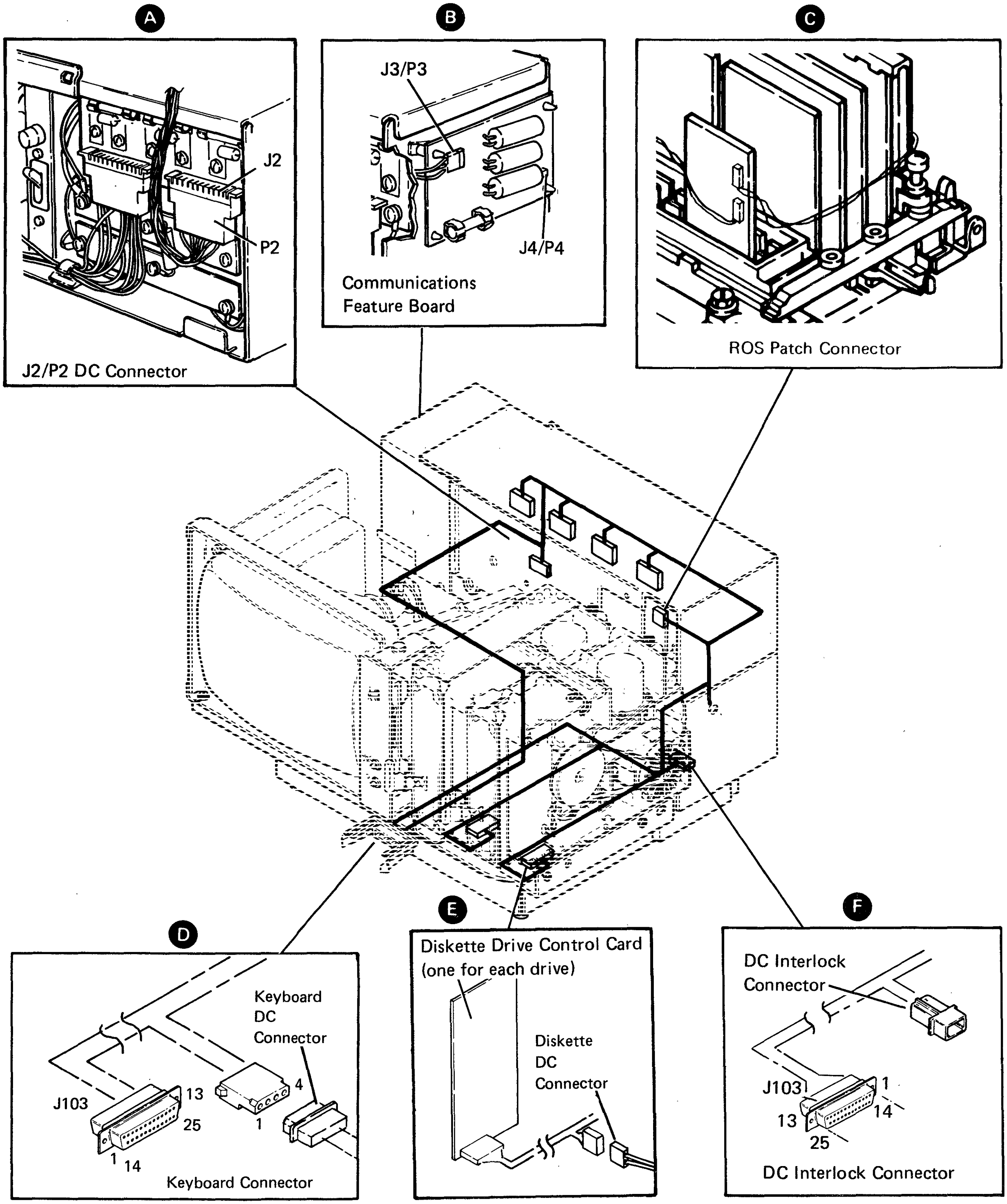

*See MIM 457 for Power Supply TB Connections.

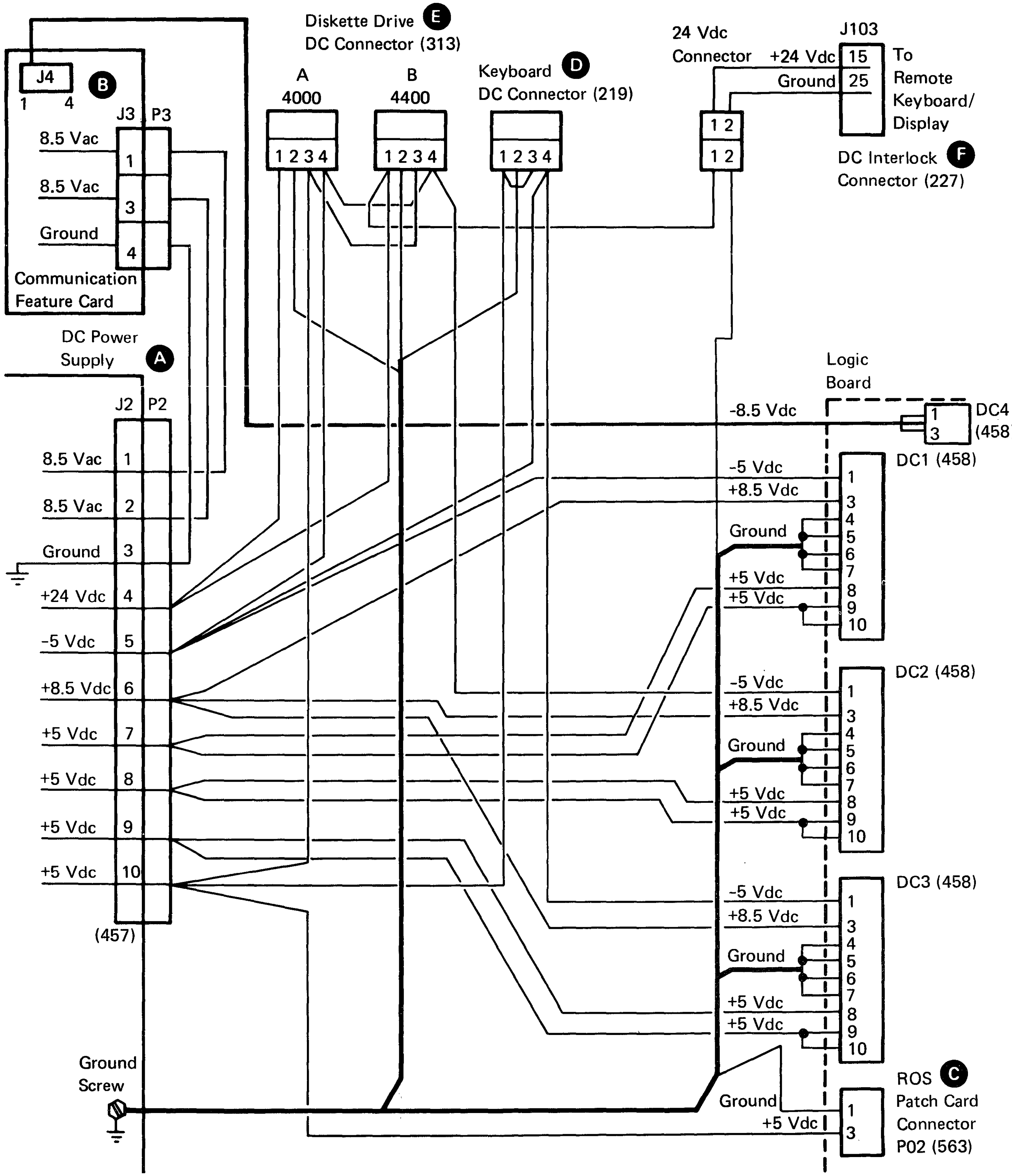
**Chart B**

| Fan AC Connections | |
|---|---|
| United States and Canada 60 Hz | World Trade 50 and 60 Hz |
| TB1-3 | TB1-4 |

## 455 DC DISTRIBUTION

The following figure shows the distribution and the connection points of the DC voltages in the IBM 5285.





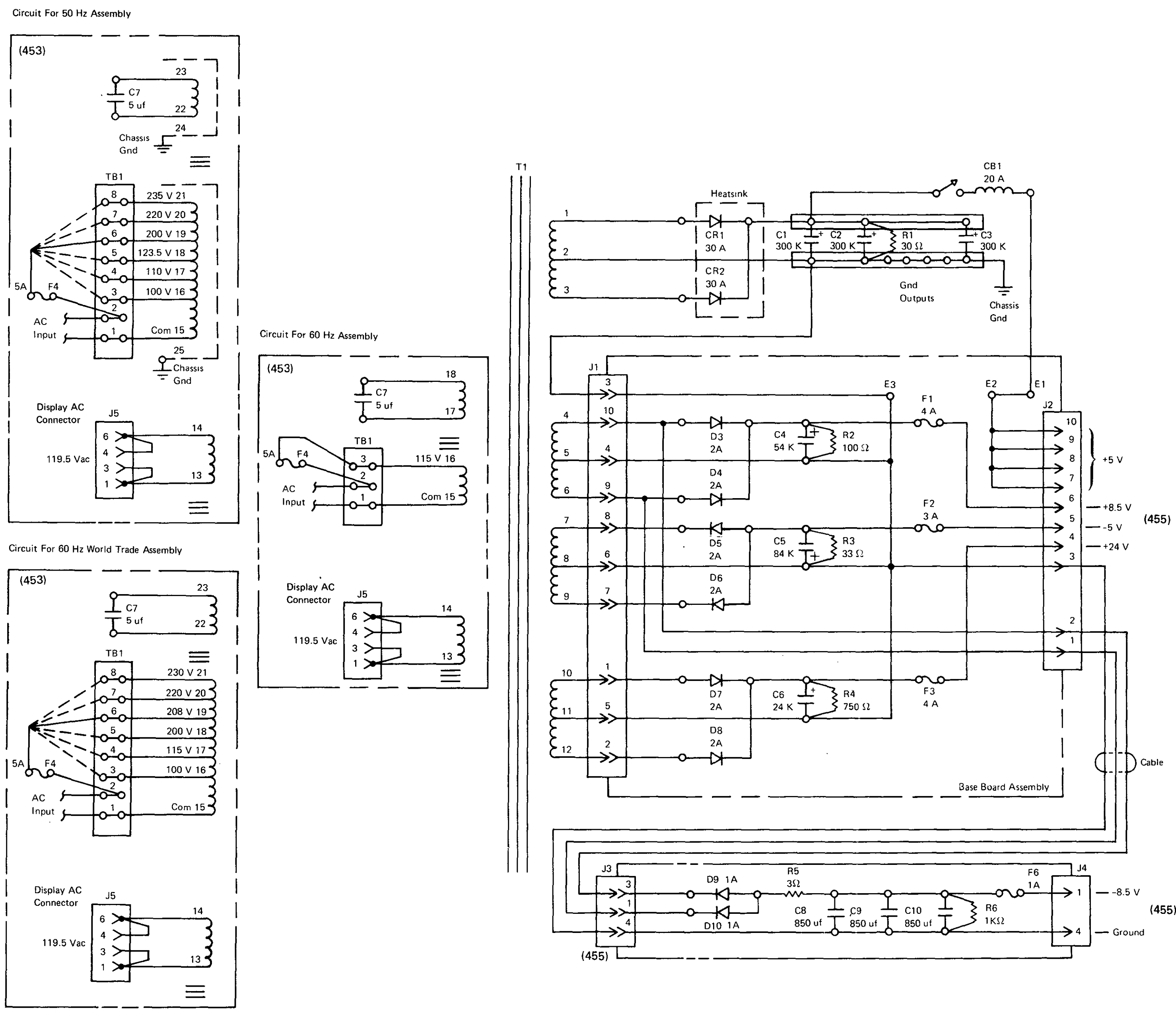
Diskette Drive E
DC Connector (313)
A
4000
B
4400
1 2 3 4
1 2 3 4
Keyboard D
DC Connector (219)
1 2 3 4
24 Vdc
Connector
+24 Vdc
Ground
J103
15
25
To
Remote
Keyboard/
Display
1 2
1 2
DC Interlock F
Connector (227)
J4
B
1
4
J3
P3
8.5 Vac
1
8.5 Vac
3
Ground
4
Communication
Feature Card
DC Power
Supply A
J2
P2
8.5 Vac 1
8.5 Vac 2
Ground 3
+24 Vdc 4
-5 Vdc 5
+8.5 Vdc 6
+5 Vdc 7
+5 Vdc 8
+5 Vdc 9
+5 Vdc 10
(457)
Logic
Board
-8.5 Vdc
1
3
DC4
(458)
DC1 (458)
-5 Vdc
+8.5 Vdc
Ground
+5 Vdc
+5 Vdc
1
3
4
5
6
7
8
9
10
DC2 (458)
-5 Vdc
+8.5 Vdc
Ground
+5 Vdc
+5 Vdc
1
3
4
5
6
7
8
9
10
DC3 (458)
-5 Vdc
+8.5 Vdc
Ground
+5 Vdc
+5 Vdc
1
3
4
5
6
7
8
9
10
Ground
Screw
Ground
+5 Vdc
1
3
ROS C
Patch Card
Connector
P02 (563)

## 457 POWER SUPPLY WIRING DIAGRAM

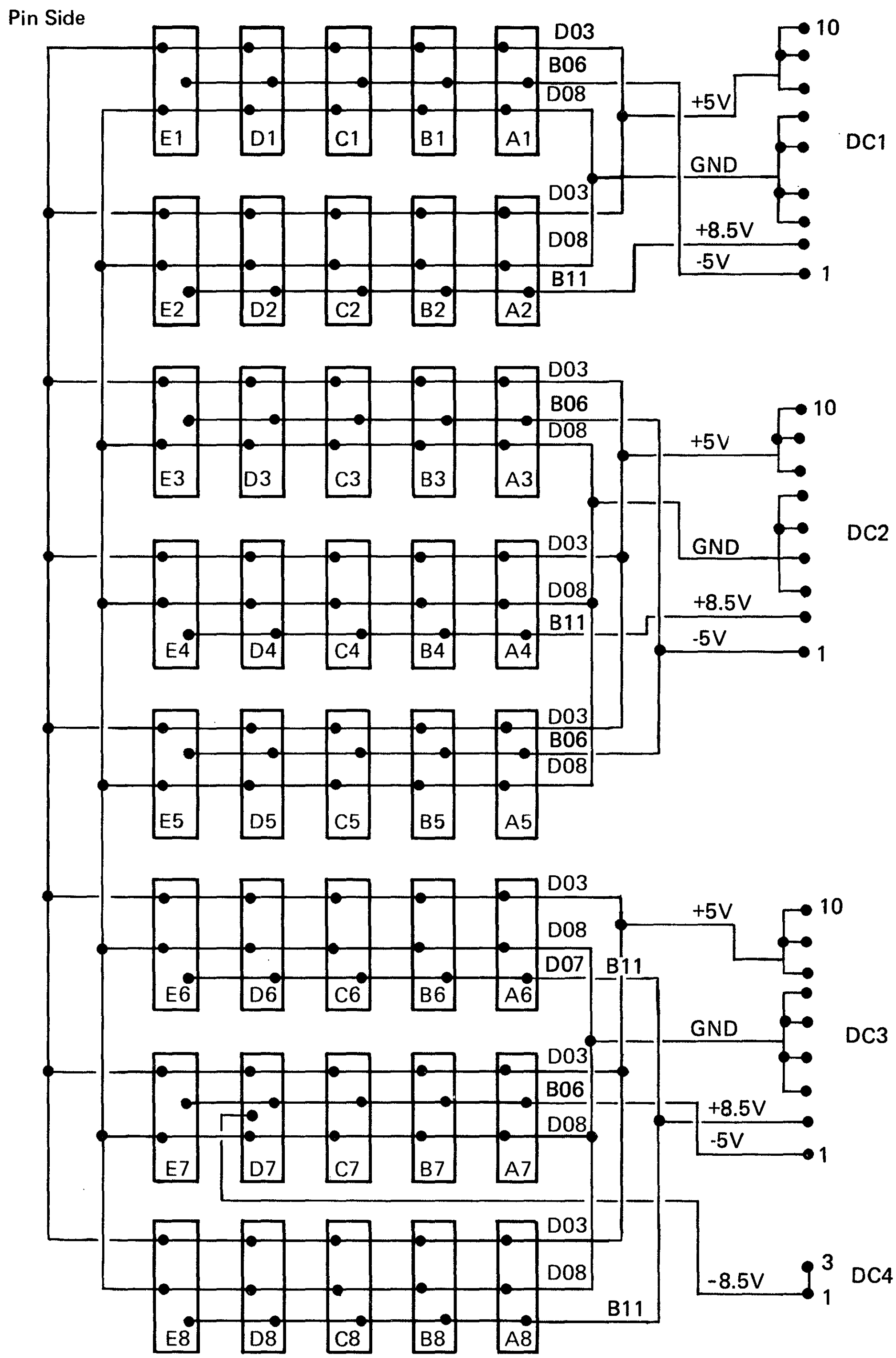
The following figure shows the wiring diagram for the IBM 5285 power supply.

**DANGER**
Some power supply components become hot with use.

**DANGER**
Voltage is present at the power supply when the power cord is connected to the service outlet.



Circuit For 50 Hz Assembly
(453)
C7
5 uf
Chassis Gnd
TB1
235 V 21
220 V 20
200 V 19
123.5 V 18
110 V 17
100 V 16
Com 15
5A F4
AC Input
Display AC Connector
J5
119.5 Vac
Circuit For 60 Hz World Trade Assembly
230 V 21
220 V 20
208 V 19
200 V 18
115 V 17
100 V 16
Circuit For 60 Hz Assembly
115 V 16
T1
Heatsink
CR1 30 A
CR2 30 A
C1 300 K
C2 300 K
R1 30 Ω
C3 300 K
CB1 20 A
Gnd Outputs
J1
E3
E2
E1
J2
F1 4 A
F2 3 A
F3 4 A
D3 2A
D4 2A
D5 2A
D6 2A
D7 2A
D8 2A
C4 54 K
R2 100 Ω
C5 84 K
R3 33 Ω
C6 24 K
R4 750 Ω
+5 V
+8.5 V
-5 V
+24 V
(455)
Cable
Base Board Assembly
J3
D9 1A
D10 1A
R5 3Ω
C8 850 uf
C9 850 uf
C10 850 uf
R6 1KΩ
F6 1A
J4
-8.5 V
Ground


Pin Side
D03
B06
D08
E1
D1
C1
B1
A1
10
+5V
DC1
GND
1
+8.5V
-5V
B11
E2
D2
C2
B2
A2
E3
D3
C3
B3
A3
DC2
E4
D4
C4
B4
A4
E5
D5
C5
B5
A5
D07
E6
D6
C6
B6
A6
DC3
E7
D7
C7
B7
A7
-8.5V
3
DC4
E8
D8
C8
B8
A8

## 461 VOLTAGE LEVEL CHECKS

**DANGER**
Line voltage is present at the power supply when the power cord is connected to the service outlet.

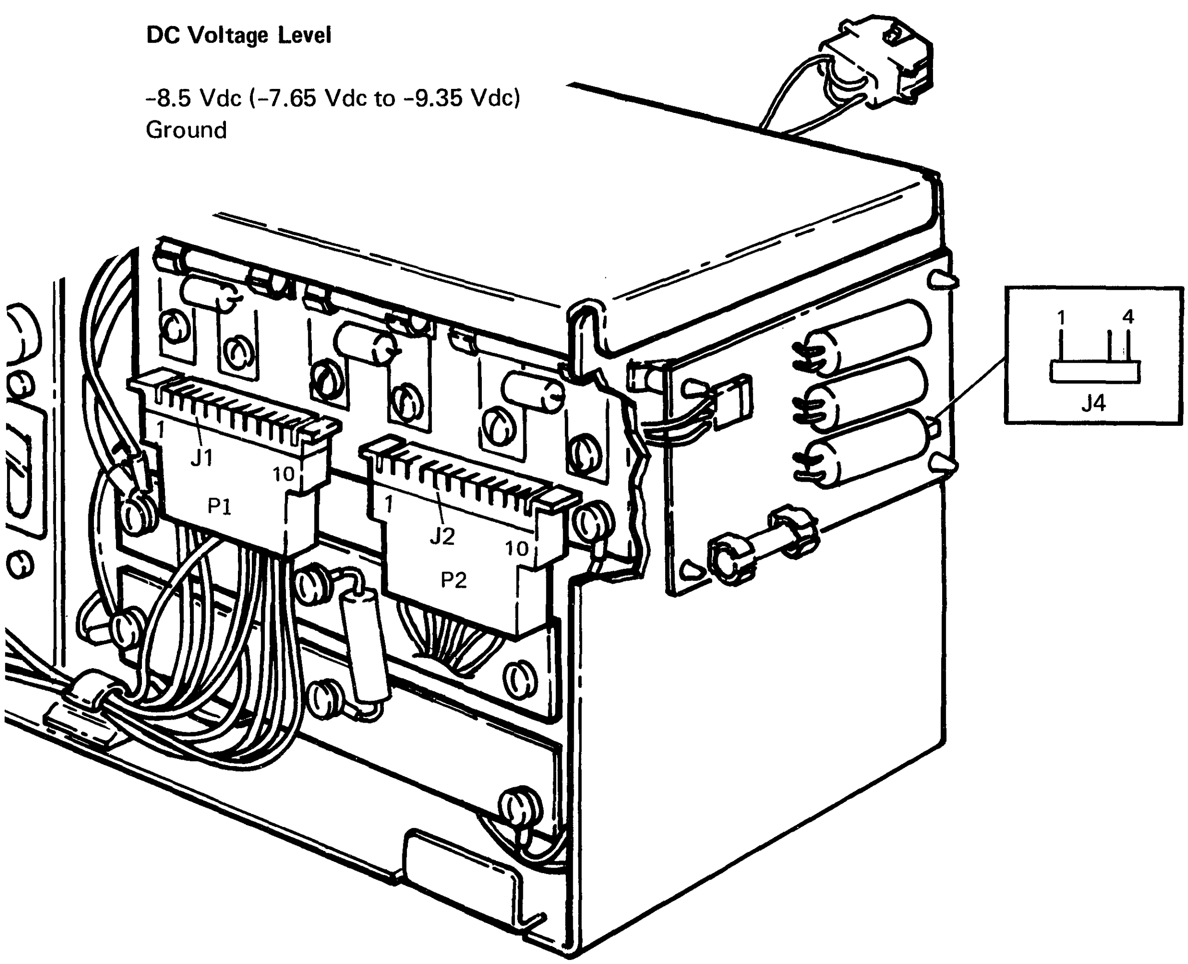
**DANGER**
Some power supply components become hot with use.

The voltage levels can be checked on the power supply at cable connector J2.

| J2 Pin | DC Voltage Level |
|---|---|
| 3 | Ground |
| 4 | +24 Vdc (+21.6 Vdc to +26.4 Vdc) |
| 5 | -5 Vdc (-4.5 Vdc to -5.5 Vdc) |
| 6 | +8.5 Vdc (+7.65 Vdc to +9.35 Vdc) |
| 7 through 10 | +5 Vdc (+4.5 Vdc to +5.5 Vdc) |

If the communications feature board assembly is installed, the communications voltage levels can be checked on the power supply at cable connector J4.

| J4 Pin | DC Voltage Level |
|---|---|
| 1 | -8.5 Vdc (-7.65 Vdc to -9.35 Vdc) |
| 4 | Ground |



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## 463 RIPPLE VOLTAGE LEVEL CHECK

The following tools and test equipment are used to measure the AC ripple voltage on a DC voltage line:

- Multimeter
- dB adapter
- Connector assembly dual plug and holder

**CAUTION**
The maximum rated circuit-to-ground voltage of the dB adapter is 42.4 volts. 'The dB adapter could be damaged if this voltage is exceeded.

**DANGER**
Some power supply components become hot with use.

1. Set the range switch on the multimeter to the 0.6 milliampere position and carefully attach the dB adapter to the top of the multimeter switch panel.

2. Connect the dB adapter to the input and ground jacks.

3. Verify that the dB adapter battery is good by setting the range switch on the dB adapter to the Batt Test position. If the battery is good, the Battery Test indicator will turn on.

4. Set the slide switch on the dB adapter to the 600 ohms position.

5. Set the range switch on the dB adapter to the 0 position.

6. Attach the dB meter adapter leads to the DC voltage to be measured and set the data station Power switch to the On position.

7. Read the voltage on the 0-60 AC scale on the multimeter.

8. If the reading is more than 1.0 volts, divide the reading by 10. The result you get is the AC ripple voltage level. If the reading is less than 1.0 volt, proceed to step 9.

9. Set the range switch on the dB adapter to the -20 position.

10. Read the voltage on the 0-60 AC scale on the multimeter.

11. Divide the reading by 100. The answer is the AC ripple voltage level.

The following table shows the maximum permitted ripple voltage:

| Supply Voltage | Ripple Voltage |
|---|---|
| +5 Vdc | 0.15 Vac |
| -5 Vdc | 0.15 Vac |
| +8.5 Vdc | 0.25 Vac |
| -8.5 Vdc | 0.25 Vac |
| +24 Vdc | 0.72 Vac |

## 470 POWER SUPPLY REMOVAL AND REPLACEMENT

**DANGER**
Voltage is present at the power supply when the power cord is connected to the service outlet.

**DANGER**
Some power supply components become hot with use.

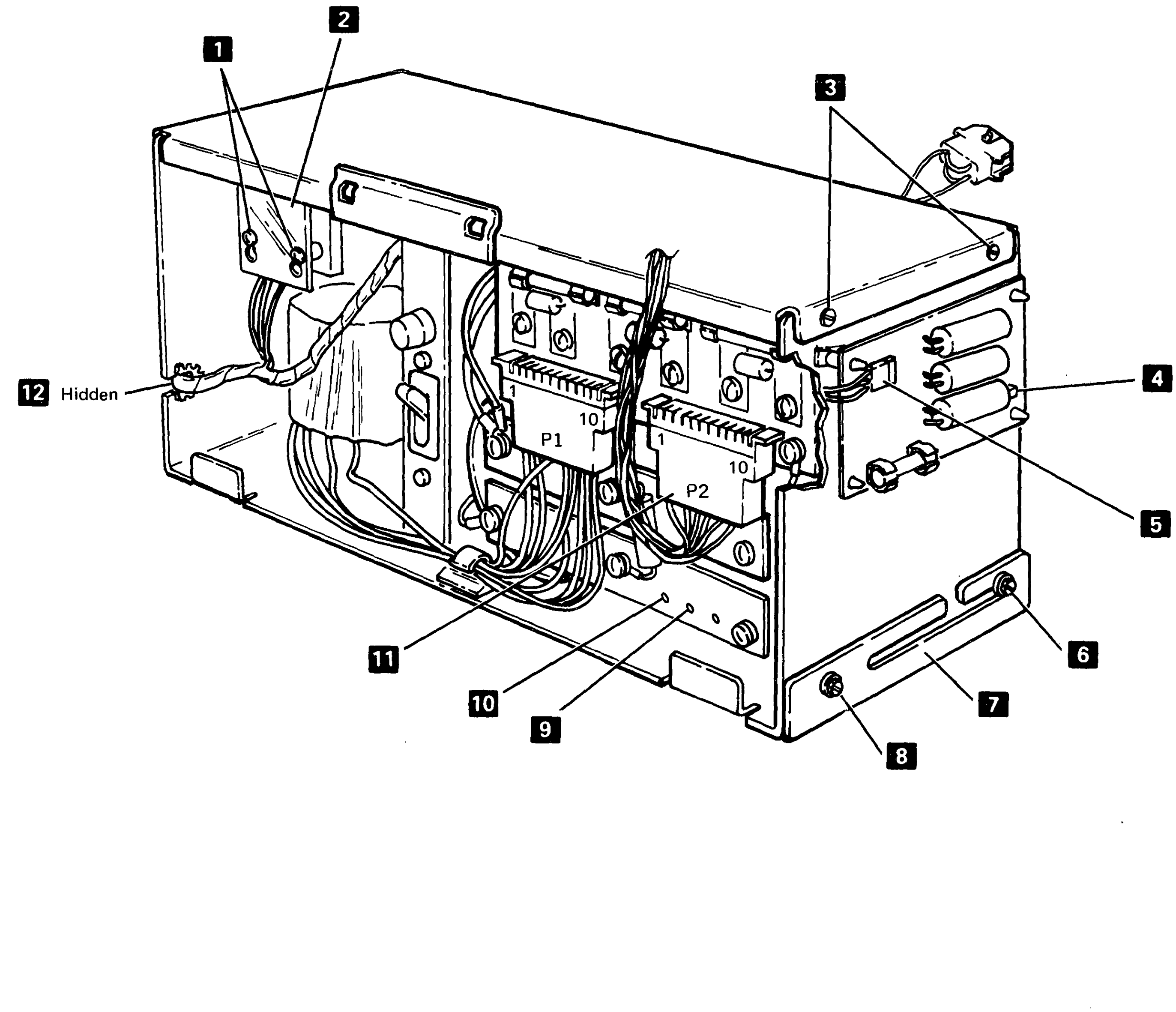
**Removal**

1. Power off.
2. Disconnect the power cord from the service outlet.
3. Remove the data station covers (031).
4. Disconnect P2 **11**.
5. If the communications feature is installed, disconnect P3 **4**.
6. Remove the two ground wire screws **9** and **10**.
7. Loosen the two screws **1** on the TB1 cover **2**; then remove the cover and the three bottom wires on TB1.
8. Remove the four screws **3** (two on each end of the power supply).
9. Remove the logic board and fan (521).
10. Remove screw **12**; then remove the ground wire.
11. Remove the two screws **8** (one on each end of the power supply).
12. Loosen the two screws **6** (one on each end of the power supply).
13. Slide the power supply away from the display assembly until the screw **6** can be lifted from the bracket **7**.
14. Lift the power supply from the data station base.

**Replacement**

For replacement of the power supply, reverse the steps in the removal procedure.

**Note:** If a new power supply is to be installed, remove the communications feature card, the line plate, and the surge protector from the old power supply and reinstall them on the new power supply (471). These are features and might not be present on the power supply.


1
2
3
4
5
6
7
8
9
10
11
12 Hidden
P1
P2
1
10
1
10

## 471 COMMUNICATIONS FEATURE POWER SUPPLY CARD REMOVAL AND REPLACEMENT

**DANGER**
Voltage is present at the power supply when the power cord is connected to the service outlet.

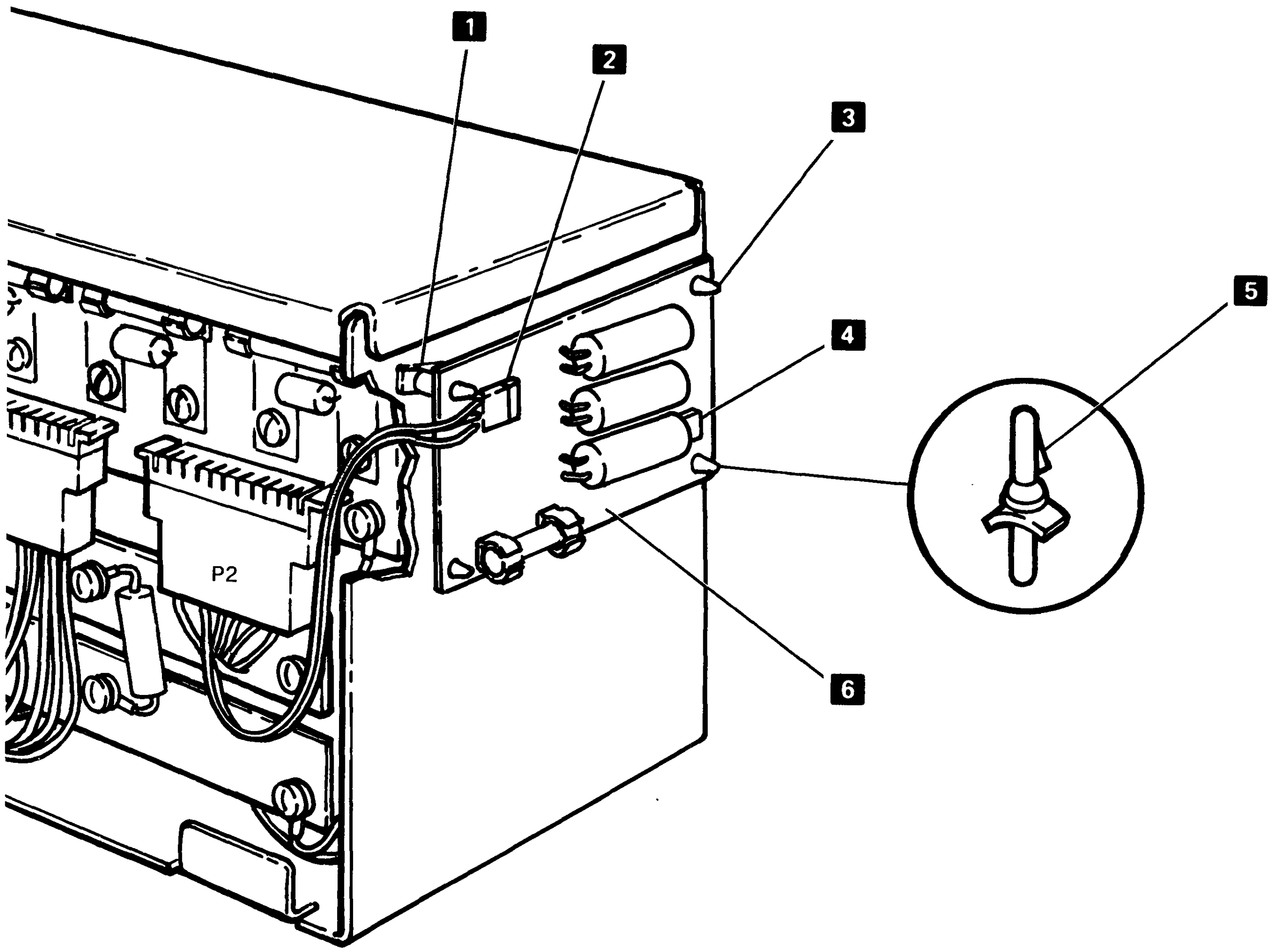
**DANGER**
Some power supply components become hot with use.

**Removal**

1. Power off.
2. Disconnect the power cord from the service outlet.
3. Remove the data station covers (031).
4. Disconnect P3 **2** and P4 **4**.
5. Press the tabs **5** on the mounting pins **3** one at a time while pulling on the card **6**.

**Replacement**

For replacement of the communications feature power supply card, reverse the steps in the removal procedure.



## 474 BOARD ASSEMBLY REMOVAL AND REPLACEMENT

**DANGER**
Line voltage is present at the power supply when the power cord is connected to the service outlet.

---

**DANGER**
Some power supply components become hot with use.

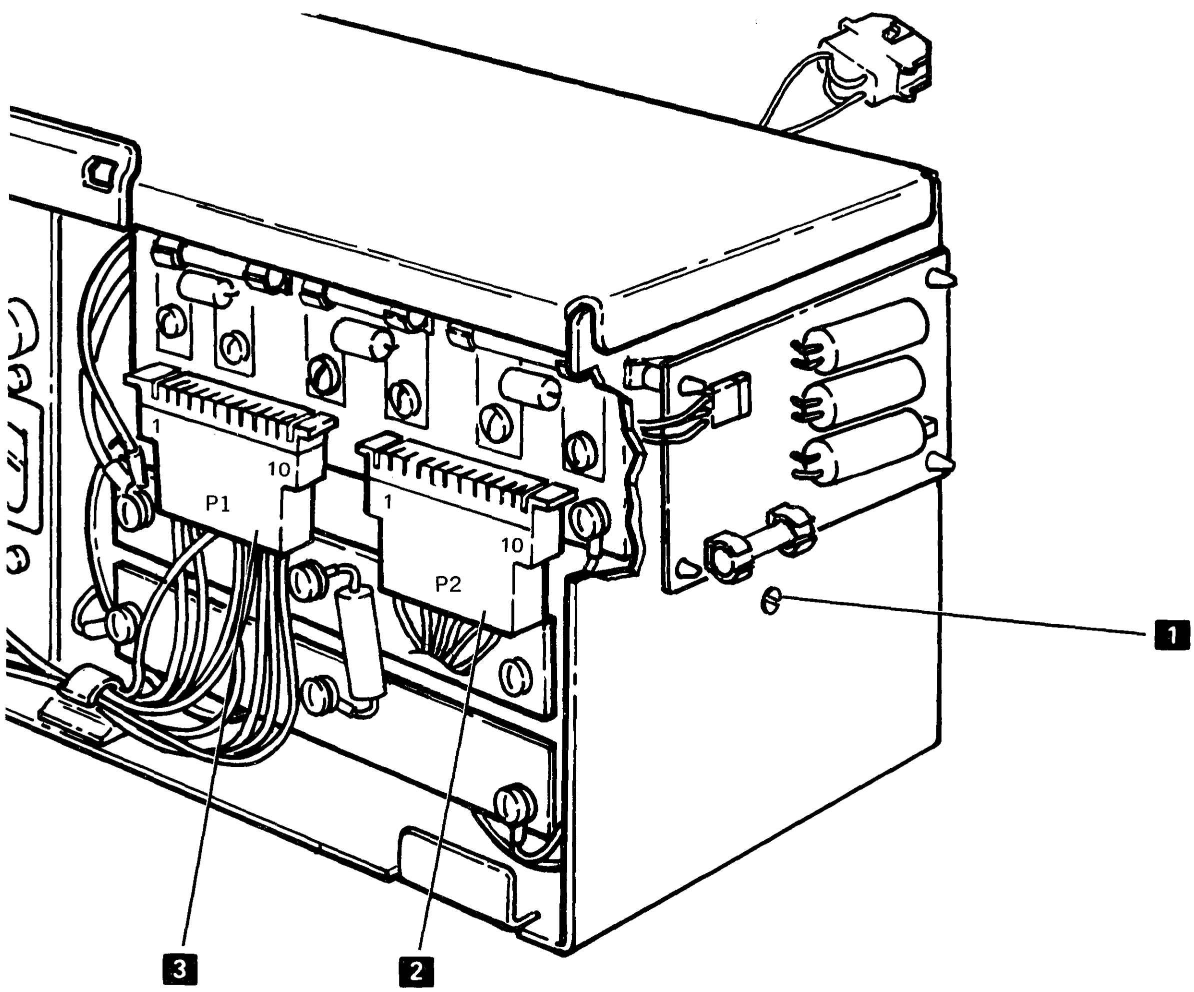
---

**Removal**

1. Power off.
2. Disconnect the power cord from the service outlet.
3. Remove the data station cover (031).
4. Disconnect power supply connectors P1 **3** and P2 **2**.
5. Loosen the screw **1**, which tightens the capacitor strap.
6. Remove the board and capacitor assembly from the power supply.

**Replacement**

For replacement of the board assembly, reverse the steps in the removal procedure.



## 476 RESONANT CAPACITOR C7 REMOVAL AND REPLACEMENT

**DANGER**
550 volts is present at the resonant capacitor (C7) when the machine power is on.

### Removal

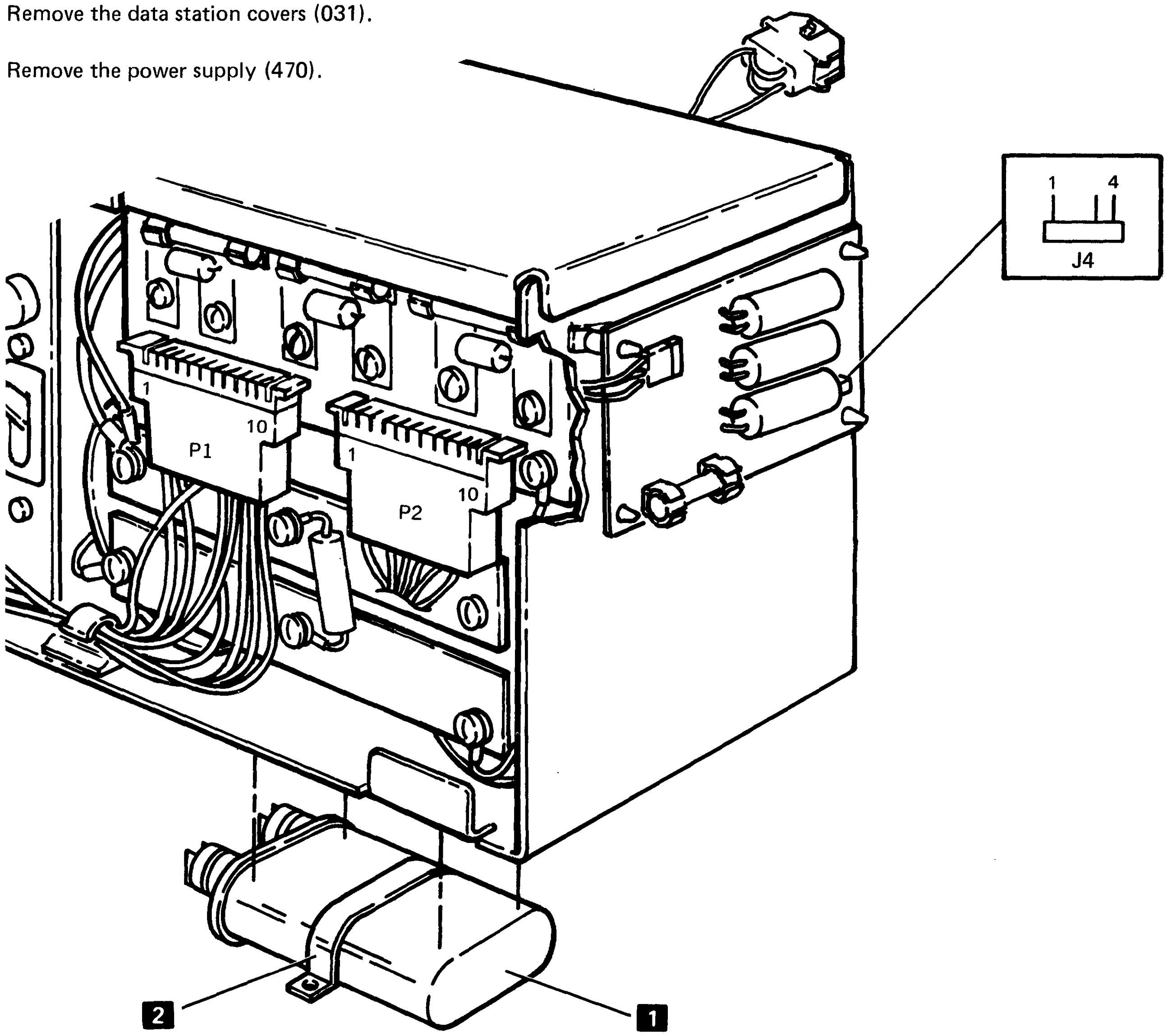
1. Power off.
2. Disconnect the power cord from the service outlet.
3. Remove the data station covers (031).
4. Remove the power supply (470).

**DANGER**
Capacitor discharge might be present at the resonant capacitor.

5. Remove the leads from the resonant capacitor **1**.
6. Loosen the screw **2** and slide the resonant capacitor out of the mounting bracket.

### Replacement

For replacement of the resonant capacitor, reverse the steps in the removal procedure.



## Power Cord and Line Filter

### 480 REMOVAL AND REPLACEMENT

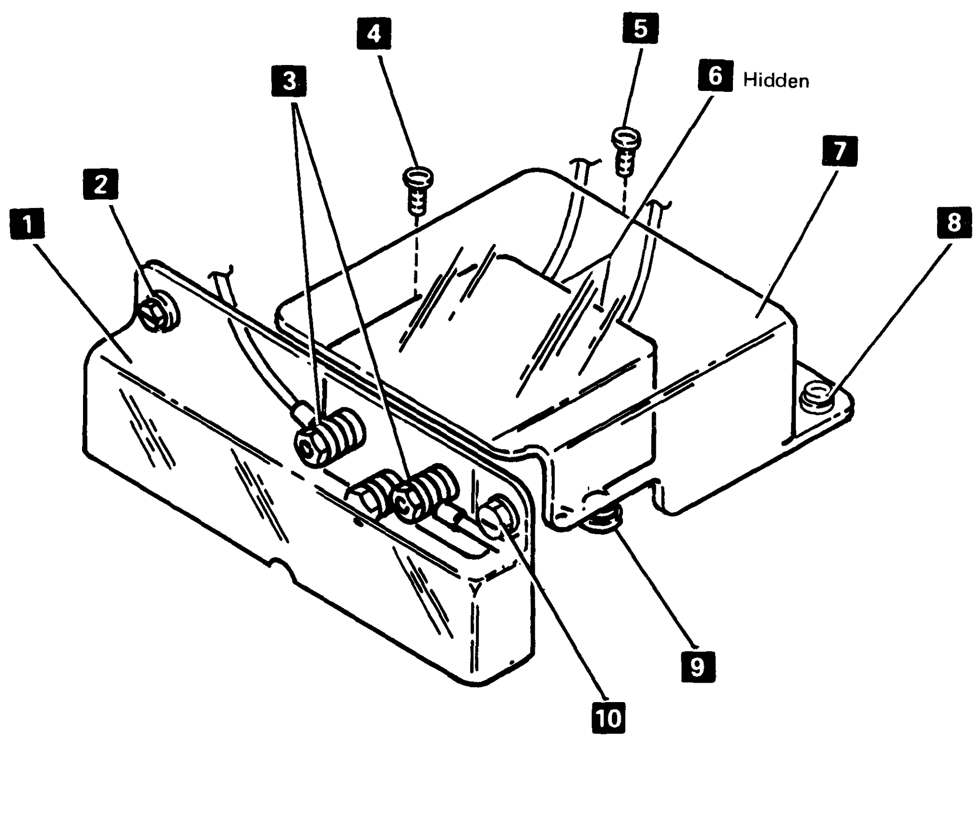
**DANGER**
Voltage is present at the line filter when the Power switch is in the Off position and the power cord is connected to the service outlet.

#### Removal

1. Power off.
2. Disconnect the power cord from the service outlet.
3. Remove the data station covers (031).
4. Slide the power supply away from the display assembly (470, steps 4 through 7).
5. Remove screws 2 and 10 ; then remove the cover 1 .
6. Remove the two nuts 3 then remove the wires from the terminals. The power cord has now been removed from the line filter. If the power cord is to be removed, remove any strain reliefs and pull the power cord from the data station base. If the line filter is to be removed, proceed to step 7.
7. Remove screws 5 and 8 then remove the cover 7 .
8. Remove the two nuts 6 then remove the wires from the terminals.
9. Remove screws 4 and 9 then lift the line filter from the data station base.

#### Replacement

For replacement of the power cord and line filter, reverse the steps in the removal procedure.



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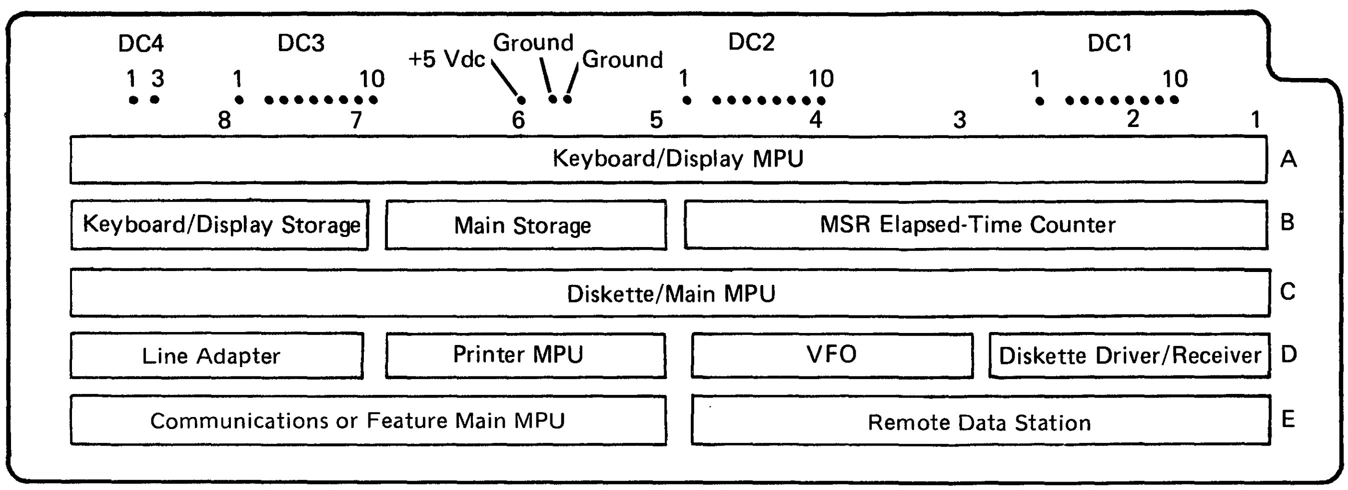
## Logic and Cards

### 501 CARD PLUG CHART

The card plug chart shows the card configurations for the IBM 5285 Programmable Data Station. To determine which card to use, see 503.



## 503 CARD OPTIONS

The card option table shows which cards to use for the different configurations available. See 501 for the card plug chart.

| Card Location | Function | Size | Reference | Remarks |
|---|---|---|---|---|
| A1 | Keyboard/display MPU | 8-wide | 200 | Contains 2 K bytes of keyboard storage |
| B1 | Elapsed-time counter | 2-wide | 771, 773 | |
| B1 | 1-MSR and elapsed-time counter | 2-wide | 771 | Communicating IBM 5285 only |
| B1 | 4-MSR and elapsed-time counter | 4-wide | 773 | Non-communicating IBM 5285 only |
| B5 | Main storage | 2-wide | 403 | Additional main storage |
| B7 | Keyboard storage | 2-wide | 207 | Additional keyboard storage |
| C1 | Diskette/main MPU | 8-wide | 303 | Contains 32 K bytes of main storage |
| D1 | Diskette driver/receiver | 2-wide | 305 | Non-communicating IBM 5285 only |
| D3 | VFO | 2-wide | 501 | |
| D5 | Printer MPU | 2-wide | 731 | |
| D7 | EIA | 2-wide | 823 | Communicating IBM 5285 only |
| D7 | DDSA | 2-wide | 825 | Communicating IBM 5285 only |
| D7 | 38LS World Trade switched | 2-wide | 821 | Communicating IBM 5285 only |
| D7 | 38LS United States switched | 2-wide | 815 | Communication IBM 5285 only |
| D7 | 38LS World Trade nonswitched | 2-wide | 819 | Communicating IBM 5285 only |
| D7 | 38LS United States nonswitched, manual answer | 2-wide | 813 | Communicating IBM 5285 only |
| D7 | 38LS United States nonswitched, SNBU, auto-answer | 2-wide | 817 | Communicating IBM 5285 only |
| D7 | 38LS United States nonswitched, SNBU, manual answer | 2-wide | 813 | Communicating IBM 5285 only |
| E1 | Data station adapter | 4-wide | 201 | Used when IBM 5281 is attached |
| E1 | Dual data station adapter | 4-wide | 203 | Used when IBM 5282 is attached |
| E5 | BSC/SDLC communications attachment | 4-wide | 811 | Communicating IBM 5285 only |
| E5 | Feature Main MPU | 4-wide | 402 | Non-communicating IBM 5285 only |

## 505 LOGIC BOARD AND LOGIC CARD PART NUMBERS

The following chart supplies the logic board part numbers and engineering change level and the logic card part numbers and engineering change levels for the IBM 5285 Programmable Data Station. If the part number of a card in the machine and the part number for that card in the chart do not agree, check the customer engineer memorandums (CEMs) to ensure that you have the correct card. If you do have the correct card, write the new part number and the new engineering change level for that card in the blank columns provided in the chart. The cards are listed with the oldest part number on the left and the newest part number on the right.

## 505 LOGIC BOARD AND LOGIC CARD PART NUMBERS (continued)

| Location Size | Name | Part No. E.C. Level | Part No. E.C. Level | Part No. E.C. Level | Part No. E.C. Level | Part No. E.C. Level | Part No. E.C. Level | Part No. E.C. Level |
|---|---|---|---|---|---|---|---|---|
| A-Board | | 4177481 10-28946 | 4177481 838494 | 7364107 839753 | | | | |
| A-A1 8-Wide | Keyboard/ Display MPU | 7364486 10-29792 | 6042977 10-29968 | 4177598 838447 | | | | |
| | ROS Patch for Keyboard/ Display MPU | | | | | | | |
| A-A1 8-Wide | Keyboard/ Display MPU Katakana* | 6042978 10-29968 | 4177600 838449 | 7364426 10-29800 | | | | |
| | ROS Patch for Keyboard/ Display MPU Katakana* | | | | | | | |
| A-B1 2-Wide | Elapsed Time Counter* | 1618152 837086 | | | | | | |
| A-B1 2-Wide | 1MSR and Elapsed Time Counter* | 7364620 840869 | | | | | | |
| A-B1 4-Wide | 4MSR and Elapsed Time Counter* | 4177924 10-28996 | 4177926 839709 | | | | | |
| A-B5 2-Wide | 16K Additional Main Storage* | 4177563 10-28936 | 4177564 838415 | 1618110 839732 | | | | |
| A-B5 2-Wide | 32K Additional Main Storage* | 4177561 10-28936 | 4177562 838399 | 1618108 839730 | | | | |

*Feature

## 505 LOGIC BOARD AND LOGIC CARD PART NUMBERS (continued)

| Location Size | Name | Part No. E.C. Level | Part No. E.C. Level | Part No. E.C. Level | Part No. E.C. Level | Part No. E.C. Level | Part No. E.C. Level | Part No. E.C. Level |
|---|---|---|---|---|---|---|---|---|
| A-B7 2-Wide | 1K Keyboard/ Display Storage* | 1618058 837027 | 4177550 838407 | 7364149 10-29012 | 4177948 839723 | | | |
| A-B7 2-Wide | 2K Keyboard/ Display Storage (W/O Aux Data Station)* | 4177551 10-28933 | 4177554 838411 | 7364146 10-29012 | 7364144 839768 | | | |
| A-B7 2-Wide | 2K Keyboard/ Display Storage (W/ Aux Data Station)* | 4177525 10-28927 | 4177526 838389 | | | | | |
| A-B7 2-Wide | 3K Keyboard/ Display Storage* | 4177527 10-28928 | 4177528 838391 | 4177897 839725 | | | | |
| A-B7 2-Wide | 4K Keyboard/ Display Storage* | 4177529 10-28929 | 4177530 838393 | | | | | |
| A-B7 2-Wide | 5K Keyboard/ Display Storage* | 4177531 10-28930 | 4177532 838395 | 4177898 839727 | | | | |
| A-C1 8-Wide | Diskette/ Main MPU | 7364264 10-29589 | 7364266 10-29591 | 7364312 839645 | | | | |
| | ROS Patch for Diskette MPU | 736447 840854 or 840823 | 736447 840854 or 840823 | | | | | |
| | ROS Patch for Main MPU | 4177910 839751 | 4177910 839751 | | | | | |
| A-D1 2-Wide | Diskette Driver/ Receiver | 4177669 10-28945 | 4177670 838483 | | | | | |

*Feature

## 505 LOGIC BOARD AND LOGIC CARD PART NUMBERS (continued)

| Location Size | Name | Part No. E.C. Level | Part No. E.C. Level | Part No. E.C. Level | Part No. E.C. Level | Part No. E.C. Level | Part No. E.C. Level | Part No. E.C. Level |
|---|---|---|---|---|---|---|---|---|
| A-D3 2-Wide | Diskette VFO | 8562949 | | | | | | |
| A-D5 2-Wide | Printer MPU One Port* | 7364279 10-29592 | 7364283 10-29594 | 7364294 840811 | | | | |
| | ROS Patch for Printer MPU One Port | | | | | | | |
| A-D7 2-Wide | 38LS WT SW Modem* | 8564479 | | | | | | |
| A-D7 2-Wide | 38LS WT NonSw Modem* | 8564418 | | | | | | |
| A-D7 2-Wide | 38LS US SW AA/MA Modem* | 8564508 | | | | | | |
| A-D7 2-Wide | 38LS US SNBU AA Modem* | 8564509 | | | | | | |
| A-D7 2-Wide | 38LS US SNBU MA Modem* | 8564510 | | | | | | |
| A-D7 2 Wide | DDSA Adapter* | 8527032 | | | | | | |
| A-D7 2-Wide | EIA/CCITT Adapter* | 5864668 | | | | | | |

*Feature

## 505 LOGIC BOARD AND LOGIC CARD PART NUMBERS (continued)

| Location Size | Name | Part No. E.C. Level | Part No. E.C. Level | Part No. E.C. Level | Part No. E.C. Level | Part No. E.C. Level | Part No. E.C. Level | Part No. E.C. Level |
|---|---|---|---|---|---|---|---|---|
| A-E1 4-Wide | Data Station Adapter* | 7364457 26-01551 | 4177582 838431 | 7364443 10-29603 | | | | |
| A-E1 4-Wide | Data Station Adapter Katakana* | 7364458 26-01551 | 4177584 838433 | 7364445 10-29603 | | | | |
| A-E1 4-Wide | Dual Data Station Adapter* | 7364459 26-01551 | 4177586 838435 | 7364447 10-29604 | | | | |
| A-E1 4-Wide | Dual Data Station Adapter Katakana* | 7364460 26-01551 | 4177588 838437 | 7364451 10-29604 | | | | |
| A-E5 4-Wide | Comm MPU W/Attenuator* | 7364201 10-29013 | 4177752 839614A | 7364138 839755A | | | | |
| | ROS Patch for Comm MPU W/Attenuator | | 7364438 868243 | | | | | |
| A-E5 4-Wide | Comm MPU W/O Attenuator* | 7364213 10-29013 | 4177754 839616A | 7364140 839757A | | | | |
| | ROS Patch for Comm MPU W/O Attenuator | | 7364438 868243 | | | | | |
| A-E5 4-Wide | Feature Main MPU* | 6042996 868274A | | | | | | |
| | ROS Patch for Feature Main MPU | | | | | | | |

*Feature

## 513 LOGIC CARD COVER REMOVAL AND REPLACEMENT

**Removal**

1. Power off.

2. Remove data station covers (031).

3. Push down on the top of the cover **2** and release the four latches **1** (two on each side of the cover) by pulling the cover away from the logic board **3**.

4. Press down on the side of the logic card cover **2** and release the lower edge of the cover from its latch on the logic card frame. (Note the location of the logic card insertion tools on the logic cards.)

5. Press down on the other side of the logic card cover **2** and release that lower edge of the cover from its latch on the logic card frame. The cover can now be lifted from the logic cards.

**CAUTION**
The logic cards will overheat if patch cards (either ROS patch or dummy patch) are not installed.

6. When no ROS patch cards are installed, install dummy patch cards to ensure correct air flow.

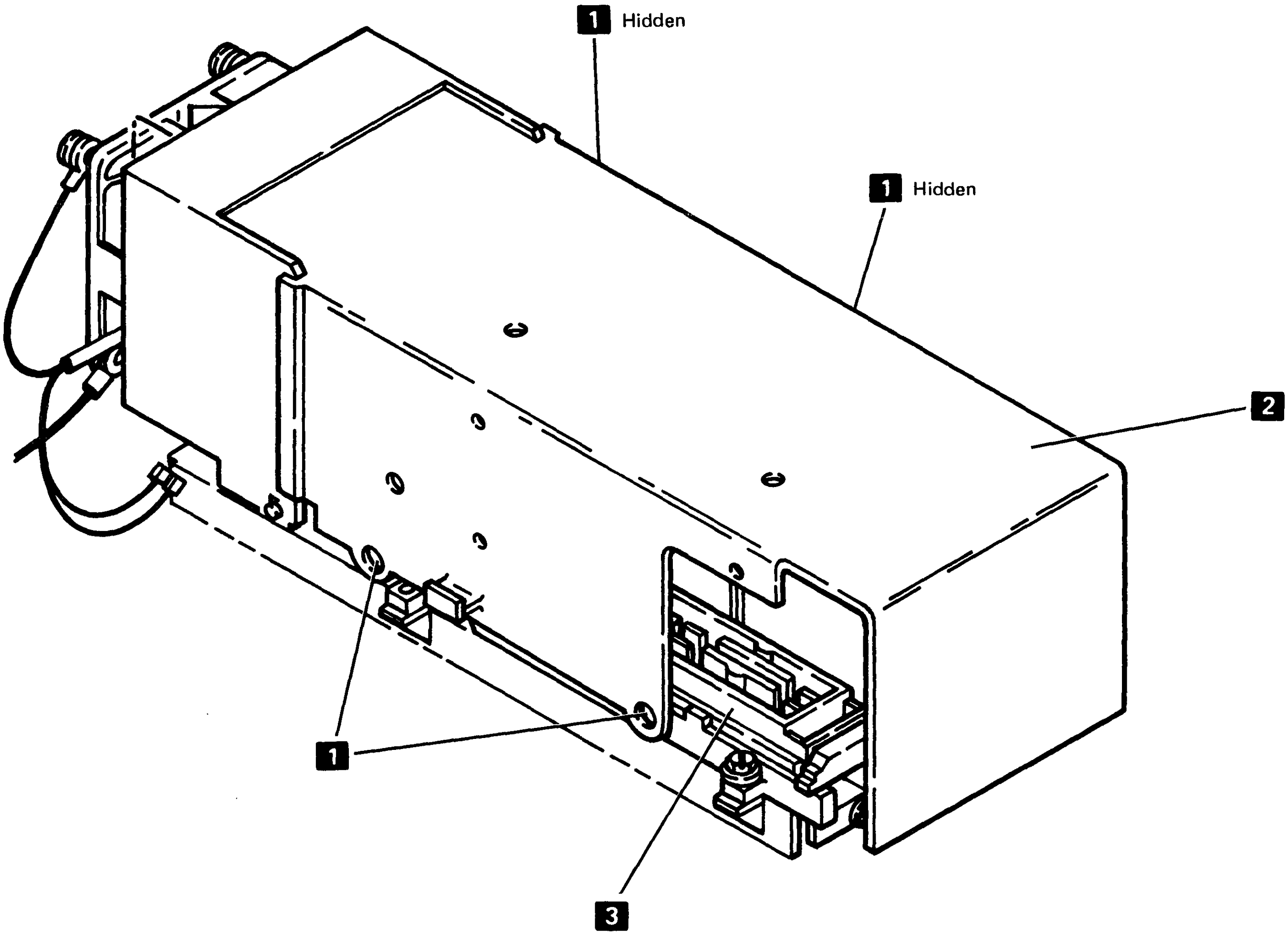
**Replacement**

For replacement of the logic card cover, observe the following cautions and reverse the steps in the removal procedure.

**CAUTION**
Ensure that all cables are properly placed to prevent the cover from cutting the cables.

**CAUTION**
Ensure that the card insertion tools are placed properly in the cover to prevent damage to the logic cards.

## 513 LOGIC CARD REMOVAL AND REPLACEMENT (continued)



## 515 FAN SHROUD REMOVAL AND REPLACEMENT

### Removal

1. Power off.

2. Remove the data station cover (031).

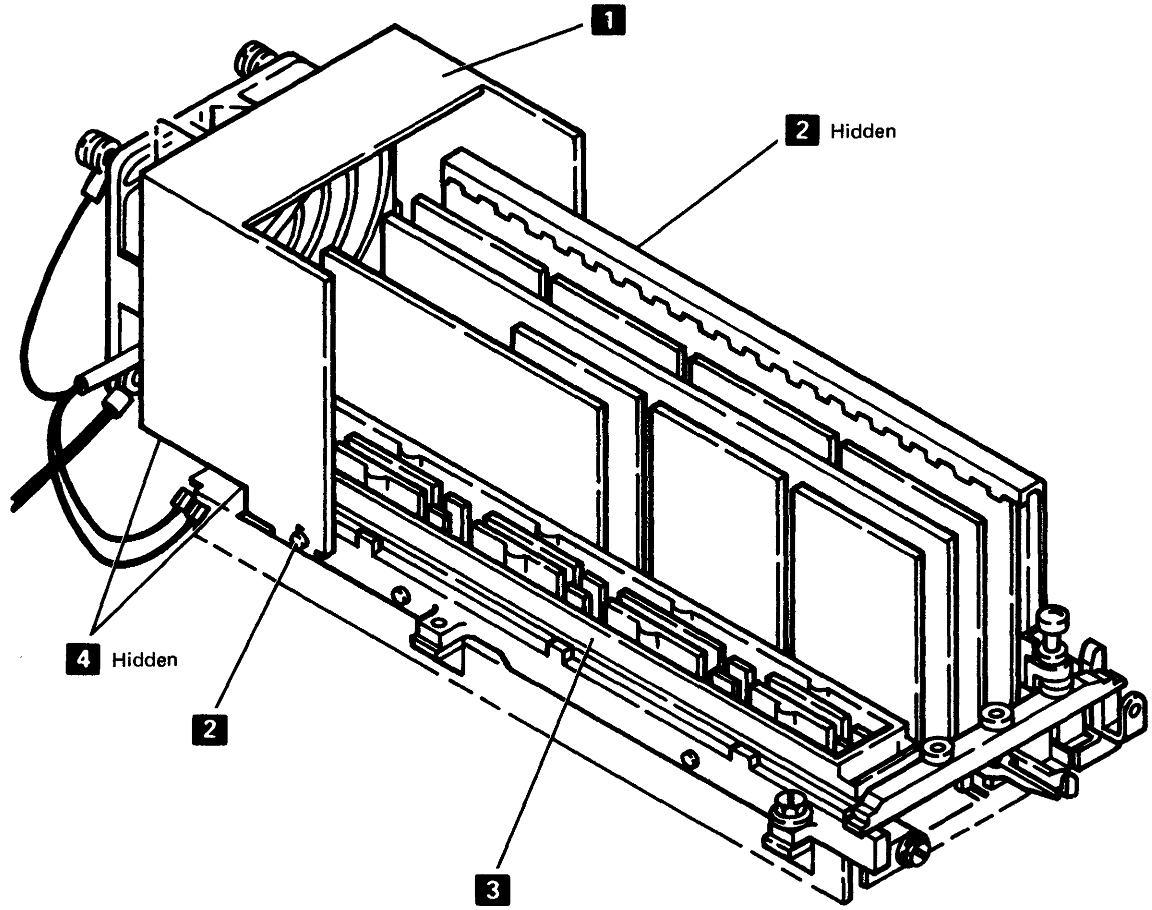
3. Tilt the fan shroud **1** away from the logic board **3** to release the two latches **2**.

4. Lift the fan shroud away from the logic board to release the two latches **4** (hidden from view).

### Replacement

For replacement of the fan shroud, observe the following caution and reverse the steps in the removal procedure.

**CAUTION**
Ensure that the cables are properly placed to prevent the fan shroud from cutting the cables.



## 521 LOGIC BOARD REMOVAL AND REPLACEMENT

**CAUTION**
The logic board and the cards can be damaged if they are removed with the Power switch set to the On position.

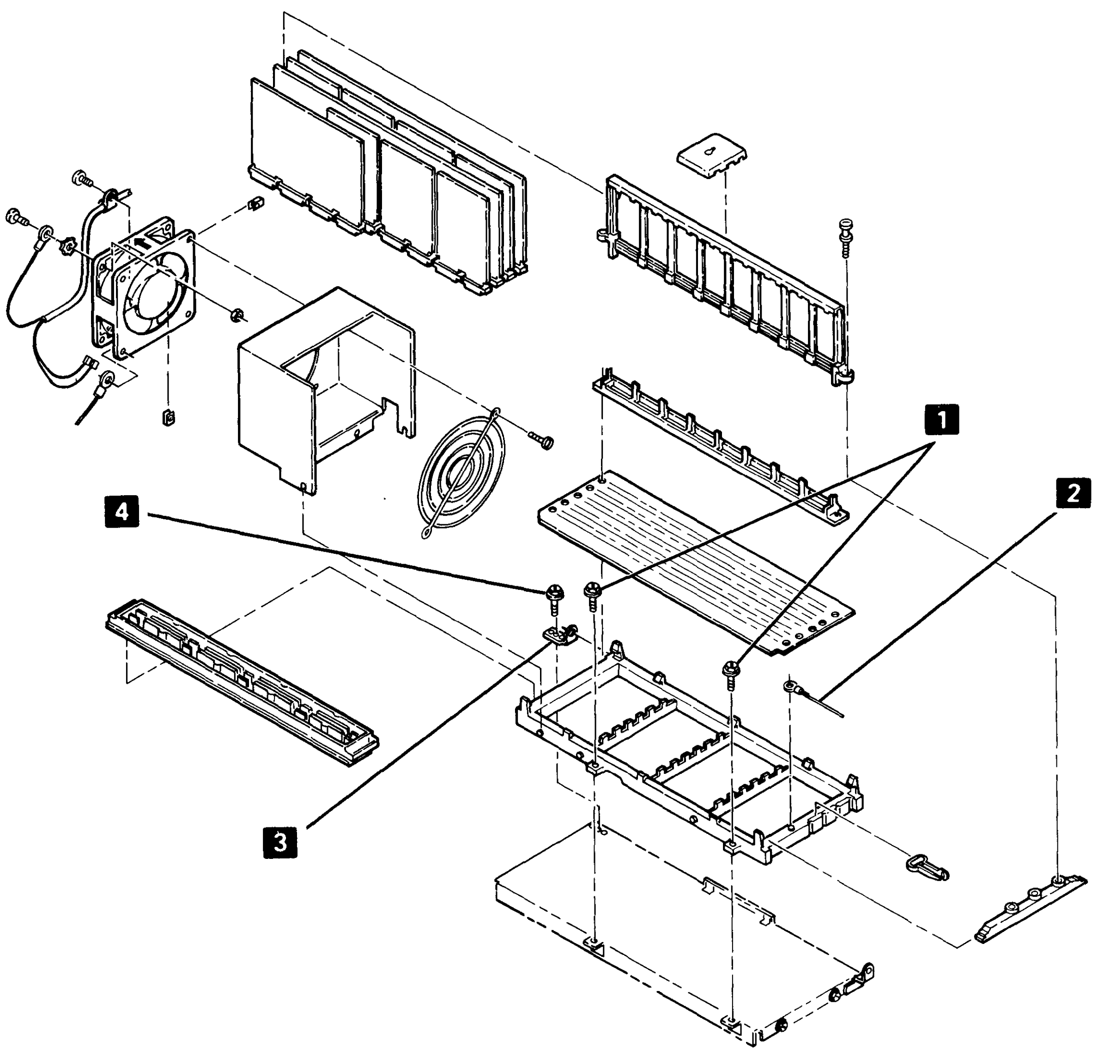
### Removal

1. Power off.
2. Remove the data station covers (031).
3. Remove the logic card cover (513).
4. Remove the fan shroud (515).
5. Disconnect all cable connectors and plugs from the logic cards and the logic board.
6. Loosen the two screws **1**.
7. Loosen the pivot bracket screw **4**, then remove the pivot bracket **3**.
8. Remove the retaining cables **2** from the power supply.
9. Remove the logic board from the power supply.
10. Remove all logic cards. Note the position of the cards for the replacement procedure.

### Replacement

For replacement of the logic board, reverse the steps in the removal procedure.

**Note:** When installing a new logic board, all logic cards and other hardware must be moved to the new logic board.



## 523 LOGIC CARD REMOVAL AND REPLACEMENT

**CAUTION**
The logic cards and the logic board could be damaged if the logic cards are removed with the Power switch set to the On position.

### Removal

1. Power off.
2. Remove the data station covers (031).
3. Disconnect any cable connectors or plugs attached to the logic card being removed.

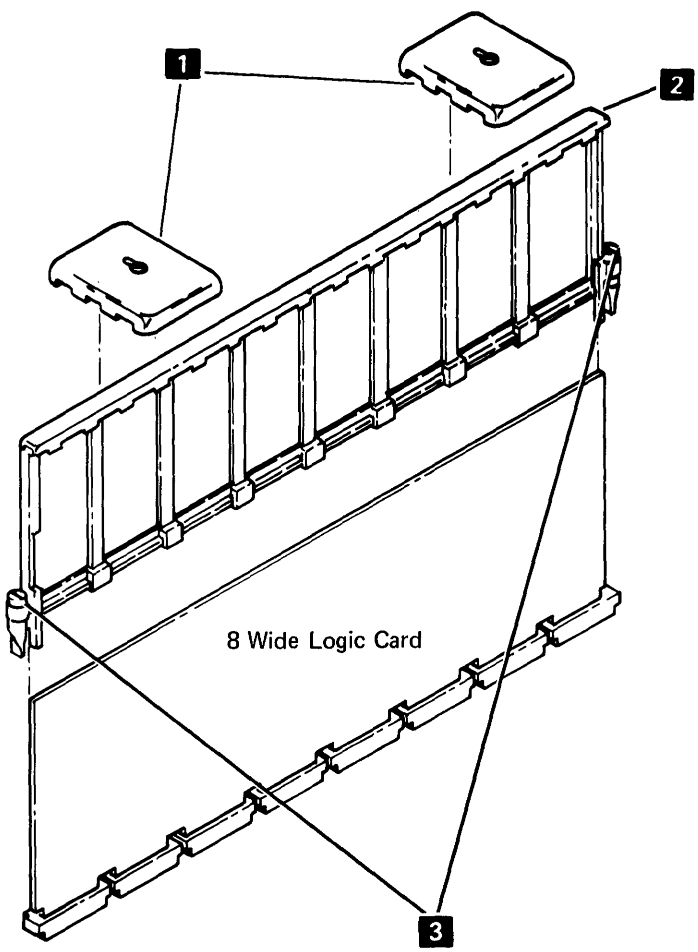
**CAUTION**
Always use the card jacks 3 and the card holder 2 to loosen the 8-wide logic cards or the cards could be damaged.

4. Remove the selected logic cards.

### Replacement

**CAUTION**
Always use the card insertion tools 1 to insert 8-wide logic cards into the machine or the shrouds could break.

1. Check for broken shrouds before inserting the card.
2. Install the selected logic card. For the 8-wide card, use even pressure on the card insertion tools 1 until the card is properly seated.
3. Attach any cable connectors or plugs to the selected logic card.



## 525 FAN REMOVAL AND REPLACEMENT

**Removal**

1. Power off.
2. Remove the data station covers (031).
3. Remove the fan shroud (515).
4. Disconnect the AC wires from the fan motor.
5. Remove the fan motor from the fan shroud.

**Replacement**

For replacement of the fan, reverse the steps in the removal procedure. Ensure that the fan is installed so the air moves away from the logic cards.

## 531 NET LIST

The net list shows all lines in alphabetic order and each logic pin to which the line is connected. This is not a point-to-point net list.

| Line Name | A | B | C | D | Comm E | Feature Main MPU E |
|---|---|---|---|---|---|---|
| +access 0 dr 4800 | | | 1D06 | 1D06 | | |
| +access 0 dr 4C00 | | | 1D07 | 1D07 | | |
| +access 1 dr 4800 | | | 1B07 | 1B07 | | |
| +access 1 dr 4C00 | | | 1D05 | 1D05 | | |
| +advance bit ring | | | 8D02 | 5B09 | | 5B09 |
| -allow comm | 1B02 | | | 5D09 | | |
| -attn from comm | | | 4B07 | | | 7D04 |
| -attn from diskette | | | 4D07 | | | 7D07 |
| -attn from kbd/display | 4D06 | | 4D06 | | | 7B07 |
| -attn from printer | | | 4B09 | 5D02 | | 7B02 |
| -attn from 1 TP | | | 4D09 | | | 7B03 |
| -attn from 2 TP | | | 4B08 | | | 7D02 |
| -attn to comm See note 4 | | | 4D11 | | 5B02 | |
| -attn to diskette See note 5 | | | 4B13 | | | 7B08 |
| -attn to diskette See note 4 | | | 4B13 | | | |
| -attn 1 to diskette See note 5 | | | 5B09 | | | 7D05 |
| -attn to kbd/display See note 4 | 4D13 | | 4D13 | | | |
| -attn to kbd/display See note 5 | 4D13 | | | | | 7D09 |
| -attn 1 to kbd/display See note 5 | | | 4D13 | | | 7D10 |
| -attn to printer See note 5 | | | | 5B02 | | 7B11 |
| -attn to printer See note 4 | | | 4B12 | 5B02 | | |
| -attn 1 to printer See note 5 | | | 4B12 | | | 7B12 |
| -attn to 1 TP | | | 4D12 | | | 7D12 |
| -attn to 2 TP | | | 4D10 | | | 7D13 |
| -bit req 1 | | | 5D02 | | | |
| -bit req 2 | | | 7D13 | | 5B04 | |
| -bit req 3 | | | 7D12 | | | |
| -bit req 3 (I/O) | 3D02 | | | | 1D05 | 1D05 |
| -bit req 4 | | | 7D11 | 5B04 | | |
| -bit req 4 (I/O) | 3B08 | | | | | |
| -bit req 5 | 2B02 | | 7D10 | | | |
| -bit req 5 (I/O) | 3B07 | | | | | |
| -bit req 6 | | | 7D09 | | | |
| -bit req 7 | | | 7D07 | | | |
| -bit req 8 | | | 7D06 | | | 8B12 |

| Line Name | A | B | Card Row C | D | Comm E | Feature Main MPU E |
|---|---|---|---|---|---|---|
| -bit req 8-1 | | | 8B07 | | | 7B09 |
| -carrier det (DCE) | | | | 7B12 | 7B12 | |
| -carrier det (cable) | | | | 8D12 | 8D12 | |
| -chip select disable | 4B13 | 7D07 | | | | |
| -chip select 1 | 4B12 | 7D05 | | | | |
| -chip select 2 | 4B09 | 7B05 | | | | |
| -clear storage | 2B06 | 8D02 | | | | |
| -clear to send (DCE) | | | | 7D13 | 7D13 | |
| -clear to send (cable) See note 1 | | | | 8B10 | 8B10 | |
| +coupler cut through (CCT) See note 1 | | | | 8D09 | 8D09 | |
| +CRT2 (+5 V) | | | | | 3B03 | 3B03 |
| +CRT3 (gnd) | | | | | 3B08 | 3B08 |
| +data modem ready (DA) See note 1 | | | | 8D02 | 8D02 | |
| -data set rdy (DCE) | | | | 7B13 | 7B13 | |
| -data set rdy (cable) See note 1 | | | | 8D09 | 8D09 | |
| -data term rdy (DCE) | | | | 7B02 | 7B02 | |
| -data term rdy (cable) See note 1 | | | | 8D02 | 8D02 | |
| data tip (DCE) See note 1 | | | | 7D05 | 7D05 | |
| data tip (cable) | | | | 7D06 | 7D06 | |
| +dev sel 1 | | | 5B02 | | | |
| +dev sel 2 | | | 7B13 | | 5D04 | |
| +dev sel 3 | | | 7B12 | | | |
| +dev sel 3 (I/O) | 2B09 | | | | 1D06 | |
| +dev sel 4 | | | 7B11 | 5D04 | | |
| +dev sel 4 (I/O) | 3B02 | | | | | |
| +dev sel 5 | 8B02 | | 7B10 | | | |
| +dev sel 5 (I/O) | 3B03 | | | | | |
| +dev sel 6 | | | 7B05 | | | |
| +dev sel 7 | | | 7B08 | | | |
| +dev sel 8 | | | 7B07 | | | 8D12 |
| +dev sel 8-1 | | | 8D11 | | | 8D02 |
| -diag break code | 5B07 | | | | 2B03 | 2B03 |
| +diag force video | 5B08 | | | | 1B04 | 1B04 |
| -diag serial data | 5B05 | | | | 2B04 | 2B04 |
| +diag serial data clk | 5B04 | | | | 2B05 | 2B05 |

| | | | Card Row | | | Feature |
|---|---|---|---|---|---|---|
| Line Name | A | B | C | D | Comm E | Main MPU E |
| -diag strobe | 5D09 | | | | 2B02 | 2B02 |
| +diskette 2 sense 4800 | | | 2D06 | 2B04 | | |
| +diskette 2 sense 4C00 | | | 2B03 | 2B03 | | |
| -display diag | 4D11 | | | | 1B03 | 1B03 |
| +dual display | 4D02 | | | | 1B07 | 1B07 |
| -EAR bit 0 | 2D13 | 2D13 | | | 2B09 | 2B09 |
| -EAR bit 1 | 2B13 | 2B13 | | | 2B08 | 2B08 |
| -EAR bit 2 | 2D12 | 2D12 | | | 2D12 | 2D12 |
| -EAR bit 3 | 2B12 | 2B12 | | | 2B12 | 2B12 |
| -EAR bit 4 | 2D11 | 2D11 | | | 2D11 | 2D11 |
| -EAR bit 5 | 2D10 | 2D10 | | | 2D10 | 2D10 |
| -EAR bit 6 | 2B10 | 2B10 | | | 2B10 | 2B10 |
| -EAR bit 7 | 2D09 | 2D09 | | | 2D09 | 2D09 |
| -EIA wrap See note 1 | | | | 7D05 | 7D05 | |
| +erase gate 4800 | | | 1B03 | 1B03 | | |
| +erase gate 4C00 | | | 1B02 | 1B02 | | |
| -extended sense bit | 8B03 | 2B07 | | | | |
| -feat card installed | 5D02 | 8D04 | | | | |
| -feat chip select | 8D04 | 8B02 | | | | |
| -feat stor sel | | 5B03 | 7B02 | | | |
| +file data in | | | 2B10 | 3B12 | | |
| +file data 4800 | | | 2B06 | 2D05 | | |
| +file data 4C00 | | | 2D07 | 2B05 | | |
| -file in use 4C00 | | | 2D05 | 2B09 | | |
| -file in use 4800 | | | 1B08 | 2D09 | | |
| -force POR | | | 3D12 | | | |
| +head engage 4800 | | | 1D09 | 1D09 | | |
| +head engage 4C00 | | | 1B09 | 1B08 | | |
| +index 4800 | | | 1D04 | 1D13 | | |
| +index 4C00 | | | 1D02 | 1D02 | | |
| -inner tracks | | | 1B11 | 1B13 | | |
| -IOD in bit 0 DOT | 1D13 | 1D13 | | | 1D13 | 1D13 |
| -IOD in bit 1 DOT | 1B13 | 1B13 | | | 1B13 | 1B13 |
| -IOD in bit 2 DOT | 1D12 | 1D12 | | | 1D12 | 1D12 |
| -IOD in bit 3 DOT | 1B12 | 1B12 | | | 1B12 | 1B12 |

| Line Name | Card Row A | B | C | D | Comm E | Feature Main MPU E |
|---|---|---|---|---|---|---|
| -IOD in bit 4 DOT | 1D11 | 1D11 | | | 1D11 | 1D11 |
| -IOD in bit 5 DOT | 1B11 | 1D09 | | | 1D09 | 1D09 |
| -IOD in bit 6 DOT | 1D10 | 1D10 | | | 1D10 | 1D10 |
| -IOD in bit 7 DOT | 1B10 | 1B10 | | | 1B10 | 1B10 |
| -IOD out bit 0 | 7D02 | 7D02 | | | | |
| -IOD out bit 1 | 7B02 | 7B02 | | | | |
| -IOD out bit 2 | 7B03 | 7B03 | | | | |
| -IOD out bit 3 | 7D04 | 7D04 | | | | |
| -IOS kb A | 4D10 | | | | 1D07 | 1D07 |
| -IOS kb B | 4D09 | | | | 1B09 | 1B09 |
| -I/O SAR bit 0 DOT | 8D05 | 8D05 | | | 4D05 | 4D05 |
| -I/O SAR bit 1 DOT | 8B05 | 8B05 | | | 4B05 | 4B05 |
| -I/O SAR bit 2 DOT | 8D06 | 8D06 | | | 4D06 | 4D06 |
| -I/O SAR bit 3 DOT | 8B06 | 8B04 | | | 4B04 | 4B04 |
| -I/O SAR bit 4 DOT | 8D07 | 8D07 | | | 4D07 | 4D07 |
| -I/O SAR bit 5 DOT | 8B07 | 8B07 | | | 4B07 | 4B07 |
| -I/O SAR bit 6 DOT | 8B08 | 8B08 | | | 4B08 | 4B08 |
| -I/O SAR bit 7 DOT | 8D09 | 8D09 | | | 4D09 | 4D09 |
| -I/O SAR bit 8 DOT | 8B09 | 8B09 | | | 4B09 | 4B09 |
| -I/O SAR bit 9 DOT | 8D10 | 8D10 | | | 4D10 | 4D10 |
| -I/O SAR bit 10 DOT | 8B10 | 8B10 | | | 4B10 | 4B10 |
| -I/O SAR bit 11 DOT | 8D11 | 8D11 | | | 4D11 | 4D11 |
| -I/O SAR bit 12 DOT | 8D12 | 8D12 | | | 4D12 | 4D12 |
| -I/O SAR bit 13 DOT | 8B12 | 8B12 | | | 4B12 | 4B12 |
| -I/O SAR bit 14 DOT | 8D13 | 8D13 | | | 4D13 | 4D13 |
| -I/O SAR bit 15 DOT | 8B13 | 8B13 | | | 4B13 | 4B13 |
| -I/O storage data bit P DOT | 7D09 | 7D09 | | | | |
| -I/O storage data bit 0 DOT | 7D13 | 7D13 | | | 3D13 | 3D13 |
| -I/O storage data bit 1 DOT | 7B13 | 7B13 | | | 3B13 | 3B13 |
| -I/O storage data bit 2 DOT | 7D12 | 7D12 | | | 3D12 | 3D12 |

## 531 NET LIST (continued)

| Line Name | A | B | C | D | Comm E | Feature Main MPU E |
|---|---|---|---|---|---|---|
| -I/O storage data bit 3 DOT | 7B12 | 7B12 | | | 3B12 | 3B12 |
| -I/O storage data bit 4 DOT | 7D11 | 7D11 | | | 3D11 | 3D11 |
| -I/O storage data bit 5 DOT | 7B11 | 8B03 | | | 4B03 | 4B03 |
| -I/O storage data bit 6 DOT | 7D10 | 7D10 | | | 3D10 | 3D10 |
| -I/O storage data bit 7 DOT | 7B10 | 7B10 | | | 3B10 | 3B10 |
| +kbd 2 | 1D07 | | | | 3B05 | 3B05 |
| +kbd 3 | 1D06 | | | | 3D04 | 3D04 |
| +kbd 4 (gnd) | | | | | 1B08 | 1B08 |
| -keylock disable | 1B07 | | | | 1D04 | 1D04 |
| +load config reg | 5B02 | 7B08 | | | | |
| +MFM mode | | | 2D11 | 3D07 | | |
| +off hook (OH) See note 1 | | | | 8B03 | 8B03 | |
| osc input | | | | 4B07 | | |
| osc input | | | | 4B08 | | |
| -parity bit DOT | | 5D09 | 5D09 | | | |
| -parity error | 4D04 | 5B07 | 4D04 | | | |
| +POR | 8B04 | | 8B04 | 5B03 | 5B03 | 5B03 |
| -POR | 2B04 | 5B05 | 2B04 | | 1B02 | 1B02 |
| -POR | | 2B04 | | | | |
| -POR cmd | 4B04 | | 4B04 | | | |
| -rate sel (DCE) | | | | 7B04 | 7B04 | |
| -rate sel (cable) | | | | 8D06 | 8D06 | |
| +rd/-wt DOT | 5D07 | | 5D07 | 5D07 | 5D07 | 5D07 |
| +rd/-wt (I/O) | 2B03 | 7B04 | | | | |
| +rec bmc | | | | | 7D07 | |
| +rec clk (cable) | | | | 8D10 | 8D10 | |
| -rec clk (DCE) | | | | 7B08 | 7B08 | |
| +rec line data (DCE) | | | | 7B10 | 7B10 | |
| +rec line data (cable) | | | | 8B04 | 8B04 | |
| +rec nonsw data | | | | 8B09 | 8B09 | |
| -rec nonsw data | | | | 8D13 | 8D13 | |
| -regen | | 5D04 | 7B03 | | | |
| -req to send (DCE) | | | | 7D02 | 7D02 | |
| -req to send (cable) See note 1 | | | | 8B03 | 8B03 | |
| -ring ind (DCE) | | | | 7D12 | 7D12 | |

| Line Name | A | B | C | D | Comm E | Feature Main MPU E |
|---|---|---|---|---|---|---|
| -ring ind (cable) See note 1 | | | | 8B13 | 8B13 | |
| +ring indicate See note 1 | | | | 8B13 | 8B13 | |
| -SAR bit 0 DOT | 6D13 | 6D13 | 6D13 | 6D13 | 6D13 | 6D13 |
| -SAR bit 1 DOT | 6B13 | 6B13 | 6B13 | 6B13 | 6B13 | 6B13 |
| -SAR bit 2 DOT | 6D12 | 6D12 | 6D12 | 6D12 | 6D12 | 6D12 |
| -SAR bit 3 DOT | 6B12 | 6B12 | 6B12 | 6B12 | 6B12 | 6B12 |
| -SAR bit 4 DOT | 6D11 | 6D11 | 6D11 | 6D11 | 6D11 | 6D11 |
| -SAR bit 5 DOT | 6D10 | 6D10 | 6D10 | 6D10 | 6D10 | 6D10 |
| -SAR bit 6 DOT | 6B10 | 6B10 | 6B10 | 6B10 | 6B10 | 6B10 |
| -SAR bit 7 DOT | 6D09 | 6D09 | 6D09 | 6D09 | 6D09 | 6D09 |
| -SAR bit 8 DOT | 6B09 | 6B09 | 6B09 | 6B09 | 6B09 | 6B09 |
| -SAR bit 9 DOT | 6B08 | 6B08 | 6B08 | 6B08 | 6B08 | 6B08 |
| -SAR bit 10 DOT | 6D07 | 6D07 | 6D07 | 6D07 | 6D07 | 6D07 |
| -SAR bit 11 DOT | 6B07 | 6B07 | 6B07 | 6B07 | 6B07 | 6B07 |
| -SAR bit 12 DOT | 6D06 | 6D06 | 6D06 | 6D06 | 6D06 | 6D06 |
| -SAR bit 13 DOT | 6B06 | 6B06 | 6B06 | 6B06 | 6B06 | 6B06 |
| -SAR bit 14 DOT | 6D05 | 6D05 | 6D05 | 6D05 | 6D05 | 6D05 |
| -SAR bit 15 DOT | 6B05 | 6B05 | 6B05 | 6B05 | 6B05 | 6B05 |
| -SAR grp bit 4 DOT | 6D04 | 6D04 | 6D04 | 6D04 | 6D04 | 6D04 |
| -SAR grp bit 5 DOT | 6B04 | 6B04 | 6B04 | 6B04 | 6B04 | 6B04 |
| -SAR grp bit 6 DOT | 6B03 | 6B03 | 6B03 | 6B03 | 6B03 | 6B03 |
| -SAR grp bit 7 DOT | 6B02 | 6B02 | 6B02 | 6B02 | 6B02 | 6B02 |
| -sel head 1 | | | 1B10 | 1B10 | | |
| -sel standby (DCE) | | | | 7B03 | 7B03 | |
| -sel standby (cable) | | | | 8B05 | 8B05 | |
| +select file 2 (gnd) | | | | 3B09 | | |
| +std clk | | | 2B13 | 3B02 | | |
| +std data | | | 2B12 | 3B04 | | |
| -storage data bit 0 DOT | 5D13 | 5D13 | 5D13 | 5D13 | 5D13 | 5D13 |
| -storage data bit 1 DOT | 5B13 | 5B13 | 5B13 | 5B13 | 5B13 | 5B13 |
| -storage data bit 2 DOT | 5D12 | 5D12 | 5D12 | 5D12 | 5D12 | 5D12 |
| -storage data bit 3 DOT | 5B12 | 5B12 | 5B12 | 5B12 | 5B12 | 5B12 |
| -storage data bit 4 DOT | 5D11 | 5D11 | 5D11 | 5D11 | 5D11 | 5D11 |
| -storage data bit 5 DOT | 5B11 | 5B09 | 5B11 | 5B11 | 5B11 | 5B11 |
| -storage data bit 6 DOT | 5D10 | 5D10 | 5D10 | 5D10 | 5D10 | 5D10 |

| Line Name | A | B | C | D | Card Row Comm E | Feature Main MPU E |
|---|---|---|---|---|---|---|
| -storage data bit 7 DOT | 5B10 | 5B10 | 5B10 | 5B10 | 5B10 | 5B10 |
| -storage req DOT | 5D06 | | 5D06 | 5D06 | 5D06 | 5D06 |
| -storage req (I/O) | 2B08 | | | | 1D02 | |
| +store/-fetch | 5B09 | 5B02 | 7D05 | 5D09 | 7D11 | 7D11 |
| -strobe | | 5D06 | 7B04 | | | |
| +sub ring bit 1 | | | 8D06 | 5B08 | | 8B02 |
| +sub ring bit 2 | | | 8D05 | | | 6D02 |
| +sub ring bit 3 | | | 8D04 | | | |
| -switch filter | | | 1D11 | 1D11 | | |
| +switch hook (SH) See note 1 | | | | 8B10 | 8B10 | |
| -t comp | 5D05 | | 5D05 | 5D05 | 5D05 | 5D05 |
| -t comp (I/O) | 4B06 | | | | 3B02 | 3B02 |
| +t sel (I/O) | 2B05 | 7B09 | | | 3B07 | 3B07 |
| + test clk | | | | | 2B06 | 2B06 |
| -test control (DCE) | | | | 7B05 | 7B05 | |
| -test control (cable) | | | | 8D07 | 8D07 | |
| -test ind (DCE) | | | | 7D10 | 7D10 | |
| -test ind (cable) | | | | 8D11 | 8D11 | |
| -timer overflow | 7D07 | 2B08 | | | | |
| -valid address | | 5D02 | 4D02 | | | |
| +VFO sync in | | | 2D12 | 3B10 | | |
| +write/erase sense 4800 | | | 2B08 | 2B10 | | |
| +write/erase sense 4C00 | | | 2B07 | 2B07 | | |
| +write gate 4800 | | | 1B05 | 1B05 | | |
| +write gate 4C00 | | | 1B04 | 1D04 | | |
| +write trigger | | | 1D10 | 1D10 | | |
| +wt/-rd | | 5D07 | 5D04 | | | |
| +xmit bmc | | | | | 7D07 | |
| -xmit clk (cable) | | | | 8D04 | 8D04 | |
| -xmit clk (DCE) | | | | 7B07 | 7B07 | |
| +xmit line data (cable) | | | | 8B07 | 8B07 | |
| +xmit line data (DCE) | | | | 7D04 | 7D04 | |
| +xmit nonsw data | | | | 8B02 | 8B02 | |
| -xmit nonsw data | | | | 8D05 | 8D05 | |
| 001 MHz | 3B05 | 2B02 | 7D02 | | 3D02 | 3D02 |

| Line Name | Card Row A | B | C | D | Comm E | Feature Main MPU E |
|---|---|---|---|---|---|---|
| 002.25 MHz | 7B09 | | 7B09 | 5B07 | 5B07 | |
| 004 MHz | | | 5B05 | | | 8B06 |
| 006 MHz | | | 8B02 | 5B05 | | |
| 009 MHz | 3B04 | | 7D04 | | 2B13 | 2B13 |
| 009 MHz | | | | | 5B08 | |
| 018 MHz | 1B04 | | 8B03 | | 4D04 | 4D04 |
| 100 Hz | 4B02 | 1D07 | 8D07 | | 2D13 | 2D13 |
| 200 KHz | | | 8B05 | | | 8D10 |
| 250 Hz | | | 6D02 | | | 8B08 |
| +4F clk phase 1 | | | 2D13 | 3B03 | | |
| +4F clk phase 2 | | | 2D10 | 3D12 | | |
| -5V | 1B06 | 1B06 | 1B06 | 1B06 | 1B06 | 1B06 |
| -5V | 3B06 | 3B06 | 3B06 | 3B06 | 3B06 | 3B06 |
| -5V | 5B06 | 5B06 | 5B06 | 5B06 | 5B06 | 5B06 |
| -5V | 7B06 | 7B06 | 7B06 | 7B06 | 7B06 | 7B06 |
| +8.5V | 2B11 | 2B11 | 2B11 | 2B11 | 2B11 | 2B11 |
| +8.5V | 4B11 | 4B11 | 4B11 | 4B11 | 4B11 | 4B11 |
| +8.5V | 6B11 | 6B11 | 6B11 | 6B11 | 6B11 | 6B11 |
| +8.5V | 8B11 | 8B11 | 8B11 | 8B11 | 8B11 | 8B11 |
| -8.5V | | | | 7D07 | | |

Notes:

1. This net is listed twice with different line names: one for EIA/CCITT and one for 38LS.
2. All D03 board pins are +5 volts. All D08 pins are ground.
3. For all voltage nets, see 458.
4. Used when the feature main MPU is not installed.
5. Used when the feature main MPU is installed.

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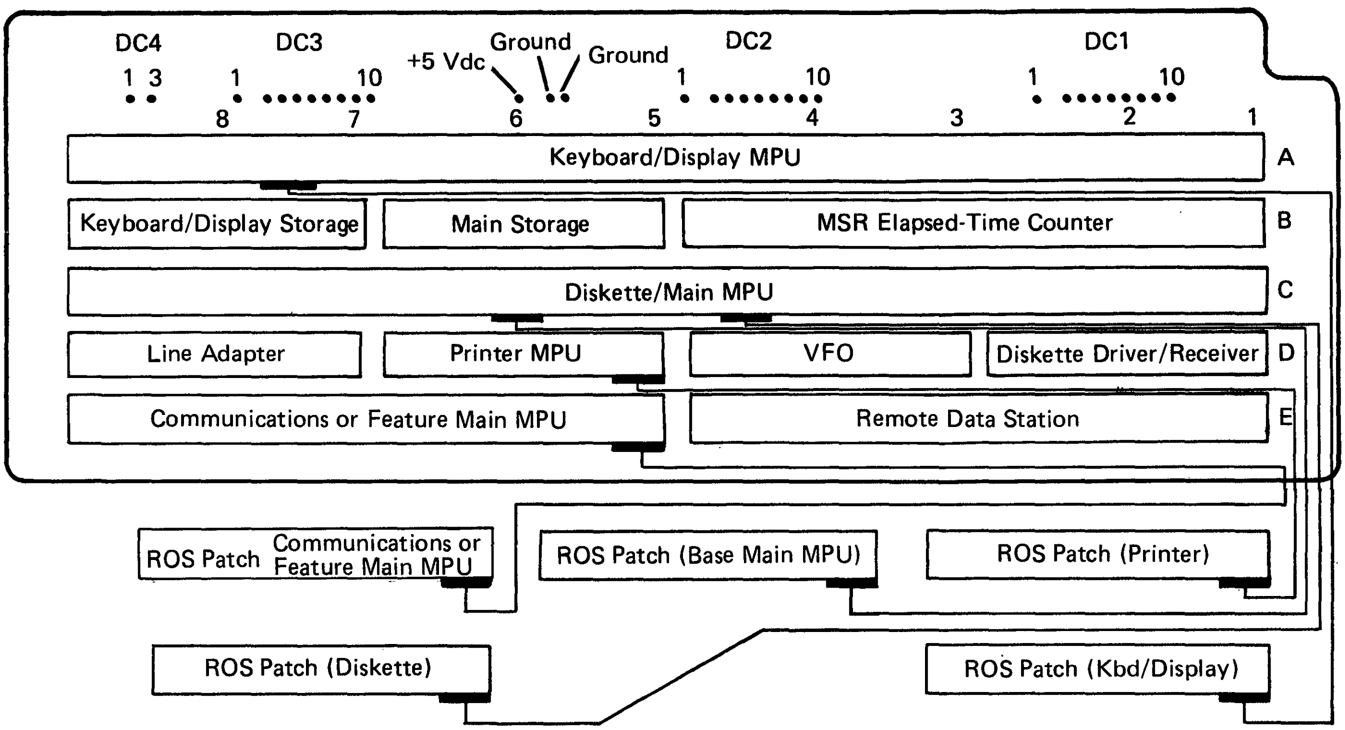
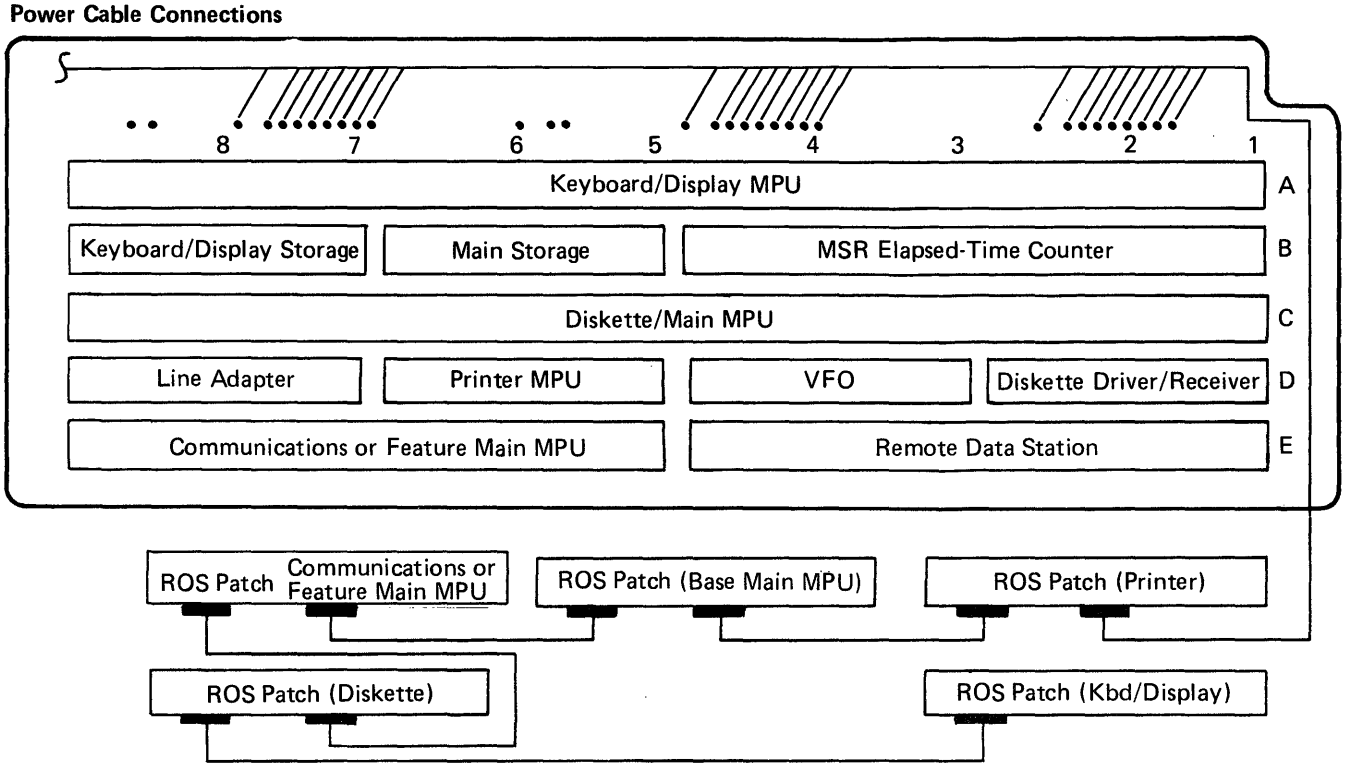
## 561 ROS PATCH CARD LOCATIONS AND CABLES

The following figure shows where the different ROS patch cards plug in on the logic board.

**Signal Cable Connections**




**Power Cable Connections**



## 563 ROS PATCH CARD REMOVAL AND REPLACEMENT

**Removal**

1. Power off.
2. Remove the data station covers (031).
3. Remove the logic card cover (513).
4. Disconnect the signal cable **1** from the ROS patch card.
5. Remove the retainer clip **4** and remove the power cable from J02 **3**.
6. If a power cable is present at J03 **5**, remove the retainer clip **6** and remove the cable.
7. Remove the ROS patch card.

CAUTION
The logic cards will overheat if patch cards (either ROS patch or dummy patch) are not installed.

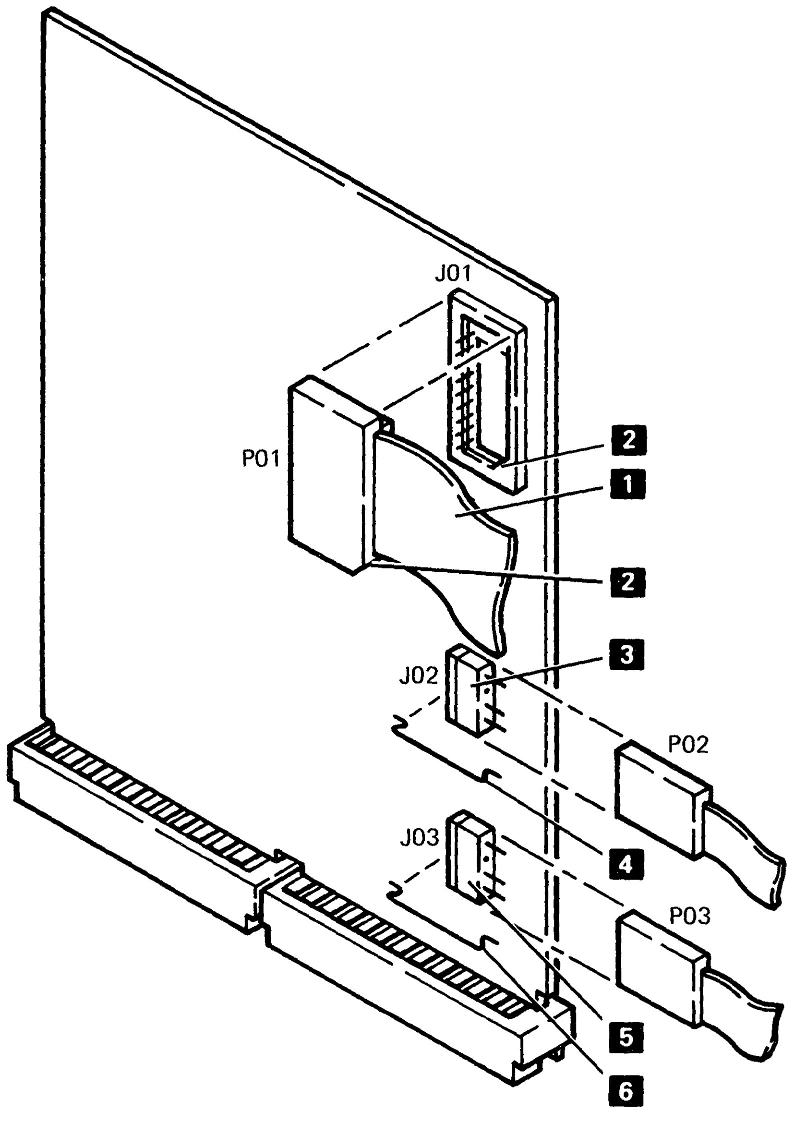
9. If you are not going to install a ROS patch card in the same position as the one you just removed, install a dummy patch card in that position.

**Replacement**

For replacement of the ROS patch card, observe the following and reverse the steps in the removal procedure.

1. Align the corner cut on the signal cable connector **2** with the corner cut of the connector on the ROS patch card.
2. Route the cables correctly (561).

563 ROS PATCH CARD
REMOVAL AND REPLACEMENT (continued)



## 565 ROS PATCH CARD IDENTIFICATION

All MPU modules that can have a patch installed have the following labels:

- Kx — Keyboard/display MPU
- $M_Bx$ — Base Main MPU
- $M_Fx$ — Feature Main MPU
- $D_Bx$ — Base diskette MPU
- $P_Tx$ — Printer MPU
- Cx — Communications MPU

The alphabetic character identifies the MPU module. The numeric character identifies the level of microcode in the module.

ROS patch cards also have a label. The label identifies the MPU with which that card is associated and when the card must be installed and removed.

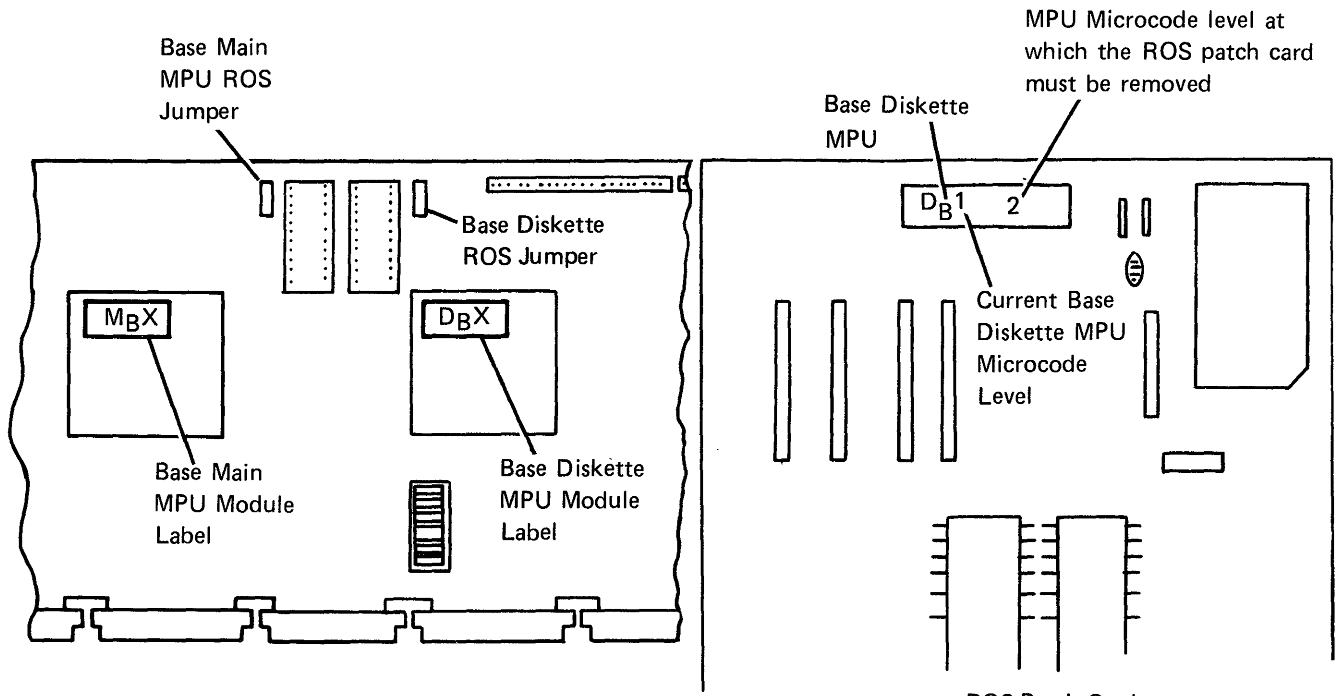
For example, a ROS patch card with a label of $D_B12$ is associated with the base diskette MPU ($D_B$). The 1 in the ROS patch card label denotes that the card must be used with an MPU that has a microcode level of 1.

The 2 in the ROS patch card label denotes that the card must be removed when an MPU card with a microcode level of 2 or higher is installed.

Do not install a ROS patch card if the microcode level on the MPU label is higher than the microcode level on the ROS patch card.

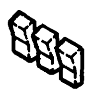
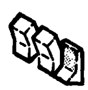
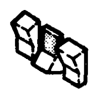
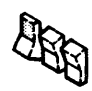
If a ROS patch card is installed, the ROS patch jumper on the associated MPU card must be removed before the ROS patch can be used.

When a ROS patch card is removed, the ROS patch jumper on the associated MPU card must be installed.



## 705 PRINTER ADDRESSES

If the printer installed on the system does not have the Cable Thru feature (no address switches on the printer), the address is always 8000. If the printer installed on the system does have the Cable Thru feature, the following chart shows the valid printer addresses and the printer address switch settings. See the printer MIM for the location of the address switches.

| Port On Rear Of Controller | Printer Address | | | | |
|---|---|---|---|---|---|
| 20 | 8000 | 8001 | 8002 | 8003 | 8004 |
| 5256 And 5225 Printer Address Switch Setting |  |  |  |  |  |

## 711 TWINAXIAL CABLE CONTINUITY AND POLARITY CHECK

Use the continuity and polarity check to test the twinaxial cable for open and shorted lines and for lines that have reversed polarity.

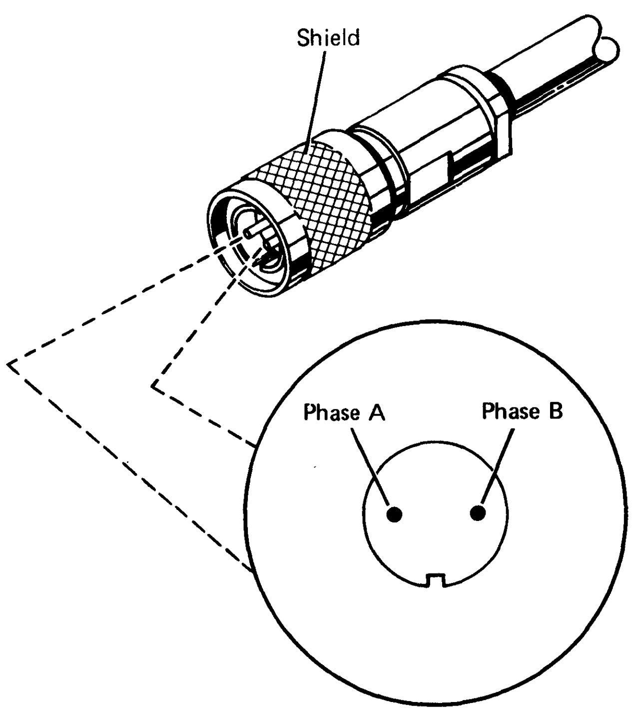
The total length of the cables cannot exceed 1524 meters (5000 feet).

To perform the continuity and polarity checks, you need an ohmmeter to measure resistance and jumpers to connect the signal lines (connector pins) to the cable shields (connector body).

### Continuity Check

Perform the continuity check as follows:

1. Unplug both ends of the cable. The following resistance measurements must exceed 100 000 ohms.
   a. Phase A to phase B
   b. Phase A to shield
   c. Phase B to shield




2. Connect Phase A and Phase B to the shield at one end of the cable.

3. Perform the following resistance measurements at the other end of the cable:
   a. Phase A to phase B 110 ohms or less
   b. Phase A to shield 70 ohms or less
   c. Phase B to shield 70 ohms or less

**Note:** If the preceding checks show that the cable is open or shorted, see 713 to find the location of the open or shorted lines.

### Polarity Check

Perform the polarity check as follows:

1. Connect phase A to the shield at one end of the cable.

2. Perform the following resistance measurement at the other end of the cable:

   Phase A to shield 70 ohms or less

**Note:** If the resistance exceeds 70 ohms, the lines are reversed.

## 713 TWINAXIAL CABLE QUALITY CHECK

Use the cable signal quality check to determine the location of the following types of failures: an open, a short circuit, a poor connection, or a wrong impedance match.

It is the customers responsibility to install and maintain the cables; therefore, use this procedure only under the following conditions:

- If the maintenance procedures instruct you to do so
- If the failure exists after you have performed all of the maintenance procedures
- If the customer cannot determine the problem and requests assistance

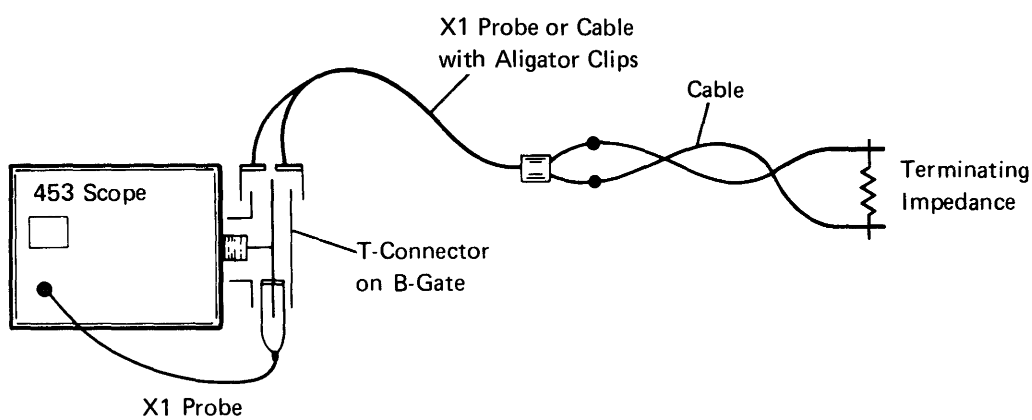
**Test Descriptions Using the Oscilloscope**

This cable check is known as TDR (time domain reflectometry). For more information on TDR, see *An Oscilloscope Measurement Procedure for Twisted and Coaxial Cables*, S226-3913.

Use the following tools and test equipment to perform the cable signal quality check.

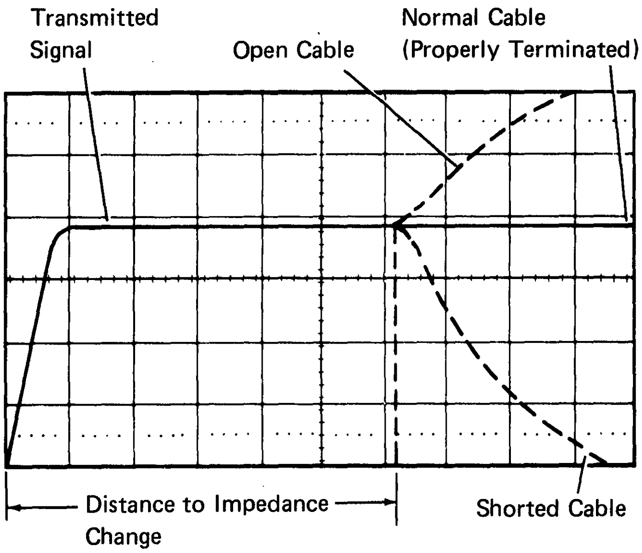
- Tektronix 453 or 475 oscilloscope
- BNC T-connector
- Either of the following:
  - Times-1 (X1) probe or
  - Coaxial cable with a BNC connector on one end and alligator clips on the other end.
- Probe tip to BNC adapter
- Resistor assembly. The resistor assembly is needed only if the end of the twinaxial cable is not terminated at a printer.

This test transmits a signal down the cable using the square wave from the b-gate output on the oscilloscope as shown. Cables up to a maximum of 1524 meters (5000 feet), can be checked.



## 713 TWINAXIAL CABLE QUALITY CHECK (continued)

The following figure shows an oscilloscope display of a transmitted signal for a normal cable and the change that occurs if the cable is open or shorted:




*Normal Cable*

If the cable is terminated by the correct load impedance (110 ohms), all the power of the transmitted signal is used by the terminating impedance.

*Defective Cable*

If there is a cable failure that changes the impedance of the cable, part of the signal is returned to the signal source as a reflection.

A shorted cable causes the impedance to be lower than normal. The reflection is out of phase; this causes a decrease in the amplitude of the signal.

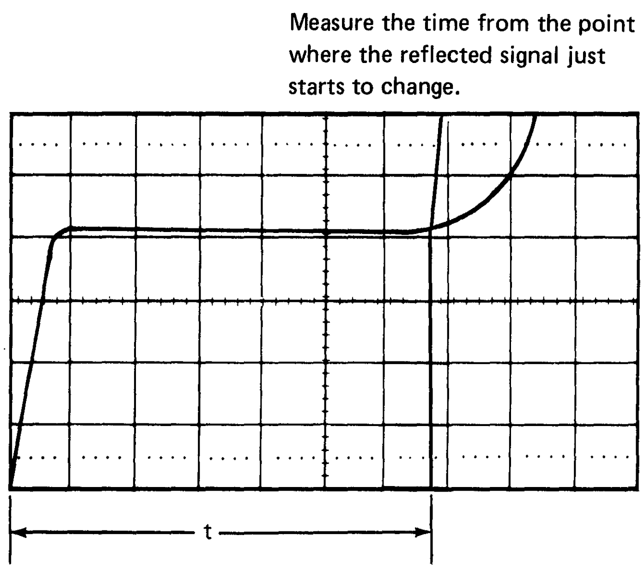
An open cable causes the impedance of the cable to be higher than normal. The reflection is out of phase; this causes an increase in the amplitude of the signal.

**Calculating Distance to Cable Problem**

Use the calculations described in the following figure to determine the distance to a cable problem from the end of the cable you are checking.

In making the calculations, it is important that you:

- Calculate the distance precisely
- Measure the time in microseconds
- Determine the time (t) by multiplying the b-time base by the number of oscilloscope divisions as shown in the following figure:




Calculations for determining the distance in feet and meters are:

Distance in feet = t x 324.7 feet
Distance in meters = t x 99 meters
t = time in microseconds. To find t, multiply the b-time base setting by the number of oscilloscope divisions.

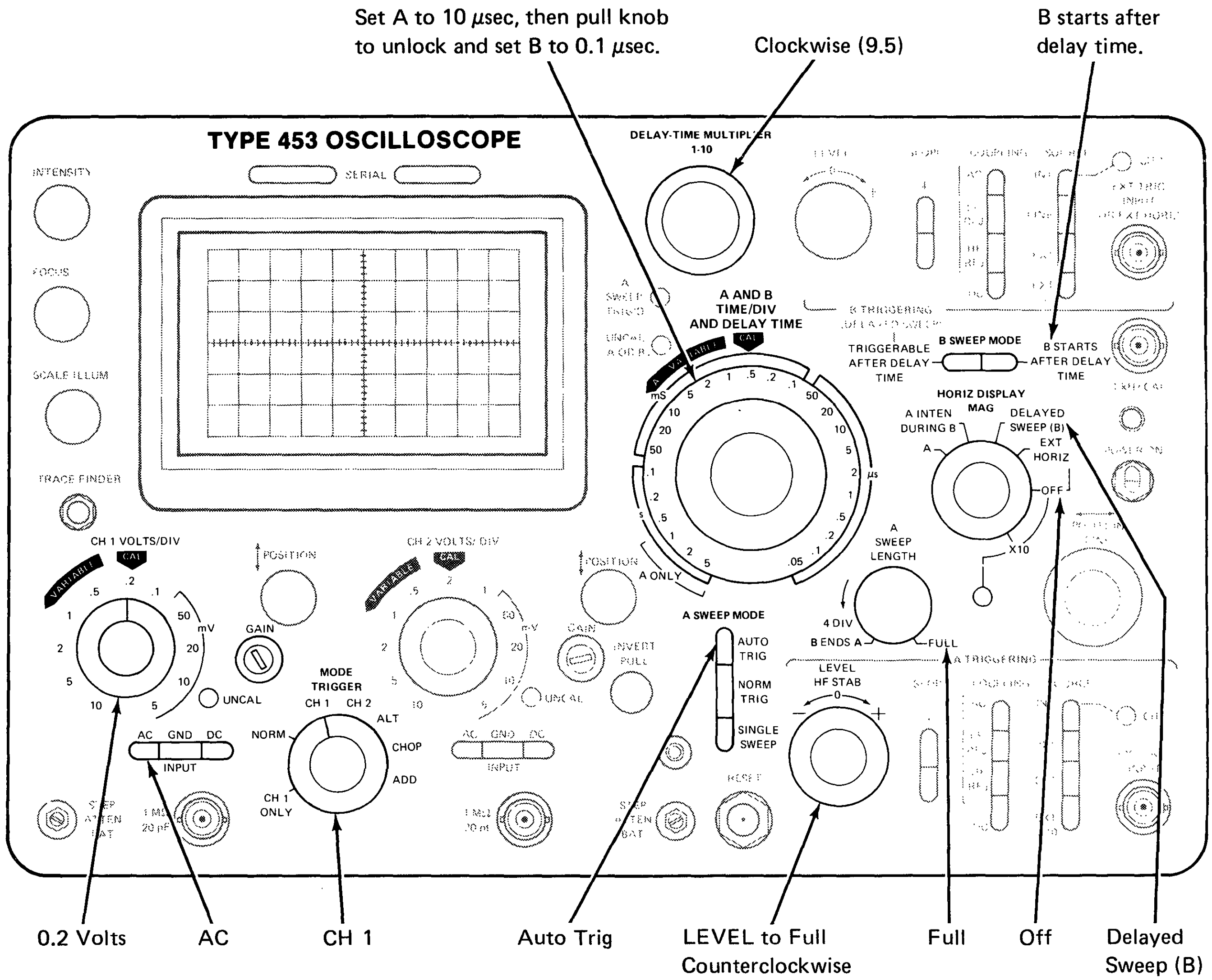
For example, the following calculation is for the transmitted signal above (assuming that the b-time base is set for 0.1 microseconds).

t = 6.8 divisions x 0.1 = 0.68 microseconds
0.68 microseconds x 99 meters = 67.3 meters
0.68 microseconds x 324.7 feet = 220.8 feet

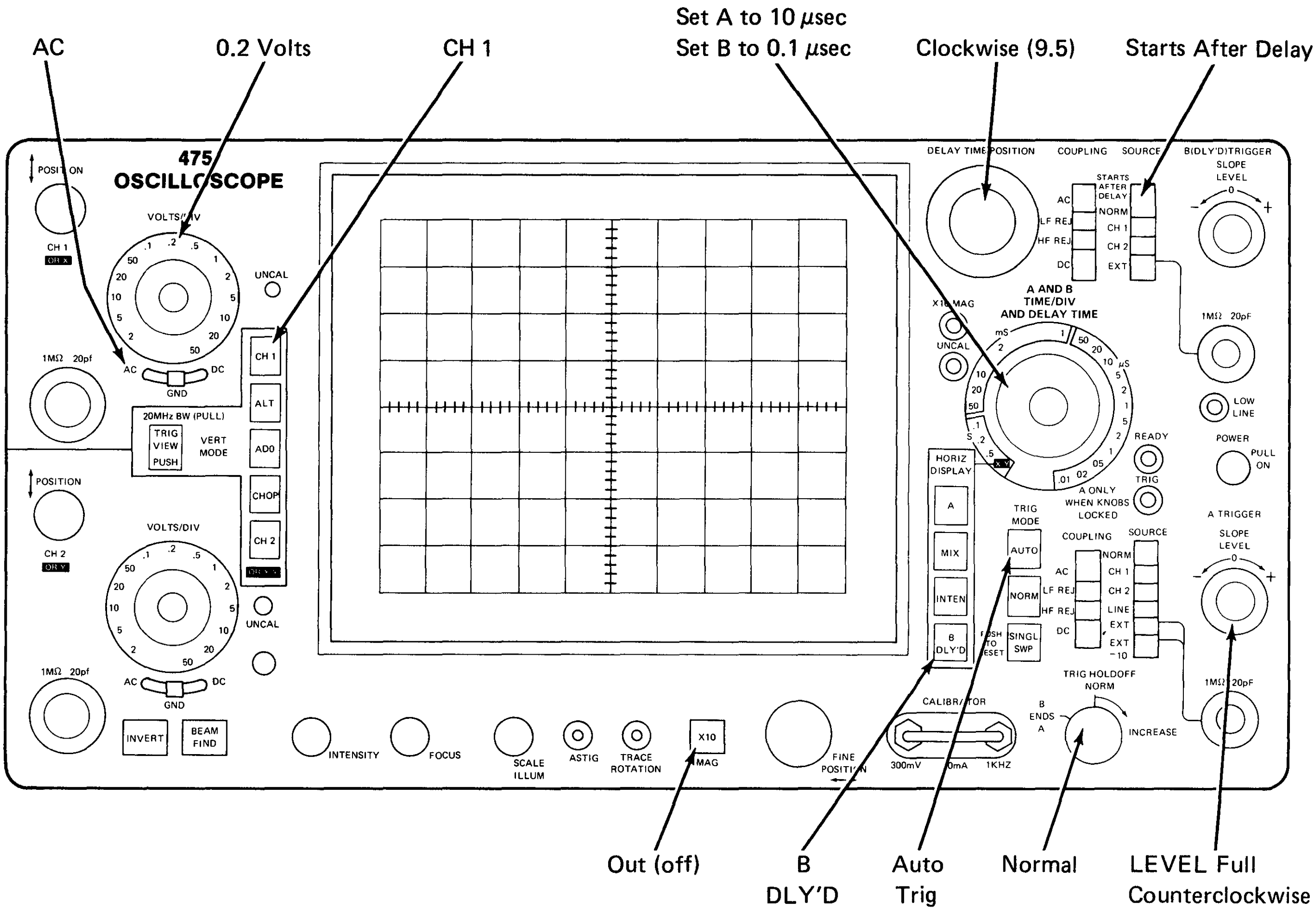
## 713 TWINAXIAL CABLE QUALITY CHECK
(continued)

**Cable Quality Check Procedures**

1. Set the controls and switches on the oscilloscope as shown in the following figures:



## 713 TWINAXIAL CABLE QUALITY CHECK
**(continued)**

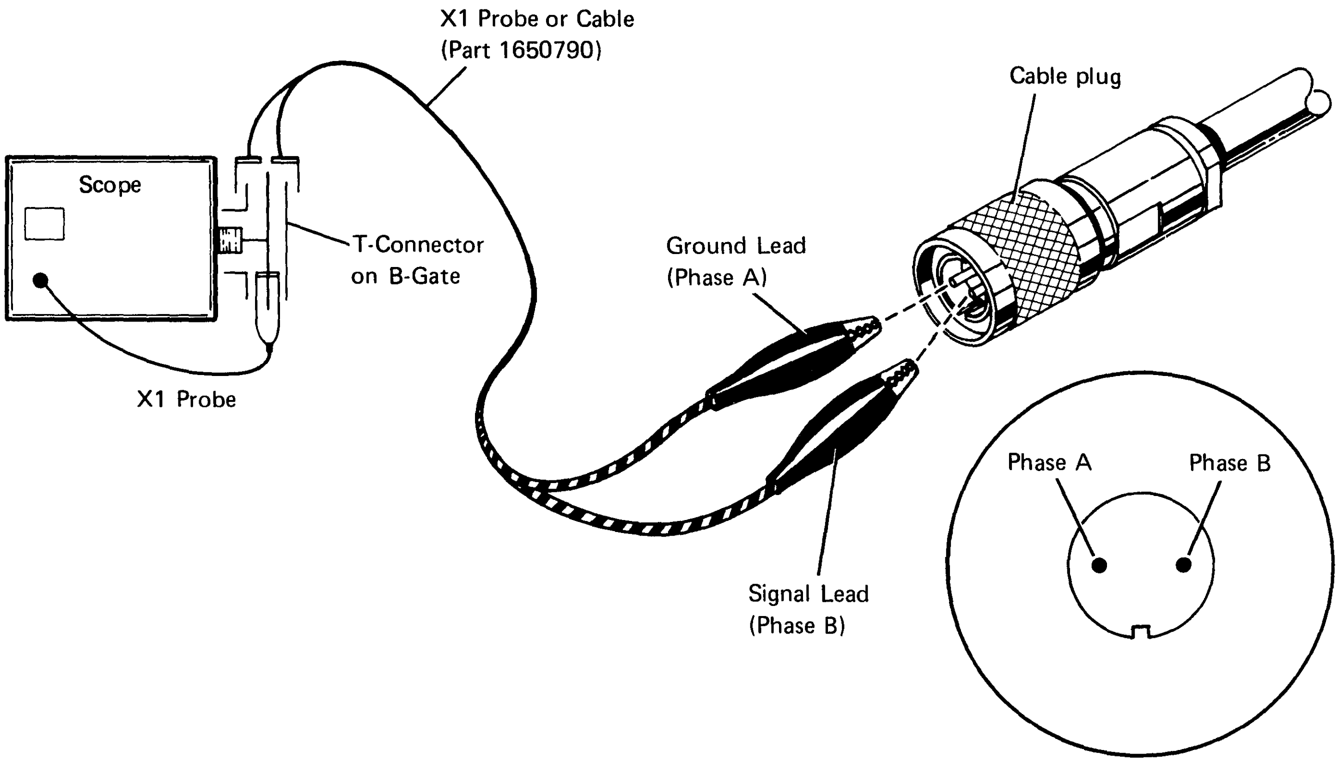


## 713 TWINAXIAL CABLE QUALITY CHECK
**(continued)**

2. Connect the T-connector to the b-gate on the side panel or rear of the oscilloscope as shown in the following figure. (The output of the b-gate transmits a signal on the cable.)

3. Connect a times-1 (X1) probe from the channel 1 input to one side of the T-connector.

4. Connect a times-1 (X1) probe or a cable with alligator clips to the other side of the T-connector.

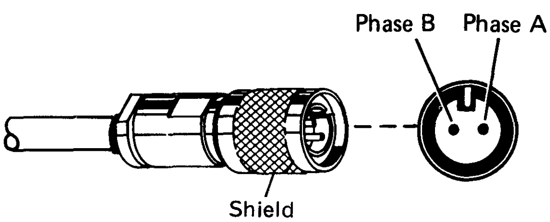


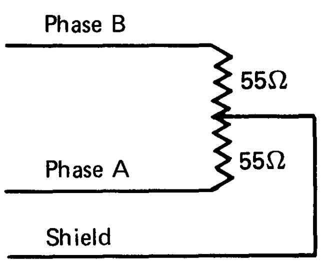
## 713 TWINAXIAL CABLE QUALITY CHECK (continued)

5. Ensure that the other end of the cable being checked is terminated. There are two ways to terminate the cable:

   - Connect the cable to the printer. If the printer has a Cable Thru feature (two twinaxial cable connectors on the back of the printer) set the terminate switch to 1.

   - Terminate the end of cable with a resistor assembly as shown.




6. Connect the alligator clips to the end of the cable being checked. To check all possible combinations for bad cables, scope each of the following connections:

   - The ground lead to phase A and the signal lead to phase B.

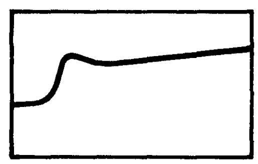
   - The ground lead to the shield and the signal lead to phase B.

   - The ground lead to the shield and the signal lead to phase A.

7. Depending on the reflection you see, adjust the oscilloscope as follows:

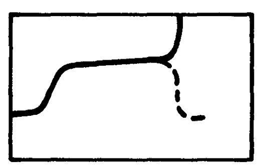
| Reflection | Meaning | Adjustment |
|---|---|---|
| None | The cable might be good or the first good part of a long cable is displayed with the failing point not displayed (that is, the cable is longer than 100 meters (328 feet) | Increase the b-time/div from 0.1 to 0.2 microseconds or higher until a reflection is forced |
| Single or Multiple | The failing point is less than 50 meters (164 feet) from your end of the cable or the b-time base is not set correctly. | Decrease the b-time/div to 0.05 microseconds so a single reflection is displayed |

No Reflection



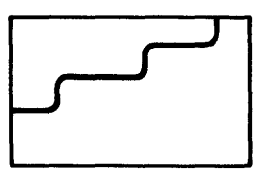
b-sweep time/div = 0.1$\mu$s/div

Single reflection



b-sweep time/div = 0.1$\mu$s/div

Multiple reflections



b-sweep time/div = 0.1$\mu$s/div

8. When a reflection is displayed, use the calculation previously described to determine the distance from the end of the cable to the failure.

## 713 TWINAXIAL CABLE QUALITY CHECK (continued)

### Testing Considerations

To determine the length of the cable, unplug both ends of the cable. Once the reflection is displayed, short the opposite end of the cable. If the displayed reflection changes by 180 degrees, you are displaying the other end of the cable. No change in deflection indicates a failure in the cable. Use the connection combinations listed in step 6 until the display changes. Determine the length of the cable by using the calculation previously described.

Cables can be connected together up to a maximum length of 1524 meters (5000 feet).

The B-setting of 0.1 microseconds displays cables of up to 100 meters (328 feet) or the first part of longer cables. To display longer cables of up to 1524 meters (5000 feet), use the B-setting of up to 2 microseconds. The 2 microsecond setting equals 198 meters (649.4 feet)/division.

To expand small changes, adjust the channel 1 position knob and channel 1 volts/div to a lower setting.

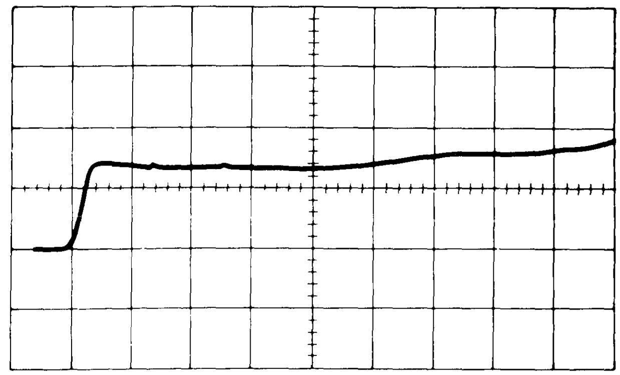
Large impedance changes at long distances from the test end of the cable can cause reflections no larger than small impedance changes close to the test end of the cable.

Failure points less than 6 meters (20 feet) from the tested end of the cable, cause reflections to occur inside the rise time of the oscilloscope. Test both ends of the cable if no clear reflection of the failure point is displayed.

**Note:** The 6 meter (20 feet) measurement is approximate and relies on the oscilloscope that is used.

### Oscilloscope Display Examples

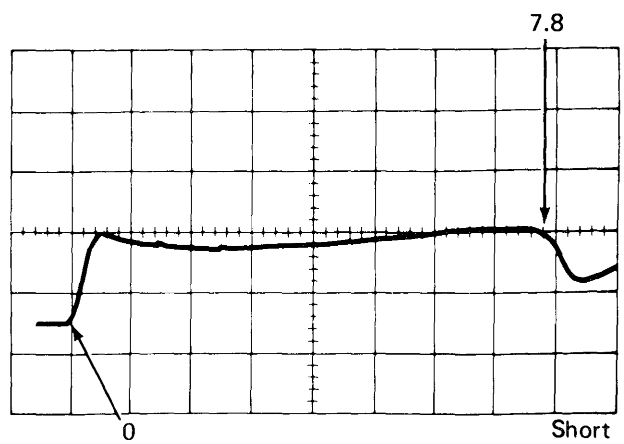
The following is a display of a good cable that is properly terminated. A gradual vertical change of the displayed signal is normal after the first oscilloscope division and will appear as an increased vertical change as the B-sweep time increases.



**Normal Cable (Properly Terminated)**

0.5 V
A=20 $\mu$s
B=0.2 $\mu$s

In the following figure, a short circuit at the end of the cable shows a downward reflection.



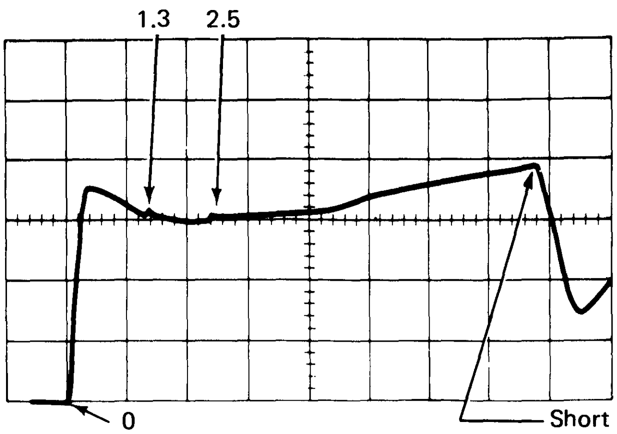

**Shorted Cable**

0.5 V
A=20 $\mu$s
B=0.2 $\mu$s

Length of sweep = 7.8 divisions
B-time/div = 0.2 microseconds/division
7.8 x 0.2 = 1.56 microseconds
1.56 x 99 = 154 meters or
1.56 x 324.7 = 507 feet

## 713 TWINAXIAL CABLE QUALITY CHECK (continued)

The following figure is the same as the preceding figure but has a higher vertical amplitude (0.2 volts/div). Notice the two changes at 1.3 and 2.5 division from the start. They represent very small impedance reflections at cable or printer connections 26 meters (85 feet) and 50 meters (164 feet) from the start.

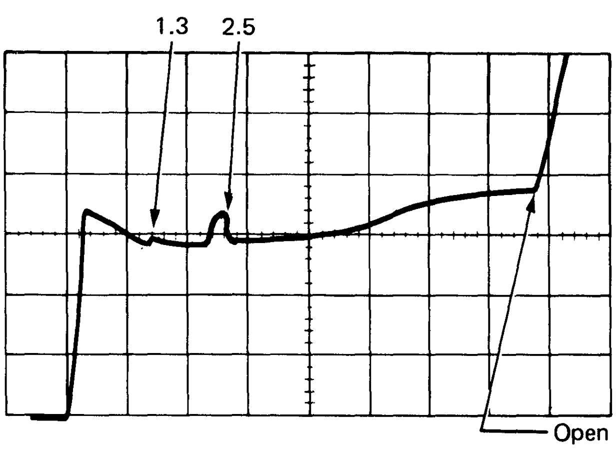



**Shorted Cable**

0.2 V
A=20 $\mu$s
B=0.2 $\mu$s

The following figure is the same as the preceding figure but with an open end. This is an effective way to measure the length of a cable.

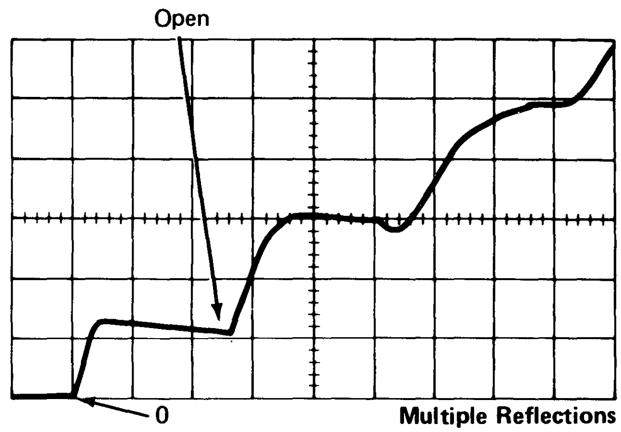
The changes at 1.3 and 2.5 indicate cable printer connections. The larger change at 2.5 indicates a worse connection than at 1.3




**Open Cable**

0.2 V
A=20 $\mu$s
B=0.2 $\mu$s

The following is a display of multiple cable reflections of a 26 meter (85 feet) good cable with an open end. The display is caused by the wrong vertical amplitude setting and the wrong b-time/div. Only the first reflection in this figure is important and should be expanded by changing the vertical amplitude to 0.2 volts/div and the b-time/div to 0.05 microsecond/div.

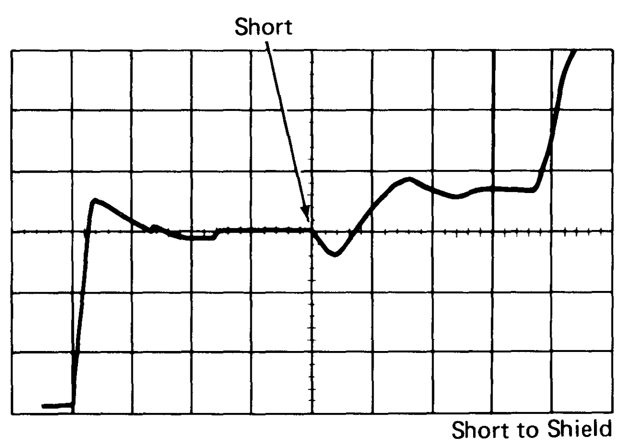



**Open Cable**

0.5 V
A=20 $\mu$s
B=0.1 $\mu$s

The following figure shows 155 meter (510 feet) cable with a short circuit from one wire to the shield at approximately 78 meters (255 feet) from the test end. The other end is open.

Notice the quick vertical changes indicated by the pointer. A reflection of more than 10 percent of the transmitted signal, measured inside 100 meters (328 feet) of the failure point, usually indicates a wrong impedance match.




0.2 V
A=20 $\mu$s
B=0.2$\mu$s

## 715 STATION PROTECTOR SERVICE CHECK

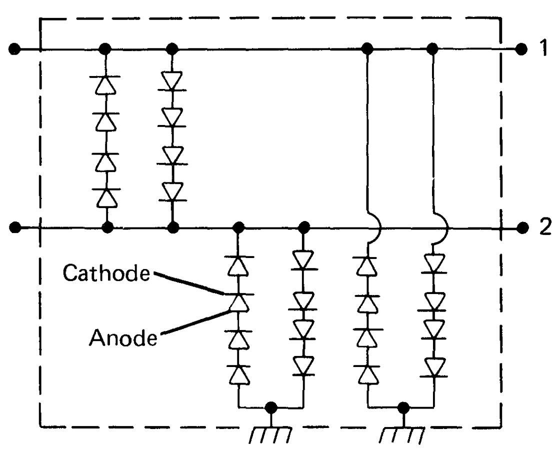
The station protector must be installed at each exit and entry point on the twinaxial cable when that cable enters or exits a building.

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

The cables to the station protector must be disconnected before the checks can be made. This will disconnect the printers from the controller.

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

Station Protector Board



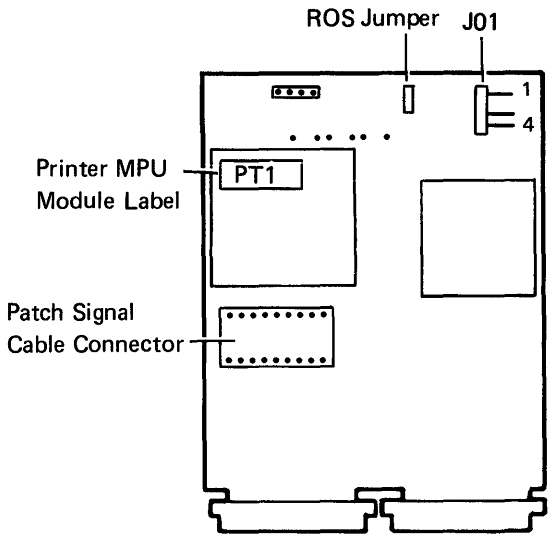

Use only CE meter part 1749231. Use the Rx 100 scale.

1. Check each diode with the black lead of the CE meter connected to the anode and the red lead connected to the cathode. The resistance should be less than 2000 ohms.

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

## 731 PRINTER MPU CARD (A-D5)

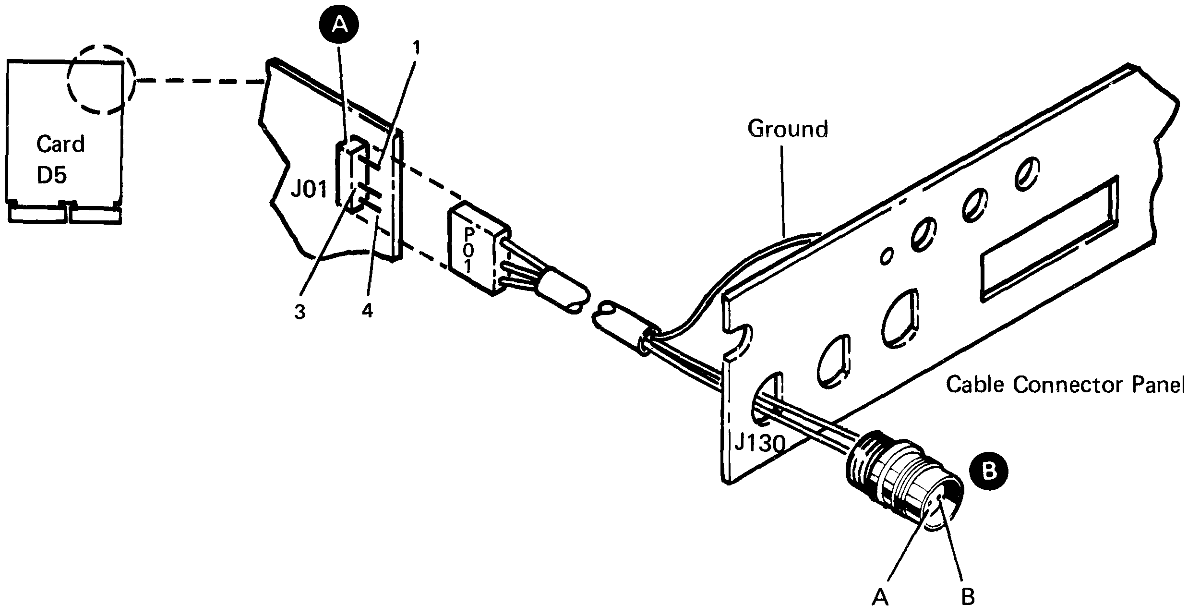
The printer MPU card contains the printer MPU and the logic needed to control one printer. The following figure shows the location of the parts on the card:




**Note:** If you exchange the printer MPU card, see 565 for information concerning the ROS jumper and the ROS patch cards.

## 741 PRINTER CABLE DIAGRAM

The following cable diagram and table shows the physical cable connections, each line name, and all associated connecting points. See 901 for information on how to use the cable diagram.




| Card D5 J01 **A** | Rear Connector Panel J130 **B** | Line Name |
|---|---|---|
| 1 | A | Port 20-A |
| 3 | | Ground |
| 4 | B | Port 20-B |

**Note:** Pin B on J130 is identified by a dot on the rear of the connector.

## Magnetic Stripe Reader

### 751 MAGNETIC STRIPE READER SERVICE CHECK

1. Power on.

2. Load the standalone program MSRTEST from the diagnostic diskette 1 (971). Use the keyboard associated with the MSR to be tested.

3. Hold the test card so the magnetic stripe is at the bottom of the card and is facing you.

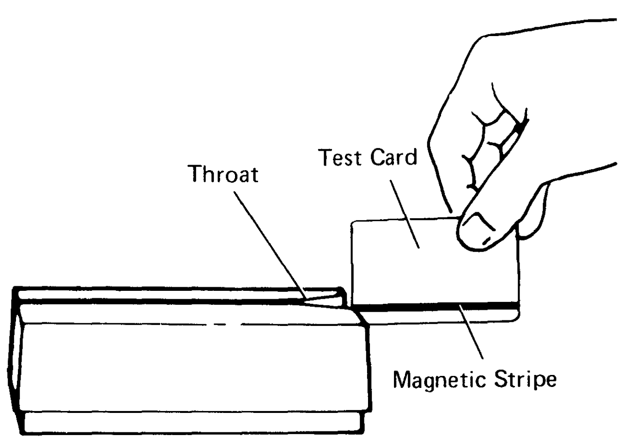
4. Insert the test card into the throat.

5. Move the test card smoothly and continuously through the magnetic stripe reader from right to left at a rate of 120 millimeters to 1000 millimeters (5 inches to 40 inches) per second.

**Note:** The card must remain against the bottom surface of the throat.

6. The following characters should appear on the display screen:

   BB0123456789BACDE0123456789




### 761 MAGNETIC STRIPE READER REMOVAL AND REPLACEMENT

**Removal**

1. Power off.

2. Remove the data station covers (031).

3. Remove the logic board cover (521).

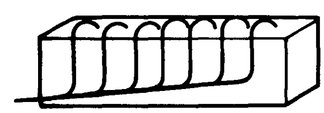
4. Disconnect the magnetic stripe reader cable from the MSR logic card (785).

5. Remove the power supply (470).

6. Remove the strain reliefs from the cable.

7. Remove the grommet from the cable access hole.

8. Fold the cable wires as shown:



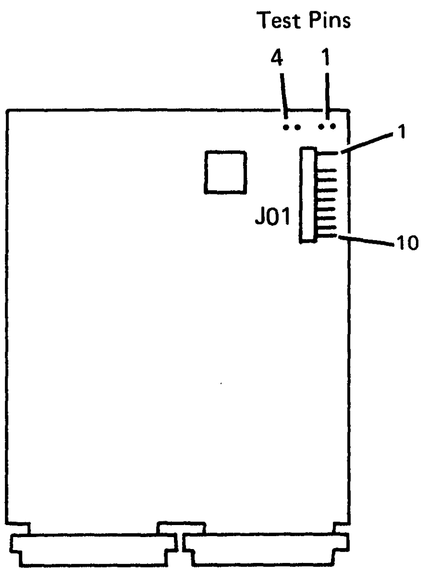
9. Remove the MSR cable from the data station base. (Note the cable routing for the replacement procedure).

**Replacement**

For replacement of the MSR, reverse the steps in the removal procedure.

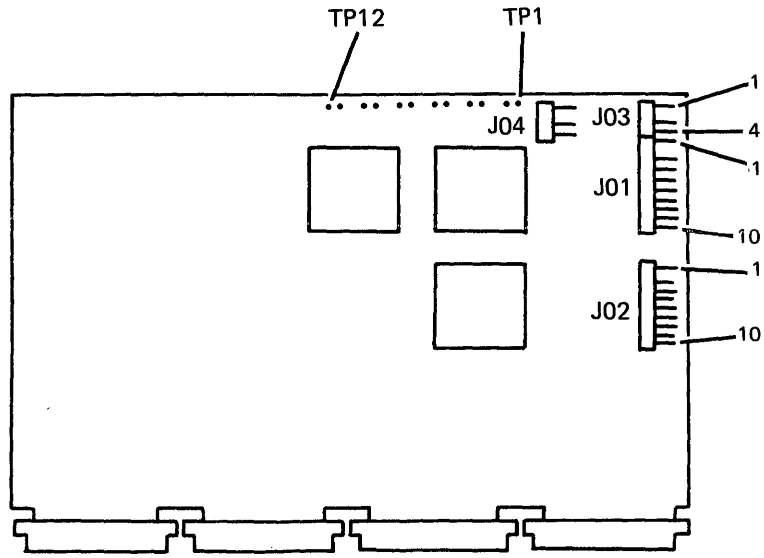
## 771 1 MSR AND ELAPSED-TIME COUNTER CARD (A-B1)

The 1 MSR and elapsed-time counter card contains the logic needed to control one MSR and one elapsed-time counter. The following figure shows the location of the parts on the card:



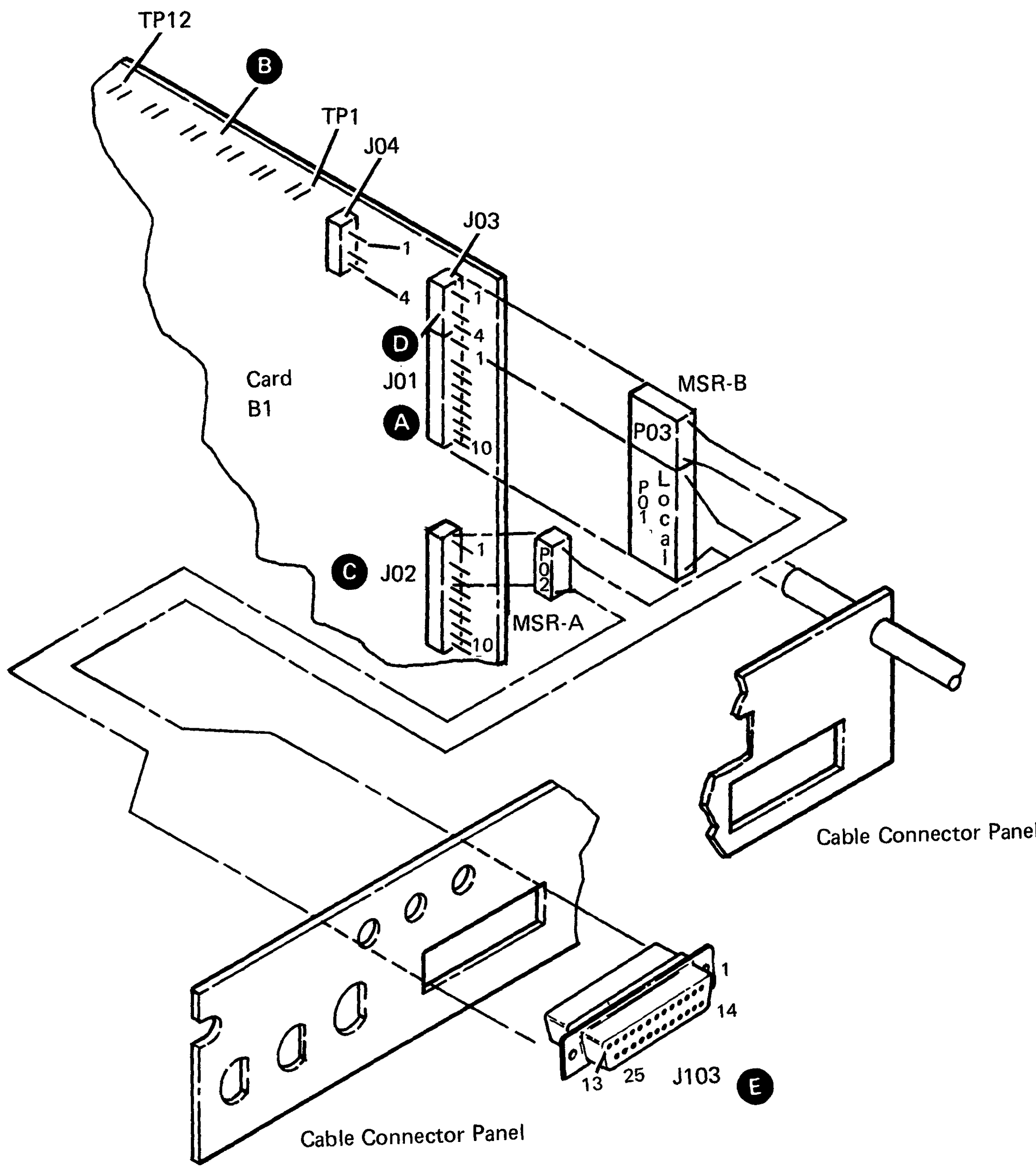

## 773 4 MSR AND ELAPSED-TIME COUNTER CARD (A-B1)

The 4 MSR and elapsed-time counter card contains the logic needed to control up to four MSRs and one elapsed-time counter. The following figure shows the location of the parts on the card:



## 785 MSR CABLE DIAGRAM (MACHINES WITHOUT COMMUNICATION FEATURE)

The following cable diagram and table shows the physical cable connections, each line name, and all associated connecting points. See 901 for information on how to use the cable diagram. The arrow (→) indicates the logical direction of signal.



## 785 MSR CABLE DIAGRAM (MACHINES WITHOUT COMMUNICATION FEATURE) (continued)

**Local MSR**

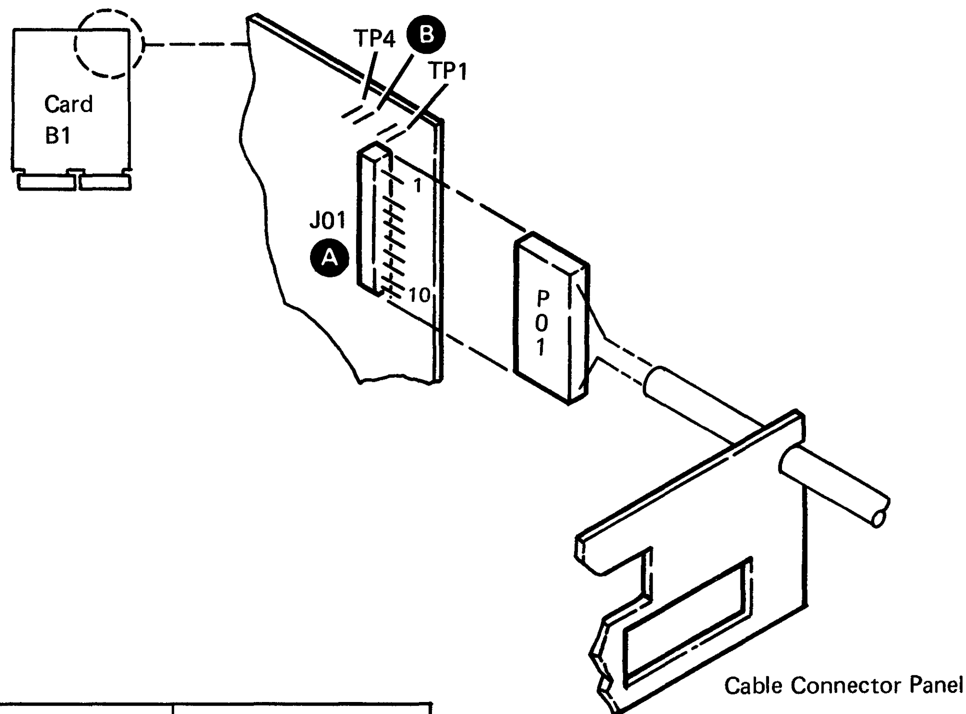
| | Card B1 | | |
|---|---|---|---|
| | TP B | J01 A | Line Name |
| | | 4 | ground |
| ← | 10 | 5 | +photocell MSR-A |
| ← | 9 | 6 | +raw data MSR-A |
| | | 7 | ground |
| | | 8 | +5 Vdc |
| | | 9 | ground |
| | | 10 | -5 Vdc |

**Remote MSR**

| | Card B1 | | | | Rear Connector | |
|---|---|---|---|---|---|---|
| | TP B | J02 C | TP B | J03 D | Panel J103 E | Line Name |
| ← | 4 | 1 | | | 16 | +photocell MSR-A |
| ← | 3 | 3 | | | 17 | +raw data MSR-A |
| | | 4 | | | Frame ground | ground |
| | | | | | | |
| ← | | | 2 | 1 | 18 | +photocell MSR-B |
| ← | | | 1 | 3 | 19 | +raw data MSR-B |
| | | | | 4 | Frame ground | ground |

## 787 MSR CABLE DIAGRAM (MACHINES WITH COMMUNICATION FEATURE)

The following cable diagram and table shows the physical cable connections, each line name, and all associated connecting points. See 901 for information on how to use the cable diagram. The arrow (→) indicates the logical direction of the signal.




| | Card B1 | | Line Name |
|---|---|---|---|
| | TP B | J01 A | |
| | | 4 | ground |
| ← | 2 | 5 | +photocell MSR-A |
| ← | 1 | 6 | +raw data MSR-A |
| – | | 7 | ground |
| – | | 8 | +5 Vdc |
| – | | 9 | ground |
| – | | 10 | -5 Vdc |

## Communications

This section contains procedures for installing jumpers on communications logic cards, procedures for using communications test equipment, and communications cable diagrams. For additional maintenance information, see Line Adapter Cards in the Theory section of this manual.

### 811 COMMUNICATIONS MPU CARD JUMPERS (A-E5)

The following communications MPU card diagram shows the location of card jumpers. Use this diagram when you perform any of the following card jumpering procedures.

#### 2-Wire or 4-Wire Selection for 38LS Nonswitched Modems

The communications MPU card can be jumpered to connect the 38LS modem to a 2-wire or a 4-wire nonswitched network. The 4-wire circuit supplies two leads to transmit and two to receive. A 2-wire circuit uses two leads to both transmit and receive.

The 2-wire/4-wire jumpers must be installed for a 2-wire circuit and removed for a 4-wire circuit.

#### EIA/CCITT Jumper

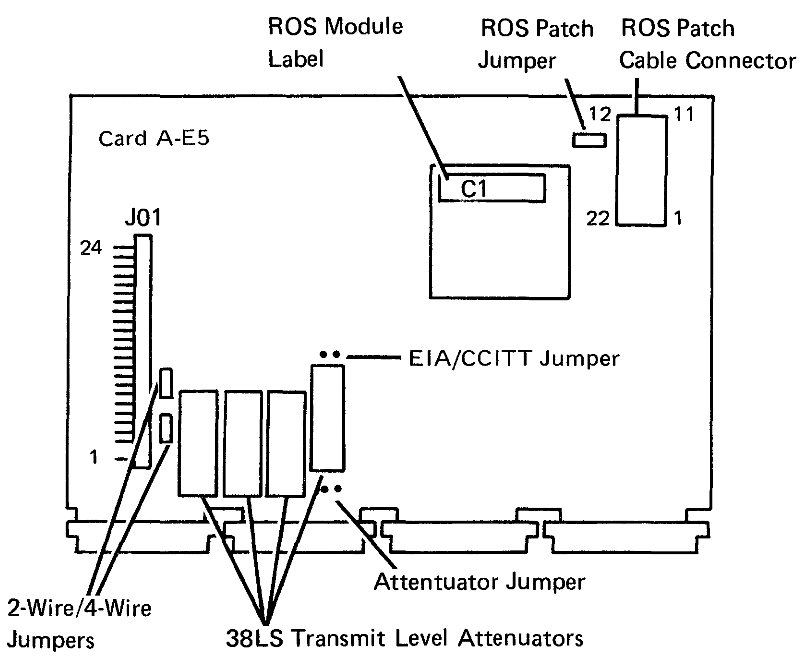
Remove the EIA/CCITT jumper on the communications MPU card if the 38LS card is installed in location A-D7.

#### Attenuator Jumper

The attenuator jumper must be installed when the MPU card without attenuators is installed.

#### ROS Patch Jumper

If you exchange the communications MPU card, see 565 for information about the ROS patch jumper and ROS patch card.

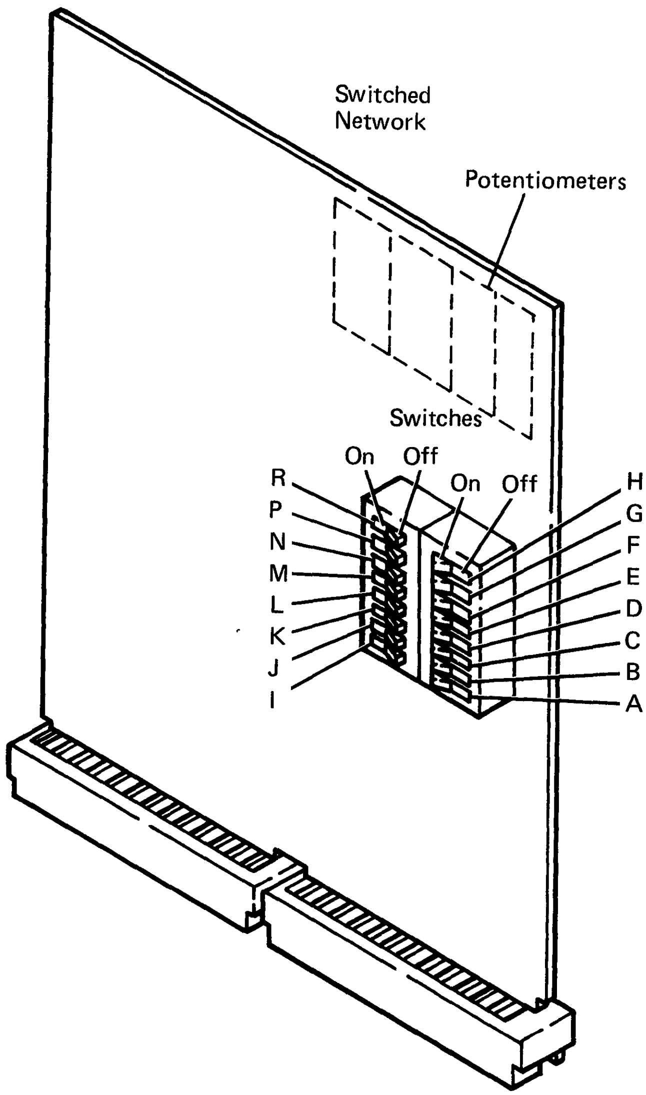


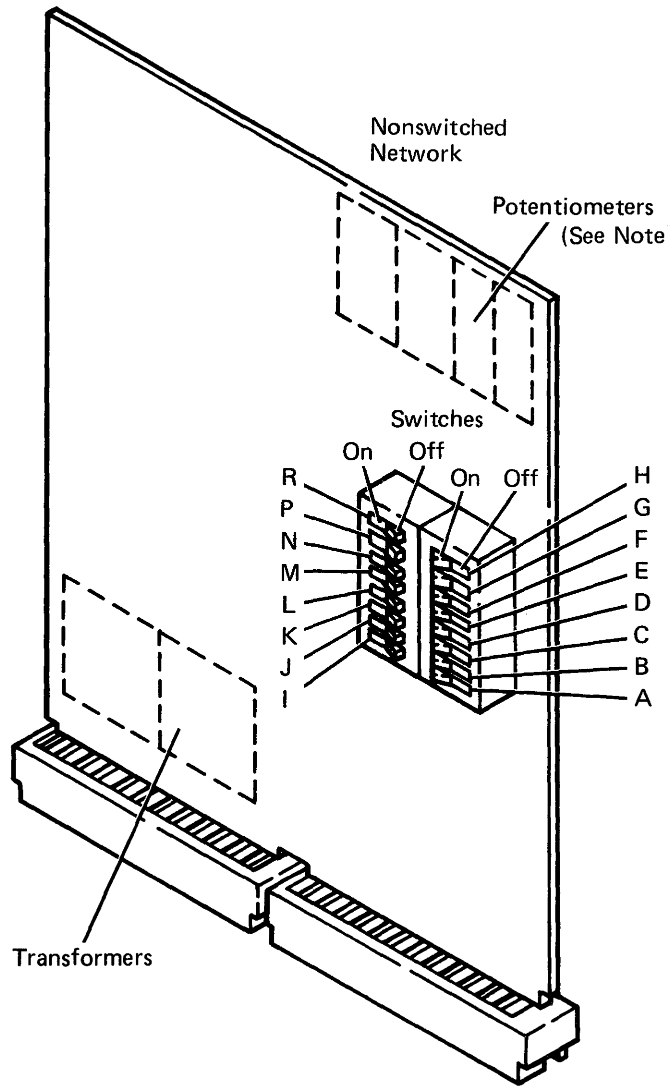

(The attenuators are present on cards in the United States and Canada when a 38LS switched network card is installed.)

## 812 38LS CARD IDENTIFICATION (A-D7)

To aid you in determining which 38LS card is installed on your IBM 5285, the following figures show the component arrangement on the different cards.

**38LS for United States and Canada**

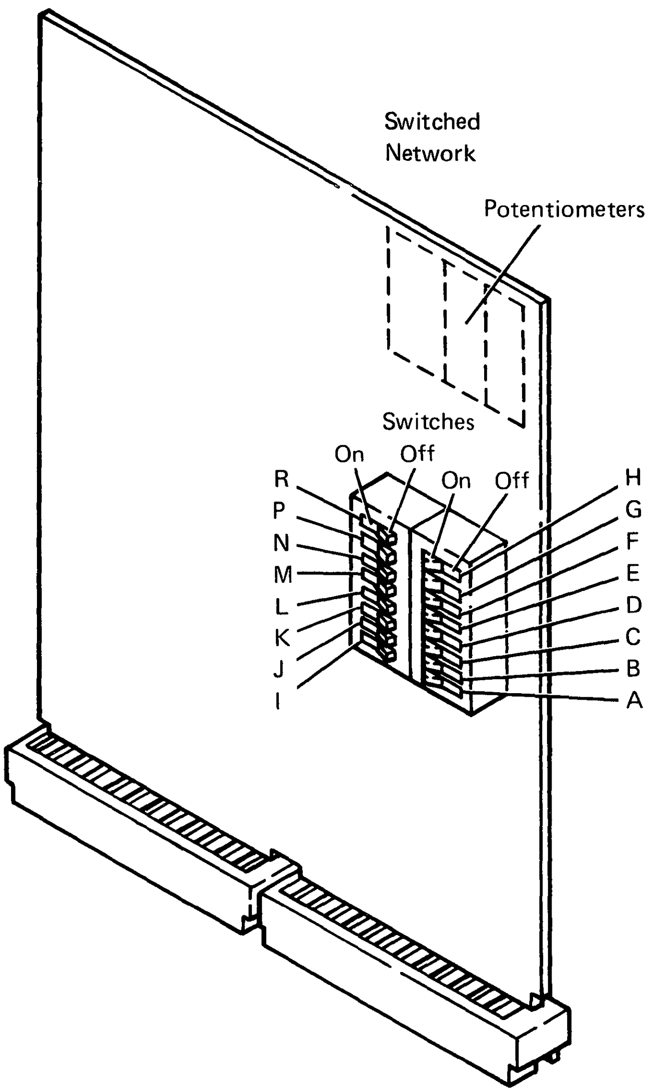


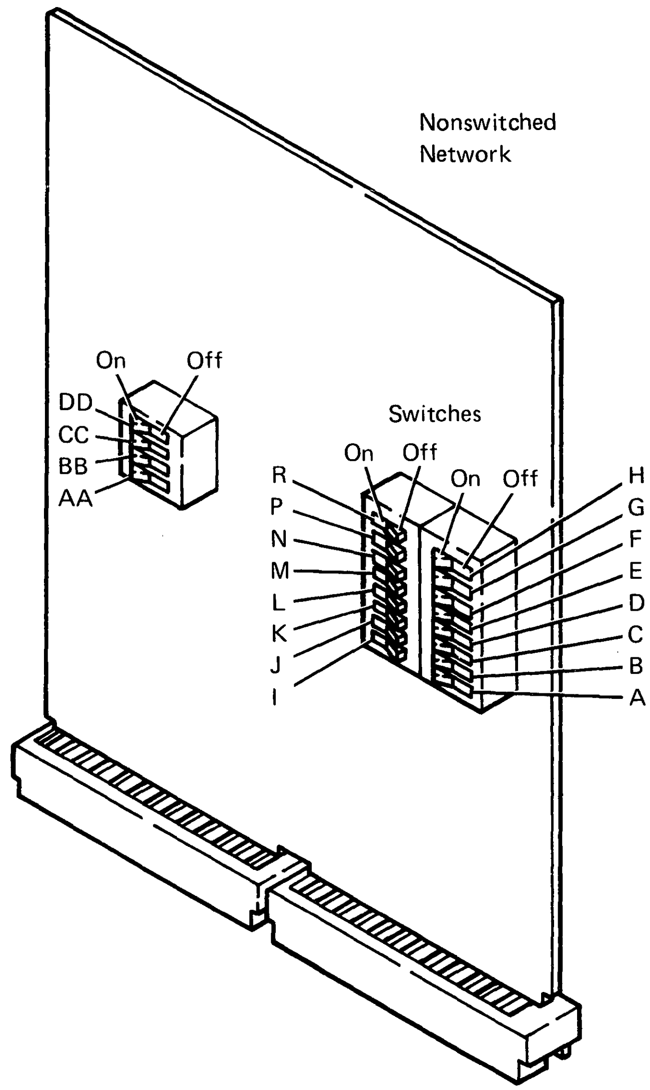




**Note:** The 38LS for a nonswitched network with manual answer SNBU has three potentiometers. The 38LS for a nonswitched network with auto-answer SNBU has four potentiometers.

## 812 38LS CARD IDENTIFICATION (A-D7) (continued)

### 38LS For World Trade Countries (except Canada)




**Note:**
Remove the plastic switch cover to change the settings of the switches. After you have changed the settings of the switches, reinstall the switch cover over the switches.

## 812 38LS CARD IDENTIFICATION (A-D7) (continued)

The 38LS modem features are shown in the following chart. The pages following the chart show the personalization of each model used in the IBM 5285.

| | **United States and Canada**<br><br>**Switched Network** | **United States and Canada**<br><br>**Nonswitched Network with SNBU (with auto-answer)** | **United States and Canada**<br><br>**Nonswitched Network with SNBU (with manual answer)** | **World Trade Countries (except Canada)**<br><br>**Nonswitched Network** | **World Trade Countries (except Canada)**<br><br>**Switched Network** |
|---|---|---|---|---|---|
| Frequencies<br>Mark (1)<br>Space (0)<br>Answer** | <br>1300 Hz<br>2100 Hz<br>2100 Hz (V23 mode) | <br>1300 Hz<br>2100 Hz<br>2100 Hz (V23 mode) | <br>1300 Hz<br>2100 Hz | <br>1300 Hz<br>2100 Hz | <br>1300 Hz<br>2100 Hz |
| Line Termination | 600 ohms | 600 ohms | 600 ohms | 600 ohms | 600 ohms |
| Levels<br>Transmit | <br>Adjustable (0 dBm* to -15 dBm* both data and answer**) | <br>0 dBm SNBU adjustable (0 dBm* to -15 dBm* for both data and answer) | <br>0 dBm SNBU adjustable (0 dBm* to -15 dBm* for data) | <br>0 dBm to -18 dBm | <br>0 dBm to -18 dBm |
| Receive Threshold on/off | -43 dBm/-48 dBm | -33 dBm/-38 dBm<br>-43 dBm/-48 dBm (SNBU) | -33 dBm/-38 dBm<br>-43 dBm/-48 dBm (SNBU) | -43 dBm/-48 dBm | -43 dBm/-48 dBm |
| 2-Wire or 4-Wire | 2-wire | Selectable SNBU 2-wire | Selectable SNBU 2-wire | Selectable | 2-wire |
| Timings<br>Answer Tone Duration** | <br>3.5 seconds | <br>3.5 seconds (SNBU) | <br>3.5 seconds (SNBU) | | <br>3.5 seconds |
| Clear-to-Send Delay | 230 milliseconds | Adjustable (30, 80, or 230 milliseconds)<br>230 milliseconds (SNBU) | Adjustable (30, 80, or 230 milliseconds)<br>230 milliseconds (SNBU) | Adjustable (30, 80, or 230 milliseconds) | 230 milliseconds |
| Echo Clamp | 150 milliseconds | Adjustable (0, 50, or 150 milliseconds)<br>150 milliseconds (SNBU) | Adjustable (0, 50, or 150 milliseconds)<br>150 milliseconds (SNBU) | Adjustable (0, 50, or 150 milliseconds) | 150 milliseconds |
| Equalization | None | None | None | Four stages of compensation (center-frequency delay with amplitude distortion, high-frequency delay, low-frequency delay, and additional center-frequency delay) | Four stages of compensation (center-frequency delay with amplitude distortion, high-frequency delay, low-frequency delay, and additional center-frequency delay) |
| Wrap Test Propagation Delay | 1.2 milliseconds | 1.2 milliseconds | 1.2 milliseconds | 3.0 milliseconds | 3.0 milliseconds |

*If the attenuators are present on the communications MPU card, the transmit levels can be specified in the communications configuration record through a range of 0 dBm to -15 dBm; see the *5280 Communications Reference Manual,* SC34-0247. The transmit level on the 38LS card must be set to 0 dBm.

**These specifications are for auto-answer only.

## 813 38LS PERSONALIZATION—NONSWITCHED NETWORK WITH MANUAL ANSWER SNBU—UNITED STATES AND CANADA

| | Switch Group 1 | Switch Group 2 | |
|---|---|---|---|
| Off (not used) | R | H | Transmit Level for SNBU |
| Clear-to-Send Delay | P | G | |
| | N | F | |
| Off | M | E | |
| Echo Clamp | L | D | |
| 2-Wire/4-Wire | K | C | |
| | J | B | |
| Transmit level | I | A | |

Remove the plastic switch cover to change the settings of the switches. After you have changed the settings of the switches, reinstall the cover over the switches.

- 2-wire or 4-wire selection for nonswitched networks
  - For 4-wire operation, set switch K on and switch J off.
  - For 2-wire operation, set switch K off and switch J on.
  - Also see 811 for 2-wire or 4-wire selection on the communications MPU card.
- Clear-to-send delay selection
  - For 4-wire operation, set switch N off and switch P on (30-millisecond delay).
  - For 2-wire operation, set switch N off and switch P off (230-millisecond delay).
- Echo clamp time selection[1]
  - For 150-millisecond time, set switch L off.
- Set switch M off.
- Transmit level for SNBU
  - Use the following table and set the transmit level to 0 dBm. (The transmit level is specified in the communications configuration record.)

| | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| 0 dBm | 1 | | | | | | | | |
| -1 dBm | | 1 | | | | | | | |
| -2 dBm | | | 1 | | | | | | |
| -3 dBm | | | | 1 | | | | | |
| -4 dBm | | | | | 1 | | | | |
| -5 dBm | | | | | | 1 | | | |
| -6 dBm | 1 | | | | | | 1 | | |
| -7 dBm | | 1 | | | | | 1 | | |
| -8 dBm | | | 1 | | | | 1 | | |
| -9 dBm | | | | 1 | | | 1 | | |
| -10 dBm | | | | | 1 | | 1 | | |
| -11 dBm | | | | | | 1 | 1 | | |
| -12 dBm | 1 | | | | | | | 1 | |
| -13 dBm | | 1 | | | | | | 1 | |
| -14 dBm | | | 1 | | | | | 1 | |
| -15 dBm | | | | 1 | | | | 1 | |
| -16 dBm | | | | | 1 | | | 1 | |
| -17 dBm | | | | | | 1 | | 1 | |
| -18 dBm | 1 | | | | | | | | 1 |

1 = On    Blank = Off

[1] The selection of both 4-wire and the 30-millisecond clear-to-send delay eliminates the echo regardless of the position of switch L.

## 815 38LS PERSONALIZATION–SWITCHED NETWORK–UNITED STATES AND CANADA

| | Switch Group 1 | Switch Group 2 | |
|---|---|---|---|
| Off (not used) | R | H | |
| | P | G | |
| | N | F | |
| Off | M | E | Transmit Level |
| Off (not used) | L | D | |
| On | K | C | |
| Auto-answer or Manual Answer | J | B | |
| Transmit Level | I | A | |

Remove the plastic switch cover to change the settings of the switches. After you have changed the settings of the switches, reinstall the switch cover over the switches.

- Auto-answer or manual answer selection
  - For auto-answer, set switch J on.
  - For manual answer, set switch J off.

- Set switch M off

- Set switch K on on.

- Transmit level selection
  - Use the following chart and set the transmit level to 0 dBm. (The transmit level is specified in the communications configuration record.)

| | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| 0 dBm | 1 | | | | | | | | |
| -1 dBm | | 1 | | | | | | | |
| -2 dBm | | | 1 | | | | | | |
| -3 dBm | | | | 1 | | | | | |
| -4 dBm | | | | | 1 | | | | |
| -5 dBm | | | | | | 1 | | | |
| -6 dBm | 1 | | | | | | 1 | | |
| -7 dBm | | 1 | | | | | 1 | | |
| -8 dBm | | | 1 | | | | 1 | | |
| -9 dBm | | | | 1 | | | 1 | | |
| -10 dBm | | | | | 1 | | 1 | | |
| -11 dBm | | | | | | 1 | 1 | | |
| -12 dBm | 1 | | | | | | | 1 | |
| -13 dBm | | 1 | | | | | | 1 | |
| -14 dBm | | | 1 | | | | | 1 | |
| -15 dBm | | | | 1 | | | | 1 | |
| -16 dBm | | | | | 1 | | | 1 | |
| -17 dBm | | | | | | 1 | | 1 | |
| -18 dBm | 1 | | | | | | | | 1 |

1 = On Blank = Off

## 817 38LS PERSONALIZATION—NONSWITCHED NETWORK WITH AUTO-ANSWER SNBU—UNITED STATES AND CANADA

| | Switch Group 1 | Switch Group 2 |
|---|---|---|
| Off (not used) | R | H |
| Clear-to-Send Delay | P | G |
| | N | F |
| Off | M | E |
| Echo Clamp | L | D |
| 2-Wire/4-Wire | K | C |
| | J | B |
| Transmit Level | I | A |

Switch Group 2 (H through A): Transmit Level for SNBU (for both data and answer tone)

Remove the plastic switch cover to change the settings of the switches. After you have changed the settings of the switches, reinstall the switch cover over the switches.

- 2-wire or 4-wire selection for nonswitched networks
  - For 4-wire operation, set switch K on and switch J off.
  - For 2-wire operation, set switch K off and switch J on.
  - Also see 811 for 2-wire or 4-wire selection for communications MPU card jumpers.

- Clear-to-send delay selection
  - For 4-wire operation, set switch N off and switch P on (30-millisecond delay).
  - For 2-wire operation, set switch N off and switch P off (230-millisecond delay).

- Echo clamp time selection[1]
  - For 150-millisecond time, set switch L off.

- Set switch M off.

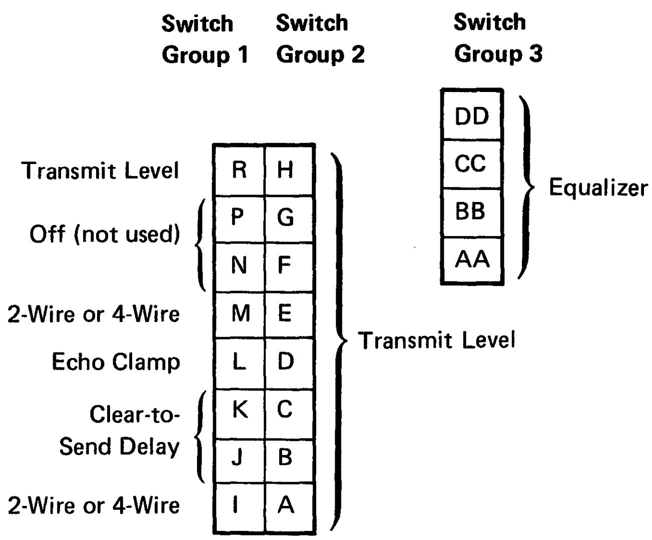
- Transmit level selection (for SNBU)
  - Use the following chart and set the transmit level to 0 dBm. (The transmit level is specified in the communications configuration record.)

| | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| 0 dBm | 1 | | | | | | | | |
| -1 dBm | | 1 | | | | | | | |
| -2 dBm | | | 1 | | | | | | |
| -3 dBm | | | | 1 | | | | | |
| -4 dBm | | | | | 1 | | | | |
| -5 dBm | | | | | | 1 | | | |
| -6 dBm | 1 | | | | | | 1 | | |
| -7 dBm | | 1 | | | | | 1 | | |
| -8 dBm | | | 1 | | | | 1 | | |
| -9 dBm | | | | 1 | | | 1 | | |
| -10 dBm | | | | | 1 | | 1 | | |
| -11 dBm | | | | | | 1 | 1 | | |
| -12 dBm | 1 | | | | | | | 1 | |
| -13 dBm | | 1 | | | | | | 1 | |
| -14 dBm | | | 1 | | | | | 1 | |
| -15 dBm | | | | 1 | | | | 1 | |
| -16 dBm | | | | | 1 | | | 1 | |
| -17 dBm | | | | | | 1 | | 1 | |
| -18 dBm | 1 | | | | | | | | 1 |

1 = On  Blank = Off

[1]The selection of both 4-wire and the 30-millisecond clear-to-send delay eliminates the echo clamp regardless of the position of switch L.

## 819 38LS PERSONALIZATION–NONSWITCHED NETWORK–WORLD TRADE COUNTRIES (EXCEPT CANADA)




Remove the plastic switch cover to change the settings of the switches. After you have changed the settings of the switches, reinstall the switch cover over the switches.

- 2-wire or 4-wire selection for nonswitched networks
  - For 4-wire operation, set switch I on and switch M off.
  - For 2-wire operation, set switch 1 off and switch M on.
  - For 2-wire operation, set switch I off and switch M on.
  - Also see 811 for 2-wire or 4-wire selection on the communications MPU card.
- Clear-to-send delay selection
  - For 4-wire operation, set switch J off and switch K on (30-millisecond delay).
  - For 2-wire operation, set switch J off and switch K off (230-millisecond delay).
- Echo clamp time selection[1]
  - For 150-millisecond time, set switch L off.
- Equalizer selection
  - To disable high frequency delay, set switch AA off.
  - To disable low frequency delay, set switch BB off.
  - To disable center frequency delay, set switch DD off.
  - To enable normal delay, set switch CC on.
  - For most lines, leave the high, low, center, and normal frequency delays out (switches AA, BB, CC, and DD off).
- Transmit level selection
  —Use the chart below and set the transmit level as needed.

| | A | B | C | D | E | F | G | H | R |
|---|---|---|---|---|---|---|---|---|---|
| 0 dBm | 1 | | | | | | | | |
| -1 dBm | | 1 | | | | | | | |
| -2 dBm | | | 1 | | | | | | |
| -3 dBm | | | | 1 | | | | | |
| -4 dBm | | | | | 1 | | | | |
| -5 dBm | | | | | | 1 | | | |
| -6 dBm | 1 | | | | | | 1 | | |
| -7 dBm | | 1 | | | | | 1 | | |
| -8 dBm | | | 1 | | | | 1 | | |
| -9 dBm | | | | 1 | | | 1 | | |
| -10 dBm | | | | | 1 | | 1 | | |
| -11 dBm | | | | | | 1 | 1 | | |
| -12 dBm | 1 | | | | | | | 1 | |
| -13 dBm | | 1 | | | | | | 1 | |
| -14 dBm | | | 1 | | | | | 1 | |
| -15 dBm | | | | 1 | | | | 1 | |
| -16 dBm | | | | | 1 | | | 1 | |
| -17 dBm | | | | | | 1 | | 1 | |
| -18 dBm | 1 | | | | | | | | 1 |

1 = On Blank = Off

[1]The selection of both 4-wire and the 30-millisecond clear-to-send delay eliminates the echo clamp regardless of the position of switch L.

## 821 38LS PERSONALIZATION–SWITCHED NETWORK–WORLD TRADE COUNTRIES (EXCEPT CANADA)

| | Switch Group 1 | Switch Group 2 | |
|---|---|---|---|
| Transmit Level | R | H | Transmit Level |
| Equalizer | P | G | |
| | N | F | |
| | M | E | |
| Off (not used) | L | D | |
| On | K | C | |
| Equalizer | J | B | |
| | I | A | |

Remove the plastic switch cover to change the settings of the switches. After you have changed the settings of the switches, reinstall the cover switch over the switches.

- Equalizer selection
  - To disable high frequency delay, set switch J off.
  - To disable low frequency delay, set switch I off.
  - To disable center frequency delay, set switch P off.
  - To enable normal delay, set switch N on.
  - To disable high frequency amplifier boost, set switch M off.

For most lines, leave the high, low, center, and normal frequency delays in (switches J, I, P, and N on) and disable the high frequency amplifier boost (switch M off).

- Set switch K on.

- Transmit level selection
  - Use the chart below and set the transmit level as needed.[1]

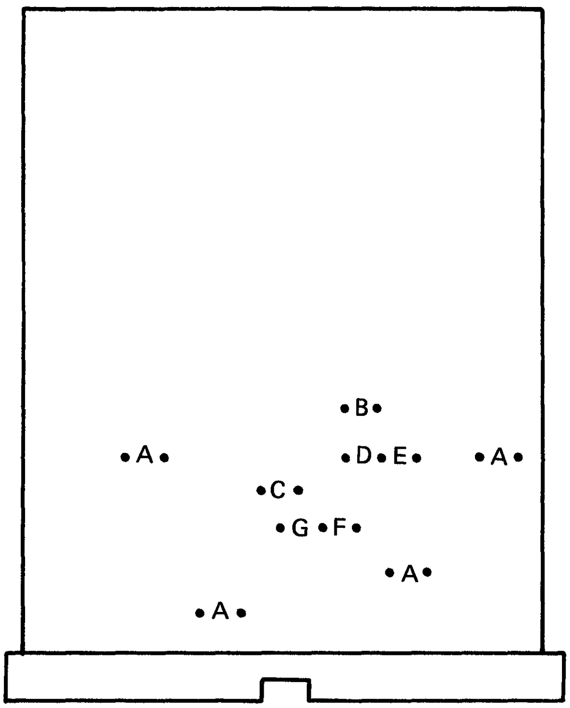
| | A | B | C | D | E | F | G | H | R |
|---|---|---|---|---|---|---|---|---|---|
| 0 dBm | 1 | | | | | | | | |
| -1 dBm | | 1 | | | | | | | |
| -2 dBm | | | 1 | | | | | | |
| -3 dBm | | | | 1 | | | | | |
| -4 dBm | | | | | 1 | | | | |
| -5 dBm | | | | | | 1 | | | |
| -6 dBm | 1 | | | | | | 1 | | |
| -7 dBm | | 1 | | | | | 1 | | |
| -8 dBm | | | 1 | | | | 1 | | |
| -9 dBm | | | | 1 | | | 1 | | |
| -10 dBm | | | | | 1 | | 1 | | |
| -11 dBm | | | | | | 1 | 1 | | |
| -12 dBm | 1 | | | | | | | 1 | |
| -13 dBm | | 1 | | | | | | 1 | |
| -14 dBm | | | 1 | | | | | 1 | |
| -15 dBm | | | | 1 | | | | 1 | |
| -16 dBm | | | | | 1 | | | 1 | |
| -17 dBm | | | | | | 1 | | 1 | |
| -18 dBm | 1 | | | | | | | | 1 |

1 = On Blank = Off

[1] Set the transmit level 1.0 to 1.5 dBm higher than the level specified by the PTT to compensate for the attenuation in the line plate.

## 823 EIA/CCITT CARD JUMPERS (A-D7)

When the EIA/CCITT card is used in the IBM 5285, jumpers B and F are needed. Also the communications MPU card must have additional jumpers (811). All other jumpers must be removed from the EIA/CCITT card. See the figure below for jumper locations.




**EIA/CCITT Card Jumpers**

A Not used or not present (four locations)
B Installed
C Not used
D Not used
E Not used
F Installed
G Not used

## 825 DDSA (A-D7)

**CAUTION**
On multipoint networks, when you use the wrap test or turn power on or off, interference is transmitted on the line. Use these operations only when necessary.

**DDSA Jumpers**

Jumpers should be installed as follows:

**Position**

A On for 2400 bps

B On for 4800 bps

C Off (not used)

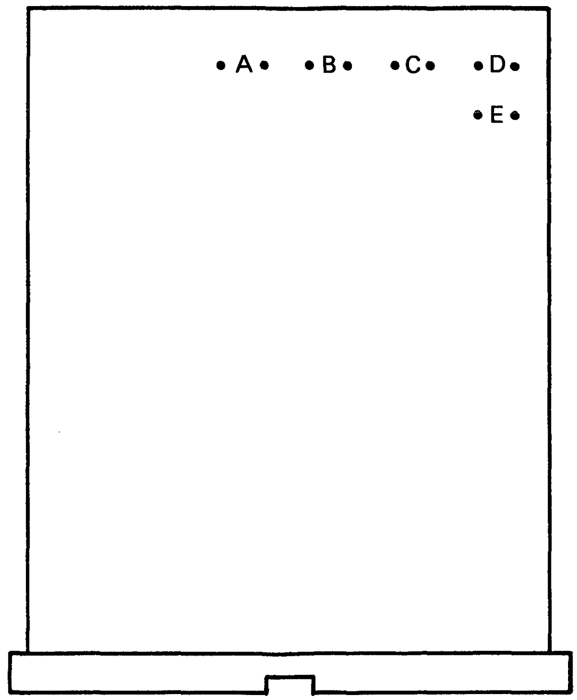
D Off (not used)

E On to disable the remote wrap path during wrap tests (needed for multipoint)

Off to enable the remote wrap path during wrap tests

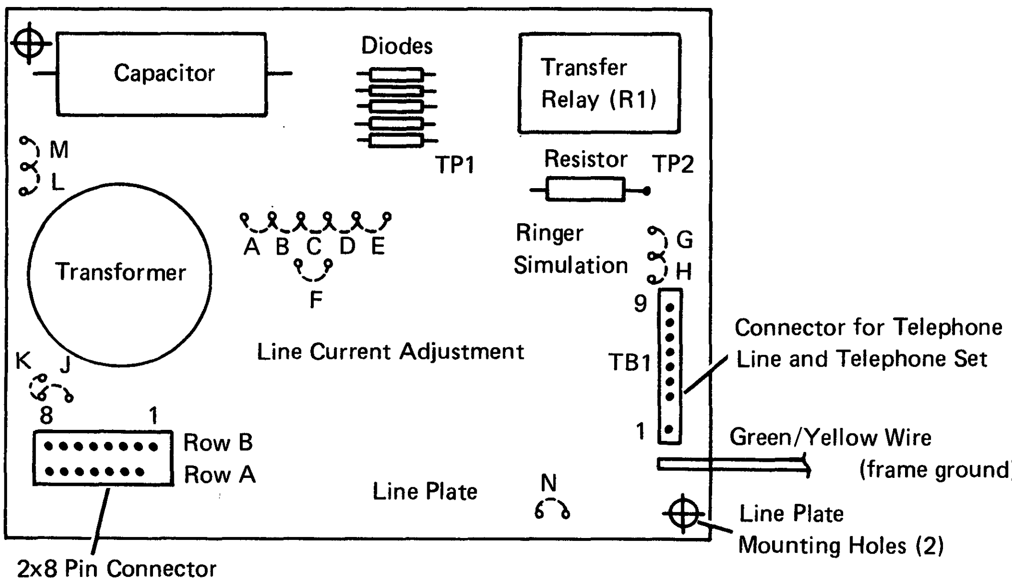
**Note:** Jumper E is needed for tributary stations on a multipoint network. Without jumper E installed, wrap tests at the tributary station lowers the performance and operation of the complete network.

There are no switches or adjustments on the DDSA card. All DDSA card functions are tested in wrap mode except for the DDSA clock synchronization.



## 827 LINE PLATE JUMPERS: WORLD TRADE COUNTRIES EXCEPT CANADA

Five jumpers are needed on the line plate. The position of one jumper is determined by whether the associated telephone set is present or missing. Another jumper position is selected so that the telephone line current with the 38LS connected to the line matches the telephone line current with the telephone set connected to the line. See the following figure for jumper locations.




Jumpers A, B, C, D, E, and F—Line current adjustment
Jumper G— Telephone set associated
Jumper H— No telephone associated
Jumper J— Connects the -3.5 Vdc to the line plate line transformer
Jumper K— Connects data ring/ground to the line plate transformer
Jumper L— Bypasses a biased capacitor in the data tip to the line plate line transformer circuit
Jumper M—Connects the data tip to the line plate line transformer through a biased capacitor
Jumper N—Connects +8.5 Vdc from the 38LS to the line plate

## 827 LINE PLATE JUMPERS: WORLD TRADE COUNTRIES EXCEPT CANADA (continued)

**Jumper Selection Procedures**

Always use a jumper in positions G, K, M, and N with the 38LS.

The auto-answer function of the World Trade 38LS relies in part on the ability of the line plate to sense ringing current. The telephone ring circuit supplies the path for the ringing current.

The line current adjustment in the line plate meets two conditions.

1. The adjustment selects a line plate impedance such that the line current with the 38LS connected to the line is similar to the line current when the telephone set is connected to the line.

2. The adjustment limits the line current inside a range, which prevents the analog signal from being distorted by transformer core saturation or changed to a DC signal.

To adjust the line current with an associated telephone set, do the following steps.

1. Measure the voltage on the telephone set.
   a. Turn off the IBM 5285 Power switch. (This is an easy way to ensure that the telephone set is connected to the line.)
   b. Set your multimeter to the 150 Vdc range. Connect one meter lead to test point 2 (TP2).
   c. Take the telephone handset off hook.
   d. Probe test point 1 (TP1) with the other meter lead (it might be necessary to change the meter polarity).
   e. Record the meter reading.
   f. Place the telephone handset on hook.

2. Install a jumper for a primary current adjustment.
   a. Use the following table to locate the voltage level that you recorded in step 1-e.
   b. Plug the jumper position that is listed in the primary column adjacent to the applicable voltage range.

| Recorded Voltage Level | Primary Jumper | Secondary Jumper(s) |
|---|---|---|
| 0.5 to 2 | F | |
| 2 to 3.5 | E | F |
| 3.5 to 4 | E | C |
| 4 to 6 | E | C, D |
| 6 to 8 | C | E, D, B |
| 8 to 9 | C | E, D, B, A |
| 9 to 14 | D | E, C, B, A |
| 14 to 26 | B | C, D, A |
| 26 to 37 | A | D, B |
| 37 to 50 | A | B |

3. Refine the current adjustment while the 38LS is connected to the telephone line (to match the reading recorded in step 1-e).
   a. On the IBM 5285, A-board, jumper D7B02 ('data terminal ready') to D7D08 (ground).
   b. Turn on the IBM 5285 Power switch.
   c. From a nearby telephone, place a call to the IBM 5285. On the third ring, the 38LS is connected to the telephone line.
   d. Probe test point 1 (TP1) again and compare the meter reading to the level recorded in step 1-e.
   e. If the levels are different, move the jumper to one of the positions listed in the secondary column (same row as used in step 2-b). Repeat steps d and e to select the jumper position that produces the least voltage difference between the measured voltage and the recorded reading.
   f. Hang up the telephone from which the call to the IBM 5285 was placed. Remove the jumper from D7B02 and D7D08 and return the IBM 5285 to the user.

## 831 PROCEDURES FOR USING TRAP TO RECORD DATA

Use the following procedures to use TRAP (Teleprocessing Recording Analyzer Procedures) to record transmitted or received data during communications. See 975 for procedures to display or print data stored in the IBM 5285 internal data trap storage.

**Procedure For Using TRAP To Record Data From An EIA/CCITT Interface**

See the TRAP Operator's Manual (supplied with TRAP) for general information on TRAP.

1. Turn off the power to the IBM 5285, the TRAP, and the external modem.
2. Disconnect the IBM 5285 cable from the modem and plug it into the TRAP EIA 25 pin connector named Machine.
3. Plug the TRAP EIA cable into the TRAP connector (named Data Set) and into the modem.
4. Use the following chart to set up the TRAP patch-panel optional selections.

Do you want to bypass the modem by using the TRAP acoustic coupler?

Y N

Is the modem clocked by the modem or by the IBM 5285? If you do not know, check parameter C11 of the configuration record.

IBM 5285 — Modem

Modem: A

IBM 5285:

Plug the cable from the TRAP acoustic coupler (in the lid) to the nine-pin connector.

Set the Acoustic Coupler switch to the Business Machine position.

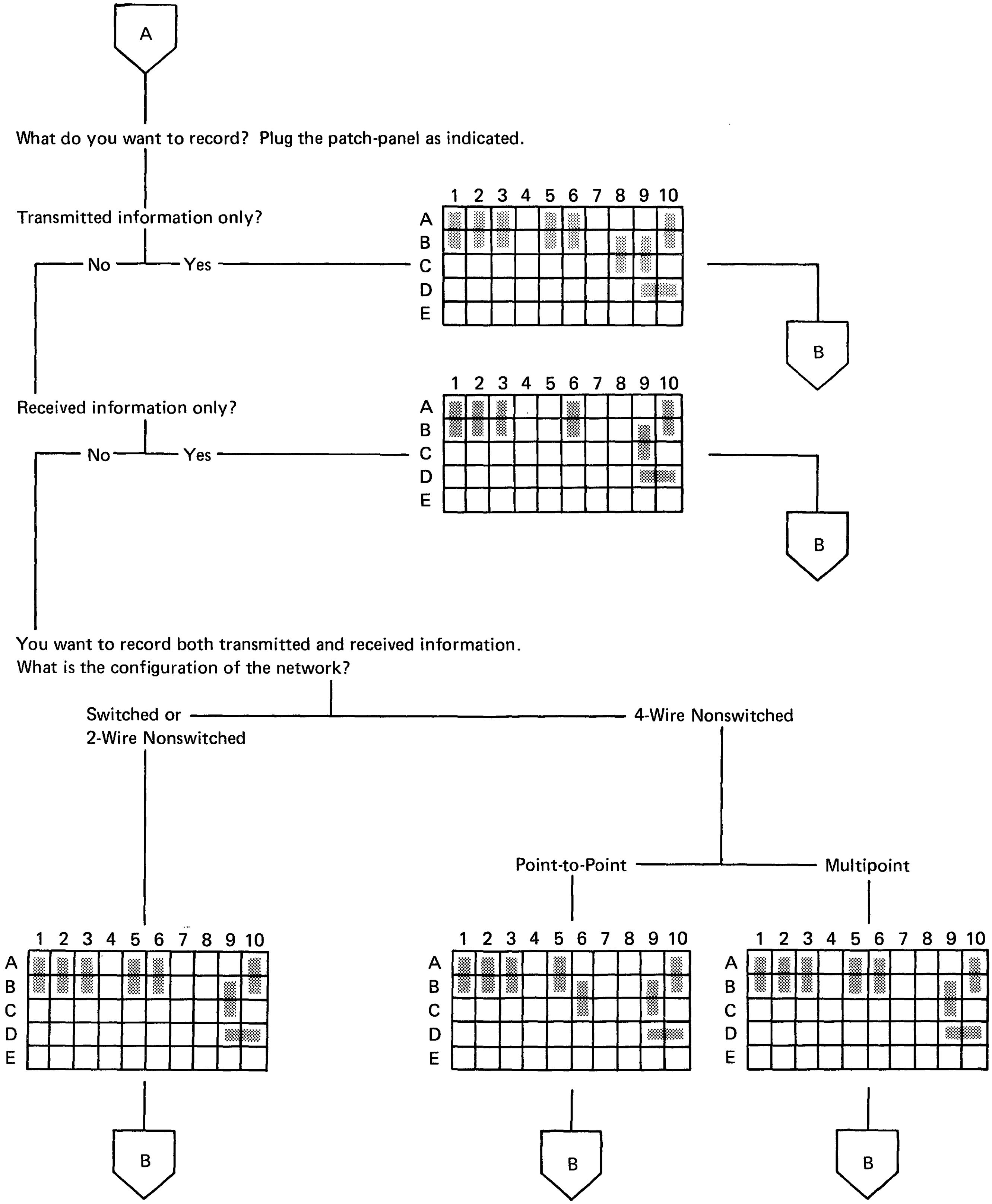
Plug C1 to E4 and plug C3 to E5 on the TRAP patch-panel.

A

Y:

Plug the cable from the TRAP acoustic coupler (in the lid) to the nine-pin connector. Set the Acoustic Coupler switch to the EIA position. Set the Clock switch to the Modem position. Turn the On/Off switch to the Off position.

A



A
What do you want to record? Plug the patch-panel as indicated.
Transmitted information only?
No
Yes
1 2 3 4 5 6 7 8 9 10
A
B
C
D
E
B
Received information only?
No
Yes
1 2 3 4 5 6 7 8 9 10
A
B
C
D
E
B
You want to record both transmitted and received information.
What is the configuration of the network?
Switched or
2-Wire Nonswitched
4-Wire Nonswitched
Point-to-Point
Multipoint
1 2 3 4 5 6 7 8 9 10
A
B
C
D
E
B

## 831 PROCEDURES FOR USING TRAP TO RECORD DATA (continued)

B

1. Set the SOS switch to the Center position. (On the Sony 270 model, set the Mode switch to the Stereo position.)

2. Set the tape speed as follows:
   1-7/8 inches per second (1200 bps only)
   3-3/4 inches per second (1200 to 2400 bps)
   7-1/2 inches per second (1200 to 4800 bps)

3. Turn on the TRAP.

4. Set the volume controls to zero.

5. Pull the red Record switches into the Record position. Both switches should lock in place.

6. Set the record level on the meters to the zero point or start of the red area on the scale for both channels. This should be done when the volume control is advanced no more than 25%.

7. Set the revolutions counter to zero.

8. When you are ready to start the tape, hold the Record switches in the record position and turn the tape control level to the forward advance position. Use the Pause position to stop and start the tape between recordings.

**Procedure For Using TRAP To Record Data From A 38LS Integrated Modem or DDSA**

1. Turn off the power to the IBM 5285 and the TRAP.

2. Remove the cover from the IBM 5285 (031).

3. Connect the cable from the technology adapter to the D7 socket pins as follows:

| Lead Colors | Pin Numbers | Line Names |
|---|---|---|
| Yellow | D7D02 | -req to send |
| Gray | D7D04 | +xmit line data |
| Black | D7D08 | ground |
| White | D7B10 | +rec line data |
| Orange | D7B08 | -rec clk (not used for 38LS) |
| Violet | D7B07 | -xmit clk (not used for 38LS) |
| Blue | D7B12 | -carrier det (not used for 38LS or DDSA) |

4. Connect the TRAP interface cable from the technology adapter to the TRAP connector marked Machine.

**Note:** Steps 5, 6, and 7 are 38LS only.

5. Plug the cable from the TRAP acoustic coupler (in the cover) to the nine-pin connector.

6. Set the Acoustic Coupler switches to the Business Machine position.

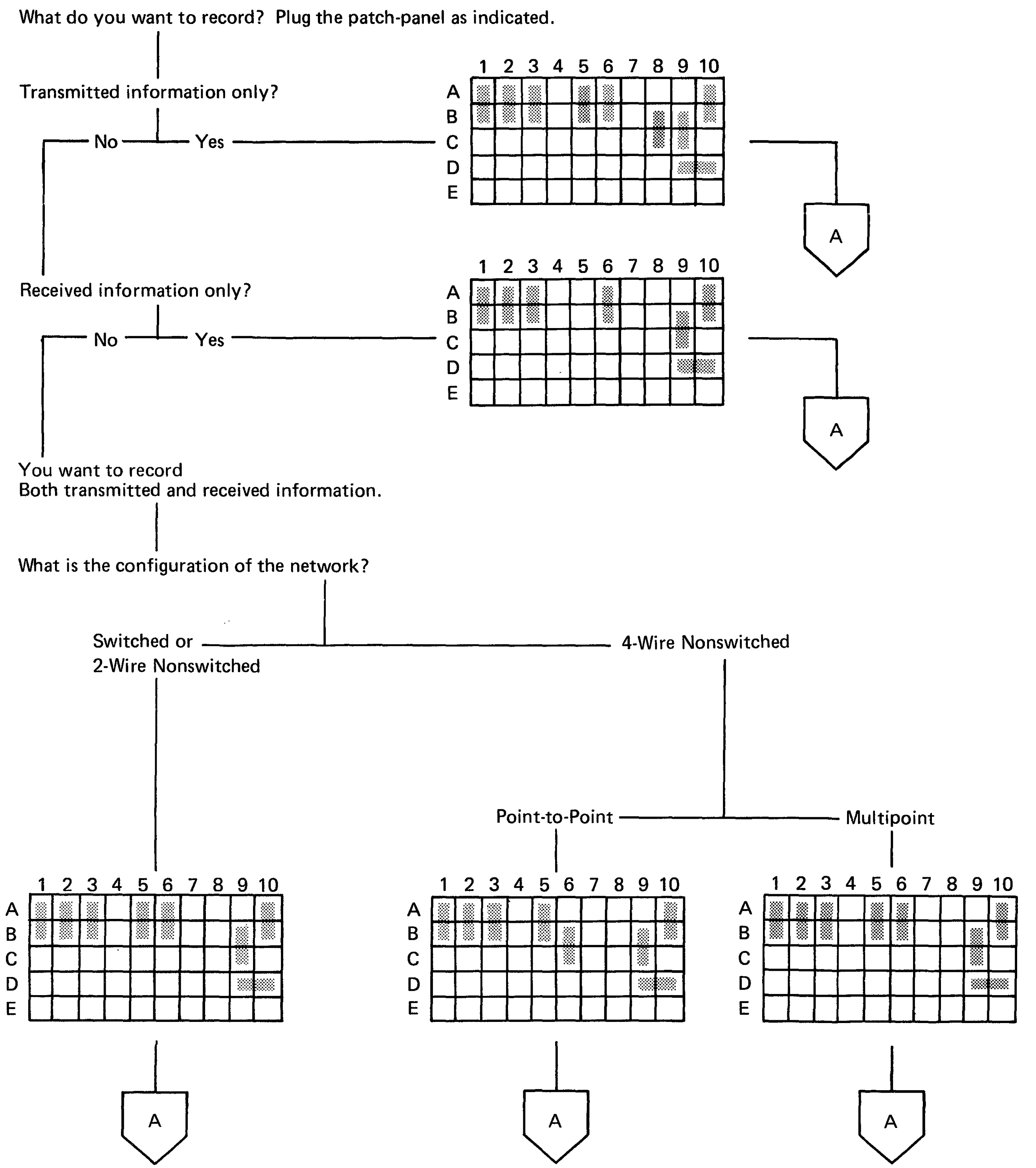
7. Set the switch on the technology adapter to the Coupler Clock position.

8. Plug C1 to E4 and C3 to E5 on the TRAP patch-panel. This step supplies clock timings to the TRAP for recording data.

**Note:** Data transmitted at 600 bps cannot be correctly recorded.

## 831 PROCEDURES FOR USING TRAP TO RECORD DATA (continued)

9. Use the following chart to set up the TRAP patch panel:



## 831 PROCEDURES FOR USING TRAP TO RECORD DATA (continued)

A

1. Set the SOS switch to the Center position. (On the Sony 270 model, set the Mode switch to the Stereo position.)

2. Set the tape speed as follows:

   1-7/8 inches per second (1200 bps only)
   3-3/4 inches per second (1200 to 2400 bps)
   7-1/2 inches per second (1200 to 4800 bps)

3. Turn on the TRAP.

4. Set the volume controls to zero.

5. Pull the red Record switches into the Record position. Both switches should lock in place.

6. Set the record level on the meters to the zero point or start of the red area on the scale for both channels. This should be done when the volume control is advanced no more than 25%.

7. Set the revolutions counter to zero.

8. When you are ready to start the tape, hold the Record switches in the Record position and turn the tape control lever to the forward advance position. Use the Pause position to stop and start the tape between each recording.

## 833 EIA/CCITT INTERFACE TESTERS

The EIA NU DATA tester or the EIA Interface Monitor and Breakout Panel attaches in series with the EIA/CCITT interface cable between the IBM 5285 and the external modem.

- The tester supplies direct access to all 25 EIA/CCITT interface leads for test equipment attachment.
- It has pencil switches to open 24 of the interface circuits.
- LED indicators are permanently connected to some interface circuits for visual check purposes.
- Patch panel wiring can be used to connect any one of the remaining interface circuits to a +EIA or a -EIA LED indicator.
- Patch panel wiring can be used to connect any interface circuits.
- Two type AA 1.5 Vdc batteries are needed for operation.
- The +EIA indicators and LEDs respond to circuit conditions as follows:

  Off = less than +3 V or open circuit
  On = +3 V minimum

- The -EIA indicators respond as follows:

  Off = -3 V or more positive or open circuits
  On = -3 V or more negative

The '±pulse traps' line indicates that a voltage state change occurred (NU DATA EIA Tester only).

The pulse trap LED is lighted on positive or negative voltage state changes. The LED remains on until the Reset switch is pressed (NU DATA EIA tester only).

## 835 PT-2 AND TP LINE MONITOR

With the PT-2 and the TP (teleprocessing) line monitor, you can display and record information from a communications line at transmission rates up to 9600 bps. You can record data at the EIA/CCITT interface or at communications MPU card probe points. The recorded information can aid you in diagnosing problems in either BSC or SDLC. For complete operation instructions, see the *IBM PT-2 and TP Line Monitor Operation, Maintenance, and Parts Manual,* SR31-0786.

If you are monitoring the interface between the communications MPU card and the line adapter card, use the technology probes supplied with the PT-2 line monitor and connect the line monitor as follows (invert the signals on all lines):

| Line Monitor Connections | Communications MPU Card Line Names |
|---|---|
| -SD | +xmit line data |
| -RS | -req to send |
| -CS | -clear to send |
| -TSET | -xmit clk (DDSA only) |
| -RD | +rec line data |
| -CD | -carrier det |
| -RSET | -rec clk (DDSA only) |
| -PR8 DSR | -data set rdy |

Go to one of the following cable diagram and table for pin numbers. Use the pin numbers in the probe point A column:

- EIA/CCITT (861)
- DDSA (863)
- 38LS (865, 867, or 869)

If you are monitoring the EIA/CCITT interface, the EIA/CCITT cable can be connected directly to the line monitor.

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## Communications Cable Diagrams

The communications cable diagrams show cable connections and probe points for the various IBM 5285 communications configurations. The tables associated with the diagrams show cable connector, board, and test point pin numbers. The tables also show level-2 and level-3 wrap paths for wrap tests. A level 2 wrap is an internal wrap on the EIA/CCITT, DDSA, or 38LS card. A level 3 wrap is an external wrap at the IBM 5285 connector panel; connector J140. The following legend is used to show signal direction and wrap paths.

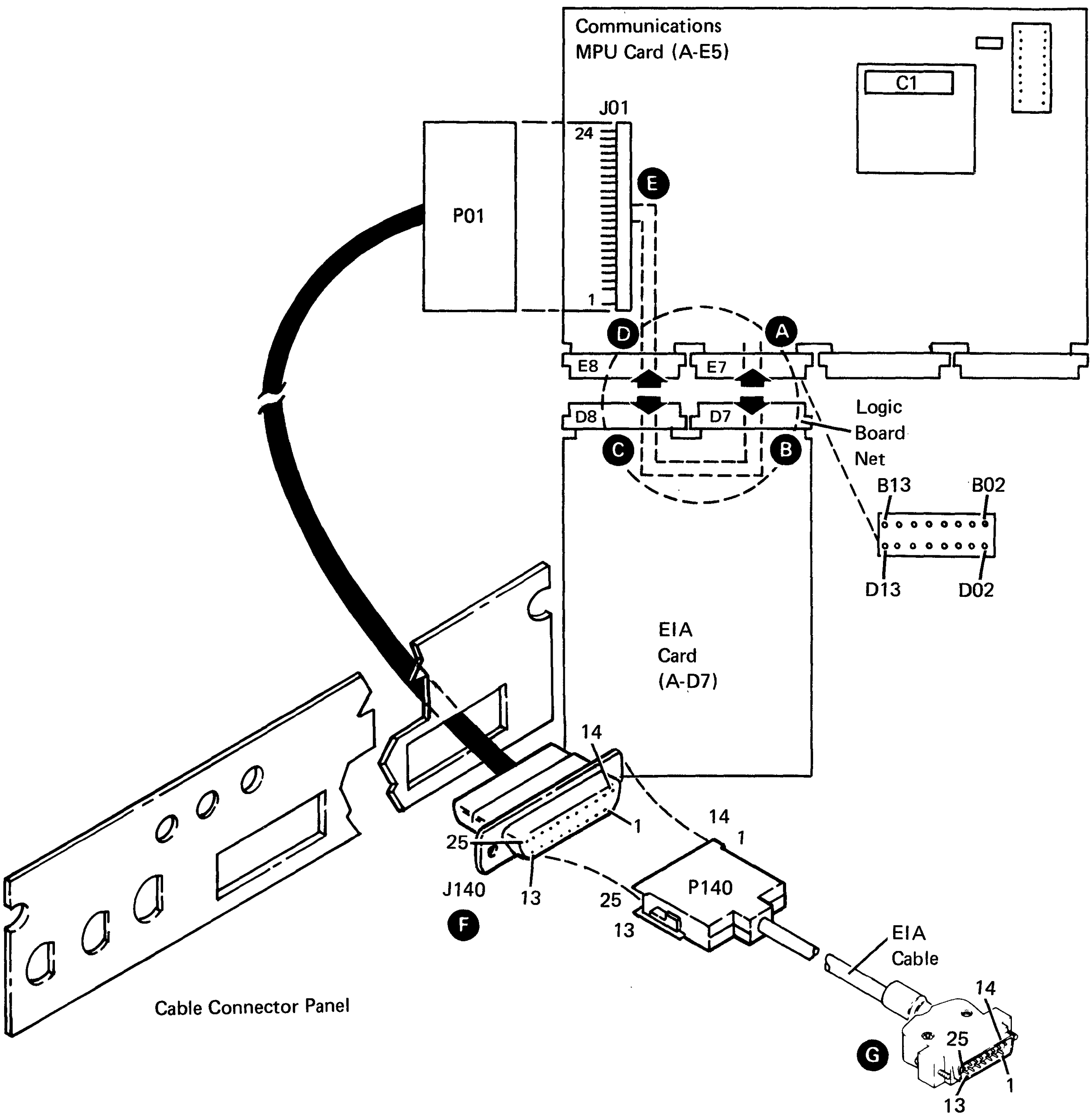
Signal is wrapped

Signal is not wrapped

Pins are common

## 861 EIA/CCITT CABLE DIAGRAM

The EIA/CCITT cable diagram and table shows the signal path from the communications MPU card to the connector panel. The table also indicates probe points that can be referenced by the MAPs. See 901 for information on how to use the cable diagram. The arrow (→) indicates the logical direction of the signal.



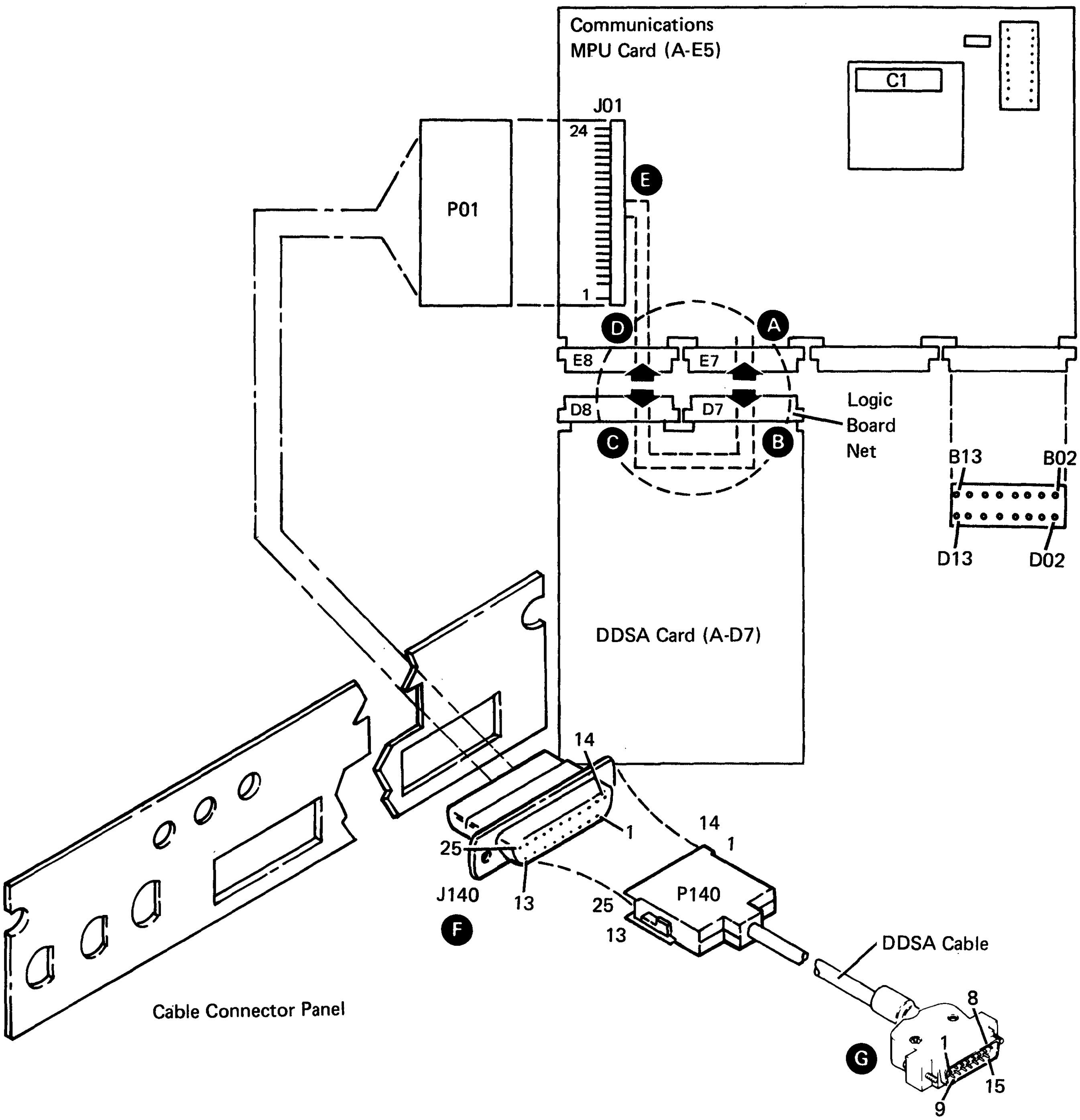
| Line Name | Line Type | Comm MPU Card | EIA Card | EIA Level 2 Wrap | EIA Card | Line Name - (see Note 2) | Comm MPU Card | Comm MPU Card E5J01 | Conn J140 | Wrap Conn Level 3 Wrap |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Probe Points | | | | | | | | |
| | | A | B | | C | | D | E | F | |
| -data term rdy | Transmit | E7B02 | D7B02 | → | D8D02 | +data term rdy (cable) | E8D02 | 15 | 20 | → |
| -data set rdy | Receive | E7B13 | D7B13 | ← | D8D09 | +data set rdy (cable) | E8D09 | 06 | 06 | ← |
| -rate sel | Transmit | E7B04 | D7B04 | → | D8D06 | +rate sel (cable) | E8D06 | 10 | 23 | → |
| -xmit clk | Receive | E7B07 | D7B07 | ← | D8D04 | +xmit clk (cable) | E8D04 | 12 | 15 | ← |
| -rec clk | Receive | E7B08 | D7B08 | → | D8D10 | +rec clk (cable) | E8D10 | 16 | 17 | ← |
| -sel standby | Transmit | E7B03 | D7B03 | → | D8B05 | +sel standby (cable) | E8B05 | 11 | 11 | → |
| -ring ind | Receive | E7D12 | D7D12 | ← | D8B13 | +ring ind (cable) | E8B13 | 21 | 22 | ← |
| -req to send | Transmit | E7D02 | D7D02 | → | D8B03 | +req to send (cable) | E8B03 | 17 | 04 | → |
| -clear to send | Receive | E7D13 | D7D13 | ← | D8B10 | +clear to send (cable) | E8B10 | 14 | 05 | ← |
| -carrier det | Receive | E7B12 | D7B12 | ← | D8D12 | +carrier det (cable) | E8D12 | 20 | 08 | ← |
| -test control | Transmit | E7B05 | D7B05 | → | D8D07 | +test control (cable) | E8D07 | 09 | 18 | → |
| -test ind | Receive | E7D10 | D7D10 | ← | | +test ind | | | | |
| -EIA wrap | Transmit | E7D05 | D7D05 | → | | | | | | |
| +xmit line data | Transmit | E7D04 | D7D04 | → | D8B07 | -xmit line data (cable) | E8B07 | 08 | 02 | → |
| +rec line data | Receive | E7B10 | D7B10 | ← | D8B04 | -rec line data (cable) | E8B04 | 13 | 03 | ← |
| -5 V | Power | E5B06<br>E7B06 | Note 1<br>Note 1 | | | | | | | |
| +8.5 V | Power | E6B11<br>E8B11 | D8B11 | | | | | | | |
| -8.5 V | Power | | D7D07 | | | | | | | |
| signal ground | | | | | | | | 22 | 7 | |

**Notes:**

1. This line is not used by the EIA/CCITT card.
2. The EIA/CCITT card inverts all EIA/CCITT signals and converts the signal levels at probe points C, D, E, and F to EIA RS-232-C/CCITT V.24-V.28 interface standards. Interface up voltage level is +3 V to +25 V. Down voltage level is -3 V to -25 V.
3. All D03 board pins are at a +5 V level. All D08 board pins are signal ground.

## 863 DDSA CABLE DIAGRAM

The DDSA cable diagram and table shows the DDSA signal path from the communications MPU card to the DDSA cable connector. The table also indicates probe points that can be referenced by the MAPs. See 901 for information on how to use the cable diagrams. The arrow (→) indictates the logical direction of the signal.

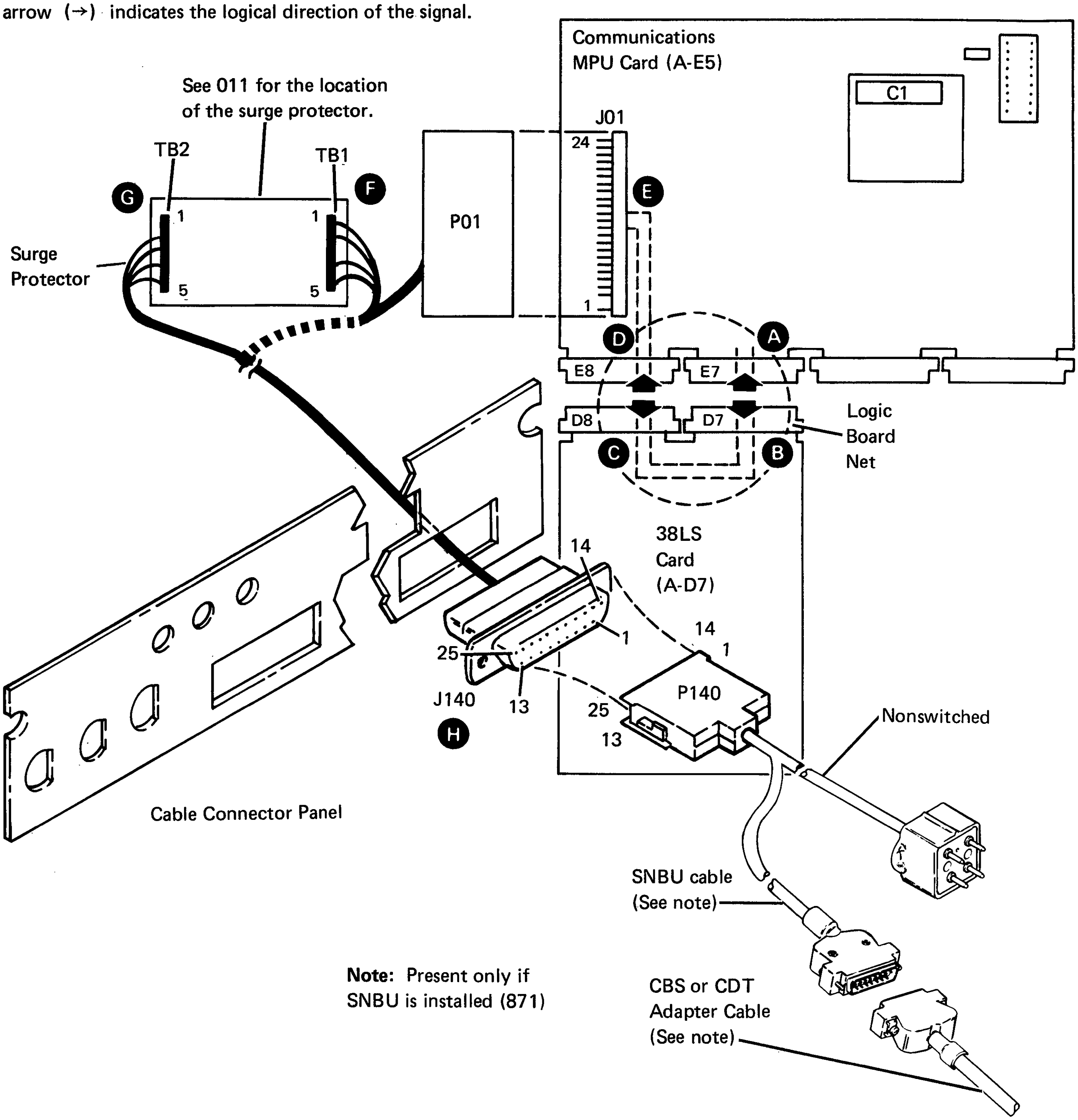


| Line Name | Line Type | Comm MPU Card | DDSA Card | DDSA Wrap Level 2 | DDSA Card | DDSA Line Names (See Note 2) | Comm MPU Card | Comm MPU CArd E5J01 | Conn J140 | Wrap Conn Level 3 | DDSA Cable Conn |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Probe Points | | | | | | | | | |
| | | A | B | | C | | D | E | F | | G |
| -data term rdy | Transmit | E7B02 | Note 1 | | | | | | | | |
| -data set rdy | Receive | E7B13 | D7B13 | ← | | | | | | | |
| -rate sel | Transmit | E7B04 | Note 1 | | | | | | | | |
| -xmit clk | Receive | E7B07 | D7B07 | ← | | | | | | | |
| -rec clk | Receive | E7B08 | D7B08 | ← | | | | | | | |
| -sel standby | Transmit | E7B03 | Note 1 | | | | | | | | |
| -ring ind | Receive | E7D12 | Note 1 | ← | | | | | | | |
| -req to send | Transmit | E7D02 | D7D02 | → | | | | | | | |
| -clear to send | Receive | E7D13 | D7D13 | ← | | | | | | | |
| -carrier det | Receive | E7B12 | D7B12 | ← | | | | | | | |
| -test control | Transmit | E7B05 | D7B05 | → | | | | | | | |
| -test ind | Receive | E7D10 | D7D10 | ← | | | | | | | |
| +xmit line data | Transmit | E7D04 | D7D04 | → | D8B02 | +xmit nonsw data | E8B02 | 03 | 13 | → | 5 |
| | | | | | D8D05 | -xmit nonsw data | E8D05 | 04 | 14 | → | 6 |
| +rec line data | Receive | E7B10 | D7B10 | ← | D8D09 | +rec nonsw data | E8B09 | 01 | 10 | ← | 3 |
| | | | | | D8D13 | -rec nonsw data | E8D13 | 05 | 12 | ← | 4 |
| -5 V | Power | E5B06 | D7B06 | | | | | | | | |
| | | E7B06 | | | | | | | | | |
| +8.5 V | Power | E6B11 | D8B11 | | | | | | | | |
| | | E8B11 | | | | | | | | | |
| -8.5 V | Power | | Note 1 | | | | | | | | |

**Notes:**
1. This line is not used by the DDSA card.
2. The DDSA card converts transmit signals to DDS standards for transmission by the DDS network. The DDSA card converts received DDS signals to IBM 5285 VTL signal levels.
3. All D03 board pins are at +5 V level. All D08 board pins are signal ground.

## 865 38LS–NONSWITCHED–CABLE DIAGRAM

The 38LS-nonswitched cable diagram and table shows the signal path from the communications MPU card to the connector (J140) on the cable connector panel. The table indicates probe points that can be referenced by the MAPs. Use this diagram for nonswitched networks in the United States and World Trade countries. If the nonswitched card has SNBU, see 867 for SNBU probe points. See 901 for information on how to use the cable diagrams. The arrow (→) indicates the logical direction of the signal.




**Note:** Present only if SNBU is installed (871)

## 865 38LS–NONSWITCHED–CABLE DIAGRAM (continued)

| Line Name | Line Type | Comm MPU Card (A) | 38LS Card (B) | 38LS Wrap Level 2 | 38LS Card (C) | 38LS Lines (See Note 2) | Comm MPU Card (D) | Comm MPU Card E5J01 (E) | Surge Protector TB 1 (F) | Surge Protector TB 2 (G) | Conn J140 (H) | Wrap Conn Level 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| -data term ready | Transmit | E7B02 | D7B02 | → | | | | | | | | |
| -data set ready | Receive | E7B13 | D7B13 | ← | | | | | | | | |
| -rate sel | Transmit | E7B04 | D7B04 | → | | | | | | | | |
| -xmit clk | Note 1 | E7B07 | D7B07 | | | | | | | | | |
| -rec clk | Note 1 | E7B08 | D7B08 | | | | | | | | | |
| -sel standby | Transmit | E7B03 | D7B03 | → | | | | | | | | |
| -ring ind | Receive | E7D12 | D7D12 | ← | | | | | | | | |
| -req to send | Transmit | E7D02 | D7D02 | → | | | | | | | | |
| -clear to send | Receive | E7D13 | D7D13 | ← | | | | | | | | |
| -carrier det | Receive | E7B12 | D7B12 | ← | | | | | | | | |
| -test control | Transmit | E7B05 | D7B05 | → | | | | | | | | |
| -test ind | Receive | E7D10 | D7D10 | ← | | | | | | | | |
| +xmit line data | Transmit | E7D04 | D7D04 | → | D8B02 | +xmit nonsw data | E8B02 | 03 | 4 | 4 | 13 | → |
| | | | | | D8B05 | -xmit nonsw data | E8D05 | 04 | 2 | 2 | 14 | → |
| +rec line data | Receive | E7B10 | D7B10 | ← | D8B09 | +rec nonsw data | E8D09 | 01 | 5 | 5 | 10 | ← |
| | | | | | D8D13 | -rec nonsw data | E8D13 | 05 | 1 | 1 | 12 | ← |
| -5 V | Power | E5B06<br>E7B06 | D7B06 | | | | | | | | | |
| +8.5 V | Power | E6B11<br>E8B11 | D8B11 | | | | | | | | | |
| -8.5 V Note 4 | Power | | D7D07 | | | | | | | | | |

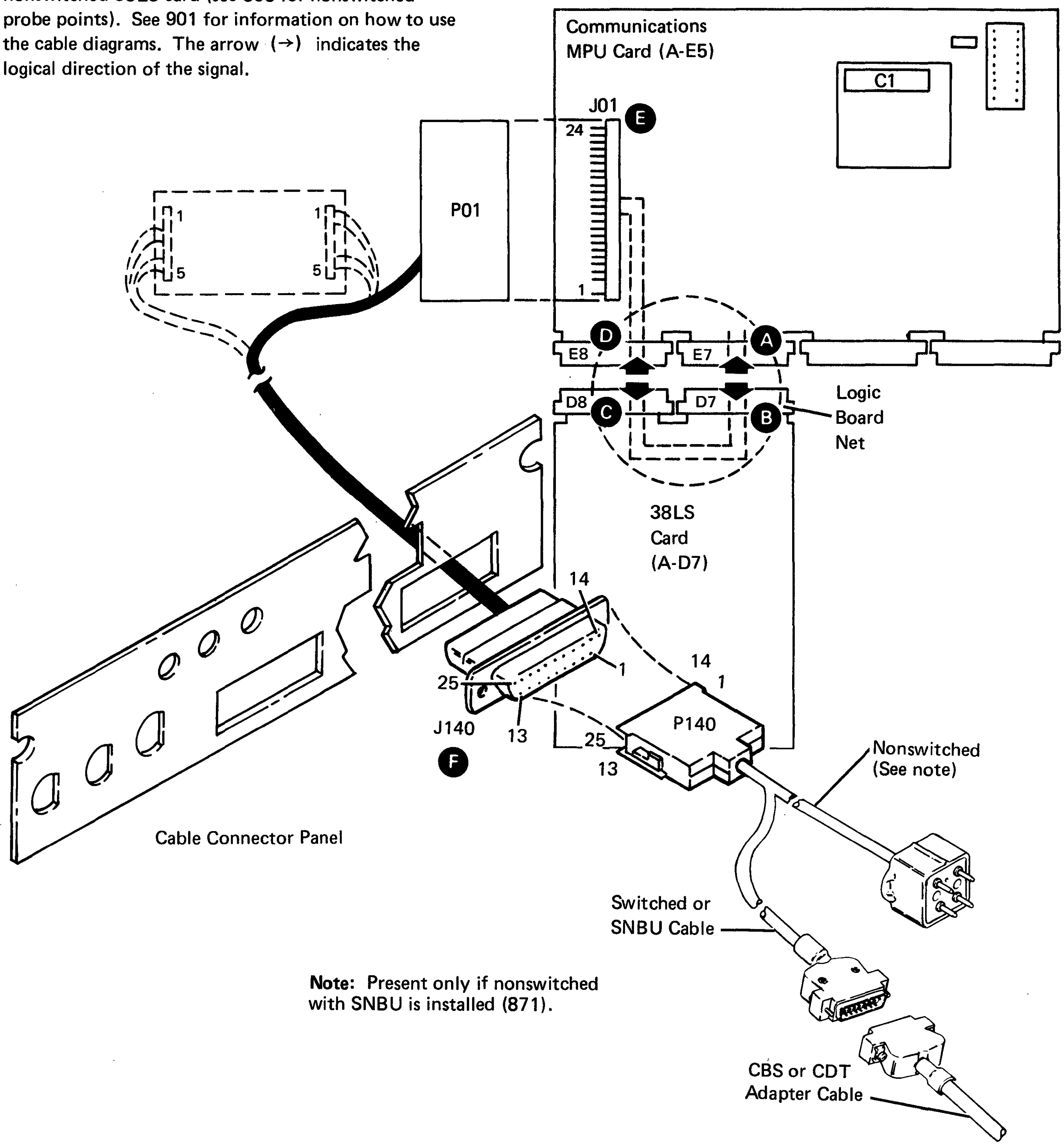
Probe Points: A, B, C, D, E, F, G, H

**Notes:**

1. This line is not used by the 38LS card. However, the communications MPU card might fail if this line becomes shorted.
2. The 38LS card converts transmit signals to analog signals for the communications network. The card converts received analog signals to VTL levels for the communications attachment card.
3. All D03 board pins are at a +5 V level. All D08 board pins are signal ground.
4. On the 38LS card, -8.5 V is used for United States auto-answer only.

**867 38LS–SWITCHED OR SNBU–CABLE DIAGRAM**

The 38LS-switched or SNBU-cable diagram and table show the signal path from the communications MPU card to the connector (J140) on the cable connector panel. The table indicates probe points that can be referenced by the MAPs. Use this cable diagram for switched networks for the SNBU section of a nonswitched 38LS card (see 865 for nonswitched probe points). See 901 for information on how to use the cable diagrams. The arrow (→) indicates the logical direction of the signal.




Note: Present only if nonswitched with SNBU is installed (871).

## 867 38LS–SWITCHED OR SNBU–CABLE DIAGRAM (continued)

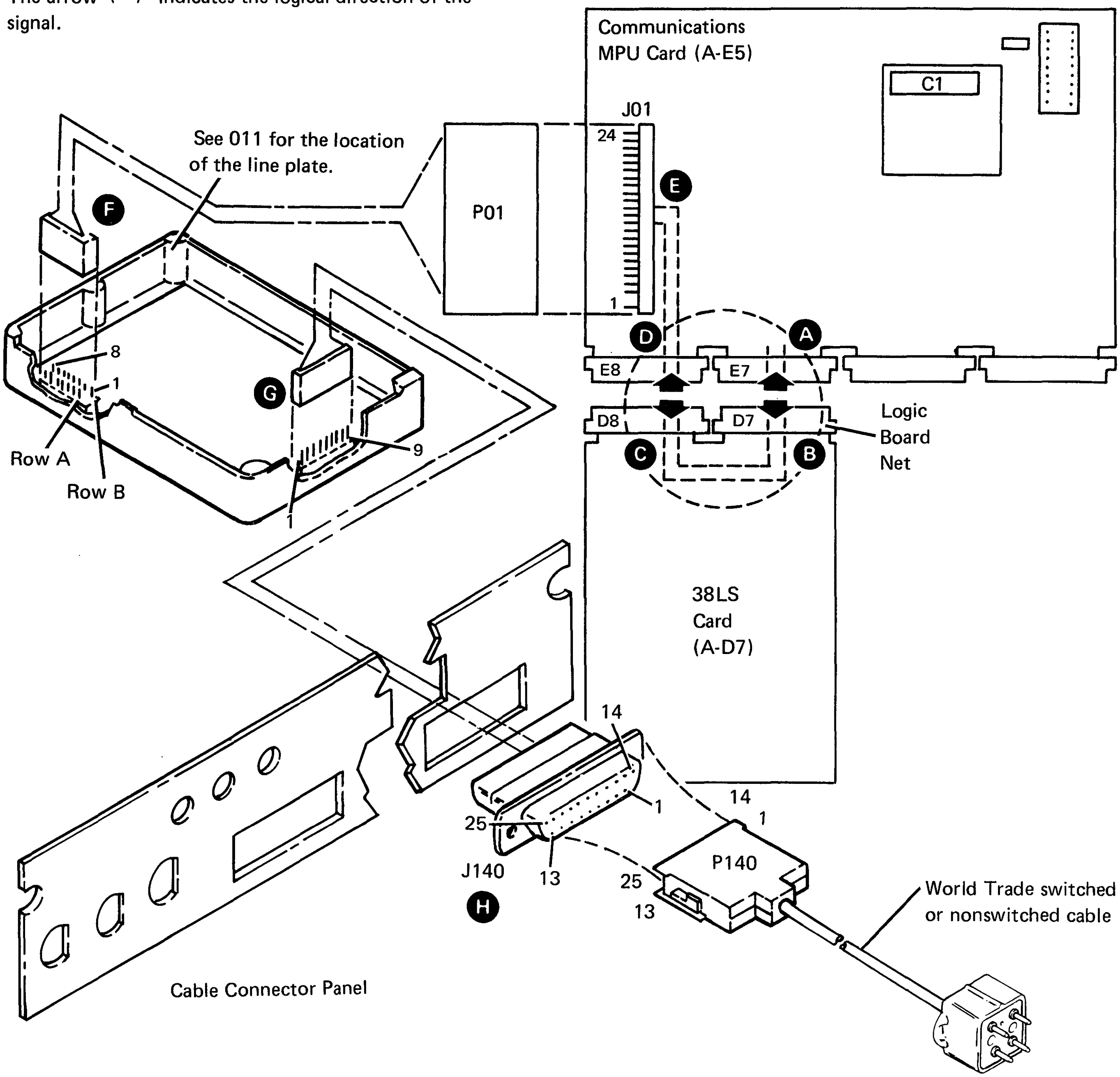
| Line Name | Line Type | Comm MPU Card (A) | 38LS Card (B) | 38LS Wrap Level 2 | 38LS Card (C) | 38LS Lines (See Note 2) | Comm MPU Card (D) | Comm MPU Card E5J01 (E) | Conn J140 (F) | Wrap Conn Level 3 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Probe Points | | | | | | | | |
| –data term ready | Transmit | E7B02 | D7B02 | → | | | | | | |
| –data set ready | Receive | E7B13 | D7B13 | ← | | | | | | |
| –rate sel | Transmit | E7B04 | D7B04 | → | | | | | | |
| –xmit clk | Note 1 | E7B07 | D7B07 | | | | | | | |
| –rec clk | Note 1 | E7B08 | D7B08 | | | | | | | |
| –sel standby | Transmit | E7B03 | D7B03 | → | | | | | | |
| –ring ind | Receive | E7D12 | D7D12 | ← | D8B13 | +ring indicate (RI) | E8B13 | 21 | 22 | ← |
| –req to send | Transmit | E7D02 | D7D02 | → | | | | | | |
| –clear to send | Receive | E7D13 | D7D13 | ← | | | | | | |
| –carrier det | Receive | E7B12 | D7B12 | ← | | | | | | |
| –test control | Transmit | E7B05 | D7B05 | → | | | | | | |
| –test ind | Receive | E7D10 | D7D10 | ← | | | | | | |
| +xmit line data | Transmit | E7D04 | D7D04 | → | D7D05 | data tip (DT) Note 4 | E7D05 | 07 | 09 | → |
| +rec line data | Receive | E7B10 | D7B10 | ← | D7D06 | data tip (DT) Note 4 | E7D06 | 07 | 09 | ← |
| | | | | | D8B03 | +off hook (OH)) | E8B03 | 17 | 04 | → |
| | | | | | D8D02 | +data modem ready (DA) | E8D02 | 15 | 20 | → |
| | | | | | D8D09 | +coupler cut through (CCT) | E8D09 | 06 | 06 | ← |
| | | | | | D8B10 | +switch hook (SH) | E8B10 | 14 | 05 | ← |
| data ring gnd | | E5D08 | | | | data ring (DR) | | 23 | 21 | |
| -5 V | Power | E5B06<br>E7B06 | D7B06 | | | | | | | |
| +8.5 V | Power | E6B11<br>E8B11 | D8B11 | | | | | | | |
| -8.5 V Note 3 | Power | | D7D07 | | | | | | | |

**Notes:**

1. This line is not used by the 38LS card.
2. All D03 board pins are at a +5 V level. All D08 pins are signal ground.
3. On the 38LS card, –8.5 V is used for United States auto-answer only.
4. This line goes to the 38LS transmit level attenuators on the communications MPU card. If the attenuators are not present, pin E7D05 is jumpered to pin E7D06 on the communications MPU card.

## 869 38LS–WITH WT LINE PLATE–SWITCHED NETWORK CABLE DIAGRAM

This 38LS cable diagram and table shows the signal path from the communications MPU card through the 38LS card and the WT line plate to the connector (J140) on the cable connector panel. The table indicates probe points that can be referenced by the MAPs. Use this cable diagram when the WT line plate is installed. See 901 for information on how to use the cable diagrams. The arrow (→) indicates the logical direction of the signal.



## 869 38LS—WITH WT LINE PLATE—SWITCHED NETWORK CABLE DIAGRAM (continued)

| Line Name | Line Type | Comm MPU Card | 38LS Card | 38LS Wrap Level 2 | 38LS Card | 38LS Lines | Comm MPU Card | Comm MPU Card E5J01 | | Line Plate Conn | Line Plate 38LS Interface | Line Plate TB 1 | J140 | Line Plate PTT Interface Lines |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Probe Points | | | | | | | | | | | | |
| | | A | B | | C | | D | E | | F | | G | H | |
| -data term ready | Transmit | E7B02 | D7B02 | → | | | | | | | | | | |
| -data set ready | Receive | E7B13 | D7B13 | ← | | | | | | | | | | |
| -rate sel | Note 1 | E7B04 | D7B04 | | | | | | | | | | | |
| -xmit clk | Note 1 | E7B07 | D7B07 | | | | | | | | | | | |
| -rec clk | Note 1 | E7B08 | D7B08 | | | | | | | | | | | |
| -sel standby | Transmit | E7B03 | D7B03 | → | | | | | | | | | | |
| -ring ind | Receive | E7D12 | D7D12 | ← | D8B13 | ring indicate | E8B13 | 21 | ← | A02 | Current Detect 2 | | | |
| -req to send | Transmit | E7D02 | D7D02 | → | | | | | | | | | | |
| -clear to send | Receive | E7D13 | D7D13 | ← | | | | | | | | | | |
| -carrier det | Receive | E7B12 | D7B12 | ← | | | | | | | | | | |
| -test control | Transmit | E7B05 | D7B05 | → | | | | | | | | | | |
| -test ind | Receive | E7D10 | D7D10 | ← | | | | | | | | | | |
| +xmit line data | Transmit | E7D04 | D7D04 | → | D7D05 | data tip (DT) | E7D05 | 07 | → | A08 | Data Tip | 9 | 13 | Telephone Line 1 |
| | | | | | | | | | | | | 8 | 14 | Telephone Line 2 |
| | | | | | | | | | | | | 7 | 10 | Telephone Set 1 |
| | | | | | | | | | | | | 6 | 12 | Telephone Set 2 |
| -rec line data | Receive | E7B10 | D7B10 | ← | D7D06 | data tip (DT) | E7D06 | 07 | | | | 5 | | Ground |
| | | | | | D8B03 | +off hook (OH) | E8B03 | 17 | → | B05 | Transfer Relay | | | |
| | | | | | D8D02 | +data modem ready (DA) | E8D02 | 15 | → | A04 | Data Indicate | | | |
| | | | | | D8D09 | +coupler cut through (CCT) | E8D09 | 06 | ← | B07 | -3.5V | | | |
| | | | | | D8B10 | +switch hook (SWH) | E8B10 | 14 | ← | B01 | Current Detect 1 | | | |
| -5 V | Power | E5B06<br>E7B06 | D7B06 | | | | | | | | | | | |
| +8.5 V | Power | E6B11<br>E8B11 | D8B11<br>D7D07 | | | | | | | | | | | |
| data ring gnd | | | | | | | E5D08 | 23 | | B08 | Data Ring | | | |

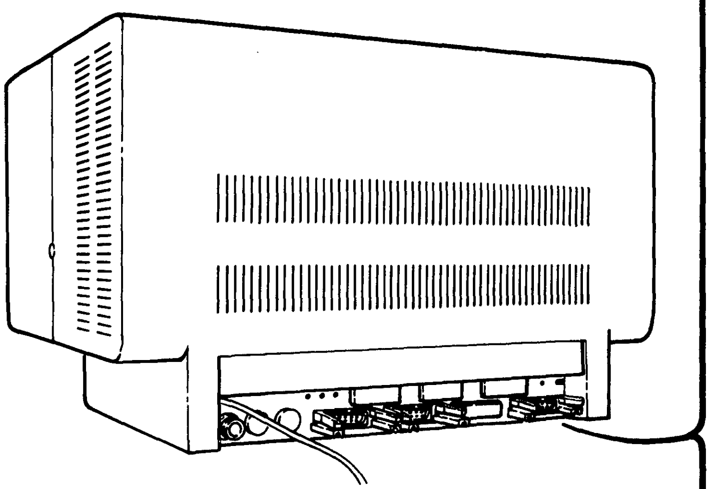
**Notes:**

1. This line is not used by the 38LS card.
2. All D03 board pins are at a +5 V level. All D08 pins are signal ground.

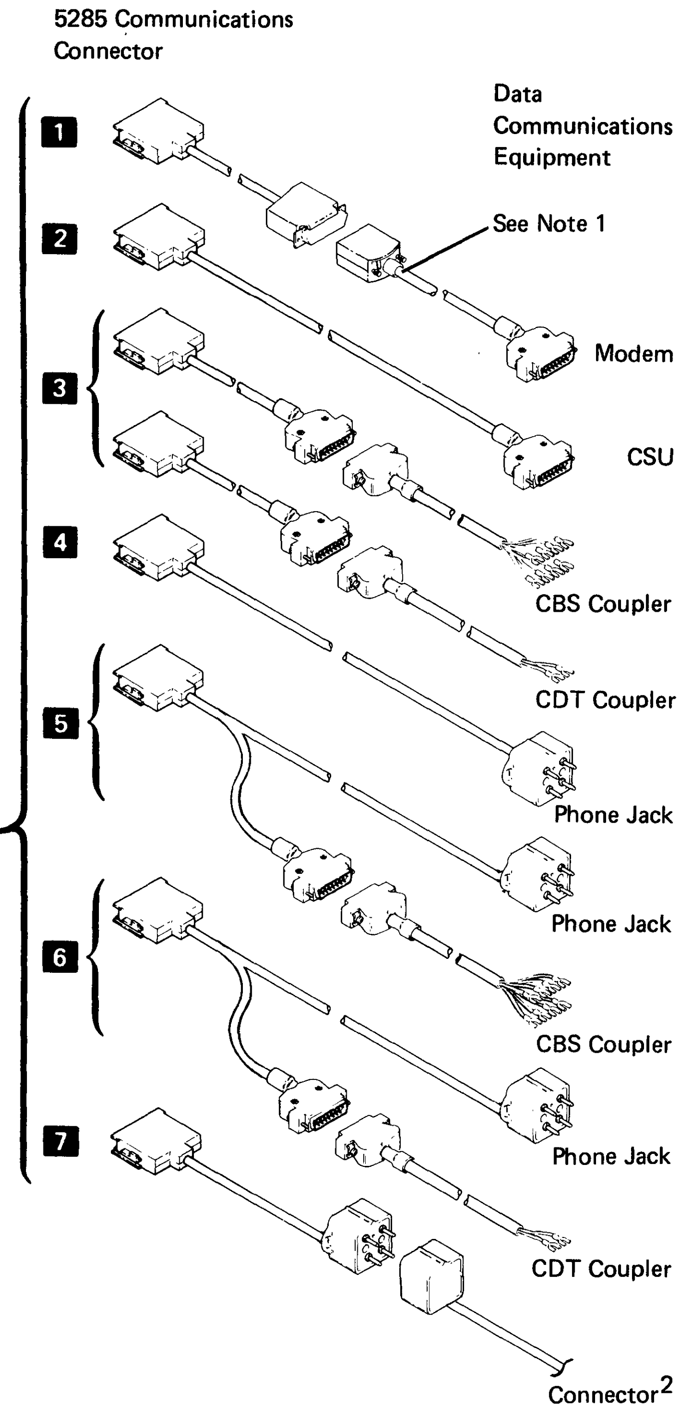
## Communications Cable Connections

### 871 COMMUNICATIONS EXTERNAL CABLES

A list and diagram of all the communications external cables available are shown in the following figure. For additional information about connecting the IBM 5285 to data communications equipment, see Line Adapter Cards in the Theory section of this manual.



1 EIA/CCITT[1]
2 DDSA
3 US Switched Network
4 US Nonswitched Network
5 US Nonswitched with SNBU and AA
6 US Nonswitched Network with SNBU and MA
7 WT Nonswitched or switched Network[2]




[1] An adapter cable is required to connect the EIA/CCITT interface cable to the modem in the following countries:

- Japan, part 4834494 (shown in drawing)
- United Kingdom, part 1727744

[2] Connector type determined by World Trade country

## 901 CABLE DIAGRAM DESCRIPTION

The cable diagrams are used to diagnose failures in a signal line referenced by the MAPs. When a signal line is indicated by the MAPs as failing, the MAPs might direct you to one of these cable diagrams to trace the signal line to determine the point of failure. The cable diagrams show:

- The relationship of internal cables, cable connectors, and the cable connector panel.
- All points that a signal line passes through from the cable connector panel, through the logic card, to the source or load A.
- The test points located throughout the device D.
- The location of any driver or receiver in the signal line C. (When a signal is inverted, it is inverted at C.)
- The logical direction of the signal, indicated by an arrow B.

A

| Line Name | Card C1 (Diskette Main MPU) Logic Board Pin | Card D1 (Diskette Driver/Receiver) Logic Board Pin | B C | Test Point D | Conn D1J48 | Conn D1J4C | Cable Connector Panel J111 | Line Name |
|---|---|---|---|---|---|---|---|---|
| –inner tracks* | C1B11 | D1B13 | → D | 26 | 05 | | 05 | +inner tracks* |

All plugs (such as P111) are attached to the ends of cables. All jacks (such as J111) are attached to either a card or to the chassis.

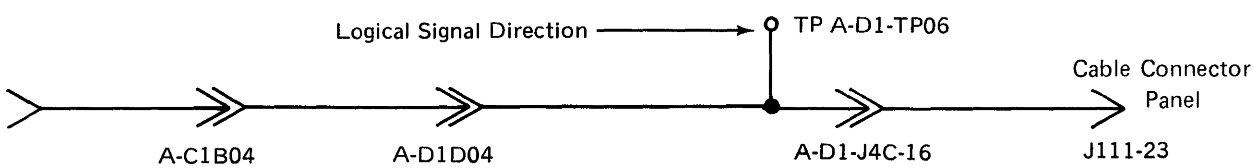
## 901 CABLE DIAGRAM DESCRIPTION (continued)

### Direct Feed-Through Circuit

The simplest circuit is the direct feed-through, such as '+ write gate 4C00' shown in cable diagram 319. This circuit is shown in 319 as:

| Line Name | Card C1 (Diskette Main MPU) Logic Board Pin | Card D1 (Diskette Driver/Receiver) Logic Board Pin B | | Test Point C | Conn D1J48 E | Conn D1J4C D | Cable Connector Panel J111 F | Line Name |
|---|---|---|---|---|---|---|---|---|
| +write gate 4C00 | C1B04 | D1D04 | → | 06 | | 16 | 23 | +write gate 4C00 |

This circuit can be diagrammed as follows:

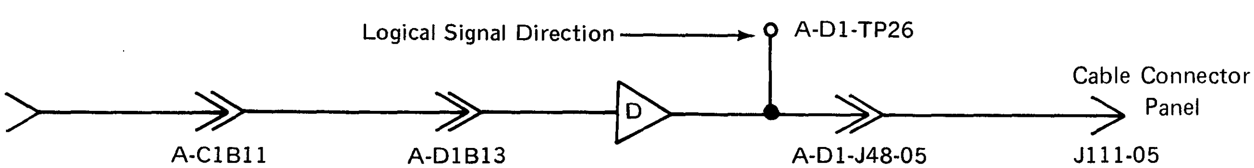



### Inverting Driver/Receiver Circuit

The '-inner tracks' signal shown in diagram 319 is an example of an inverting driver circuit.

| Line Name | Card C1 (Diskette Main MPU) Logic Board Pin A | Card D1 (Diskette Driver/Receiver) Logic Board Pin B | | Test Point C | Conn D1J48 E | Conn D1J4C D | Cable Connector Panel J111 F | Line Name |
|---|---|---|---|---|---|---|---|---|
| –inner tracks* | C1B11 | D1B13 | → D | 26 | 05 | | 05 | +inner tracks* |

This circuit can be diagrammed as follows:




In this circuit, the action of the driver (D) inverts the active level of the signal. The original signal '-inner tracks' exits the driver as '+ inner tracks'.

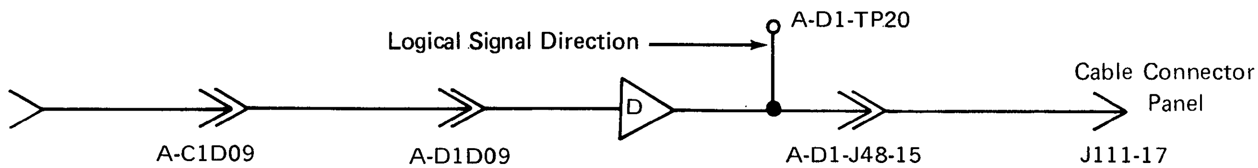
## 901 CABLE DIAGRAM DESCRIPTION (continued)

### Non-Inverting Driver/Receiver Circuit

The '+head engage 4800' signal shown in diagram 319 is an example of a non-inverting driver circuit.

| | Card C1 (Diskette Main MPU) | Card D1 (Diskette Driver/Receiver) | | | | | Cable Connector Panel | |
|---|---|---|---|---|---|---|---|---|
| Line Name | Logic Board Pin A | Logic Board Pin B | | Test Point C | Conn D1J48 E | Conn D1J4C D | J111 F | Line Name |
| +head engage 4800 | C1D09 | D1D09 | → D | 20 | 15 | | 17 | +head engage 4800 |

This circuit can be diagrammed as follows:




In this circuit, the action of the driver (—D—) does not invert the active level of the signal.

## 903 TERMINATOR/LOAD RESISTOR

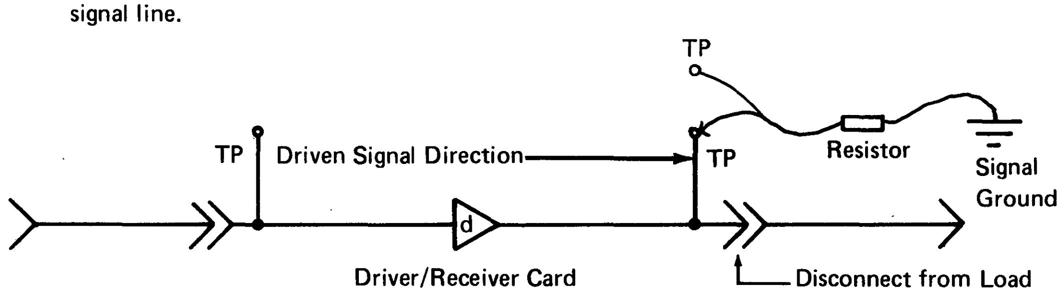
Use the terminator/load resistor to determine if a circuit is operating correctly. When you suspect that a circuit is open or shorted, disconnect the load and use the resistor to properly terminate the line. You can now probe or scope the circuit to determine whether the problem is at the source or at the load.

The following diagrams show examples of the use of the terminator/load resistor.

**Resistor as Terminator**

To use the resistor as a terminator:

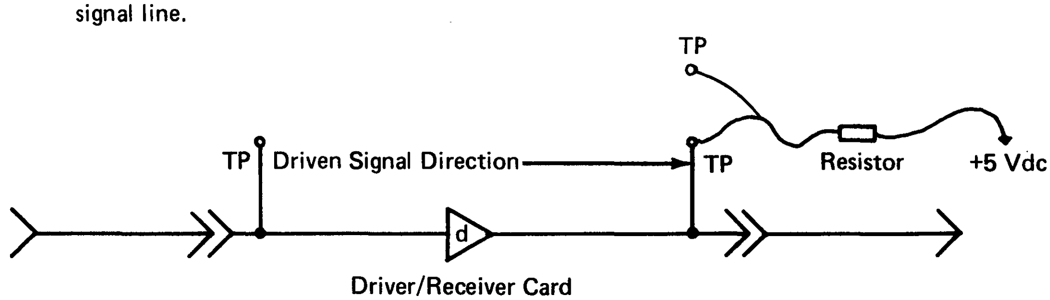
1. Disconnect the external cable.
2. Connect the resistor to the signal line.
3. Connect the other end of the resistor to ground.
4. Connect the probe or scope to the resistor at the signal line.




**Resistor as Load**

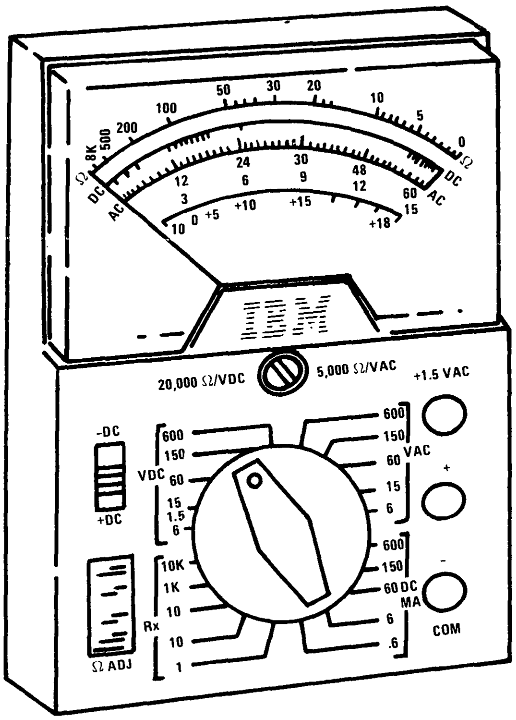
To use the resistor as a load:

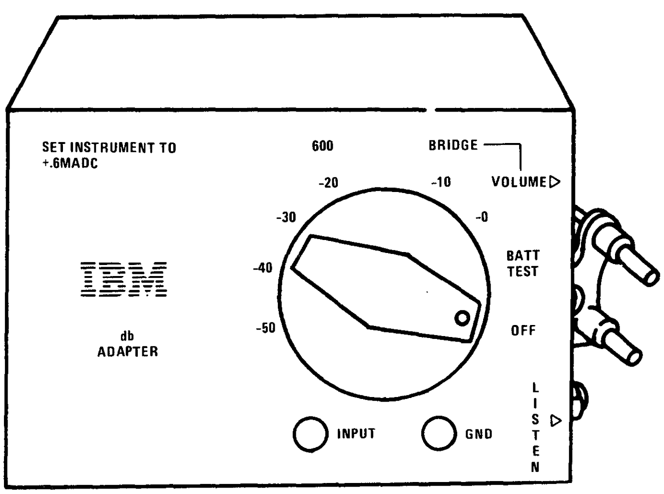
1. Connect the resistor to the signal line.
2. Connect the other end of the resistor to +5 Vdc.
3. Connect the probe or scope to the resistor at the signal line.



## 904 MULTIMETER/dB ADAPTER

The dB adapter and the multimeter which are shown in the following illustration, can be used for measuring transmit and receive signal levels.




The dB adapter has the following features:

- The dB adapter is attached directly on top of the multimeter switch panel.
- The lowered area in the bottom of the adapter box aligns with the lifted area of the multimeter range switch. This ensures the proper connection of the tools and the proper multimeter DC range (0.6 ma DC).
- An earphone can be used to listen to the line signals at the same time an online measurement is taken (bridge mode only). A listening volume control is provided on the adapter.
- The light emitting diode glows to indicate a good battery when the rotary switch is in the battery test position. A 9V transistor radio type battery is required.

**Diagnostic User Procedure**

1. Set the multimeter range switch to the 0.6 mA position, and carefully attach the dB adapter on top of the multimeter switch panel.
2. Connect the dB adapter leads to the *INPUT* and *GRD* jacks.
3. Verify that the battery is good by setting the range switch to *BATT TEST.*
4. Set the range switch to 0 dB.
5. Set the two-position slide switch to *BRIDGE* or *600* ohms, as required for the dB measurement to be made.
6. Attach the dB meter adapter leads to the circuit to be measured, and activate the circuit.
7. Change the range switch for a 1/2 to 2/3 scale reading with the pointer.
8. Use the adapter chart or algebraically add the scale reading to the range switch setting for the true measurement value in dB.

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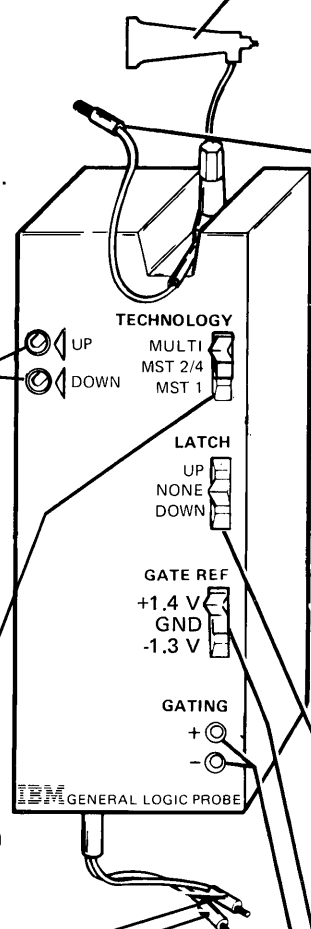
## 905 GENERAL LOGIC PROBE

The general logic probe supplies visual information of line level. (Refer to the handbook that comes with the probe.)

### Testing Procedure

Connect the general logic probe power leads and set the switches as stated. Connect the test terminal to A-A1-B04. Both the Up light and the Down light should pulse. Do not use the probe tip extender to check out the general logic probe. Use of this extender could cause unreliable results.




### 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.

### Logic Selector (TECHNOLOGY)

Use the Multi setting for the IBM 5280 system.

### Power Leads

+Red
-Black

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

(For the following connection locations, see 451).
Connect the black (-) lead to power supply E3 (ground).
Connect the red (+) lead to power supply E2 (+5 Vdc).

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

### Probe Tip

The line being probed is connected to this terminal.

**Note:** To prevent wrong visual information, this lead should not be placed near the high-voltage transformer or near the neck of the cathode-ray tube.

### Ground Lead

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

Wrong visual information will result if this lead is *not* connected to signal ground.

**Note:** In order to avoid wrong visual information, this lead should not be placed near the high-voltage transformer or near the neck of the cathode-ray tube.

### Latch Switch

The Up position permits the Up light to lock on a positive pulse.
The Down position permits the Down light to lock on a negative pulse.
The None Position resets the lights and does not let the Up or Down lights lock.
The None position is used for most probing within the data station.

### Gate Ref Volts Switch

Set the Gate Ref Switch to +1.4V.

### Gating Terminals

The setting of the Gating depends on the procedure being performed.

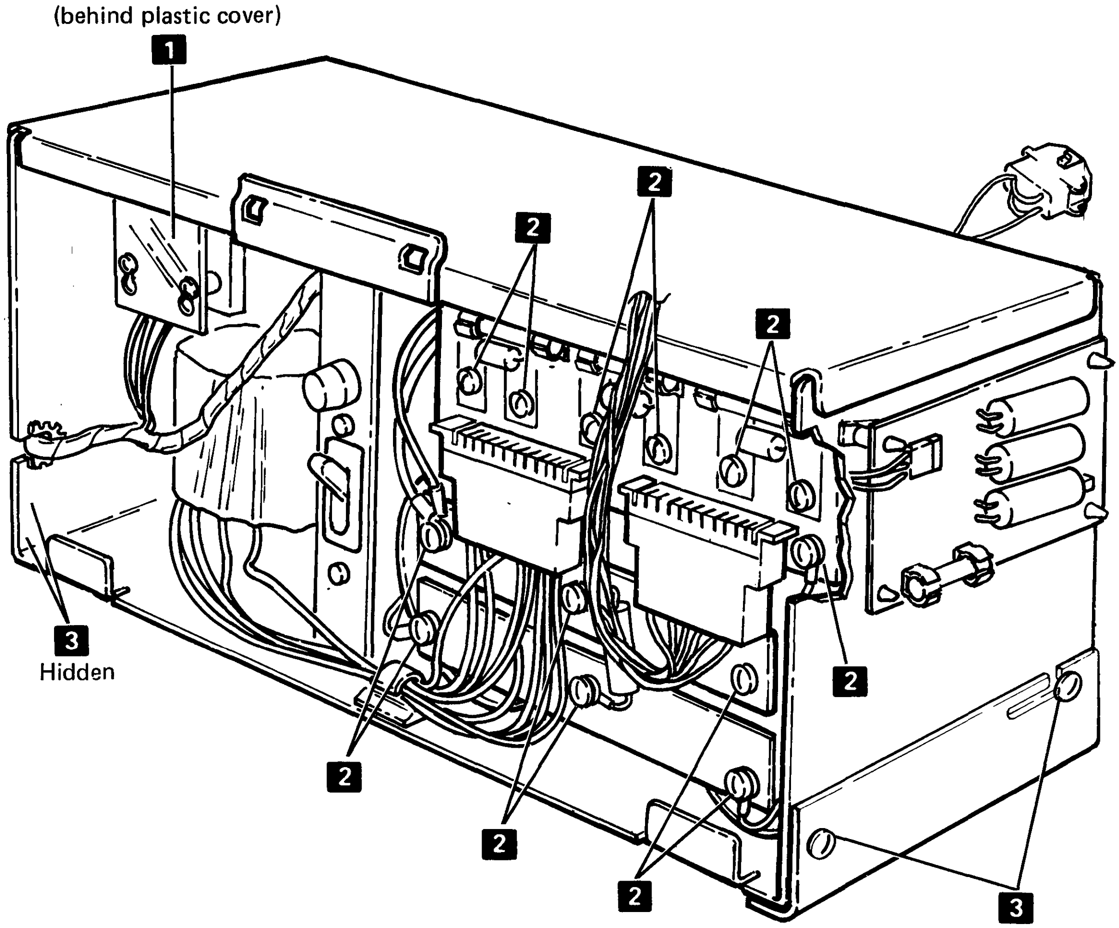
## 911 ELECTROSTATIC DISCHARGE SERVICE AIDS

In either or both low temperature and low humidity environments, the IBM 5280 system might be subjected to electrostatic discharges (ESD). ESD can come from persons or other machines touching the IBM 5280 system. The types of intermittent failures caused by ESD are:

- Keyboard errors
  - Error code 1171–keyboard overrun
  - Error code 1202–invalid scan code
  - Incorrect character(s) entered from the keyboard
- Temporary diskette errors in the system error log
- Read/write storage parity errors
- Checks and errors that are unrelated to the programs operation

Make the following adjustments to reduce the effect of ESD:

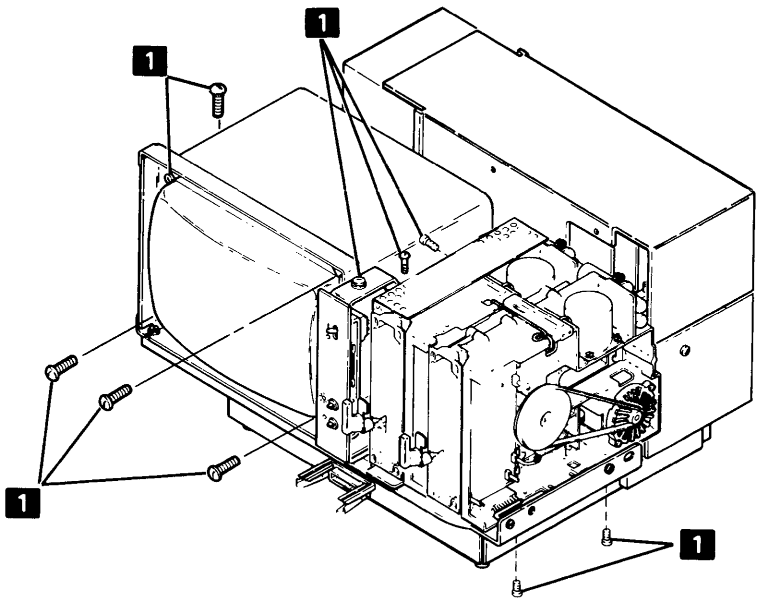
- Tighten all screws in the power supply. This includes mounting screws 3, terminal block screws 1, and voltage distribution connection screws 2.

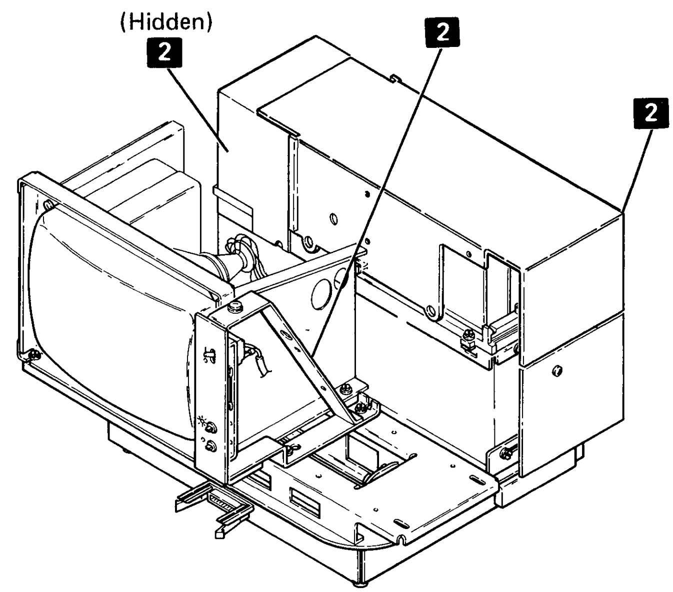


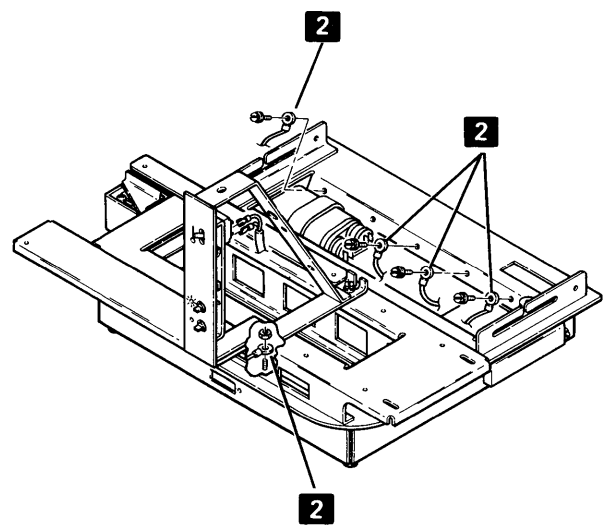

- Check for the proper system ground at the service outlet. A conduit or neutral ground is not sufficient. Ensure that the AC input voltage is within the proper limits. For information on proper grounds and voltage limits, see the *IBM 5280 Planning and Site Preparation Guide,* GA21-9351.

## 911 ELECTROSTATIC DISCHARGE SERVICE AIDS
**(continued)**

- Tighten all of the mechanical mounting screws **1** and all of the ground strap screws **2**.

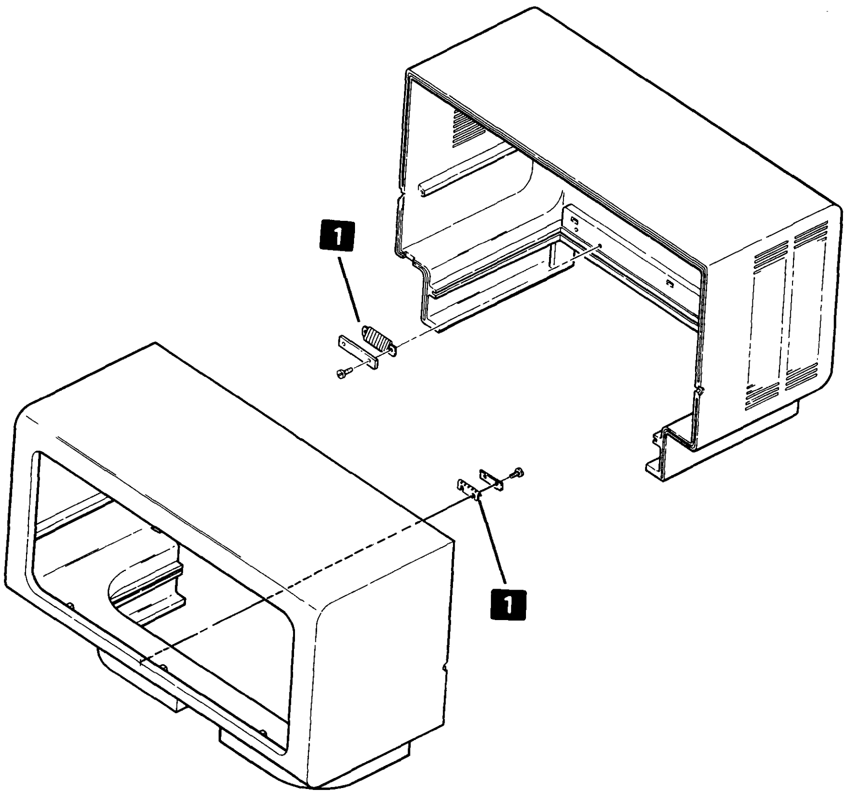


## 911 ELECTROSTATIC DISCHARGE SERVICE AIDS (continued)

- Adjust the covers for proper fit, ensuring that the grounding fingers **1** make good contact.




A correctly assembled and adjusted system can still have failures when the conditions which cause ESD are high. The solution to ESD problems under such conditions is to decrease or remove the source of the static. The following procedures might help to eliminate the source of the static electricity:

- Use antistatic solution on the floors.
- Ensure that other machines do not hit or rub the machine covers.
- Ensure that the temperature or humidity is at a proper level.

For additional information on ESD, as well as other sources of electromagnetic interference (EMI), see the *IBM 5280 Planning and Site Preparation Guide,* GA21-9351.

## 921 ABSOLUTE DUMP PROCEDURE

An absolute dump writes the contents of main storage onto an absolute dump diskette. Main storage is written onto the diskette from address 00 to the end of main storage or to the end-of-data marker on the diskette. An absolute dump diskette contains DMP in the first three positions of track 0, head 0, sector 1.

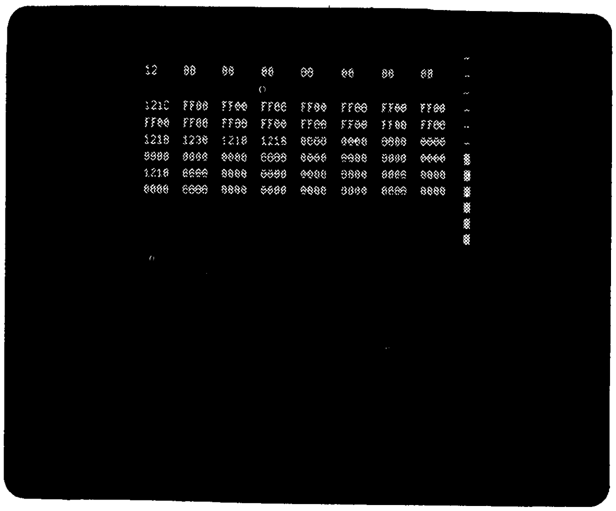
Use the SYSDUMP utility to format an absolute dump diskette. Use the following procedure to dump main storage:

1. Find a diskette drive that is ready and contains a diskette with an open data set (drive-in-use indicator on).
2. Open the diskette locking lever and remove the diskette. The diskette drive should start seeking and continue to seek for approximately five seconds.
3. While the diskette drive is seeking, insert the absolute dump diskette and close the diskette locking lever.
4. The data from main storage should start dumping to the diskette. This is indicated by the movement of the diskette drive head/carriage assembly.
5. The dump is completed when the head/carriage assembly stops.
6. When the dump is completed, open the diskette locking lever and remove the absolute dump diskette.
7. Insert the diskette that was removed in step 2 and close the diskette locking lever.
8. The diskette operation that was being performed at the time this procedure was started will continue without loss of data.

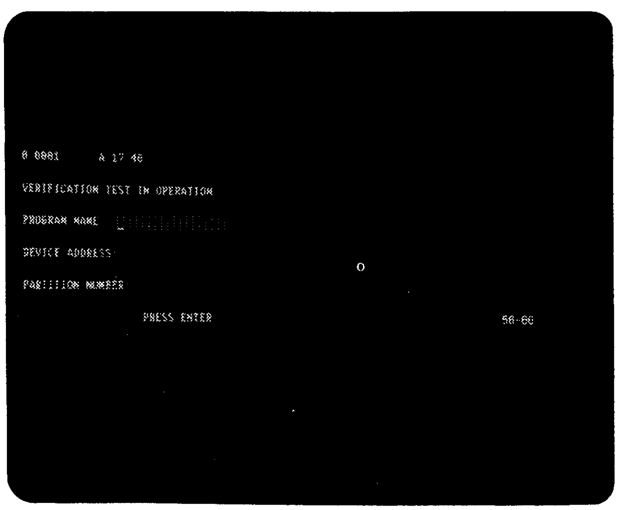
## 925 PARITY CHECK DISPLAY EXAMPLES

Some display images could appear to be indications of parity checks when they are not. The following examples will aid you in determining when you have a parity check.

No Parity Check:

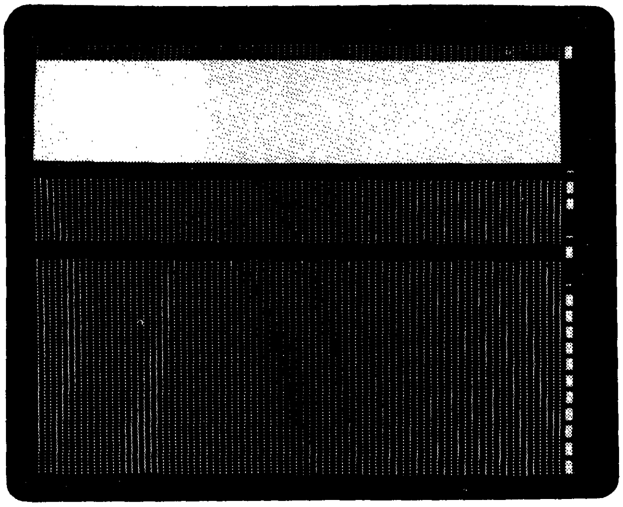


No parity check:
No reverse image
No data flashing

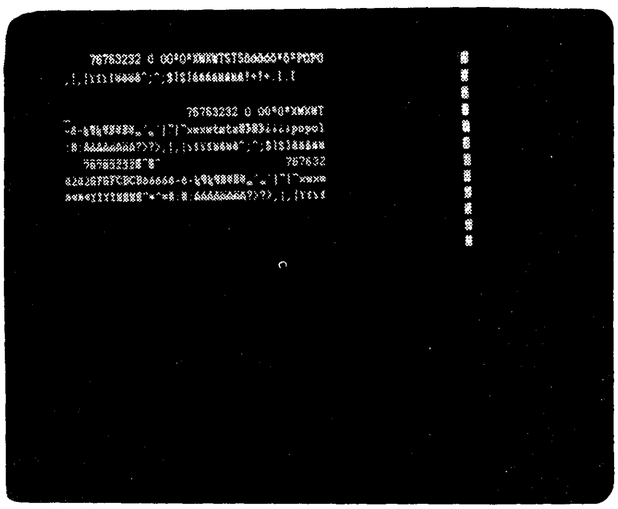



No parity check:
No reverse image
No data flashing

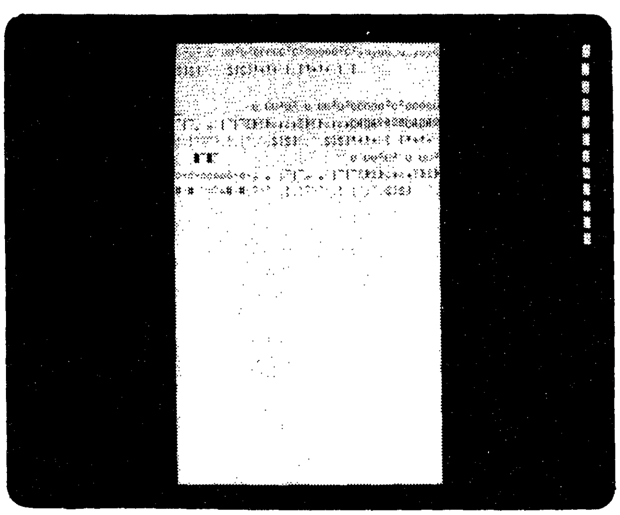
## 925 PARITY CHECK DISPLAY EXAMPLES
**(continued)**



No parity check:
Parital reverse image
No data flashing

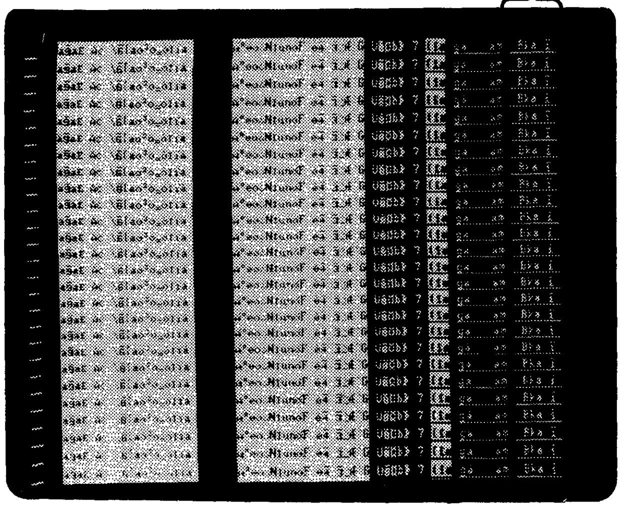


No parity check:
No reverse image
One line of data flashing



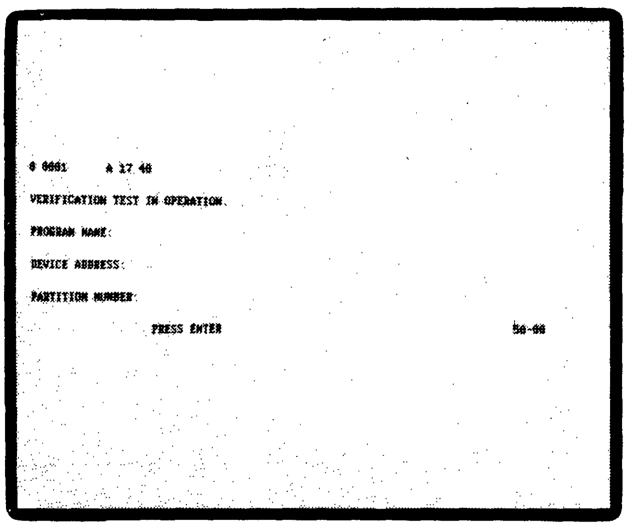
No parity check:
reverse image
half screen image
all data flashing

## 925 PARITY CHECK DISPLAY EXAMPLES (continued)

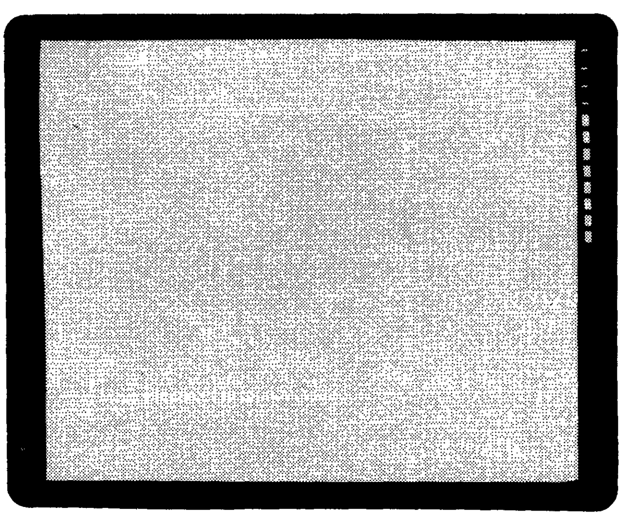


No parity check:
mixture of reverse image
and normal image
This column of data flashing

Parity Check:

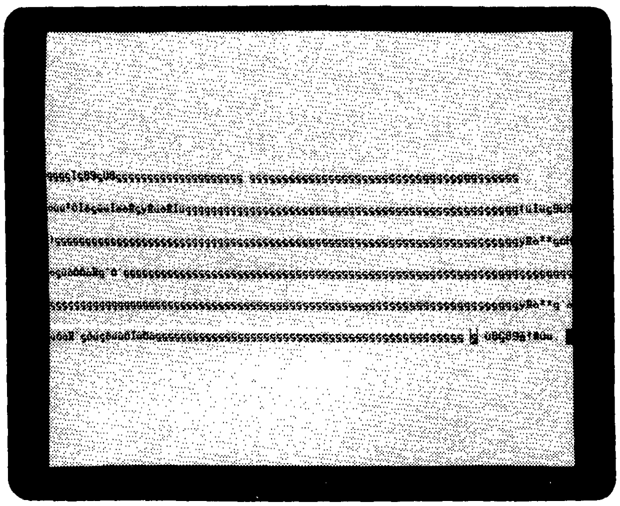



Parity Check:
Reverse image
All data flashing



Parity Check:
Reverse image

## 925 PARITY CHECK DISPLAY EXAMPLES (continued)



Parity Check:
Reverse image
All data flashing

## 931 POWER-ON CHECKOUT AND IPL

This procedure applies to all units of the IBM 5280 system. Some feature descriptions and checkout procedures might not apply to your controller.

Power-on checkout verifies base machine operation and attached feature MPUs and adapters. The power-on checkout is performed each time the Power switch is turned on, or it can be restarted from the keyboard as follows:

1. **Press the Cmd key.**
2. **Hold down the Shift key.**
3. **Press the G key.**

The power-on checkout and IPL is a sequence of step-by-step procedures to check that the system can load an IPL diskette. The display screen and keyboard speakers indicate event steps during the checkout. Any error condition that occurs during power-on checkout and IPL is displayed on the screen attached to the first partition on the system. The step in which a failure occurs is indicated by the display indicators. All display indicators are first set to an *on* condition (solid rectangular block ■) at the start of power-on checkout. Then, as each step is completed, the display indicator for that step is reset off (dash –).

The following chart is an aid in determining failures during power-on checkout and IPL:

**Note:** Dual data station display images are inverted from these shown here.

**Turn on the Power switch to start power-on checkout.**

**The hardware generates a power-on reset and activates the speaker on all keyboards (short click on the speaker).**

Did all of the speakers click? No —— **Power-on reset failed**

**Yes**

**The microcode starts a keyboard/display MPU checkout and activates the speaker on all keyboards (first long tone).**

A

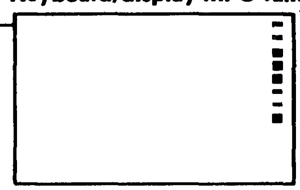
A

Did any of the keyboard speakers sound a tone? No — **Power-on checkout microcode routine did not start**

Yes

The microcode completes the keyboard/display MPU checkout and displays 12 ■ symbols.

Does the display screen either appear blank or contain a combination of dashes and ■ symbols?
Yes — (Invalid Display indicators) — **Keyboard/display MPU failed.**

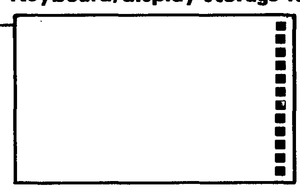


Example only. There might be other combinations of invalid dashes and ■ symbols.

No

(All following screens have valid display indicators.)
The keyboard/display MPU performs the keyboard/display storage check.

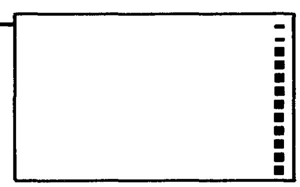
Does the display screen contain 12 ■ symbols and no dashes? Yes — **Keyboard/display storage failed.**



No

The main MPU performs the main MPU check.

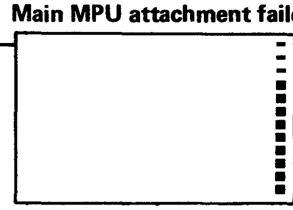
Does the display screen contain 10 ■ symbols and 2 dashes? Yes — **Main MPU failed.**



No

The main MPU performs an attachment checkout.

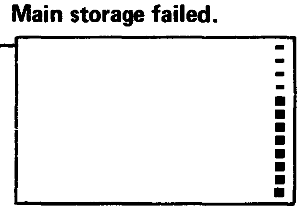
Does the display screen contain 9 ■ symbols and 3 dashes? Yes — **Main MPU attachment failed.**



No

The main MPU performs the main storage check.

Does the display screen contain 8 ■ symbols and 4 dashes? Yes — **Main storage failed.**



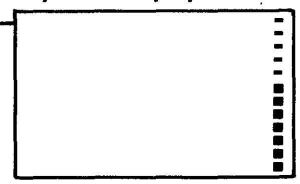
No

The keyboard/display MPU performs a main storage access check.

B

B

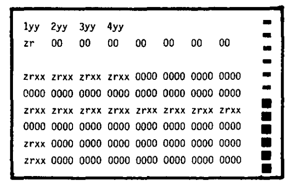
Does the display screen contain 7 ■ symbols and 5 dashes? Yes — **Keyboard/display main storage access failed.**



No

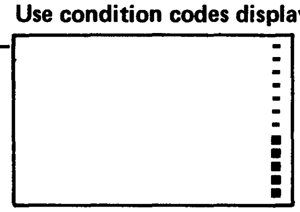
The diskette MPU searches for a ready diskette drive with an IPL diskette.

Does the display screen contain 6 ■ symbols and 6 dashes? Yes — **An IPL device was not found. The display screen contains coded information; see the condition table that follows.**



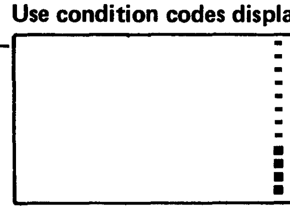

No

Does the display screen contain 5 ■ symbols and 7 dashes? Yes — **Use condition codes displayed as an aid in failure analysis.**



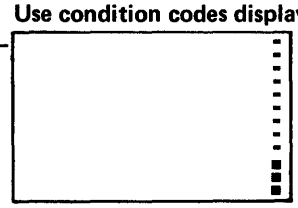
No

Does the display screen contain 4 ■ symbols and 8 dashes? Yes — **Use condition codes displayed as an aid in failure analysis.**



No

Does the display screen contain 3 ■ symbols and 9 dashes? Yes — **Use condition codes displayed as an aid in failure analysis.**



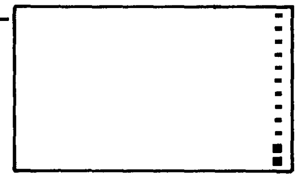
No

The diskette MPU loads the IPL program from diskette.

C

C

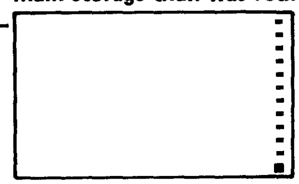
Does the display screen contain 2 ■ symbols and 10 dashes? **Yes** → **Initial program load program failed to load properly.**



**No**

The main MPU sets the IPL load parameters and checks the main storage size.

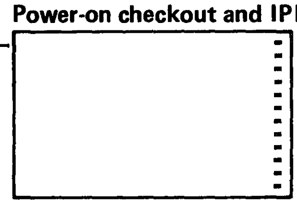
Does the display screen contain 1 ■ symbol and 11 dashes? **Yes** → **Main storage size check failed. The diskette needed more main storage than was found in the main storage check.**



**No**

All MPUs complete their checkout and all keyboard speakers are activated (second long tone).

Did any of the keyboard speakers sound a tone? **No** → **Power-on checkout and IPL sequence did not complete.**



**Yes**

Power-on checkout and IPL sequence is complete.

A load prompt is displayed.

## Condition Code Table for Power-On Checkout and IPL Failures

**Use the displayed condition codes to determine the type of failure that occurred during a power-on checkout and IPL operation. To force a condition code display, leave the diskette locking lever of the drive containing the IPL diskette open. The scan code for any pressed key can now be observed on the display.**

If the L key is the first key pressed at any time during the power-on checkout and IPL sequence, the display/alter function is started (991). To terminate the display/alter function, a power-on checkout and IPL must be done (turn the Power switch off and then on).

To terminate a scan code display function, close the diskette locking lever; the power-on checkout will continue.

The format of the display is as follows (the line positions are inverted for displays on the IBM 5282 and the IBM 5286):

**The keyboard scan code is displayed in hexadecimal for each key pressed during power-on checkout. Entry 1yy is for keyboard 0, entry 2yy is for keyboard 1, and so on.**

```
1yy  2yy  3yy  4yy
zr   zr*  00   00   00   00   00   00

zrxx zrxx zrxx zrxx 0000 0000 0000 0000
0000 0000 0000 0000 0000 0000 0000 0000
zrxx zrxx zrxx zrxx zrxx zrxx zrxx zrxx
0000 0000 0000 0000 0000 0000 0000 0000
zrxx 0000 0000 0000 0000 0000 0000 0000
zrxx 0000 0000 0000 0000 0000 0000 0000
```

**Line 1**—Keyboard scan codes

**Line 2**—Main MPU status

**Line 3**—Reserved

**Line 4**—Keyboard/display MPU status

**Line 5**—Reserved

**Line 6**—Diskette MPU/drive status (drive 40 on left through 5C on right)

**Line 7**—Reserved

**Line 8**—Printer MPU status

**Line 9**—Communications MPU status

| | |
|---|---|
| z | MPU number assigned by the microcode. |
| r | MPU ROS engineering change and patch level. These numbers are generated by the microcode but are not used during normal maintenance procedures. |
| xx | Device condition in hexadecimal. See the table on the next page for the meaning of each entry. |
| * | Present only if the feature main MPU is installed. |

| Condition Code In Hex | Description |
|---|---|
| 00 | The keyboard/display attachment has no data station attached.<br>The printer, communications, or diskette feature is not installed or the respective display checkout has been started. |
| 04 | The printer, communications, or diskette MPU check is complete. |
| 08 | Main storage check complete: the printer, communications, or diskette MPU completed a write and read at the main storage address assigned to the attachment by the main MPU in microcode. |
| 0C | 256-byte read/write main storage check complete: printer, communications, or diskette MPU completed a write and read of the first 256 bytes of main storage assigned to the attachment by the main MPU microcode. |
| 10 | The printer, communications, or diskette attachment check is complete. The diskette drive is attached to the diskette attachment but another diskette drive is doing an IPL. |
| 14 | VFO error. |
| 18 | The keyboard/display attachment has a data station attached.<br>Index pulses are too slow from the diskette drive attached to the diskette attachment.<br>**Note:** A diskette drive locking lever in the open position can also cause this condition. |
| 1A | The keyboard/display attachment has a dual data station attached. |
| 1C | The keyboard/display attachment has a data station attached and ready.<br>Index pulses are too fast from the diskette drive attached to the diskette attachment. |
| 1E | The keyboard/display attachment has a dual data station attached and ready. |
| 20 | Erase mismatch: the diskette attachment write or erase gate was active during a read operation, or write/erase sense was active during a read operation. |
| 21 | Storage overrun: the diskette MPU was unable to obtain the required storage cycles to transfer the data. |
| 23 | The diskette drive attached to the diskette attachment deactivated the ready status during a read operation. |
| 24 | No address mark detected: the diskette attachment detected no address mark on the diskette being read by this diskette drive. |
| 26 | CRC error: the diskette attachment detected a cyclic redundancy check (CRC) error on the diskette operation being performed. |
| 27 | Not used. |
| 29 | Media error: the diskette attachment cannot process the data from this diskette (damaged diskette or invalid type data [969] ). |

| **Condition Code In Hex** | **Description** |
|---|---|
| 2A | Control address mark detected: the diskette attachment detected a control address mark on the diskette operation being performed when no control address mark was expected. |
| 2C | ID mismatch: the diskette attachment found an ID on the diskette that did not match the ID that it was instructed to find. |
| 2D | Sense 2 invalid: during a diskette read or write operation the bits set in the sense register 2 are invalid. |
| 2E | Volume label error: the volume label format is not correct. |
| 30 | Non-IPL diskette: the diskette in this drive is not an IPL diskette. |
| 32 | Diskette type error: the diskette type (type 1 or 2D) on the volume label does not match the diskette being used. |
| 34 | Label error: the header label format is not correct. |
| 38 | IPL limits wrong: the IPL data set size is greater than the system main storage size. |
| 3C | Not used. |
| FF | All diskette attachment checks are complete. |

## 940 DIAGNOSTIC DISKETTE DESCRIPTIONS

Three diagnostic diskettes are provided with the IBM 5280 system. Programs are contained on two of these diskettes. The third diskette is a scratch diskette used by certain diagnostic programs.

Diagnostic diskettes 1 and 2 contain programs to:

- IPL the system and identify the keyboard type, assign program partitions, load the keyboard tables into the keyboard/storage, and display a load prompt.
- Load the Diagnostic Control Program (DCP) and run selected MAP Diagnostic Integration (MDI) programs.
- Load standalone programs to diagnose failures and to verify the operation after a repair action.
- Display or print out the error history log from the machine verification diskette.

The following shows the contents of each diagnostic diskette, and a description of diagnostic diskette 3, the scratch diskette.

**Diagnostic Diskette 1**

Diagnostic diskette 1 contains the following programs which can be loaded from the diagnostic IPL load prompt:

| Program Name | Function |
|---|---|
| SCANTEST | Keyboard scan code test |
| MSRTEST | Magnetic stripe reader test |
| CRTTEST | Display exerciser test |
| TMRTEST1 | Elapsed time counter test 1 |
| TMRTEST2 | Elapsed time counter test 2 |
| TSYSEREP | System error log recovery program |
| TCOMEREP | Communications error log and data trap recovery program |
| TMEDIA | Diskette surface analysis program |
| TPRNT | Printer test |
| PGMLOAD | Load utility for SYSTEST, PRTRPOLL, and communications utilities |

Diagnostic diskette 1 contains the following programs which can be loaded from the PGMLOAD load prompt:

| Program Name | Function |
|---|---|
| PRTRPOLL | Printer interface test |
| SYSTEST* | System exerciser test |
| SYSCLU* | Communications load utilities |
| SYSCCU* | Communications configuration utility |
| SYSBSCBA | Communications access method |
| SYSBOLT | BSC online test |

* These programs will not run if the system has been IPLed with a customer diskette. To run these programs, you must IPL the system with the diagnostic diskette 1. (941)

Diagnostic diskette 1 contains the IPL and diagnostic loader programs which are loaded and executed by the hardware IPL function. These programs are:

| Program Name | Function |
|---|---|
| TIPL | IPL starter program |
| TPARTL | Partition Loader program |
| TDDF | Definition file |
| TKBTBLS | Keyboard translate tables file |

**Note:** Attempting to load a program from the diagnostic IPL load prompt when that program is controlled by PGMLOAD, will cause a 3215 error.

## 940 DIAGNOSTIC DISKETTE DESCRIPTIONS (continued)

### Diagnostic Diskette 2

| Program Name | Function |
|---|---|
| DCP | Diagnostic control program (loaded from a load prompt) |
| MDI test routines used by DCP | These routines are automatically loaded by DCP: |
| AMEMT01 | Storage test |
| BMAINMP | Main microprocessor test |
| EKBDADP | Keyboard adapter test |
| EIOMCTL | Keyboard/display storage control test |
| EIOMEM | Keyboard/display storage test |
| GDSKT01 | Diskette test |
| GDSKT02 | Diskette test |
| GDSKT05 | Diskette test |
| GDSKT10 | Diskette test |
| GDSKT99 | Diskette test |
| KPRNT01 | Printer test |
| NCOMM01 | Communications test |
| MDI9001 | All diagnostic MDIs |
| ZMENSEL | Menu select program |

### Diagnostic Diskette 3

This diagnostic diskette is a scratch 2D diskette that has been initialized and formatted for 256 bytes per sector. The 51TD head stress test 1 (MD12520), the 51TD head stress test 2 (MD12530), and the head resolution test (MD12540) uses this diagnostic diskette.

## 941 IPL USING DIAGNOSTIC DISKETTE 1

When you IPL the system for maintenance purposes, use diagnostic diskette 1. This diskette contains a diagnostic loader program, which functions in one of two modes: diagnostic mode or customer verification mode. In diagnostic mode, extended functions and options aid you in diagnosing and isolating system problems. MAPs and MDI programs run only in diagnostic mode. In customer verification mode, the system is initialized in the same manner as the programs on the customer verification diskette.

To IPL the system using diagnostic diskette 1, do the following:

1. Power off the system.
2. Insert diagnostic diskette 1 into an available diskette drive and close the locking lever.
3. Power on the system.
4. Answer the prompts to select the desired options.

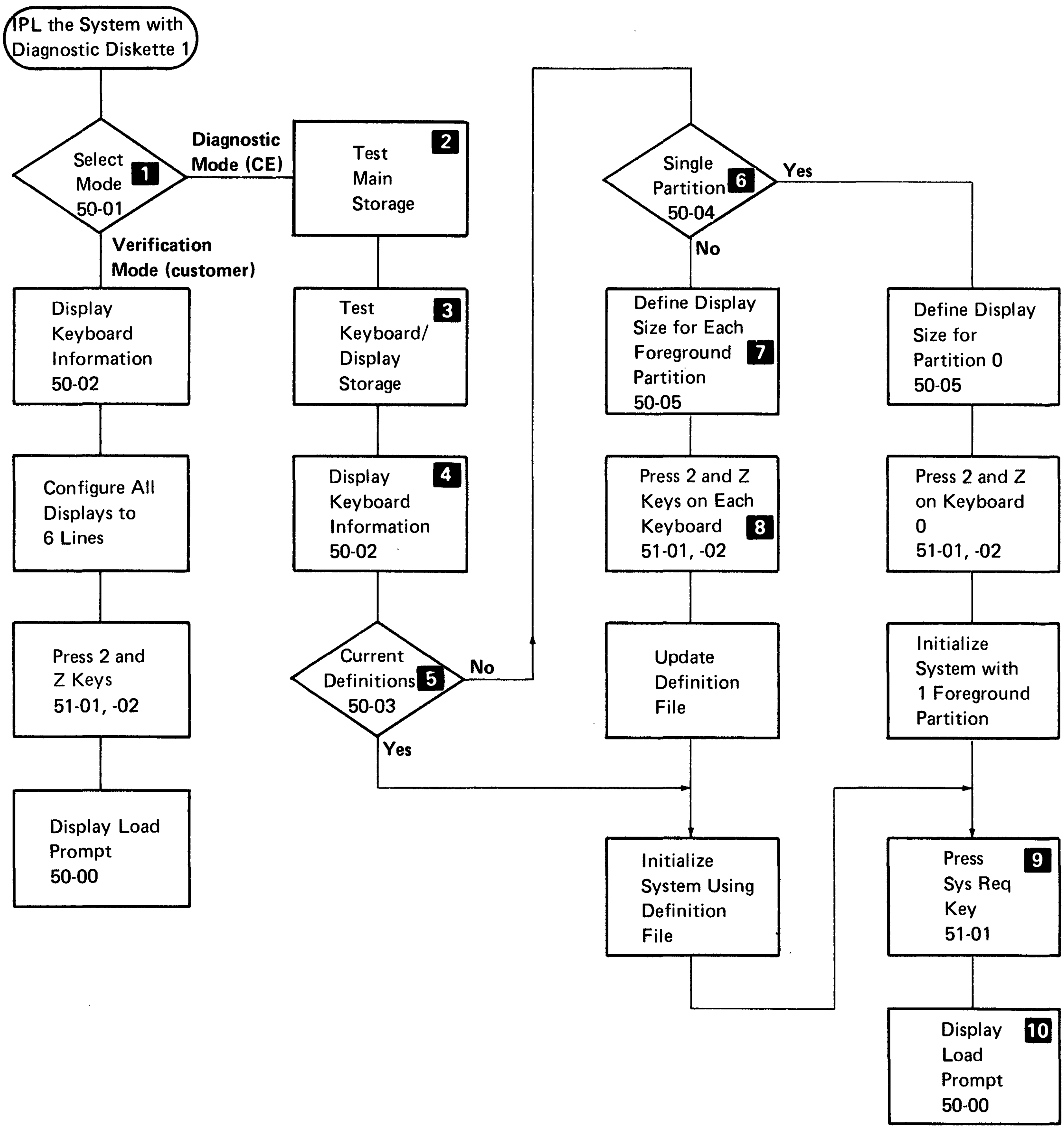
### Diagnostic Loader Program

The following are the major functions of the diagnostic loader program:

- Allocates partitions in main storage according to the number of keyboard adapters detected by the keyboard/display MPU during power on checkout, or enables you to select a single foreground partition when the prompt for this option is displayed.
- Allocates keyboard/display storage according to the display size associated with each partition. You enter the display size when you answer the prompts. The display size is then stored in a file on diskette 1.
- Determines the correct keyboard translate tables according to the scan codes generated when you press the 2 and Z keys in answer to a program prompt.
- Performs extended tests of main storage and keyboard/display storage not tested during power-on checkout. If an error occurs during these tests, an error code of 9119, 9120, or 9231 will be displayed.
- Stores information about system configuration in a definition file on diagnostic diskette 1. Therefore, you need not enter this information each time you run the program. The following information is saved in the file:
  - The amount of keyboard/display storage that is installed.
  - The size of the display associated with each foreground partition.
  - The type of keyboard associated with each foreground partition.
- Loads the definition file automatically when you answer the appropriate prompts. The file is not used if you select either customer verification mode or a single partition.

## 941 IPL USING DIAGNOSTIC DISKETTE 1 (continued)

**The following chart and descriptions explain the operation of the diagnostic loader program.**



## 941 IPL USING DIAGNOSTIC DISKETTE 1 (continued)

**1** The first prompt (50-01) of the diagnostic loader program permits you to select either customer verification mode or diagnostic mode. To select customer verification mode, press the Enter Key. To select diagnostic mode, press the X key and then the Enter key. Use diagnostic mode for MAPs and MDI programs.

**2** This test checks main storage above 32 K bytes. If an error occurs, an error code is displayed.

**3** This test checks keyboard/display storage above 2 K bytes. It checks both storage data and storage addressing. If an error occurs, an error code is displayed. The program also compares the size of storage found during the test with the size of storage stored in the definition file. If the storage sizes are not equal, the following prompt is displayed:

```
IS XX K THE CORRECT DISPLAY STORAGE SIZE?
  OPTIONS ARE
    A.  YES
    B.  NO
SELECT OPTION:  _  PRESS ENTER                    50-06
```

xx is the size of keyboard/display storage detected by the program. If this prompt is displayed, check the actual storage size installed on the system (see 207 for information about determining storage size).

If the storage installed does not equal the displayed value, select the *no* option. An error code will then be displayed. Use this error code to enter the MAPs.

If the storage installed does equal the displayed value, select the *yes* option. The definition file is then updated with the correct value. This option is valid when:

The program is run for the first time. (The value in the definition file is set to zero when the diskette is created.)

The keyboard/display storage size has been changed since the last time the program was run.

**4** The following informational message is always displayed. This information was detected by the system and the diagnostic loader program.

```
KEYBOARD INFORMATION FOR THIS SYSTEM
    X   TOTAL NUMBER OF KEYBOARDS CONNECTED TO THIS SYSTEM

    XXX DISPLAY STORAGE SIZE

PRESS ENTER TO CONTINUE                          50-02
```

**5** When prompt 50-03 is displayed, choose either to use the definition file as is or to modify the data in the definition file. If you want to use the data in the definition file to initialize the system, select the *yes* option. If you want to modify the data in the definition file or use the single partition option, select the *no* option.

When the diagnostic diskette is created, the definition file is blank; therefore, the first time you run the program, select the *no* option. In addition, if keyboard adapters, keyboard types, or keyboard/display storage is changed, select the *no* option and update the definition file.

The program compares the keyboard adapters it detects with data in the definition file. If the data is not equal, an error code is displayed and the program automatically selects the *no* option.

## 941 IPL USING DIAGNOSTIC DISKETTE 1 (continued)

**6** When prompt 50-04 is displayed, select the **no** option to update the definition file, or select the **yes** option to use a single foreground partition (the MAPs will direct you to use the **yes** option).

**7** When prompt 50-05 is displayed, you can specify the display size for the displays assigned to each foreground partition. The prompt is repeated for each foreground partition. The number of partitions needed is determined by the number of keyboards detected during power on checkout. To determine display size, refer to the system records and to 207. (For communications online tests, the display size must be set to 12.)

**8** The scan codes generated by the 2 and Z keys are unique for each keyboard type. Therefore, when you answer prompt 50-02, the program can determine the keyboard type in order to load the correct translate tables. When you press the 2 and Z keys, the keyboard type is stored in the definition file.

**9** Once the system has been initialized in diagnostic mode, prompt 51-01 is displayed on all display screens. To initialize the keyboard and display the load prompt, press the Sys Req key.

**10** When prompt 50-00 is displayed, enter the name of the program you want to run.

- For the diagnostic control program, enter DCP (951)
- For the communications online test, enter PGMLOAD (975)
- For standalone programs, enter the name of the desired program (971)
- For the system exerciser test, enter PGMLOAD (975)
- For the printer interface test, enter PGMLOAD (975)

## 951 DIAGNOSTIC CONTROL PROGRAM (DCP)

DCP is the supervisor program that controls the MAP Diagnostic Integration (MDI) tests. The DCP handles all of the prompts and keyboard responses as they are needed by each MDI test.

The system needs two partitions (7.25 K bytes each) when the MDI tests are run. DCP runs in one partition and the MDI test routines run in the other partition. When MDIs are running, no other programs should be executed.

The following describes how to:

- Load the diagnostic control program
- Interpret the DCP display during MDIs
- Control DCP during MDIs
- Interpret DCP error messages

### How to Load the Diagnostic Control Program

DCP is loaded from the diagnostic load prompt (prompt 50-00). This prompt appears when diagnostic diskette 1 is used to IPL the system.

1. To load DCP, use the diagnostic load prompt (50-00).
2. Insert diagnostic diskette 2 into a diskette drive.
3. Enter DCP for the program name.
4. Press the Field Exit key.
5. Enter the address of the diskette drive that contains diagnostic diskette 2. You can leave the partition number blank.
6. Press the Enter key.

The DCP program will now load and the following will be displayed:

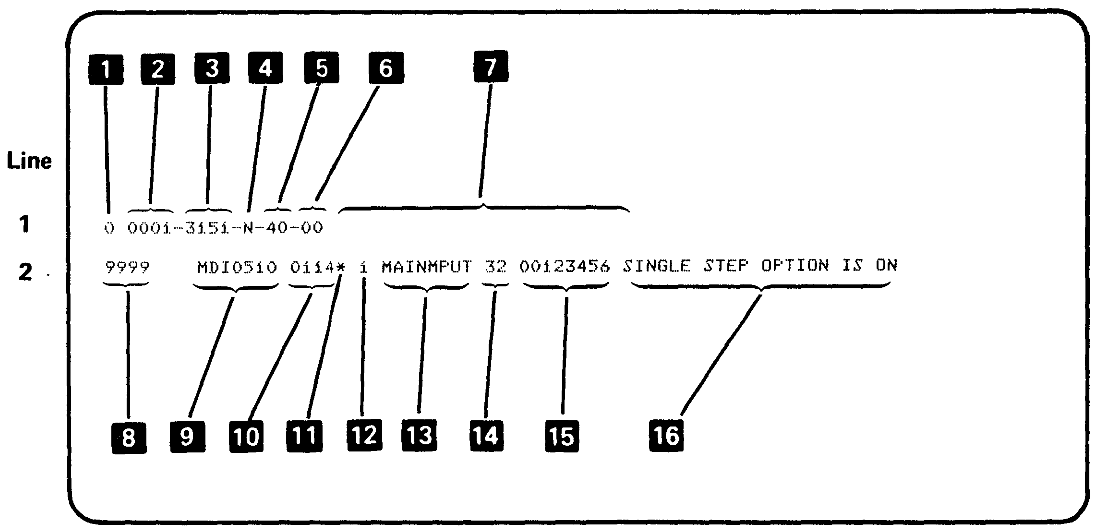
```
Line

1    0 0001
2          MD19001 0001  1  ZMENSEL  00              PRESS HELP KEY FOR DCP OPTIONS
3    MDI  AREA         MDI  AREA         TO SELECT AN MDI. ENTER THE MDI NUMBER.
4    0501 MAIN         1001 KB/DISPLAY   TO INTERRUPT AN MDI. PRESS,THE CNCL KEY.
5    2001 DISKETTE     3001 COMM         TO TERMINATE DCP, PRESS THE SYSREQ KEY.
6    7001 PRINTER                        PRESS ENTER KEY FOR DCP DESCRIPTION.
```

## 951 DIAGNOSTIC CONTROL PROGRAM (DCP) (continued)

### How to Interpret the DCP Display

The DCP controls all display messages and prompts when any MDI test is running.

The following example of a DCP display is shown only as an aid for you to interpret the contents of the six lines. All of the data shown might not be present on a display when the system is running.




Line 1 - Status line:

**1** Partition number in which DCP is running.

**2** Current position counter or column number for keyboard input.

**3** Four-position error code (see the *IBM 5280 Message Manual).*

**4** Keyboard field shift. A = alphabetic; N = numeric.

**5** Positions remaining in the keyboard input field.

**6** Hexadecimal value of the key just entered from the keyboard.

**7** 20 columns of information that can be displayed as a message by the software.

Line 2 - Data input line and DCP status line:

**8** Four-digit error code displayed for DCP-related errors. (See *How to Interpret DCP Error Messages* later in this section.)

**9** The MDI number under control of DCP.

**10** Four-digit MDI step number.

**11** The asterisk appears after the step number only if the diagnostic test failed and is in an error routine.

**12** Partition number in which the MDI test is operating.

**13** Name of the MDI test routine that is loaded.

**14** Parameter controlling the MDI test routine.

**15** Usually blank except for test status indicated while the test is running.

**16** Displays the active DCP option or the answer (yes or no) in single step mode.

Lines 3 through 6 are used for the MDI text messages.

## 951 DIAGNOSTIC CONTROL PROGRAM (DCP) (continued)

**How to Control DCP During MDIs**

The following operations permit you to control DCP:

| Result Wanted | Operation to Perform |
|---|---|
| To terminate an MDI test after the MDI step being executed is completed | Press the Cancel (Cncl) key. |
| To return to the MDI area menu after the MDI has automatically terminated | Press the Enter key. |
| To continue the MDI test after you have completed the requested action on the display screen | Press the Enter key. |
| To answer the question displayed on the screen | Press the Y or N key for yes or no answers. Then press the Enter key. |
| To return to the load prompt display and select a different program (standalone or user program) | Press the Sys Req key. |
| To terminate a loop | Press the Cncl key. |
| To change to a different DCP option (the options are not used by MDIxx01 menus) | Press the Help key. (See the next section, *DCP Options.*) |

*DCP Options*

To select and activate DCP options, press the Help key repeatedly until the desired option appears on the DCP status display line (line 2).

The following are the DCP options.

*Single step:* The MDI stops executing after the tests for each step have been run. The display shows the result (line 2 – single step answer = XXX) and the text (lines 3 through 6) for the MDI step. To continue the MDI test, either press the Enter key, or press the Y or N key and then press the Enter key. Pressing the Y or N key overrides the answer as determined by the MDI test. This answer is displayed on the DCP status line.

*Loop on good machine path:* When the MDI reaches a terminating step where control normally returns to the menu, DCP restarts the MDI originally selected. If the MDI leaves the good machine path, it stops at the last step on the good machine path. The DCP then resets the *loop on good machine path* option and sets the *single step* option.

*Loop continuously on step:* The DCP goes to the selected MDI step and executes the test repeatedly. The keyboard tone is sounded if the tests fail. Use the *single step* option to select the step you want to loop on. Then change to the *loop continuously on step* option.

*Loop until answer = y/n:* The DCP goes to the selected MDI step and executes the test repeatedly. (Some selected steps might have prerequisite steps and may not work with this option.) When the answer occurs from the tests, the *loop until answer = y/n* option is reset and the *single step* option is set. DCP then goes to the stop point of the *single step* option.

## How to Interpret DCP Error Messages

The DCP-detected errors and their messages are as follows:

3151 The DCP device went not ready. Insert the same diagnostic diskette and press the Enter key *or* insert the diagnostic diskette into a different device and enter that device address (4000, 4400......5C00).

9999 DCP cannot find an available partition to load the MDI test routine. This condition occurs on a 4-keyboard system if the Sys Req key is pressed on each keyboard when prompt 51-05 is displayed during diagnostic IPL. To recover, do the following:

1. Power down the system.
2. IPL the system using the IBM 5280 diagnostic loader program (941).
3. Press the Sys Req key on only one of the keyboards.
4. Load the DCP.

XXXX These are standard IBM 5280 error codes. The message definitions and recovery procedures for these errors can be found in the *IBM 5280 Message Manual.*

## 961 MAP DIAGNOSTIC INTEGRATION (MDI) TESTS

MDI tests are executed under control of the diagnostic control program (DCP). The DCP handles all of the text prompts, keyboard-required responses, and diagnostic routines as they are needed by each MDI test.

Two partitions are required to run the MDI tests. DCP runs in one partition and the MDI tests run in the other partition. When MDIs are running, no other programs should be executed.

To load an MDI test, do the following:

1. Load the DCP (951). The following prompt is then displayed:

```
                  1
0 0001
       MDI9001 0001  1  ZMENSEL  00            PRESS HELP KEY FOR DCP OPTIONS
MDI  AREA          MDI  AREA          TO SELECT AN MDI, ENTER THE MDI NUMBER.
0501 MAIN          1001 KB/DISPLAY    TO INTERRUPT AN MDI, PRESS THE CNCL KEY.
2001 DISKETTE      3001 COMM          TO TERMINATE DCP, PRESS THE SYSREQ KEY.
7001 PRINTER                          PRESS ENTER KEY FOR DCP DESCRIPTION.
                          2
```

2. Select either an MDI area menu or an individual MDI test.

To select an MDI area (device type or function) menu, key in the four digits **1** from the MDI area list **2**. The area menu is then displayed. You can then enter the number of the individual MDI test.

To select an individual MDI test, key in the four digits **1** of the MDI test that you want to load.

## 961 MAP DIAGNOSTIC INTEGRATION (MDI) TESTS (continued)

**Description of MDI Tests**

A short description of each MDI test follows. The descriptions are grouped by MDI area.

*Base System Area (MDI0501):*

MDI0510 Main MPU Opcode Test — tests all internal opcodes for correct function.

MDI0520 Auto Main Storage Test — does a read and write check on main storage using the size determined during power-on checkout.

MDI0530 Manual Main Storage Test — does a read and write check on main storage using the value you entered for the upper limit address of main storage to be tested.

*Keyboard/Display Area (MDI1001):*

MDI1060 Keyboard/Display Storage Test — tests all the installed keyboard/display storage and the storage control logic.

MDI1070 Keyboard Adapter Test — performs a status test, register test, scan code wrap test, and a scan code overflow test.

*Diskette Area (MDI2001 and MDI2501):*

MDI2020 Diskette Adapter Test — tests the diskette MPU external registers and performs read diagnostic functions to verify the read path through the diskette adapter.

MDI2040 Drive-in-Use Test — tests the drive-in-use indicators on all diskette drives. The normal condition of an indicator when on indicates an open data set on the diskette drive.

MDI2050 Drive MAP Support Exerciser — permits you to select the drive and the command to be executed by the drive. Functions such as read, write, seek, and the drive ready condition are checked. The MAPs reference this MDI as an aid to diagnose failures.

MDI2060 Functional Drive Test — does a write, read, and access to a diskette drive to verify the drive function and interface.

MDI2510 Drive Head Alignment Test — tests the head alignment of the primary head on a specified drive.

MDI2520 51TD Head Stress Test 1 — attempts to identify diskette media or diskette head problems. This MDI runs only on a type 2D diskette formatted to 256 bytes per sector (use diagnostic diskette 3). This MDI writes a hexadecimal DB6 (110110110110) pattern on each sector for cylinders 60 through 76 and then reads these sectors. The '+switch filter' line is not made active (not normal).

This MDI can indicate failures not found by the diskette surface analysis program (TMEDIA) or failures not logged in the system error log report program (TSYSEREP).

If this MDI test fails, a message instructs you to run the 51TD head stress test 2 (MDI2530).

MDI2530 51TD Head Stress Test 2 — attempts to identify possible diskette head or diskette media problems. This MDI runs only on a type 2D diskette formatted to 256 bytes per sector (use diagnostic diskette 3). This MDI writes a hexadecimal DB6 (110110110110) pattern on each sector for cylinders 60 through 76 and then reads these sectors. The '+inner track' line and the '+switch filter' line are not made active.

If this MDI test fails, a message display instructs you to run the 51TD Head Resolution Test (MDI2540).

If this MDI test does not fail, run the 51TD head stress test 1 (MDI2520) again after 30 days to check for additional head wear.

After the 51TD head stress test 2 is completed, re-initialize the type 2D diskette that was used.

## 961 MAP DIAGNOSTIC INTEGRATION (MDI) TESTS (continued)

MDI2540 S1TD Head Resolution Test - writes a repeated pattern of hexadecimal FF FF FF FF AA AA AA AA on track 76. The test then goes into a continuous read loop. You can scope this data to determine head resolution. Head resolution is the ratio of the signal amplitude of hexadecimal FF to the signal amplitude of hexadecimal AA.

If the head resolution is more than 0.5, the head is probably good. If the head resolution is less than 0.4, the head is bad. When the head resolution is between 0.4 and 0.5, use the system error log report program (TSYSEREP) data to determine if the head is bad.

The head is bad if the TSYSREP data indicates data failures on cylinders 64 through 76 and the head resolution is less than 0.5.

See 965 to check the head resolution.

*Communication Area (MD13001):*

MDI3010 Communications Setup Test - specifies the type of communications installed on the system and the initialization of the communications control block (CCB) interface. You can select one of the following features and perform the communications tests and wrap functions for that feature:

- EIA feature
- DDSA feature
- 38LS feature

If an encoding device is used, ensure that either the mode switch is in nonencode mode or the device is removed from the line before running the wrap test.

*Printer Area (MDI7001):*

MDI7010 Printer MPU/Adapter Test - checks the printer MPU and the printer adapter for a minimum print function and verifies the data transmitted to the printer. The following tests are run:

- Adapter wrap test
- Line quality test
- Minimum print operation/ communications verification

For printer failures, see the maintenance document supplied with the printer.

## 963 DISKETTE MEDIA PROBLEMS

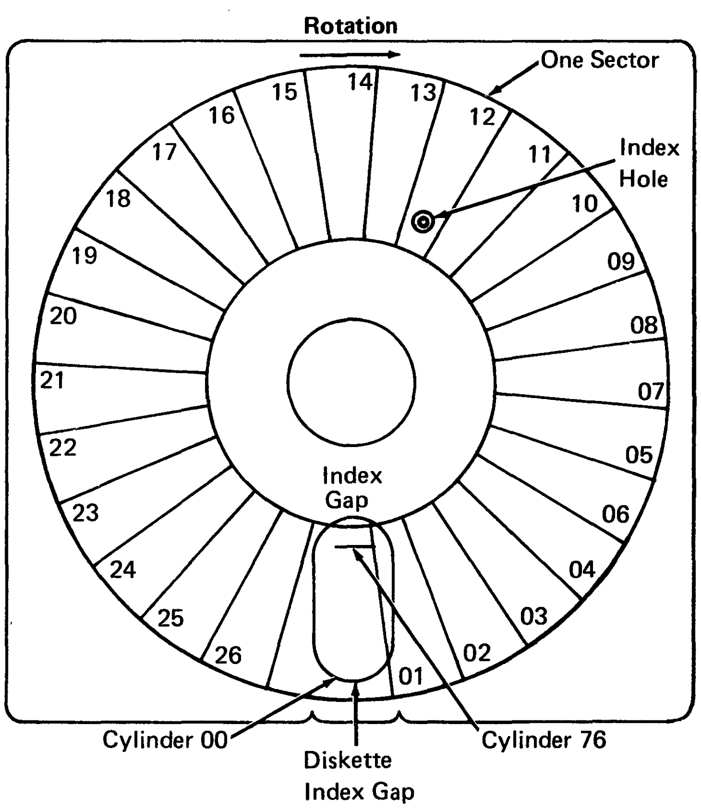
Conditions that affect the quality of the diskette are:

- A dent, scratch, crease, or fingerprint causes errors on the same sectors, usually across tracks that are next to each other.
- A larger center hole causes errors on sectors that are on opposite sides of the center hole. (Example: sectors 01 and 15 or sectors 06 and 19).
- Fibers from the diskette cover cause random errors.

To look for visible damage:

1. Align the index hole in the diskette with the hole in the diskette cover.
2. Use the following diskette figure to locate the physical sectors on the diskette. This figure shows a diskette 2D with 26 sectors and sequential sector sequence numbers. Sector 01 always has the same physical locations on the diskette regardless of the sector size or the sector sequence numbering.

*2D diskette with 26 sectors per track.*



## 965 HEAD RESOLUTION SERVICE AID

Use the following to check the head resolution:

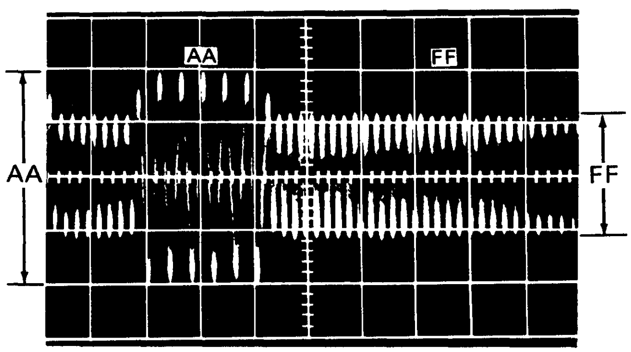
1. Use a diskette 2D (diagnostic diskette 3).

2. Select the 51TD Head Resolution Test (MDI2540) (961).

3. Enter the address of the diskette drive that contains the diskette 2D used in step 1.

4. Use a Tektronix 453, 454, or a similar oscilloscope with X10 probes. Use the chart for oscilloscope setting and lead connections.

5. Calculate the head resolution by dividing the hex FF signal amplitude by the hex AA signal amplitude.




AA = 4.2cm FF = 2.4cm

$$\text{Head Resolution} = \frac{2.4}{4.2} = 0.57$$

| Control | Setting |
|---|---|
| A sweep mode | Normal Trig |
| Channel A level | Adj + |
| Channel A coupling | DC |
| Channel A slope | + |
| Channel A source | External |
| Trigger | Normal |
| Mode | Add |
| Channel 1 volts/division | 5 mV/div |
| Channel 2 volts/division | 5 mV/div |
| Channel 1 input | AC |
| Channel 2 input | AC |
| Invert | Pull out |
| Times per division | 20 ms/div |
| Channel 1 probe | TPAMP1 (preamp TP1) |
| Channel 2 probe | TPAMP2 (preamp TP2) |
| Connect trigger to | TPE01 (+index) |

## 971 STANDALONE PROGRAM LOADING

Standalone programs do not need the diagnostic control program (DCP). Therefore, each one is run as a separate program. A standalone program uses only one partition (7.25 K bytes).

The following standalone programs are available on diagnostic diskette 1:

| Program Name | Function |
|---|---|
| SYSTEST* | System exerciser test |
| SCANTEST | Keyboard scan code test |
| MSRTEST | Magnetic stripe reader test |
| CRTTEST | Display exerciser test |
| TMRTEST1 | Elapsed time counter test 1 |
| TMRTEST2 | Elapsed time counter test 2 |
| TPRNT | Printer test |
| TSYSEREP | System error log recovery program |
| TMEDIA | Diskette surface analysis program |
| TCOMEREP | Communications error log and data trap recovery program |
| PRTRPOLL* | Printer interface test |

The printer test (TPRNT) and diskette surface analysis program (TMEDIA) are also on the machine verification diskette.

* SYSTEST and PRTRPOLL are standalone programs but must be loaded from PGMLOAD (940).

You can load a standalone program from either the load prompt displayed by the diagnostic diskette (prompt 50-00) or the user IPL program diskette (prompt 05-00). If you use the user IPL program diskette load prompt, check with the user to ensure that the partition is 7.25 K or larger. Make sure the test you are going to run will not interfere with other jobs running in the system.

1. To load a standalone program, use one of the load prompts.
2. Insert diagnostic diskette 1 into one of the diskette drives.
3. Enter the program name from the preceding list.
4. Press the Field Exit key.
5. Enter the address of the diskette drive that contains diagnostic diskette 1. You can leave blank the partition number assigned to the keyboard you are using. If you use a different keyboard, you must enter the partition number assigned to that keyboard.
6. Press the Enter key to load the program.

For additional information on each standalone program, see 975, *Description of Standalone Programs*.

## 975 STANDALONE PROGRAMS

### System Exerciser Test (SYSTEST)

The system exerciser test verifies correct operation of the various devices on the system. This test will exercise a maximum of 1 keyboard/display, 2 diskette drives, and 1 magnetic stripe reader.

To load the system exerciser test (SYSTEST), see 971.

To terminate this test, select option 4 on the operator interrupt menu.

### Keyboard Scan Code Test (SCANTEST)

The keyboard scan code test verifies the keyboard hardware interface to the adapter.

To conduct a valid test, load the program into the failing partition. If the failing keyboard does not permit you to answer a standard load prompt, you might have to load the failing partition from another data station.

To load the keyboard scan code test (SCANTEST), see 971.

To terminate this test, press the space bar six times.

### Magnetic Stripe Reader Test (MSRTEST)

The magnetic stripe reader test reads the test card or a user card. The data from the card is displayed.

To load the magnetic stripe reader test (MSRTEST), see 971. See 751 for a description of how to run the MSRTEST test.

To terminate this test, either press the Sys Req key or press the Cmd key followed by the End of Job key.

### Display Exerciser Test (CRTTEST)

The display exerciser test permits you to adjust and verify the size and position of the display.

To load the display exerciser test (CRTTEST), see 971.

To terminate this test, either press the Sys Req key or press the Cmd key followed by the End of Job key.

### Elapsed Time Counter Test 1 (TMRTEST1)

The elapsed time counter test 1 is a digital display of the elapsed time counter in hours, minutes, and seconds.

To load the elapsed time counter test 1 (TMRTEST1), see 971.

To terminate this test, either press the Sys Req key or press the Cmd key followed by the End of Job key.

### Elapsed Time Counter Test 2 (TMRTEST2)

The elapsed time counter test 2 checks for hardware problems that TMRTEST1 cannot sense.

To load the elapsed time counter test 2 (TMRTEST2), see 971.

To terminate this test, either press the Sys Req key or press the Cmd key followed by the End of Job key.

### Printer Test (TPRNT)

The printer test operates the printer functions such as tab, new line, and carriage return. The test also attempts to print nonprintable characters and verifies that they are not printed.

To terminate the printer test when in a loop mode (option 1 from prompt 54-02), either press the Sys Req key or press the Cmd key followed by the End of Job key. When terminating the printer test, the printer must finish unloading the buffer before a terminate screen is displayed. Therefore, there might be a delay of several seconds before any display screen prompt or message is indicated.

### System Error Log Recovery Program (TSYSEREP)

The system error log recovery program processes the error history log (TLOGFILE) on the machine verification diskette and formats the output for either the display or the printer.

To load the system error log recovery program (TSYSEREP), see 971. To terminate this program, press the Sys Req key.

The following is an example of a permanent set of error logs displayed:

```
                                                                      L
PERMANENT ERROR LOGS          PRESS ENTER TO CONTINUE           K     1
#  ERR  DEV   PROGRAM  P# I# DEVICE DEPENDENT  -HEX   -EBCDIC   CNT 13NOV79/0000
01 3301 4000 SYSCON    00 00 0C25C2B0C7C1D3E7D3C9E2E5   __B_GALXLIST 001
A  B    C    D         E  F  \__________G___________/   \____H____/  J
```

The following describes the permanent error log display:

**A** (#) Position number inside the log area

**B** (Err) Error Code

**C** (Dev) Address of device in error

**D** (Program) Program name

**E** (P #) Partition number

**F** (I #) IOB number

**G** (Device Dependent-Hex) Device-dependent data shown in hexadecimal format. See 991, *Hard Error Table format,* bytes OD-19 for the meaning of this data.

**H** (-EBCDIC) Device-dependent data shown in EBCDIC format. Nonalpha, nonnumeric and nonblank characters are shown as an underscore.

**J** (Cnt) The number of times the error occurred.

**K** Date and time the error log was dumped to diskette.

**L** The number of the set of error logs being displayed.

Up to three errors can be displayed at a time. Press enter to display additional errors until the end of the log is reached.

## 975 STANDALONE PROGRAMS (continued)

The following is an example of a temporary error log displayed:

```
                                                                                                   D
TEMPORARY ERROR LOGS          PRESS ENTER TO CONTINUE                                              1
DEV  ERR--CNT ERR--CNT ERR--CNT ERR--CNT ERR--CNT ERR--CNT ERR--CNT 13NOV79/0000
8000  2548-001
A     B   C
```

A (Dev) Address of device in error

B (Err) Error Code

C (Cnt) Number of times the error occurred

D The number of the set of error logs being displayed.

### Diskette Surface Analysis Program (TMEDIA)

The diskette surface analysis program reads every record on the diskette and stores the CRC (cyclic redundancy check) errors and missing data address marks.

The following errors are displayed:

| | |
|---|---|
| CD xx | Data field CRC error |
| CI xx | ID field CRC error |
| DS xx | Defective sector |
| MA xx | Missing all address marks on a track |
| MD xx | Missing data address mark |
| MI xx | Missing ID field |
| MT xx | Missing track |

xx equals the number of times the error occurred.

To load the diskette surface analysis program (TMEDIA), see 971.

The following is an example of what will be displayed when TMEDIA is running but no errors have been found. There are twelve registers reserved to log TMEDIA errors. These registers are numbered 1 through 12 in the example.

```
0

 1            2            3

 4            5            6

 7            8            9

 10           11           12

 TMEDIA  RUNNING                                       59-05
```

## 975 STANDALONE PROGRAMS (continued)

The following is an example of what will be displayed when all twelve registers are full and TMEDIA has stopped. TMEDIA stops so the errors can be viewed.

```
0 0000      A 00 40

 1   26006  CD  01  2   27006  CD  07  3   27006  CD

 4   28006  CD  07  5   28006  CD      6   29006  CD  07

 7   29006  CD      8   30006  CD  07  9   30006  CD

10   30007  CD  01 11   31006  CD  07 12   31006  CD

TMEDIA  HALTED          _PRESS ENTER TO CONTINUE                    9-05

                A     B    C    D    E    F    G
```

A Register number
B Track number
C Sector number
D Error type
E Number of times the error occurred

In the example shown above, TMEDIA has posted 7 CD errors for track 31 sector 006 in register 11. These are soft errors. (A register will hold a maximum of 7 soft errors.) An eighth CD error occurred on track 31 sector 006. This error is posted as a hard error in register 12 F. A hard error is indicated by the absence of the error count field G.

To terminate TMEDIA, press the Sys Req key or press the Cmd key followed by the End of Job key.

## Communications Error Log and Data Trap Recovery Program (TCOMEREP)

The communications error log and data recovery program reads the error history log (TLOGFILE) on the machine verification diskette and formats the output for either the display or the printer. The error history log has two different log areas: the communications error log, and the communications data trap.

The error history log (TLOGFILE) contains the last five dumps made. The user dumps the error log each time before power off of the system or if he is prompted to do so when a hard communications error occurs. The receive data in the communications data trap is shown with an underscore.

To load the communications error log and data trap recovery program (TCOMEREP), see 971.

After you load the program, you can select either the communications error log or the data trap. To determine the protocol of the data stored in the data trap, select the error log first then check the status bytes. For example, status byte 2, bit 0 indicates whether NRZI mode is used. The following figure shows the format of the communications error log and the location of status bytes.

To terminate this program, either press the Sys Req key or press the Cmd key followed by the End of Job key.

```
        CAM                    MPU

ERROR1  0000NNNNNNNNN0000      0000

ERROR2  0000NNNNNNNNN0000      0000

ERROR3  0000NNNNNNNNN0000      0000

ERROR4  0000NNNNNNNNN0000      0000

ERROR5  0000NNNNNNNNN0000      0000
```

The number of times this error occurred.

Error code (see *CCB Error Codes*).

The number of times this error occurred.

Partition number.

IOB number.

Program Name

Error code (see the *IBM 5280 Message Manual).*

Status byte 2 is displayed at this location on the screen. The byte is described at *Hex Displ* 01 in the *CCB Status Bytes and Counters* chart later in this section.

```
Indicator and status bytes

00 01 02 03 04 05 06 07 E0 E1 E2 E3

60 61 62 63 64 65 66 67 68 69 6A 6B

1C 1D 22 34 3F 4C 4F 53 D9 F8 F9

3839 3A3B
```

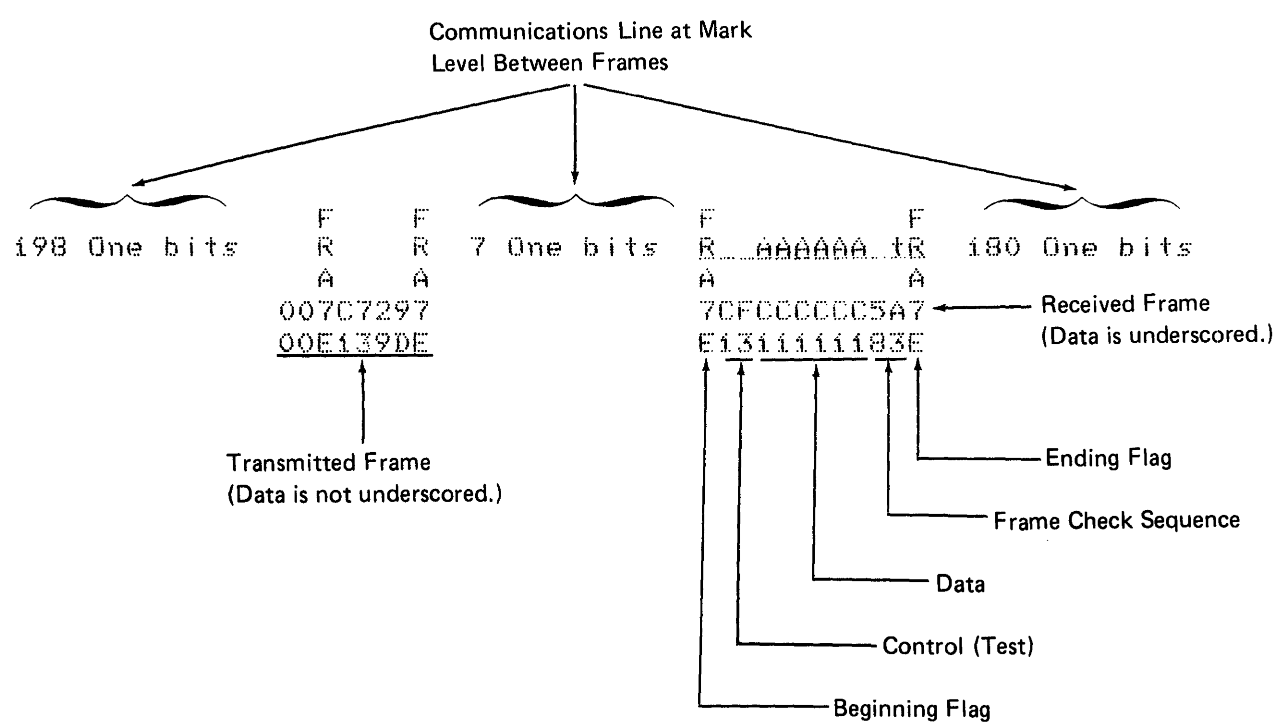
CCB status bytes: The values displayed or printed will be the information from the CCB. However, for your reference, the hexadecimal value shown in this example are the displacements from the leftmost byte of the CCB to the respective byte shown on the screen. The displacement is shown in the charts that describe the status bytes, see *CCB Status Bytes and Counters.*

When you select the communications data trap, you are prompted to select one of the following protocols for the data stored in the trap:

- SDLC NRZI
- SDLC Non-NRZI
- Binary SDLC NRZI
- Binary SDLC Non-NRZI
- BSC ASCII
- BSC EBCDIC
- Binary BSC

SDLC NRZI or SDLC Non-NRZI data is displayed or printed in the same format. The TCOMEREP program converts the data before it is displayed or printed. The following examples show the format of the data trap output.

*SDLC NRZI and Non-NRZI*



*Binary SDLC NRZI and Non-NRZI*

| Communications Line at Mark Level Between Frames | Beginning Flag | Station Address | Control | Frame Check Sequence | Ending Flag |
|---|---|---|---|---|---|

```
335 One bits | 011111101000001111001001111001000101111001111110   <-- Received Frame (Data is underscored.)
199 One bits | 0000000000000000000111111010000011110011101001010  <-- Transmitted Frame (Data is not underscored.)
0101110010111110   8 One bits
```

Transmitted Frame
(Data is not underscored.)

Received Frame
(Data is underscored.)

*BSC ASCII*

Received ENQ (Data is underscored.)

Transmitted ACK0 (Data is not underscored.)

Text

BCC (Only one BCC is received in ASCII mode).

```
 SSE        SSDA      SSSSSSSS                             SSSSSEB        SSDA
 YYN        YYLK      YYIYYYYYABCDEEG      789           ¢!YYYYYTC        YYLK
 NNQ        NNEO      NNXNNNNN                           NNNNNBC          NNE1
C110FFFAA21113FAAB11011111144444444      $33000000000000551111110FFFAA21113
A665FFFBAD6600FFA26626666661234567 89    '8906789ABCDEFBD666667DFFFBAD6601
```

Transmitted ACK1 Response

*BSC EBCDIC*

Received ACK1 (Data is underscored.)

Transmitted Text and BCC (Data is not underscored.)

```
SS          DA        S        SSS              EBB   SS          DA        S
YY 1        LK        Y        YYT              TCC   YY bks BKLK           Y
NN          E1        N        NNX              BCC   NN          E0        N
33EF1245616FFFAA635555550533002 3              EF28CFA933789ABCD17FFFAA635555555
2211222220 1FFFBA42555555452220 00             FF605FA2222222222 00FFFBA425555555
```

Received Response and ACK0

*Binary BSC*

Received ACK0 (1070)

First Bit Received

SYN Character (32)

First Bit Transmitted

```
0101100001000000011110   26 One bits   0101010 1      00001010101001001100 01

00110001000000000000000000000
```

Second SYN Character

Start of Second SYN Character

Printer Interface Test (PRTRPOLL)

The printer interface test program (PRTRPOLL) tests the interface between the IBM 5280 system and the IBM 5225 printer.

To load the printer interface test program, do the following:

1. With a load prompt displayed, insert diagnostic diskette 1 into a diskette drive.

2. Enter the name PGMLOAD.

3. When the PGMLOAD menu is displayed, select option 5 (PRTRPOLL).

If the PRTRPOLL program does not detect a printer interface problem and no other error occurs while the program is running, the program will terminate and the following message will be printed:
'PRTRPOLL Test - interface did not fail - load and run TPRNT or go to the system entry MAPs'.

If the PRTRPOLL program does not detect a printer interface problem, but another error occurs while the program is running, the program will terminate and the following message will be displayed:
'Hardware error-restart or run TPRNT or go to the system entry MAPs'

If the PRTRPOLL program does detect a printer interface problem, the program will not terminate. To terminate the continuously running program, do either of the following:

- Press the Print key. This will allow either a restart of the program or an exit from the program.

- Press the Cmd key followed by the End of Job key. This will terminate the program.

### BSC Online Test Program (SYSBOLT)

The BSC online test program (SYSBOLT) tests the communications link for proper operation. This utility aids in detecting and/or correcting malfunctions and can be run when you suspect problems in the communications link. This utility can be run with any BSC system with which the IBM 5280 can communicate, provided the host system has requester/responder capability and supports at least one of the tests that the IBM 5280 supports.

The SYSBSCBA communications access method (CAM) must be loaded into a background partition. Then the SYSBOLT program must be loaded into a foreground partition. After the programs are loaded, you respond to prompts that request data for the online test to be run and, if applicable, the text of the test. When the test is complete, the results of the test are displayed.

To run the BSC online test program, you need a communications configuration record that specifies the correct network information for the TP test center.

#### Creating a Communications Configuration Record

To create a communications configuration record, use the diagnostic diskette 1 and IPL the system (941). When prompt 50-00 is displayed, load the PGMLOAD program. When the menu is displayed, select option 3 (SYSCCU).

Option 3 loads a configuration record named BSC3741 into storage and displays the prompts shown in the following prompt chart. As each prompt is displayed, enter the correct value for your system. If the value shown in the BSC3741 column of the prompt chart is correct for your system, just press the Enter key. The program automatically bypasses prompts that do not apply to your system.

You can, if you wish, change the value of selected prompts. To select a prompt, enter the question ID of the prompt.

Information about the configuration of your system can be obtained from either the user or from the *System Planning and Site Preparation Guide,* GA21-9351.

To end the succession of prompts at any time, regardless of the mode of operation, press the End Input key sequence. SYSCCU then displays prompt 61-63, which asks where to save the configuration record. You must name the configuration record you have just created, and remember the name for future use of the record.

The configuration record you just created does not replace the BSC3741 configuration record. It is a separate record. The BSC3741 configuration record remains unaltered on the diagnostic diskette 1.

**Prompt Chart**

| Prompt Number | Option | Entry or Action Taken | BSC3741 Default Record |
|---|---|---|---|
| (Question ID) | | | |
| 61-01 | Data set name<br>Device address<br>Configuration name | SYSDCCR<br>4000<br>BSC3741 | |
| 61-02 | | Press Enter | |
| 61-03<br>(C1) | 1. Nonswitched point-to-point<br>2. Switched point-to-point<br>3. Multipoint | Select option | 2 |
| 61-04<br>(C2) | 1. Integrated modem<br>2. EIA-external modem<br>3. DDSA | Select option | 2 |
| 61-05<br>(C3) | For integrated modems only | Set to the value specified by the user | |
| 61-06<br>(C4) | For integrated modems only | Yes for SNBU<br>No for all others | |
| 61-07<br>(C5) | 1. Manual call/answer<br>2. Auto answer | Select option (see note 1) | 1 |
| 61-08<br>(C6) | CDSTL | Select option 1 | |
| 61-09<br>(C7) | Answer tone origin | Select either option | |
| 61-10<br>(C8) | Timer value | 00 | |
| 61-11<br>(C9) | Answer tone origin | Select either option | |
| 61-12<br>(C10) | 1. IBM external modem<br>2. Non-IBM external modem | Select option | 1 |
| 61-13<br>(C11) | 1. Internal clocking<br>2. Modem clocking | Select option | 2 |

Note 1: If you are using an acoustic coupler, select autoanswer. Prompts 61-08 through 61-11 will then be displayed.

**Prompt Chart (continued)**

| Prompt Number | Option | Entry or Action Taken | BSC3741 Default Record |
|---|---|---|---|
| 61-14 (C12) | 1. Full speed modem rate<br>2. Half speed modem rate | Select option | 1 |
| 61-15 (C13) | 1. Constant request to send<br>2. Not constant request to send | Select option | |
| 61-16 (C14) | DSR timeout | Press Enter | 01 |
| 61-17 (C15) | Line speed | Enter line speed | 1200 |
| 61-18 (C16) | CTS delay | Press Enter | 02 |
| 61-19 (C17) | CAM name | Press Enter | SYSBSCBA |
| 61-20 (C18) | 1. EBCDIC line code<br>2. ASCII line code | Select option | 1 |
| 61-21 (C19) | Trace table | 050 | 100 |
| 61-34 (B1) | 1. IBM 3741 look-alike<br>2. IBM 3780 look-alike<br>3. MRJE | Select option 1 | 1 |
| 61-35 (B2) | 1. IBM 5280 sends initial line bid<br>2. Host sends initial line bid | Select option 1 | 1 |
| 61-36 (B3) | 1. IBM 5280 is primary station<br>2. IBM 5280 is not primary station | Select option 2 | 1 |
| 61-37 (B4) | Terminal ID | Press Enter | |
| 61-38 (B5) | Host ID | Press Enter | |
| 61-41 (B8) | 1. Unblocked record format<br>2. Blocked record format | Select option 1 | 1 |
| 61-42 (B9) | ITB blocking factor | | |

**Prompt Chart (continued)**

| Prompt Number | Option | Entry or Action Taken | BSC3741 Default Record |
|---|---|---|---|
| 61-43 (B10) | 1. Use IRS characters<br>2. Do not use IRS characters | | |
| 61-44 (B11) | Block size | | |
| 61-45 (B12) | 1. Transmit in transparent mode<br>2. Do not transmit in transparent mode | Select the option needed for the test you will run | 2 |
| 61-46 (B13) | 1. Expand blanks in data received<br>2. Do not decompress blanks | Press Enter | 2 |
| 61-47 (B14) | 1. Use blank truncation<br>2. Do not use blank truncation | Press Enter | 2 |
| 61-48 (B15) | 1. Enable reverse interrupt<br>2. Do not enable reverse interrupt | Press Enter | 2 |
| 61-49 (B16) | TTD receive limit | Press Enter | 07 |
| 61-50 (B17) | CAM I/O buffer size | 00514 | 00130 |
| 61-51 (B18) | Line bid retries | Press Enter | 15 |
| 61-52 (B19) | Number of EOTs to send to EOT | Press Enter | |
| 61-53 (B20) | Number of leading PADs | Press Enter (see note 2) | 02 |
| 61-54 (B21) | Number of trailing PADs | Press Enter | 01 |
| 61-55 (B22) | Receive timeout | Press Enter | 03 |
| 61-56 (B23) | Receive retry | Press Enter | 07 |

Note 2: If the 38LS or EIA/CCITT card is installed and the internal clock is set to 1200 bps, enter 03.

**Prompt Chart (continued)**

| Prompt Number | Option | Entry or Action Taken | BSC3741 Default Record |
|---|---|---|---|
| 61-57 (B24) | Transmit timeout | Press Enter | 01 |
| 61-58 (B25) | Continue timeout | Press Enter | 02 |
| 61-59 (B26) | WACK receive limit | Press Enter | 015 |
| 61-60 (B27) | Record retransmit limit | Press Enter | 03 |
| 61-63 | Device set name<br>Device address<br>Configuration name (see note 3) | SYSDCCR<br>4000<br>________<br>________<br>________ | |
| 61-61 | 1. Print the record<br>2. Do not print the record | Select option | |
| 61-62 | Printer address | Press Enter | |
| 61-64 | End option | 2. | |

Note 3: Enter a name for the configuration record (up to 8 characters). Write the name of the configuration record on the blank lines provided. Remember the name: it will be needed to run SYSBOLT.

*Loading and Running the BSC Online Test*

Use the following procedure to load and run the BSC online test.

1. Insert the diagnostic diskette 1 into diskette drive 4000 and IPL the system. The diagnostic diskette 1 must be configured for your system (see Creating a Communications Configuration Record in this section).

2. When the load prompt (50-00) is displayed, enter PGMLOAD in the program name field.

3. When prompt LD01 is displayed, select the SYSCLU option (option 1) and press the Enter key to load the configuration record prompt 60-01.

4. When prompt 60-01 is displayed, use the → 1 (Field Advance) key to place the cursor in the device address field. Enter the device address. The cursor will advance to the configuration name field. Enter the name you assigned to the altered BSC3741 record and press the Enter key. (See prompt # 61-63 in the prompt chart.)

5. When prompt LD01 is displayed again, select the SYSBOLT option (option 2) and press the Enter key.

6. If the IBM 5280 is the requester, it must send the initial line bid and be designated as the secondary station. If the IBM 5280 is the responder, the host must send the initial line bid and the IBM 5280 must be the primary station. These options were selected in the configuration record, prompt 61-35.

Answer the following prompt:

```
SINGLE BSC CAM ONLINE TEST UTILITY

WHAT FUNCTION DO YOU WANT TO EXECUTE?

  OPTIONS ARE

    1. REQUESTER TEST

    2. RESPONDER TEST

    3. WRAP TEST

    4. TERMINATE

SELECT OPTION:   _  PRESS ENTER                        67-01
```

- Select option 1 to run a test with the IBM 5280 as the requester; this means that it sends the RFT (request for test) header. If you select option 1 and the IBM 5280 is configured as a responder, the test will not function.

- Select option 2 to run a test with the IBM 5280 as the responder; this means that it receives the RFT header. If you select option 2 and the IBM 5280 is configured as a requester, the test will not function.

- Select option 3 to run a wrap test.

- Select option 4 to terminate SYSBOLT.

The following prompt appears only if you selected requester test (option 1) on the previous prompt.

```
SPECIFY THE FOLLOWING.

TEST NUMBER:

NUMBER OF T/R:

SECURITY INFORMATION, IF REQUIRED:

                    PRESS ENTER                    67-02
```

*Test number:* Enter the number of the test to be performed. The valid entries are 01, 02, 04, 05, 06, 14, 15, 16, 19, 20, 21, or 22. See *BSC Online Test* Supported by the IBM 5280 in this section.

*Number of t/r:* Enter the number of times the test data is to be sent to the IBM 5280. The valid entries are 01-99 times.

*Security information:* This is a 14-byte field used by the responder to identify the requester. The format of the security field is:

//XXX/YYY/3741

XXX = the branch office number YYY = the security code

## 975 STANDALONE PROGRAMS (continued)

If the test number is 01, the following prompt appears.

```
SPECIFY TEST MESSAGE:




                PRESS ENTER                   67-03
```

Enter the test data to be transmitted to the host. The maximum length is 293 characters.

The message *Test XX started* appears briefly after the test has begun. It appears for all tests except the wrap test. XX identifies the number of the test. For the wrap test, the message *Wrap test in process* is displayed.

The following message appears for all tests except the wrap test.

```
TEST Y COUNT=XX                      RESPONSE=ZZZ
```

Initially XX is the number of times the test data is to be transmitted or received. Each time the test data is transmitted or received, XX is decreased by 1.

ZZZ tells the results of each attempt to transmit or receive the test data. One of the following three control characters is displayed for ZZZ:

| Control Character | Meaning |
|---|---|
| RTO | Receive timeout occurred |
| NAK | Negative acknowledgement |
| ACK | Positive acknowledgement; good transmission |

The following message indicates the results of the wrap test. If the test was unsuccessful the message displayed is *Wrap test failed.*

```
WRAP TEST EXECUTED SUCCESSFULLY




Press ENTER to continue
```

The following message summarizes the results of the BSC online test. After you review the statistics, press the Enter key. The prompt requesting the function to be executed (prompt 67-01) reappears.

```
TEST COMPLETED EXECUTION
NUMBER OF ACKS =
NUMBER OF NAKS =
NUMBER OF RTOS =
PRESS ENTER TO CONTINUE
```

## 975 STANDALONE PROGRAMS (continued)

### BSC Online Tests Supported by the IBM 5280

A request-for-test (RFT) message initiates an online test. The requester is the station that sends the RFT message; the responder is the station that receives the RFT message. As a requester, the IBM 5280 can perform 12 types of tests. As a responder, the IBM 5280 supports three types of tests.

*Tests Supported When the IBM 5280 is the Requester*

| Test Number | Test Data | Code |
|---|---|---|
| 01 | Send and receive variable | EBCDIC or ASCII |
| 02 | Receive 256 bytes of EBCDIC transparent data | EBCDIC |
| 04 | Receive 245 bytes of EBCDIC data | EBCDIC |
| 05 | Receive 117 bytes of ASCII data | ASCII |
| 06 | Receive 36 alphanumeric characters | ASCII |
| 14 | Receive 36 alphanumeric characters | EBCDIC |
| 15 | Receive all zero weak pattern | EBCDIC |
| 16 | Receive-alternate zero one pattern | EBCDIC |
| 19 | Receive weak pattern transparent | EBCDIC |
| 20 | Receive 80 characters of transparent data | EBCDIC |
| 21 | Receive 120 characters of transparent data | EBCDIC |

*Tests Supported When IBM 5280 is the Responder*

| Test Number | Test Data | Code |
|---|---|---|
| 01 | Send and receive variable data | EBCDIC or ASCII |
| 06 | Send 36 alphanumeric characters | ASCII |
| 14 | Send 36 alphanumeric characters | EBCDIC |

The requester always receives the test data, with the exception of test 01 when the requester first sends the test data and then receives the same test data back. The responder always sends the test data.

For test 01, the requester sends an RFT message followed by the test data. The test data can be a maximum of 293 characters in length. The responder sends the test data back to the requester a specified number of times.

For tests 02-22, the test data is predefined. When the IBM 5280 is the requester, it sends an RFT message to the host, which identifies the test number. The host sends the predefined test data, based upon the test number, back to the IBM 5280 the number of times specified in the RFT message.

For tests 06 and 14, when the IBM 5280 is the responder, it receives an RFT message from the host. The test data for tests 06 and 14 is predefined and stored in the IBM 5280. The IBM 5280 retrieves the appropriate test data and sends it to the host the number of times specified.

The test data and format for test numbers 02 through 22 are given below.

#### Test 02—Transparent EBCDIC

Format: DLE STX... Test Data...DLE STX
Test Data: 256 EBCDIC characters in collating sequence order.

#### Test 04—Normal EBCDIC

Format: STX SYN SYN...Test Data...ETX
Test Data: 245 nondata link control characters. Data link control characters excluded are SOH, STX, ETX, ETB, ENQ, ACK, NAK, DLE.

#### Test 05—Normal ASCII

Format: STX SYN SYN...Test Data...ETX
Test Data: 117 nondata link control characters in ASCII. Same data link control character excluded as in test 04.

#### Test 06—Alphanumeric ASCII

Format: STX SYN SYN...Test Data...ETX
Test Data: Letters A through Z in alphabetic order followed by the integers 0 through 9 in ascending sequence.

**Test 14—Alphanumeric EBCDIC**

Format: STX SYN SYN...Test Data...ETX
Test Data: Letters A through Z in alphabetic order followed by the integers 0 through 9 in ascending sequence.

**Test 15—EBCDIC All Zero Weak Pattern**

Format: STX SYN SYN...Test Data...ETX
Test Data: 74 null (hex 00) characters followed by 6 SYN (hex 32) characters.

**Test 16—Alternate Zero One Pattern**

Format: STX SYN SYN...Test Data...ETX
Test Data: 40 bytes of hex AA followed by 40 bytes of hex 55.

**Test 19—Transparent EBCDIC Weak Pattern**

Format: DLE STX...Test Data...DLE ETX
Test Data: 280 null (hex 00) characters followed by 10 SYN (hex 32) characters.

**Test 20—Transparent EBCDIC**

Format: DLE STX...Test Data...DLE ETX
Test Data: 80 characters in following order: alphabetic U through Z, integers 0 through 9, hex 00 through hex 3F.

**Test 21—Transparent EBCDIC**

Format: DLE STX...Test Data...DLE ETX
Test Data: 120 characters in following order: alphabetic A through Z, integers 0 through 9, hex 00 through hex 53.

**Test 22—Transparent EBCDIC**

Format: DLE STX...Test Data...DLE ETX
Test Data: 144 characters in following order: alphabetic A through Z, integers 0 through 9, hex 00 through hex 6B.

*Wrap Test*

The wrap test provides a comprehensive test of the communications adapter and the modem; it does not test the communications line or communications hardware at the host. It runs the power on, protocol, and data communications equipment diagnostic exactly as at power-on time. The results of the test are reported on the display as either successful or failed.

**SDLC LINK TEST**

The SDLC link test checks the integrity of the SDLC link between the IBM 5285 and the communicating remote system.

To perform the SDLC link test, have the IBM 5285 operator establish the SDLC link between the IBM 5285 and the remote system. After the SDLC link has been established, contact the remote system operator and have that operator issue the SDLC link test command. The IBM 5285 will accept the SDLC link test command at anytime during SNA/SDLC communications.

If a buffer large enough to hold the data is available, the IBM 5285 will respond to the SDLC link test command with a test message of up to 266 bytes.

If a buffer large enough to hold the data is not available, the IBM 5285 will respond to the SDLC link test command with an acknowledgement of the command.

**Error-Recording Tables**

The controller MPUs and the communications access method (CAM) use tables in main storage for information about errors that occur during system operations.

The keyboard/display, diskette, and the printer MPUs store errors in the system hard error table. The system hard error table contains 25 entries of up to 26 bytes in each entry. The printer MPU also logs soft errors in the soft error table. The soft error table contains one entry for each printer installed on the system. Each entry contains 20 bytes.

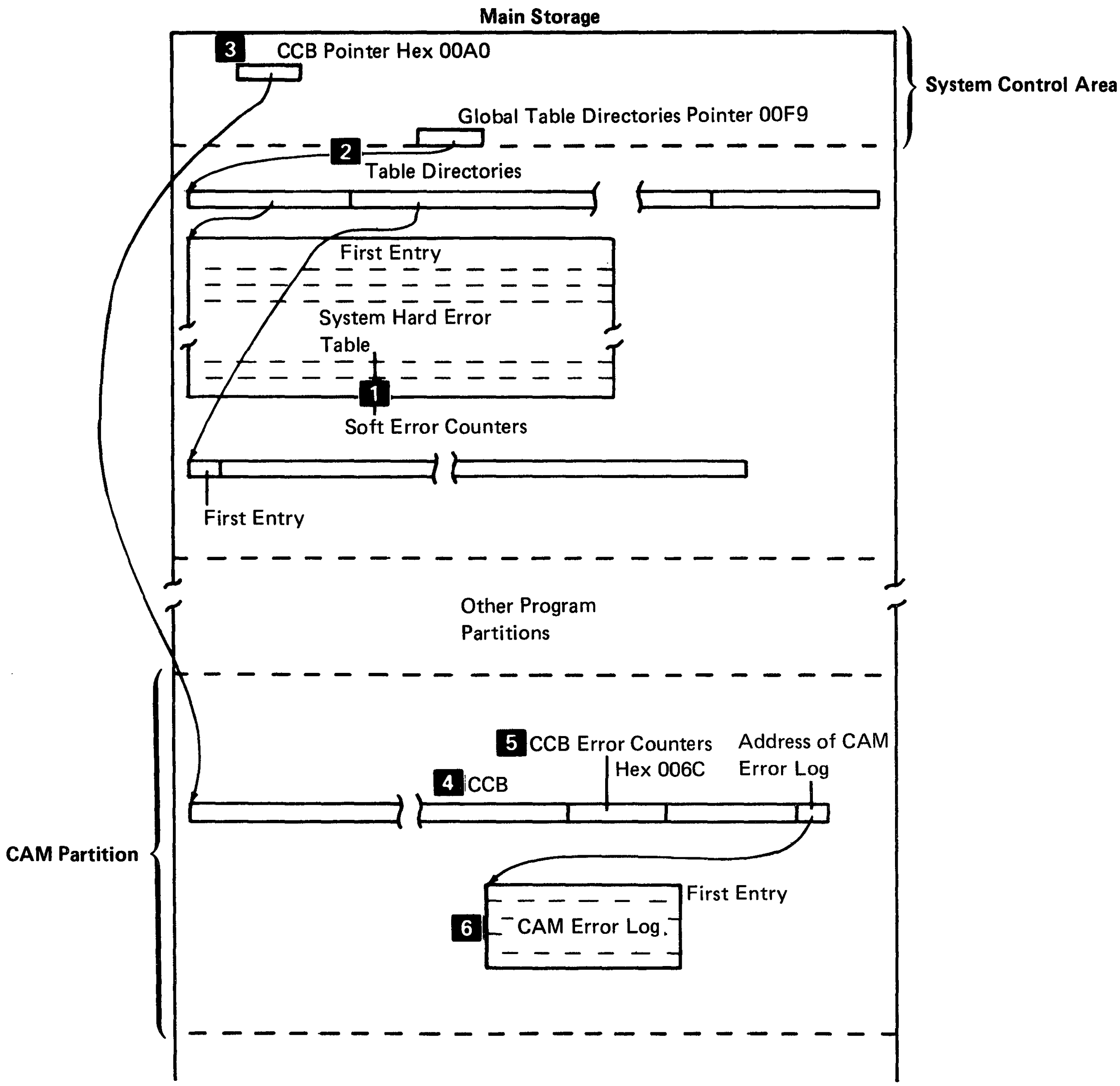
When an entry is placed into an error table, it is always placed into the first position. All positions of the table are then checked to see if that entry appears anywhere else in the table. If the entry does appear in the table, the error count of the entry that is already in the table is incremented by one. If the entry does not appear anywhere else in the table, all entries, including the one that was just made, are written into the next higher position. In either case, the entry that was just made also remains in the first position. The next entry to the table will write over the data that is in position one.

When the table becomes full, the oldest error in the table is deleted. If the table is full, it contains only the most recent errors. To prevent filling the table with duplicate errors, all duplicate errors are counted and the count is stored in each entry. The preceding description is valid for all tables except the printer soft error table; see *Printer Soft-Error Recording Table* for the format of this table.

## 975 STANDALONE PROGRAMS (continued)

The system error tables **1** are located by global table directories. The directories are located by an address in the system control area at hexadecimal displacement 00F9 from the start of page 0 **2**.

The communications MPU errors are stored in the CCB (communications control block) **4** at hexadecimal displacement 006C from the start of the CCB **5**. The CCB is located by a CCB pointer **3** in the system control area at hexadecimal displacement 00A0 from the start of page 0. The CAM errors **6** are located by an address in the CCB at hexadecimal displacement 0110 from the start of the CCB.



## 975 STANDALONE PROGRAMS (continued)

Because these tables are in main storage, they must be dumped to diskette before power off, soft IPL, or before canceling the communications access method. If the tables are not dumped to diskette, they will be lost. The following chart shows the methods and the programs supplied for displaying or printing the error tables:

**Have the error-recording tables been dumped to the machine verification diskette?**

N Y

Run the TSYSEREP program to print the system tables and the TCOMEREP program to print the communications tables, or both (see 971 for how to run these programs).

**Can the tables be dumped to the diskette?**

N Y

Have the customer run the TSYSLOG program to dump the system tables and the TCOMLOG program to dump the communications tables. Then use the TSYSEREP program to print the system tables and the TCOMEREP program to print the communications tables (see 971 for how to run these programs).

Use the display/alter function to display the tables on the screen (see 991 to display the system tables and 993 to display the communications tables).

## 991 DISPLAY/ALTER FUNCTION

**The display/alter keyboard function permits you to display, alter, and move the contents of main storage to keyboard/display storage and the contents of keyboard/display storage to main storage. In the following procedures, only the display function is described. For information about the other display/alter functions, see the *Data Areas and Diagnostic Aids Handbook.***

To use the display/alter functions, you must use keyboard 0, and the keyboard/display MPU must be operational. While you are using display/alter, no other keyboard/display operations can be performed.

Use the following procedures to display the system error tables. If you are using a typewriter keyboard, use the numeric key pad to enter the digits 0 through 9.

1. Perform the following steps to start the display/alter function after IPL has completed:
   a. Press the Cmd key.
   b. Press the L key.

   Once you start the display/alter function, you can cancel the function at any time by performing the following steps:
   a. Press and hold the Shift key.
   b. Press the E key.
   c. Press the Reset key.

2. If you are using a single display, go to step 3. If you are using a dual display or a keyboard with proof arrangement or both, enter the following:
   a. Press and hold the Shift key (Num key on a data entry keyboard).
   b. Press the C key.
   c. Release the Shift key and enter one of the following:
      01 (nonproof arrangement keyboard and a dual display)
      10 (proof arrangement keyboard and a single display)
      11 (proof arrangement keyboard and a dual display)

3. A line of data is displayed on the bottom of the screen as follows:

0 0000 xxxxxxxx xxx . . .

Data (displayed in eight 4-byte groups).

The address of the first byte of data displayed. The address is set to 0000 when the display/alter function is first started.

The main storage page number of the data displayed. The page number is set to 0 when the display/alter function is first started.

4. Press and hold the Shift key and press the 4 key.

5. Release the Shift key and enter 00F9 to display the address of the error-recording table directories as follows:

0 00F9 @@@@xxxx ...

The address of the error-recording table directories.

6. Record the address (@@@@) displayed in step 5.

7. Press and hold the Shift key and press the 4 key.

8. Release the Shift key and enter the address (@@@@) displayed in step 5. When you enter the address, the error-recording table directories are displayed as follows:

0 @@@@ xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx . . .

Other global system table directories

Soft error-recording table directory

Hard error-recording table directory

The address of the error-recording table directories

The following is the format of the error-recording table directories:

```
| 10 | 00 |  |  |  |  | 00 |  |  |
```

For the system hard error table, the maximum number of entries allowed is as follows:

10 for the base system
5 for diskette drives 2, 3, and 4
5 for the diskette drives 5, 6, 7, and 8
5 for printers

25 entries maximum

For the soft error counters, the maximum number of bytes allowed

Set to hex 00

The length of each entry (set to 00 for the soft error counters)

For the system hard error table, the number of entries in the table
For the soft error counters, the number of bytes in the table

**1** The address of the first entry in the table

Set to hex 00.

Lock control: normally set to hex 10 (hex 80 indicates table is locked)

9. Record the addresses **1** from the error-recording table directories displayed in step 8.

10. Press and hold the Shift key and press the 4 key.

11. Release the Shift key and enter the address recorded in step 9 for the table to be displayed. When you enter the address, the first 32 bytes of the table are displayed on the screen. For example, if you displayed the hard-error table, and the latest error stored was a diskette error 3307, the entry is displayed as follows:

```
0 @@@@ 33074C00 E2E8E2C9 D5C9E340 11001A02 1C406A00 83803307 8D003307 4C00E2E8
```

Error Code

Next Entry

First Entry

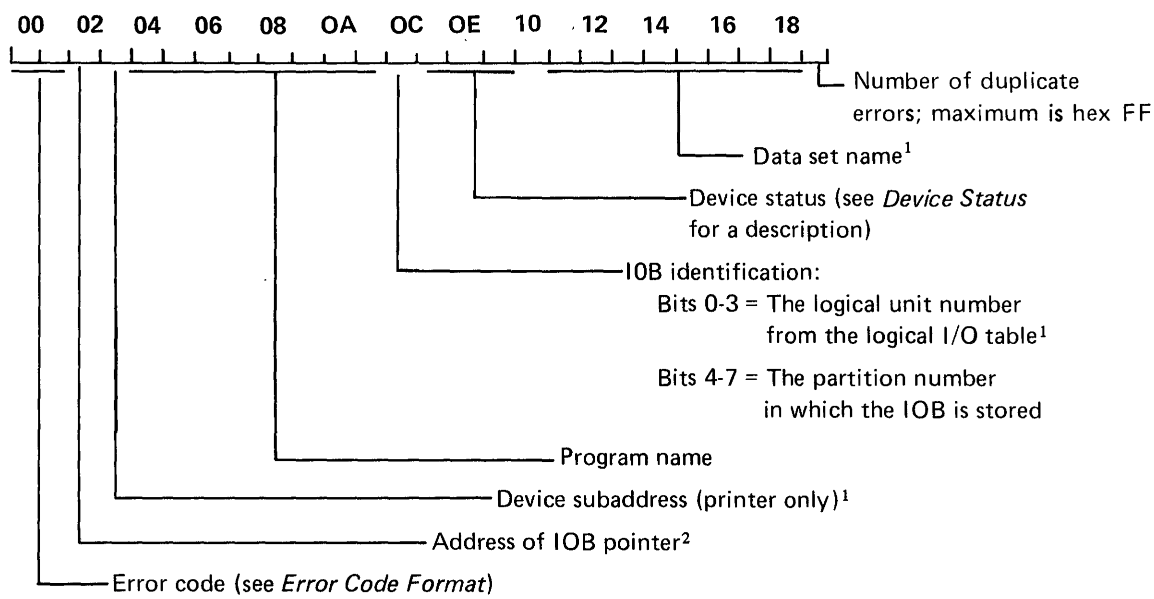
See *Hard Error Table Format* or *Printer Soft Error-Recording Table* in this section of the manual for a description of the displayed data.

12. To move the next entry to the left so that the complete entry is displayed, perform the following:
    a. Press and hold the Shift key and press the 4 key.
    b. Release the Shift key.
    c. Add hexadecimal 1A (hard table) or 14 (soft table) to the address displayed (@@@@ in the preceding example).
    d. Enter the address result.

    When you enter the address, the next entry is completely displayed.

### Hard Error Table Format

The hard error table contains up to 25 entries. Each entry contains up to 26 bytes of error information in the following format:




[1]This field contains all 0's for the keyboard/display MPU.
[2]For the keyboard/display MPU, this field points to the foreground partition associated with this keyboard. If the partition is a background partition, this field points to the foreground partition with which this background partition is associated.

*Error Code Format*

**XXXX Error Code**

Specific error condition, see the *IBM 5280 Message Manual,* GA21-9354 for a description of specific error conditions.

Error Category as Follows:

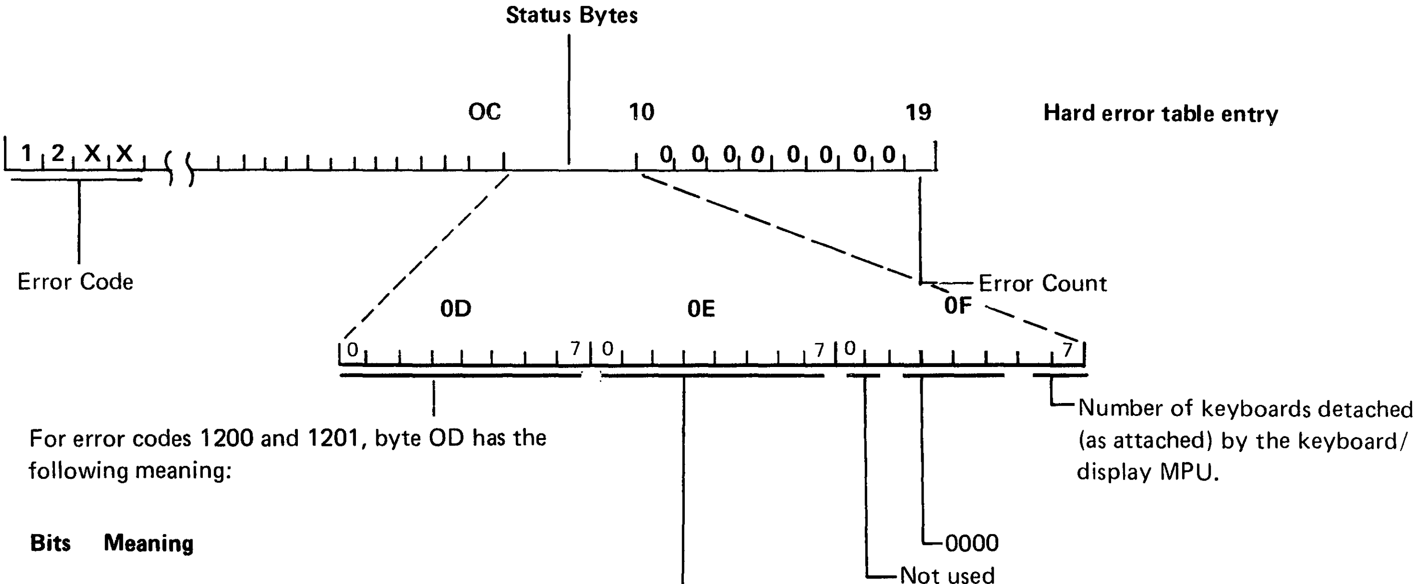
1 = Intervention required
2 = Hard error (operation is not retried)
3 = Retriable error (retried X times)
4 = IOB error (user error)
5 = Soft error (retried successfully)
6 = Exception status (such as the Cancel key pressed on the IBM 5256 printer)
7 = Warning error (user can continue)
8 = Not used
9 = User program terminated.

Device identification as Follows:

0 = Main MPU
1 = Keyboard/display MPU
2 = Printer attachment MPU
3 = Diskette MPU
4 = SNA
5 = BSC
6-8 Not used
9 = Application program
C = Previous data set (SNA)
D = Previous data set (BSC)

*Device Status*

*For the keyboard/display MPU:* The device status bytes have the following meaning for error codes 1200, 1201 and 1202. For 1204, all status bytes are not specified.




For error codes 1200 and 1201, byte OD has the following meaning:

| Bits | Meaning |
|---|---|
| 0 | 1 = A keyboard/display feature card is installed. |
| 1 | 1 = Keyboard/display storage selected is on a feature storage card. (see Note) |
| 2 | 1 = Keyboard/display storage selected is on the keyboard/display MPU card. (see Note) |
| 3-7 | Keyboard/display storage access status as follows: |
| | 01111 = Accessed by the keyboard/display MPU or by a translate cycle. |
| | 10111 = Storage accessed by display 1 hardware. |
| | 11011 = Storage accessed by display 2 hardware. |
| | 11101 = Storage accessed by display 3 hardware. |
| | 11110 = Storage accessed by display 4 hardware. |

For error code 1201, byte OD contains the invalid scan code.

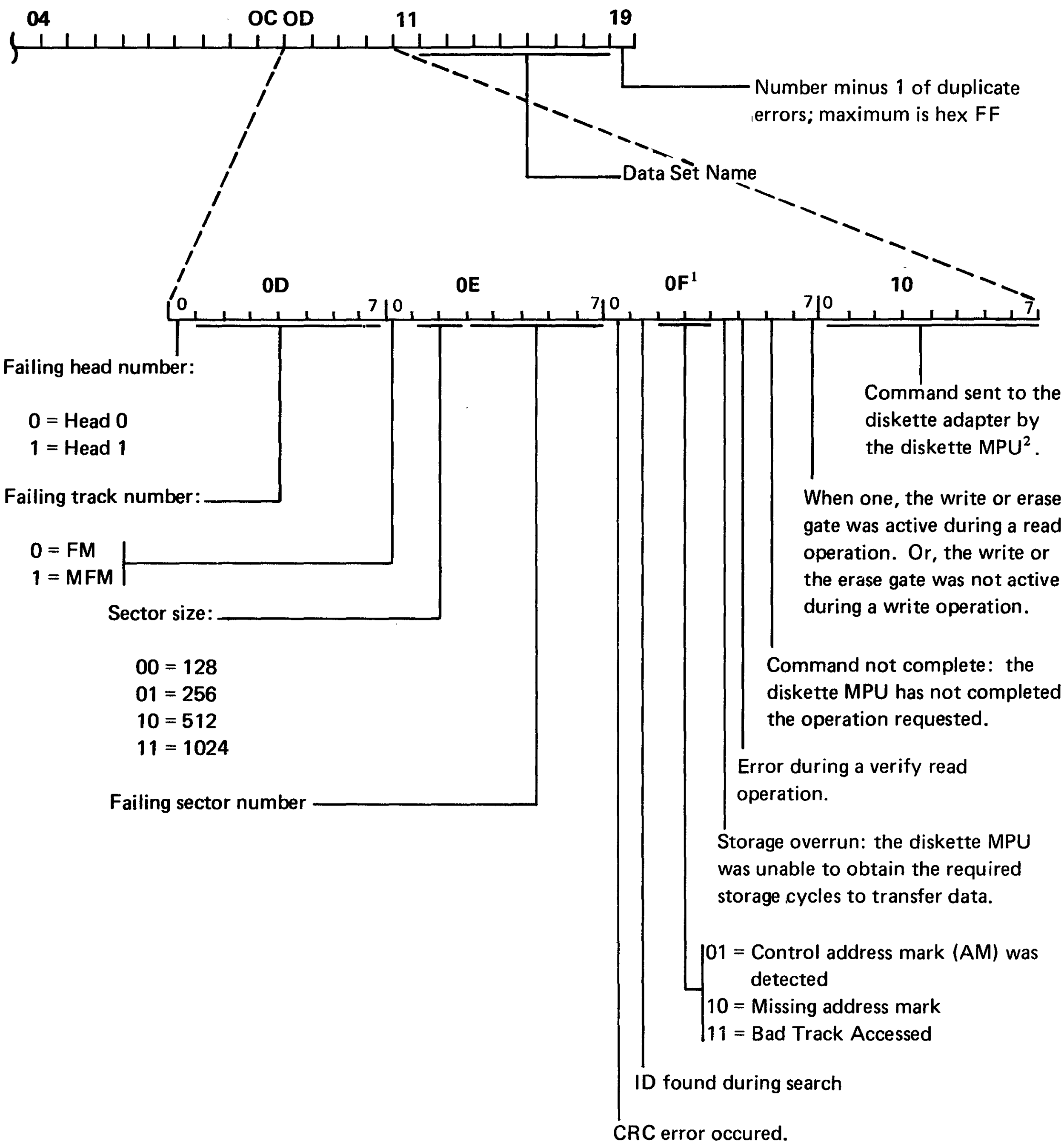
**Note:** For error codes 1200 and 1201, if bit 1 and bit 2 of byte OD are both 0, an invalid address was accessed.

For error codes 1200 and 1201, byte OE has the following meaning:

| Bit(s) | Meaning |
|---|---|
| 0-2 | Higher order bits of the keyboard/display storage address when the error occurred. |
| 3 | 0 = The error occurred when translating and writing to the display refresh buffer. |
| 4 | 0 = The last storage access was for a read operation. |
| | 1 = The last storage access was for a write operation (diagnostic use only). |
| 5 | 0 = Odd parity (parity should be even for a |
| | 1 = Even parity read, can be either for a write) |
| 6-7 | Indicates model as follows: |
| | 00 = 5288 |
| | 01 = Not used |
| | 10 = 5286 |
| | 11 = 5285 |

For error code 1202, byte OE contains the EBCDIC translation for the individual scan code.

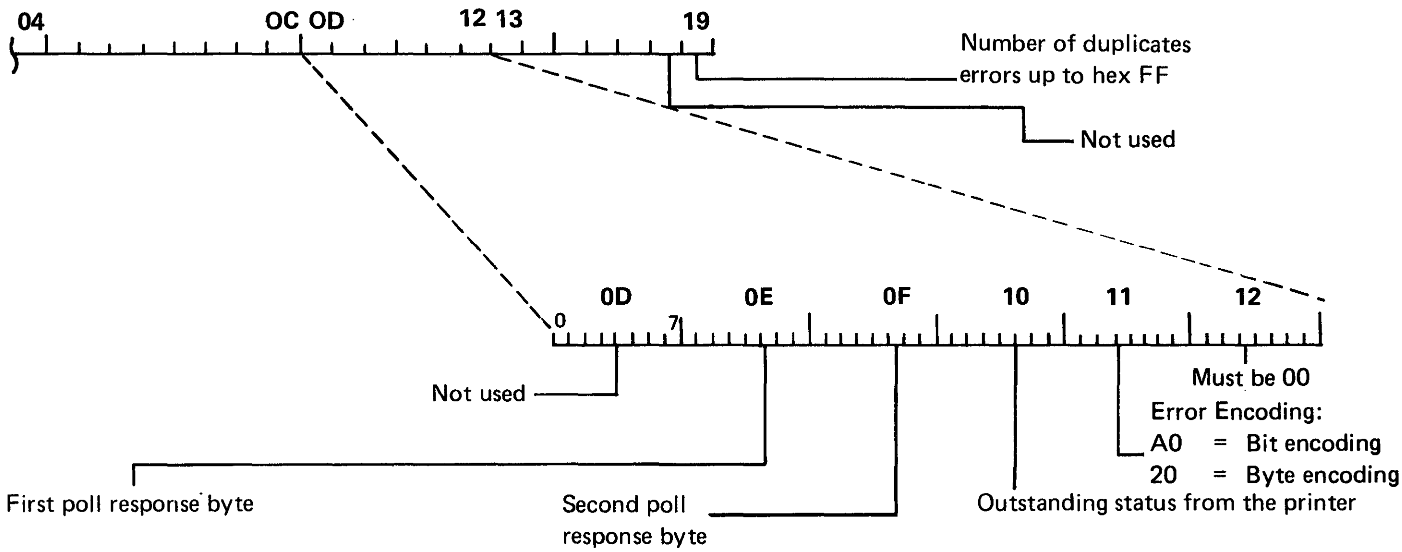
*For the diskette MPU:* The device status bytes have the following meanings:




[1] If byte 0F is equal to FF, the track contains no IDs.

[2] If the command is hex Ax or 2x, bytes 0D and 0E may not be valid.

*For the printer attachment MPU:* The status bytes have the following meanings:




| Bit(s) | Meaning |
|---|---|
| 0 | The Printer MPU is busy. |
| 1 | The printer received bad data (parity error). |
| 2 | The printer is not ready. |
| 3 | The printer has outstanding status, which must be read by the printer attachment MPU. |
| 4-6 | *Exception status from the printer:* |
| | 000 = No exception status. |
| | 010 = The printer received an invalid activate command. A read command must be followed by a read activate command and a write command must be followed by a write activate command. |
| | 011 = Undefined exception status.[1] |
| | 100 = The printer received an invalid command. |
| | 101 = Printer storage overrun: the printer received too much data or too many commands. |
| | 110 = Undefined exception status.[1] |
| | 111 = The printer was powered off and then powered on. |
| 7 | Not used by the IBM 5285 |

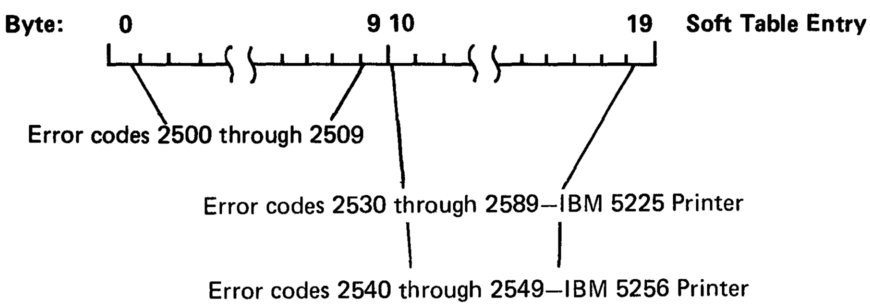
| Bit | Meaning When 1 |
|---|---|
| 0 | The printer received an invalid SCS character (usually a programming error). |
| 1 | The printer received an invalid SCS parameter (usually a programming error). |
| 2 | The printer receive buffer is full. |
| 3 | The printer operation is complete. |
| 4 | The cancel request key was pressed on the printer. |
| 5 | The printer mechanism is not ready (usually a voltage missing at the printer). |
| 6 | End of forms. |
| 7 | Printer received an unprintable character (this bit should only be on if the SGEA command is set to stop). |

| Bit | Meaning When 1 |
|---|---|
| 0 | Print wire check. |
| 1 | Emitter slow speed check. |
| 2 | Emitter fast speed check. |
| 3 | Emitter sequence check |
| 4 | No emitter pulses. |
| 5 | Emitter overrun: printer MPU cannot keep up with the emitter pulses. |
| 6 | Forms stopped. |
| 7 | Forms position check. |

[1] This exception status should not be received from the printer. If it is, it usually indicates a line hit.

**Printer Soft Error-Recording Table**

The printer soft error-recording table contains a count for each printer soft error that occurred. The table contains one entry for each printer on the system. Each entry is 20 bytes long and each byte is assigned to a specific error code as follows:




If a count byte reaches 255 (hexadecimal FF), the error code assigned to that byte is no longer counted.

## 993 COMMUNICATIONS ERROR TABLES

If an IBM communications utility is being executed, you can display communications status by pressing the Cmd key, then pressing the Shift key and pressing the Comm Status key. For all utilities except the BSC batch transfer utility, the following information is displayed. For the BSC batch transfer utility, only the function statistics are displayed.

```
XXXXXXXX FUNCTION STATISTICS                STATUS/COUNTERS  ERROR LOG INFORMATION
INPUT RECORDS:                XXXXX         00 01 02 03 04   XXXX  XXXXXXXXXXXX
DISKETTE OUTPUT RECORDS:      XXXXX         05 06 07 4F F8   XXXX  XXXXXXXXXXXX
PRINTER OUTPUT RECORDS:       XXXXX         60 61 62 63      XXXX  XXXXXXXXXXXX
DISPLAY OUTPUT RECORDS:       XXXXX         64 65 66 67      XXXX  XXXXXXXXXXXX
MULTIPLE DATA SET NAME:       XXXXXXXX      68 69 6A 53      XXXX  XXXXXXXXXXXX
```

Most Recent Error

Oldest Error

Function Statistics as Follows:

- *Input records* is the number of records read from I/O devices during execution of this utility.
- *Diskette output records, printer output records,* and *display output records* are the number of records written to these devices.
- *Multiple data set name* is the prefix of current multiple data sets if multiple data sets are used.

Output from the CAM error log; see the CAM Error Log Format in step 7 of the following procedure.

Output from the CCB error log; see CCB Error Log Format in step 7 of the following procedure and CCB Error Codes.

CCB status bytes and counters; the values shown on the screen are the hexadecimal values of the status bytes and counters from the CCB. However, for your reference, the hexadecimal values shown in this example are the displacements from the leftmost byte of the CCB to the respective byte shown on the screen. The displacement is used in the charts that describe the status bytes and counters, see *CCB Status Bytes and Counters.* In this section.

## 993 COMMUNICATIONS ERROR TABLES (continued)

**Using the Display/Alter function to Display the Communications Error Tables**

The display/alter keyboard function permits you to display, alter, and move the contents of main storage to keyboard/display storage and the contents of keyboard/display storage to main storage. In the following procedures, only the display function is described. For information about the other display/alter functions, see the *IBM 5280 Data Areas and Diagnostic Aids Handbook.*

To use the display/alter functions, you must use keyboard 0, and the keyboard/display MPU must be operational. While you are using display/alter, no other keyboard/display operations can be performed.

Use the following procedures to display the communications error tables. If you are using a typewriter keyboard, use the numeric key pad to enter the digits 0 through 9.

1. Perform the following steps to start the display/alter function after IPL has completed:
   a. Press the Cmd key.
   b. Press the L key.

   Once you start the display/alter function, you can cancel the function at any time by performing the following steps:
   a. Press and hold the Shift key.
   b. Press the E key.
   c. Press the Reset key.

2. If you are using a single display, go to step 3. If you are using a dual display or a keyboard with proof arrangement or both, enter the following:
   a. Press and hold the Shift key.
   b. Press the C key.
   c. Release the Shift key and enter one of the following:
      01 (nonproof arrangement keyboard and a dual display)
      10 (proof arrangement keyboard and a single display)
      11 (proof arrangement keyboard and a dual display)

3. A line of data is displayed on the bottom of the screen as follows:

   **0 0000 xxxxxxxx xxx . . .**

   - Data (displayed in eight 4-byte groups).
   - The address of the first byte of data displayed. The address is set to 0000 when the display/alter function is first started.
   - The main storage page number of the data displayed. The page number is set to 0 when the display/alter function is first started.

4. Press the hold the Shift key and press the B key.

5. Release the Shift key and enter 00A0. (00A0 is the address of the CCB pointer.) The CCB is then displayed.

6. Press and hold the Shift key and press the 3 key.

7. Release the Shift key and enter one of the following:
   a. 006C (to display the CCB error table [MPU logged errors])
   b. 015C (to display the CAM error table [CAM logged errors])
   c. The CCB *Hex Displacement value* from the CCB *Status Bytes and Counters Chart* in this section to display one of the status bytes or counters.

If you selected the CCB error table, it is displayed on the screen as follows:

**X XXXX xxyyxxyy xxyyxxyy xxyyXXXX . . .**

- Five 2-byte error table entries, where:

  xx = The error code (see *CCB Error Codes*).
  yy = The number of times the error occurred.

  **Note:** Also see the previous display example in the beginning of this section (993).
- Address of the first byte of the error table.
- Page number of the CAM partition.

## 993 COMMUNICATIONS ERROR TABLES (continued)

If you selected the CAM error log, it is displayed as follows:

X @@@@ XXXXXXXX XXXXXXXX XXXXXXXX . . .

First 12-byte table entry in the following format:

Error count (the number of times minus 1 that this error occurred.)

IOB number and partition number as follows:

| Bits | Meaning |
|---|---|
| 0-3 | Number of the IOB associated with this error. |
| 4-7 | Number of the partition that contains the IOB. |

Program name

Error code

**Note:** Also see the previous display example in the beginning of this section (993).

8. To display the next 12-byte entry, perform the following:
   a. Press and hold the Shift key and press the 4 key.
   b. Release the Shift key.
   c. Add hexadecimal C to the address of the entry now displayed (@@@@ in the above example).
   d. Enter the resulting address.

When you enter the address, the next 12-byte entry is displayed.

### CCB Status Bytes and Counters

| Hex Displ | Length in Bytes in Hex | Description |
|---|---|---|
| 00 | 1 | *Status Byte 1:* |
| | | *Bit* *Meaning when 1* |
| | | 0 The free queue is empty. |
| | | 1 [1]The input queue is empty. |
| | | 2 [1]The output queue is empty. |
| | | 3 [1]The interim queue is empty. |
| | | 4 Status information has been stored in the CCB at displacement 02, 03, 04, F9, F8 bits 1 and 2, or 00 bit 5, and has not been read by the CAM. |
| | | 5 The communications link is down. |
| | | 6 The OPEN command was successfully completed. |
| | | 7 The CAM stored a command in the CCB. The MPU turns this bit off after the command is completed. |
| 01 | 1 | *Status Byte 2:* |
| | | *Bit* *Meaning when 1* |
| | | 0 Use nonreturn-to-zero (NRZI) mode (SDLC only). |
| | | 1 Adapter diagnostics are being executed. |
| | | 2 Use switched network backup (SNBU) |
| | | 3 Adapter diagnostics detected an error. |
| | | 4 The communications line is switched. |
| | | 5 The communications line is multipoint. |
| | | 6 Use connect-data-set-to-line mode. |
| | | 7 The modem is operating at half speed. |
| 02 | 1 | *Status Byte 3:* |
| | | *Bit* *Meaning when 1* |
| | | 0 A valid EOT sequence was received while the MPU was in the control state. For MRJE, an EOT was received as a response to a line bid. |
| | | 1 An EOT sequence has been transmitted (MPU has started control state). Not used for MRJE. |
| | | 2 Invalid data was placed in the output buffer. |
| | | 3 Receive retries exceeded; the MPU returns to control state. |
| | | 4 Line bid retries have been exceeded. |
| | | 5 Transmit retries exceeded; for BSC, the MPU sends an EOT and starts control state. For SDLC, the MPU stops the data trap. |
| | | 6 An RVI has been received. Not used for MRJE. |
| | | 7 The data link has been established. |
| 03 | 1 | *Status Byte 4:* |
| | | *Bit* *Meaning when 1* |
| | | 0 The message received is too long for the IBM 5280 buffer. |
| | | 1 The IBM 5280 received a disconnect sequence. |
| | | 2 The IBM 5280 transmitted a disconnect sequence. Not used for MRJE. |
| | | 3 The IBM 5280 transmitted or received a normal termination sequence. |

[1]The CAM sets this bit on when the CCB is initialized.

| Hex Displ | Length in Bytes in Hex | Description |
|---|---|---|
| | | 4 The remote terminal or system terminated the session; the IBM 5280 received an EOT while sending text. No used for MRJE. |
| | | 5 The remote system terminated the session; the IBM 5280 received an EOT before an ETX. Not used for MRJE. |
| | | 6 The IBM 5280 received an invalid identification. Not used for MRJE. |
| | | 7 System use only. |
| 04 | 1 | *Status Byte 5:* |
| | | *Bit Meaning when 1* |
| | | 0 The IBM 5280 received a SNRM command. |
| | | 1 The IBM 5280 received an XID. |
| | | 2 The IBM 5280 received an SDLC disconnect command. |
| | | 3 The IBM 5280 set command reject mode. |
| | | 4 The data link went down after a successful open, but before data was successfully transmitted or received. |
| | | 5 The activity timeout elapsed (SDLC). |
| | | 6 For BSC, the disconnect timeout elapsed. For SDLC, a frame could not be transmitted within the time specified at hexadecimal displacement 42. |
| | | 7 Normal response mode is set. |
| 05 | 1 | *Status Byte 6:* |
| | | *Bit Meaning when 1* |
| | | 0 The data-terminal-ready line is on. |
| | | 1 The request-to-send line is on. |
| | | 2 The data-set-ready line is on. |
| | | 3 The clear-to-send line is on. |
| | | 4 System use only. |
| | | 5 The data-set-ready line went off during communications. |
| | | 6 The data-set-ready line did not turn on in response to the data-terminal-ready line. |
| | | 7 The clear-to-send line did not turn on. |
| 06 | 1 | *Status Byte 7:* |
| | | *Bit Meaning when 1* |
| | | 0 The CAM sets this bit on to allow the MPU to receive data. For MRJE, the IBM 5280 transmits a WAB. |
| | | 1 The CAM sets this bit on to allow the MPU to transmit data. For MRJE, the IBM 5280 waits up to 2 seconds before transmitting, if no buffer is in the output queue. |
| | | 2 The CAM sets this bit on to allow the MPU to respond (with an EOT) to RVIs. |
| | | 3 The IBM 5280 is a primary station. |
| | | 4 ASCII mode is set (BSC). |
| | | 5 MRJE mode is set (bit 7 must be on). |
| | | 6 The MPU is bidding for the line. |
| | | 7 BSC mode is set. |
| 07 | 1 | *Status Byte 8:* |
| | | *Bit Meaning when 1* |
| | | 0 The EIA card is installed. |
| | | 1 The DDSA card is installed. |
| | | 2 The 38LS card is installed. |

| Hex Displ | Length in Bytes in Hex | Description |
|---|---|---|
| | | 3-4 Auto answer status:<br>00 = No auto answer.<br>01 = Auto answer; no answer tone.<br>10 = Auto answer; send 1300 Hz (mark) answer tone.<br>11 = Auto answer; send 2100 Hz (space) answer tone.<br>5 The IBM 5280 is operating in constant-request-to-send mode.<br>6 The IBM 5280 internal clock is used.<br>7 An external IBM Modem is installed and has wrap capability. |
| 1C | 1 | The command that the CAM issued to the MPU. |
| 1D | 1 | The completion code that describes the result of the MPU execution of the CAM command. |
| 22 | 1 | The SDLC station address. |
| 34 | 1 | The maximum number of consecutive NAKs received. |
| 38 | 2 | *Receive Record Counter:* For BSC and MRJE, the number of records received without a BCC error. For SDLC, the number of valid I-frames received. |
| 3A | 2 | *Transmit Record Counter:* For BSC and MRJE, the number of records transmitted that have received an ACK positive acknowledgement. For SDLC, the number of I-frames transmitted. |
| 3F | 1 | For BSC, the number minus 2 of leading SYN characters to be transmitted. For SDLC, the second byte of command reject data. |
| 4C | 1 | The maximum number of line bid retries before the MPU stops bidding for the line. |
| 4F | 1 | *38LS Attenuation Level and Communications data trap status:*<br>*Bit Meaning when 1*<br>0 Read data trap.<br>1 Check for trap command.<br>2 Start recording data.<br>3 System use only.<br>4 38LS 8dB attenuation.<br>5 38LS 4dB attenuation.<br>6 38LS 2dB attenuation.<br>7 38LS 1dB attenuation. |
| 53 | 1 | The cumulative number of received NAKs. |
| 60 | 1 | The number of underruns detected by the communications adapter. |
| 61 | 1 | The number of overruns detected by the communications adapter. |
| 62 | 1 | The number of data-set-ready glitches detected by the communications adapter. |
| 63 | 1 | The number of clear-to-send glitches detected by the communications adapter. |
| 64 | 1 | The number of carrier detect glitches detected by the communications adapter. |
| 65 | 1 | For BSC and MRJE, the number of BCC errors detected. For SDLC, the number of frame check sequence errors detected. |
| 66 | 1 | For BSC, the number of receive data timeouts detected by the MPU. For SDLC, the number of sequence number errors detected by the MPU. For MRJE, the number of block control byte sequence errors detected during transmit or receive. |
| 67 | 1 | The number of MPU transmit retries. |
| 68 | 1 | For BSC and MRJE, the number of line bid timeouts detected by the MPU. For SDLC, the number of the valid test commands received. |
| 69 | 1 | For SDLC, the number of test responses transmitted. |
| 6A | 1 | The number of BSC read timeouts detected by the MPU. |
| 6B | 1 | The number of BSC continue timeouts (WACK or TTDs transmitted). Not used for MRJE. |
| D9 | 1 | The time required for the clear-to-send line to turn on after the request-to-send line is turned on. |

| Hex Displ | Length in Bytes in Hex | Description |
|---|---|---|
| E0 | 1 | *Status Byte 9:*<br>*Bit Meaning*<br>0 1 = BSC mode.<br>1 System use only.<br>2 1 = ASCII mode.<br>3-5 000 = Background<br>001 = Data set control.<br>010 = SDLC receive/transmit.<br>011 = Diagnostics.<br>100 = BSC message transfer state.<br>101 = BSC control state.<br>110 = MRJE.<br>111 = System use only.<br>6 1 = Transmission complete.<br>7 1 = Close command has been issued. |
| E1 | 1 | *Status Byte 10 for SDLC Receive Mode:*<br>*Bit Meaning when 1*<br>0 System use only.<br>1 There are too many bytes in the frame received.<br>2 The frame received used a buffer.<br>3 The frame received contained a P-bit.<br>4 No buffer is available for the received frame.<br>5 An I-frame should be transmitted.<br>6-7 01 = An I-frame was received.<br>10 = An S-frame was received.<br>11 = An NS-frame was received.<br>*Status Byte 10 for SDLC transmit mode:* Contains the control byte for the current frame or the Nr and Ns count depending on frame type and timing. |
| E1 | 1 | *Status Byte 10 for BSC:*<br>*Bit Meaning when 1:*<br>0 Transparent mode.<br>1 A DLE was received.<br>2 Heading mode.<br>3 Text mode.<br>4 ITB mode.<br>5 An ETB was received.<br>6 BCC mode.<br>7 An invalid ACK was received. |

| Hex Displ | Length in Bytes in Hex | Description |
|---|---|---|
| E2 | 1 | *Status Byte 11 for SDLC Receive Mode:*<br>*Bit Meaning when 1*<br>0 Decode the broadcast address.<br>1 An invalid buffer was released to the free queue.<br>2 Buffers are released from the interim queue to the free queue.<br>3 A received buffer is released to the input queue.<br>4 Not used.<br>5-7 *Type of Command Received:*<br>001 = Test.<br>010 = XID.<br>011 = SNRM.<br>100 = DISC.<br>101 = RR.<br>110 = RNR.<br>111 = Invalid command. |
| E2 | 1 | *Status Byte 11 for SDLC Transmit:* Contains the high-order byte of the address of the current buffer.<br>*Status Byte 11 for BSC:*<br>*Bit Meaning when 1*<br>0 A poll address was received.<br>1 A select address was received.<br>2 A receive timeout occurred.<br>3 An ID was transmitted.<br>4-7 System use only. |
| E3 | 1 | *Status Byte 12 for SDLC receive:*<br>*Bit Meaning when 1*<br>0 The MPU ignores processing this frame.<br>1 System use only.<br>2 This frame is not the first frame received.<br>3-5 100 = Transmit NSA.<br>101 = Transmit text.<br>110 = Transmit XID.<br>111 = Transmit disconnect.<br>001 = Transmit command reject.<br>010 = Transmit I-frame.<br>011 = Transmit no I-frame.<br>6-7 01 = I-frame.<br>10 = S-frame.<br>11 = NS-frame. |

| Hex Displ | Length in Bytes in Hex | Description |
|---|---|---|
| E3 | 1 | *Status Byte 12 for SDLC Transmit:* Contains the low-order byte of the current buffer address.<br>*Status Byte 12 for BSC*<br>*Bit Meaning when 1*<br>0 A TTD was received.<br>1 The second byte of the block check is the next byte compared.<br>2 0 = Send ACK0 first.<br>1 = Send ACK1 first.<br>3 An ETB was the last control character transmitted.<br>4 An ETX was the last control character transmitted.<br>5 An invalid response was received.<br>6 When the MPU is in transmit state, a WACK was the last control character received. When the MPU is in receive state, a WACK was the last control character transmitted.<br>7 When the MPU is in receive state, an RVI was the last control character transmitted. When the MPU is in transmit state, an RVI was the last control character received. |
| F8 | 1 | *System Indicators:*<br>*Bit Meaning when 1*<br>0 For BSC, character phase. For SDLC, a flag has been received.<br>1 For BSC, the IBM 5280 is being polled. Not used for MRJE.<br>2 For BSC, the IBM 5280 is being selected. Not used for MRJE.<br>1-2 For SDLC:<br>00= The IBM 5280 was not addressed.<br>01= The IBM 5280 was explicitly addressed.<br>10= The IBM 5280 received a broadcast address.<br>11= System use only.<br>3-6 System use only.<br>7 The CCB Pointer diagnostics are complete (does not necessarily indicate a successful test). |
| F9 | 1 | *Communications Line Status (not used for MRJE):*<br>*Bit Meaning when 1*<br>0 The IBM 5280 transmited a NAK in response to a line bid.<br>1 The IBM 5280 received a NAK in response to a line bid.<br>2 No free-queue buffer is available.<br>3 A conversational reply was received after an ETB.<br>4-7 System use only. |

### CCB Error Codes

The following error codes are logged in the CCB (communications control block) beginning at hexadecimal displacement 6C. These codes are logged by the MPU during communications.

### BSC Error Codes

The following error codes are logged during BSC.

| Hexadecimal Error Code | Meaning |
|---|---|
| 00-01 | Not used. |
| 02 | The transmit buffer does not begin with a proper start character (SOH or STX). |
| 03 | An ETX character appears within the data stream portion of the transmit buffer. |
| 04 | Not used. |
| 05 | An STX character appears within the data stream portion of the transmit buffer. |
| 06 | An ITB character appears within the data stream portion of the transmit buffer. |
| 07 | The transmit buffer does not end with a proper end character (ETB, ETX, ITB or STX). |
| 08 | An ETB character appears within the data stream portion of the transmit buffer. |
| 09 | An invalid ASCII character (not odd parity) occurred in the transmit buffer. |
| 0A | Not used. |
| 0B | During a receive operation, a free buffer was not available; hexadecimal displacement 19 in the CCB must be equal to or greater than the number of records per block. |
| 0C | Not used. |
| 0D | The remote station canceled the session; transmitted an EOT that was not preceded by an ETX. |
| 0E | A cancel block sequence (STX data ENQ) was received from the remote station. |
| 0F | The IBM 5280 received an invalid trailing pad character. |
| 10 | Disconnect timeout occurred on a switched line. |
| 11 | An invalid block check sequence was received. |
| 12 | Overrun during receive; the IBM 5280 MPU cannot keep up with received data. |
| 13 | Receive timeout; nothing was received from the remote station or the IBM 5280 transmitted data and did not receive a response. |
| 14 | Underrun during transmit; the IBM 5280 MPU cannot keep up with the line. |
| 15 | Transmit timeout; no transmit clock signals. |
| 16-17 | Not used. |
| 18 | The IBM 5280 received an invalid response from the remote station. |
| 19 | TTD threshold (hexadecimal displacement F3 of the CCB) exceeded; the IBM 5280 transmitted an EOT. |
| 1A | The buffer is too small for the received message or the MPU did not detect an end control character. |
| 1B | The IBM 5280 received an invalid response from the remote station. |
| 1C | Not used. |
| 1D | While in transparent mode, the IBM 5280 received a DLE SOH in the data. |
| 1E | The IBM 5280 received an invalid SOH sequence; the SOH character was not the first character. |
| 1F | AN STX was detected within the data. |
| 20 | Not used. |
| 21 | The IBM 5280 received an ETX after it received an SOH in the data. |
| 22 | The IBM 5280 received an STX but no free buffer is available for the data. |
| 23 | Receive timeout, the IBM 5280 transmitted a block of data and the remote station did not respond. |

| Hexadecimal Error Code | Meaning |
|---|---|
| 24 | A DLE was detected in the output buffer in nontransparent mode. |
| 25 | While sending a TTD, the output queue empty bit was zero (indicating data ready for transmission), but no data was in the output buffer to be transmitted. |
| 26 | The IBM 5280 transmitted a TTD and did not receive a response. |
| 27 | The IBM 5280 received an EOT within a nontransparent message. |
| 28 | Not used. |
| 29 | Receive retry count (hexadecimal displacement 54 in the CCB) exceeded; the IBM 5280 transmitted an EOT. |
| 2A | Maximum NAKs received; the IBM 5280 received a NAK in response to transmitted data, which exceeded the maximum NAKs specified (hexadecimal displacement 34 in the CCB). |
| 2B | Maximum bid retry count (hexadecimal displacement 4C of the CCB) exceeded. |
| 2C-2D | Not used. |
| 2E | Not transmit clock signals. |
| 2F | Not used. |
| 30 | The IBM 5280 received an ETX and no free buffer is available. |
| 31 | The IBM 5280 received an ETB out of sequence (first character). |
| 32 | Same meaning as code 19 (too many TTDs received). |
| 33 | The remote station terminated the session. The IBM 5280 transmitted data and the remote station transmitted an EOT in response. |
| 34-3F | Not used. |

**MRJE Error Codes**

The following error codes are logged during MRJE communications.

| Hexadecimal Error Code | Meaning |
|---|---|
| 40 | MRJE receive timeout; the IBM 5280 received nothing within the time specified during configuration (hexadecimal displacement 4B in the CCB). |
| 41 | The IBM 5280 received an MRJE data block with an out-of-sequence block control byte. |
| 42 | The IBM 5280 received an MRJE block check error. |
| 43 | MRJE overrun; the IBM 5280 MPU cannot keep up with received data. |
| 44 | MRJE underrun; the IBM 5280 cannot transmit data fast enough for the line. |
| 45 | The IBM 5280 received an MRJE data block with an invalid block control byte. |
| 46 | Communications MPU Error. |
| 47 | The remote station received an out-of-sequence block control byte. |
| 48-4F | Not used. |

## 993 COMMUNICATIONS ERROR TABLES (continued)

### SDLC Error Codes

The following error codes are logged during SDLC communications only:

| Hexadecimal Error Code | Meaning |
|---|---|
| 50 | Overrun; the data is being received too fast for the IBM 5280 MPU. |
| 51 | Underrun; the IBM 5280 cannot transmit fast enough for the line. |
| 52 | Not used. |
| 53 | Frame check sequence error. |
| 54 | The IBM 5280 received a frame with a transmit sequence error. |
| 55 | The IBM 5280 received a frame that contained less than four bytes between flags. |
| 56 | The remote station canceled the frame. |
| 57 | Not used. |
| 58 | The trailing flag was not on an 8-bit boundary. |
| 59 | Transmit timeout. The IBM 5280 cannot transmit a frame within the time specified in hexadecimal displacement 42 of the CCB. |
| 5A-75 | Not used. |
| 76-80 | Communications MPU errors. |
| 80-9F | Communications MPU errors; for example, invalid buffer addressing. (Error codes 96 through 99 are probably MPU errors, error codes 9A through 9D may be caused by either the MPU or the CAM, and error codes 9E and 9F are probably MPU errors. |

### Modem Control Error Codes

The following error codes are logged for all communications:

| Hexadecimal Error Code | Meaning |
|---|---|
| A0 | When performing an MPU open operation, the data-set-ready line was already on or the data-set-ready line did not go off on a switched line when the line was disconnected. |
| A1 | The data-set-ready line went off unexpectedly. |
| A2 | Receive timeout; the IBM 5280 received nothing within the time specified in the activity timeout timer (hexadecimal displacement 43 in the CCB). |
| A3 | The IBM 5280 detected the clear-to-send line on when attempting to turn on the request-to-send line. |
| A4 | The data-set-ready line did not turn on. |
| A5 | The clear-to-send line did not turn on. |
| A6-AF | Not used. |

## LIST OF TOOLS AND TEST EQUIPMENT

The following tools and test equipment are supplied with the IBM 5285:

| Description | Part Number | Storage Location |
|---|---|---|
| Card insertion tools | 5642825 | Base machine (2 supplied) |
| Diagnostic diskette 1 | 4177870 | MIM binder |
| Diagnostic diskette 2 | 1618001 | MIM binder |
| Diagnostic diskette 3 | 6043052 | MIM binder |
| EIA or DDSA wrap connector | 1618219 | Customer manual binder |
| 38LS NS network wrap connector | 8331287 | Customer manual binder |
| Diskette head carriage spring | 4240631 | Diskette drive |
| Diskette feeler gauge clip | 4240632 | Diskette drive |
| Terminator/load resistor (5.1KΩ) | 4177566 | MIM binder |
| Jumper-406 millimeter (16 inch) | 829118 | MIM binder |
| Jumper-127 millimeter (5 inch) | 452655 | MIM binder (2 supplied) |
| Diskette timing pin | 5562019 | Diskette drive |

The following tools and test equipment, which are not supplied, may also be required to service the IBM 5285:

| Description | Part Number | MIM Reference |
|---|---|---|
| Metric tool kit | B/M 1749235 | |
| General logic probe | 453212 | 905 |
| Oscilloscope (475 or equivalent) | | 713 |
| TRAP recorder | 2439634 | 831 |
| TP line monitor | 1749296 | 835 |
| Multimeter | 1749231 | 463 |
| dB adapter | 1749299 | 463 |
| dB adapter connector assembly | 1647116 | 463 |
| NuData tester | 453637 | 833 |
| PT-2 | 1749268 | 835 |
| BNC-T connector | 1650789 | 713 |
| Resistor assembly (2 at 50Ω each) | 7362344 | 713 |
| Probe tip to BNC connector | 435199 | 713 |
| Alligator clips | 1650790 | 713 |
| Head alignment diskette | 2455026 | |
| Dummy patch card | 816983 | |
| MSR test card | 8331402 | 751 |
| Earphone | 2728116 | 904 |

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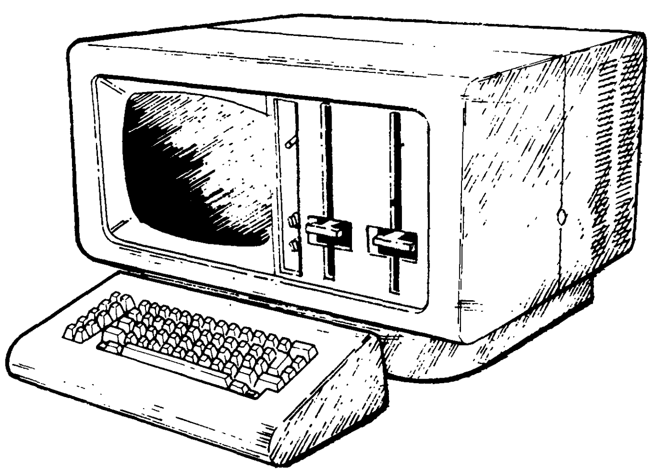
## Introduction

The IBM 5280 is a diskette-based system. It includes several data stations and programmable units that can be connected in a variety of configurations. The programmable units contain the microcode needed for the system to operate. There are several devices that attach to the data stations and the programmable units.

### DATA STATIONS

#### IBM 5281

The IBM 5281 is a tabletop data station that has one keyboard and one display assembly. The IBM 5281 must be connected to one of the programmable units before any function can be performed. A maximum of two diskette drives can be housed within the IBM 5281.

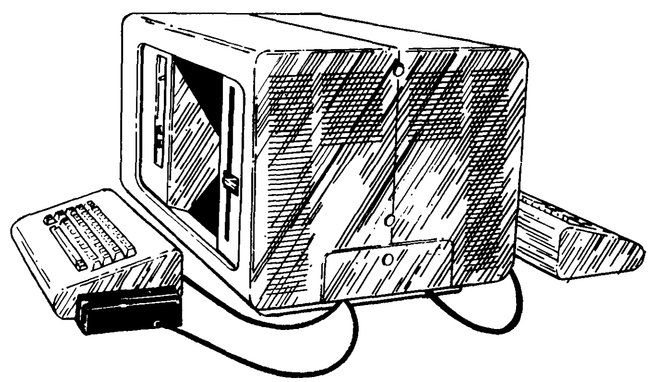


*Specifications*

- Display sizes are 480, 960, or 1920 characters. All displays on a system must be the same size.
- Storage is located in the programmable unit to which the IBM 5281 is attached.
- Keyboards available are data entry, data entry with proof arrangement, and typewriter.
- No diskette drives are required in the IBM 5281; however, a maximum of two diskette drives can be installed.
- One magnetic stripe reader can be attached, but it is not required.

#### IBM 5282

The IBM 5282 is a tabletop dual data station that has two keyboards and one display assembly. The display image is divided by mirrors to provide a separate display image for each operator. The IBM 5282 must be connected to one of the programmable units before any function can be performed. A maximum of two diskette drives can be housed in the IBM 5282.



*Specifications*

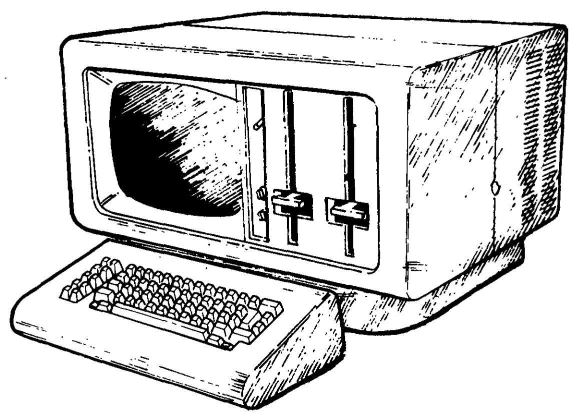
- Display sizes are 480 or 960 characters. All displays on a system must be the same size.
- Storage is located in the programmable unit to which the IBM 5282 is attached.
- Keyboards available are data entry, data entry with proof arrangement, and typewriter. Both keyboards on the IBM 5282 must be the same type.
- No diskette drives are required in the IBM 5282; however, a maximum of two diskette drives can be installed.
- Two magnetic stripe readers can be attached, but are not required.

## PROGRAMMABLE UNITS

### IBM 5285

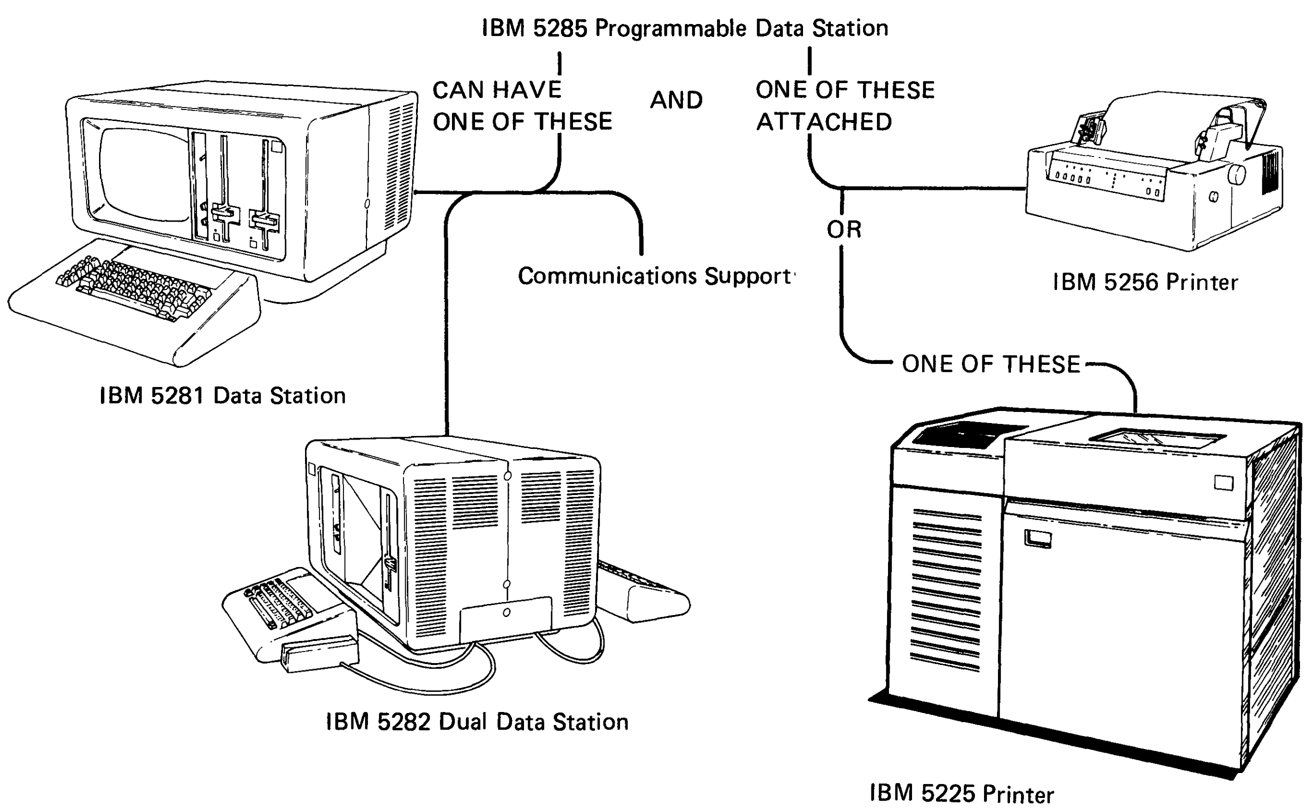
**The IBM 5285 is a tabletop programmable data station that has one keyboard, one display assembly and one diskette drive. One additional diskette drive can be added for a maximum of two drives.**

The possible configurations of an IBM 5280 system using the IBM 5285 Programmable Data Station as the controller are shown in the following illustrations:



*Specifications*

- **Display sizes are 480, 960, or 1920 characters. All displays in the system must be the same size (with the Communications feature, the minimum display size is 960 characters).**
- Storage sizes available are 32 K, 48 K, or 64 K bytes.
- Keyboards available are data entry, data entry with proof arrangement, or typewriter.
- One diskette drive is included with the IBM 5285; however, one additional drive can be added. An auxiliary data station can include two diskette drives for a maximum of four drives on the system.
- One Keylock feature can be included.
- One magnetic stripe reader can be used with the IBM 5285, and one each with the auxiliary keyboards for a maximum of three magnetic stripe readers on the system.
- One communications adapter can be included. However if communications is installed, there can be no auxiliary data station on the system.
- One Elapsed Time Counter feature can be included.
- One printer can be attached to the IBM 5285.



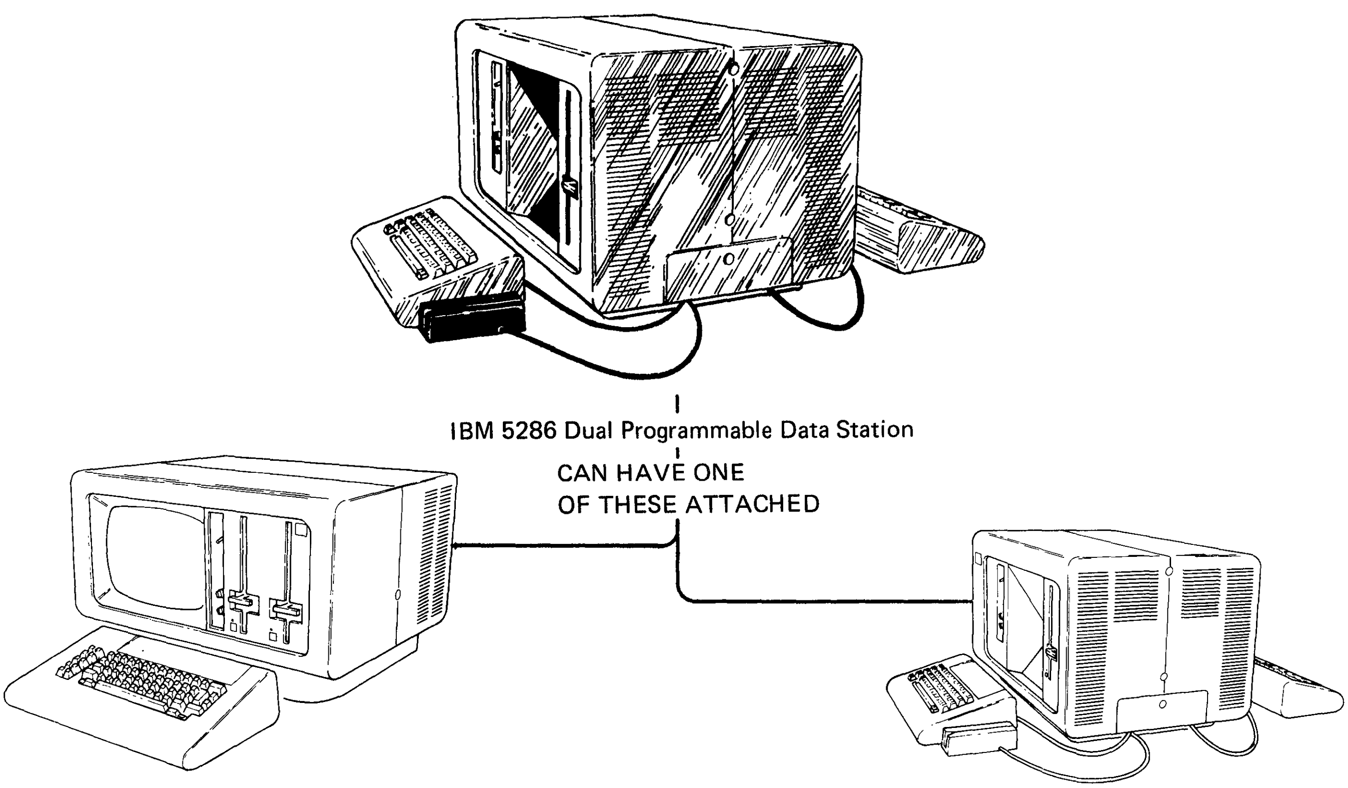
## IBM 5286

The IBM 5286 is a tabletop dual programmable data station that can be used by two operators simultaneously. The IBM 5286 has two keyboards, two diskette drives, and one display assembly. The display image is divided by mirrors to provide a separate display image for each operator.

The possible configurations of an IBM 5280 system using the IBM 5286 Dual Programmable Data Station as the controller are shown in the following illustration:

*Specifications*

- Display size is 480 characters. All displays on a system must be the same size.
- Storage sizes available are 32 K, 48 K, or 64 K bytes.
- Keyboards available are data entry, data entry with proof arrangement, or typewriter. Both keyboards on the IBM 5286 must be the same type.
- Two diskette drives are included in the IBM 5286. A maximum of two additional diskette drives can be installed in auxiliary data stations.
- Two magnetic stripe readers can be used with the IBM 5286. In addition, one magnetic stripe reader can be used with each keyboard at the auxiliary data stations.
- One Keylock feature can be included.
- One Elapsed Time Counter feature can be included.



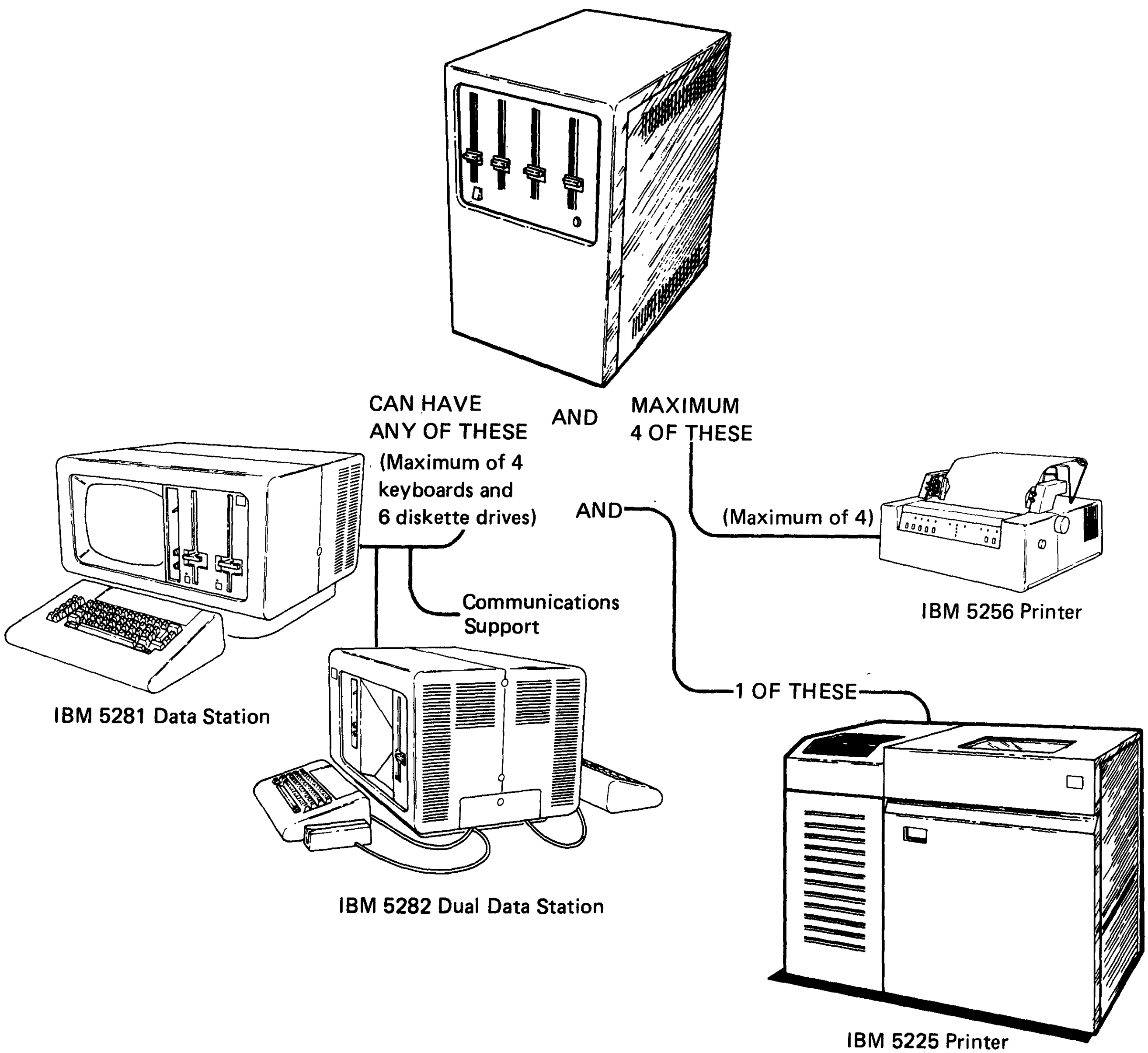

IBM 5281 Data Station

IBM 5282 Dual Data Station

**IBM 5288**

The IBM 5288 is a floor-standing programmable control unit. The IBM 5288 does not include a keyboard or a display assembly. It can contain a maximum of four diskette drives.

The possible configurations of an IBM 5280 system using the IBM 5288 Programmable Control Unit as the controller are shown in the following illustration:



*Specifications*

- Display sizes of the attached auxiliary data stations are 480, 960, or 1920 characters (with the Communications feature, the minimum display size is 960 characters). All displays on the system must be the same size.
- Storage sizes available are 32 K, 64 K, 96 K, 128 K, or 160 K bytes.
- Keyboards available on the attached data stations are data entry, data entry with proof arrangement, or typewriter.
- One diskette drive is included with the IBM 5288; however, the system can have a maximum of eight diskette drives. Of the eight drives, a maximum of six can be located in the attached data stations. A maximum of four diskette drives can be located in the IBM 5288.
- One Keylock feature can be included.
- A maximum of four magnetic stripe readers can be included with the attached data stations: one with each keyboard.
- One communications adapter can be included.
- One Elapsed Time Counter feature can be included.
- A maximum of five printers can be attached to the IBM 5288.

## ATTACHMENTS AND FEATURES

### Diskette Drives

The IBM 5280 system uses two types of diskette drives: the 31SD and the 51TD. The 31SD diskette drives use only the diskette 1. The 51TD diskette drives use the diskette 1, the diskette 2, and the diskette 2D. The diskette 2 can store twice as much data as the diskette 1. The diskette 2D can store twice as much data as the diskette 2. Data is recorded on one side of the diskette 1, while data is recorded on both sides of the diskette 2 and 2D. Each IBM 5280 system requires a minimum of one diskette drive.

The following chart shows the capacities of the diskette types that can be used on the IBM 5280 system:

| Diskette Type | Physical Record Length in Bytes | Total Storage in Bytes | Exchange Type |
|---|---|---|---|
| Diskette 1 | 128 | 246272 | Basic and I |
| Diskette 1 | 256 | 284160 | I |
| Diskette 1 | 512 | 303104 | I |
| Diskette 2 | 128 | 492544 | Basic and I |
| Diskette 2 | 256 | 568320 | I |
| Diskette 2 | 512 | 606208 | I |
| Diskette 2D | 256 | 985088 | H and I |
| Diskette 2D | 512 | 1136640 | I |
| Diskette 2D | 1024 | 1212416 | I |

### Printers

The IBM 5280 system can use either the IBM 5256 Serial Matrix Printer or the IBM 5225 Line Printer. These printers can be attached to the IBM 5280 by twinaxial cable. One printer can be attached to the IBM 5285 Programmable Data Station and up to five can be attached to the IBM 5288 Programmable Control Unit.

### Keylock Feature

The Keylock feature provides data security on the IBM 5280 system. It is a key-operated switch that can be installed on the programmable units only. The switch has three positions: local, normal, and lock. One key is required to move the switch from the lock position to the normal position and a different key is required to move the switch from the lock position to the local position. The key cannot be removed from the switch in the local position or the normal position but can be removed in the lock position.

When the switch is in the local position, communications cannot be established. If the system is in communications mode when the switch is placed in the local position, communications proceed normally until the end of the current job.

When the switch is in the normal position, communications can be established and maintained.

When the switch is in the lock position, communications cannot be established. If the system is in communications mode when the switch is placed in the lock position, communications proceed normally until the end of the job. However, in the lock position, all keyboards are disabled, and no image can be displayed on the screen.

### Magnetic Stripe Reader Feature

The Magnetic Stripe Reader feature reads magnetically encoded data from documents such as credit cards or identification cards. This feature can be a security device to ensure that only authorized persons can use the system, or it can also speed up the entry of constant data such as a credit number or an identification number. There can be one magnetic stripe reader for each keyboard on the system.

### Elapsed Time Counter Feature

The Elapsed Time Counter feature measures elapsed time to count keystrokes, to time the completion of a user's application, or to check operator performance.

### Feature Main MPU

The feature main MPU provides additional interface to main storage. It works in parallel with the base main MPU to provide faster main storage accessing for attached devices.

### Communications Feature

The Communications feature allows the IBM 5280 to communicate with another terminal or a host system using BSC (binary synchronous communications) or SDLC (synchronous data link control). Both SDLC and BSC can be used, although not simultaneously. Only programming changes are necessary to switch from one to the other.

In a BSC network, the IBM 5280 can appear to the remote station as an IBM 3741 Data Entry Station, an IBM 3780 Data Communications Terminal, or, to host RJE (remote job entry) systems, as a System/3 RJE data station.

With BSC, the IBM 5280 can transmit and/or receive using EBCDIC or ASCII transmission code and transparent or nontransparent data.

In an SDLC network, the IBM 5280 conforms to the SNA (systems network architecture) definitions. See *Systems Network Architecture Support* in this section for a list of these definitions and a description of commands and responses supported.

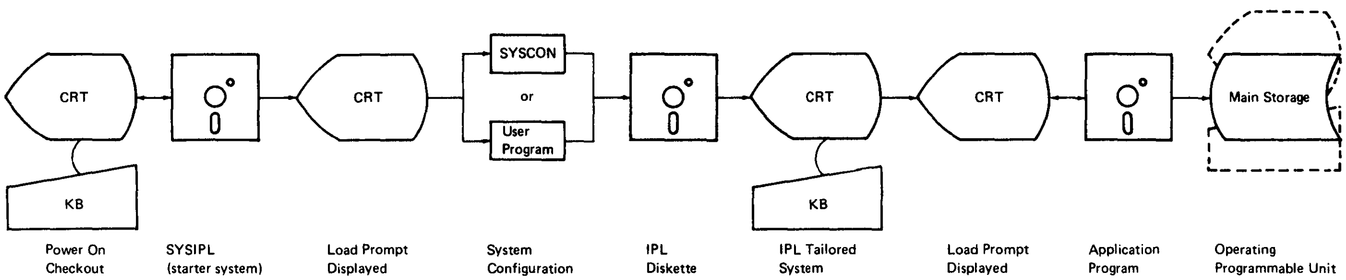
One communications line can be attached to the IBM 5280. The line can be point-to-point switched, point-to-point nonswitched, or multipoint. On a multipoint line, the IBM 5280 can be a tributary station only. On nonswitched lines, the IBM 5280 supports SNBU (switched network backup), which allows the user to use a switched line if the non-switched line is unavailable.

The IBM 5280 can communicate over either half duplex or full duplex lines; however, the IBM 5280 communicates in half duplex only. Full duplex lines can be used to reduce line turnaround time. The interface between the IBM 5280 and the line is provided by the EIA/CCITT, DDSA, or the 38LS feature. See *Line Adapter Cards* in this section for a description of these features.

## System Functional Overview

### LOADING A PROGRAM

The IBM 5280 system requires a program in main storage before any operations can occur. The following illustration shows a summary of steps that lead to loading an application program into main storage:




When the power switch on the system is set to the On position, a power-on check is performed to test the operation of several areas of the system. If an area fails, power-on check indicators are displayed to show where the failure occurred. For a detailed description of the power-on check and indicators, see 931 in the diagnostic aids section.

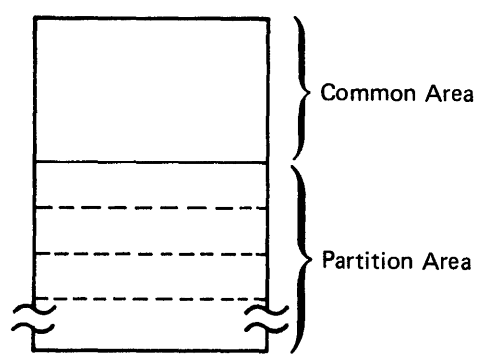
The SYSIPL program (referred to as the starter system) is supplied by IBM. It provides the user with the programming necessary to load programs into main storage. In addition, it provides the user with the system control programming required to execute an application program.

The SYSCON program is a system configuration program provided by IBM. It allows the user to tailor the system's main storage area and provides system programming for the attached devices. The user defines the system characteristics to fit his business needs. When SYSCON is executed, a user-defined IPL diskette is created.

When the user loads the system with the IPL diskette, a load prompt is displayed on each display screen that is configured on the system. The load prompt, which asks for a program name and location, allows the application program to be loaded into main storage. The application program can be either user written using the assembler or DE/RPG program product, or an IBM-supplied program.

#### Main Storage Layout

Main storage consists of two areas: the common area and the partition area as shown in the following illustration:




The common area is always located at the beginning of main storage beginning at address 0000. The information here is common to programs located in the partition area. This information is used by the system when executing the application program.

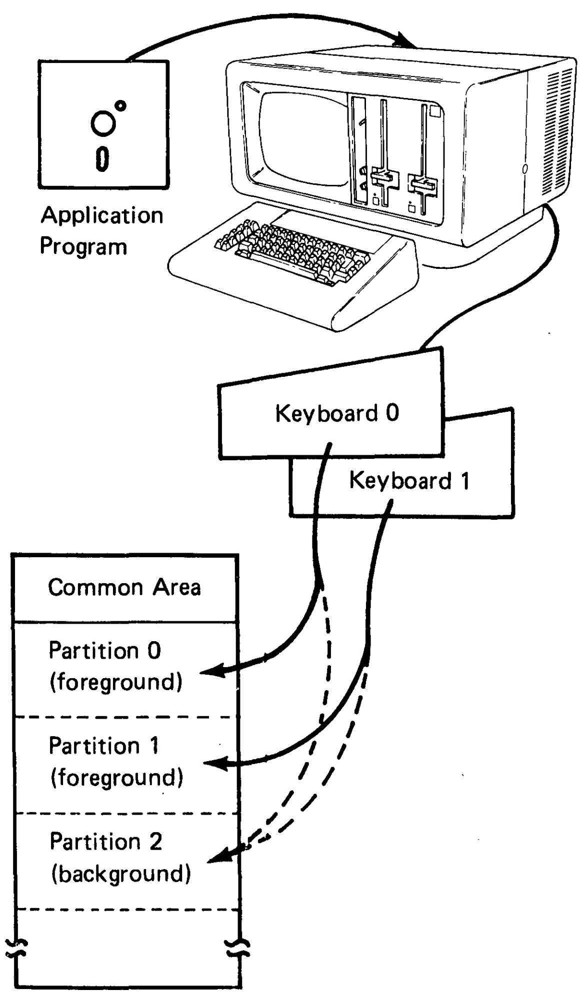
The partition area follows the common area and contains the application program. Up to eight partitions can occupy the partition area. Each partition can be up to 64 K bytes and can contain a program.

*Partition Types*

Each partition is either a foreground or a background partition. Programs that require constant interface with a keyboard are stored in foreground partitions. Each keyboard/display station on the system is assigned to a foreground partition.

Programs that require occasional interface with a keyboard are stored in background partitions. Any keyboard/display station on the system can use a program assigned to a background partition.

The following illustration shows application programs loaded into two different foreground partitions and a background partition in main storage. The program in partition 0 is always associated with keyboard/display 0. Likewise, the program in partition 1 is always associated with keyboard/display 1. The program in background partition 2 however, can be associated with either keyboard/display selected by the operator.




**EXECUTING A PROGRAM**

Programs in main storage are executed by a microprocessing unit (MPU). This MPU is the main MPU. It executes all non-I/O instructions, such as mathematical computations and data movement. I/O instructions are executed by device MPUs. Device MPUs are discussed later in this section.

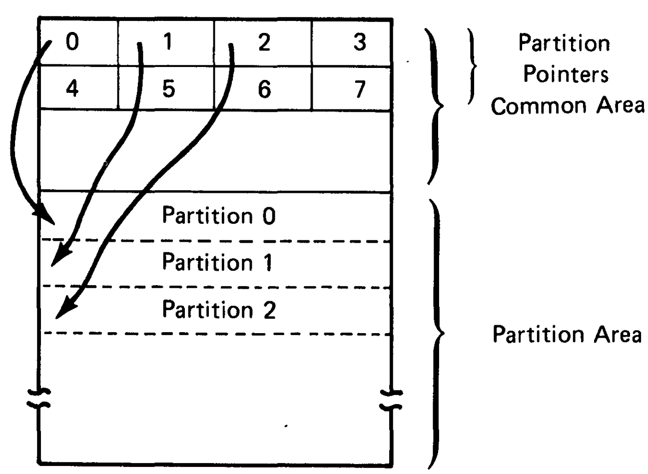
**I/O Instructions**

In a program, I/O instructions can be specified as either overlapped or non-overlapped. When an instruction is overlapped, the main MPU continues executing instructions within a partition while the I/O device is performing the I/O operation. If I/O instructions are non-overlapped, the main MPU goes to another partition and performs work there while the I/O device completes the I/O operation.

**Partition Pointers**

The main MPU locates a program in main storage by scanning partition pointers located in the first 32 bytes of the common area. There is one partition pointer for each partition that can be configured; therefore, there are eight pointers. These pointers include information such as whether a program is loaded in a partition, whether the partition is foreground or background, and the address of the beginning of the partition.

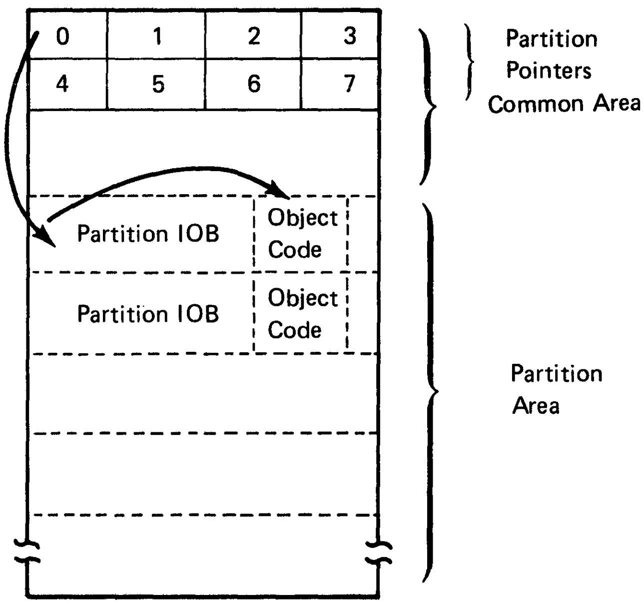
The following illustration shows how the partition pointers point to each partition:



### Partition IOB

Each partition contains a partition IOB (input/output control block). The partition IOB contains information about the partition and the program that is loaded in that partition. The main MPU uses the partition IOB to find and execute the object code instructions contained in the partition.

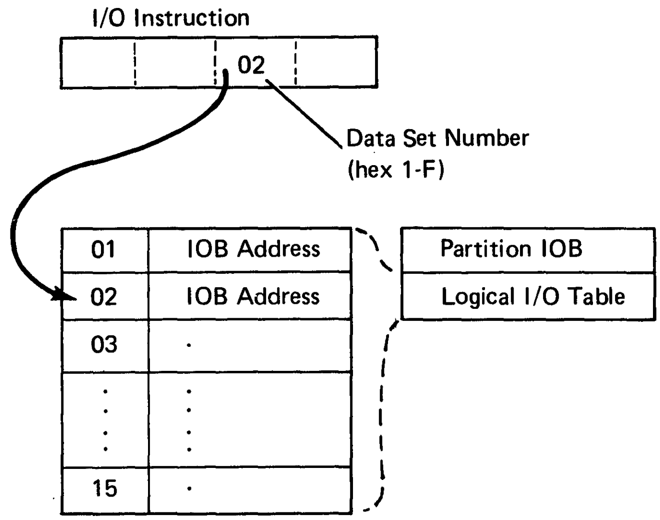
The following illustration shows the relationship of a partition pointer and a partition IOB:




The partition IOB also specifies other information, such as how long the main MPU can execute object code instructions within the partition. A timer, set when a program is assembled, is used to time program execution. When the time limit is reached, the main MPU leaves the partition and goes to the next partition.

### Device MPUs

If the main MPU encounters an I/O instruction while executing a program, it uses a data set number as an index into a logical I/O table in main storage as shown in the following illustration. (The data set number is contained in the object code instruction as specified by the user.)



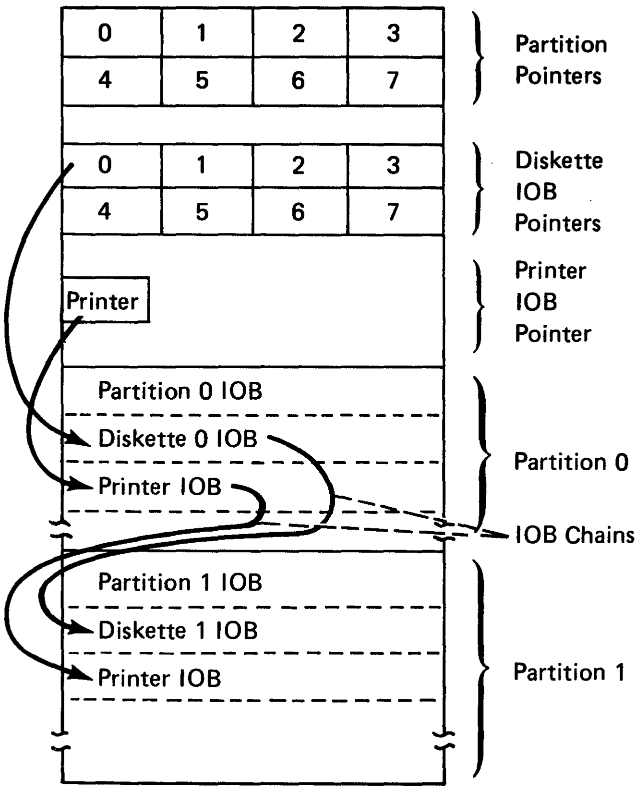

The logical I/O table consists of 4-byte entries in two different formats. One format is associated with keyboard/display IOBs, the other format is for both diskette and printer IOBs. The table contains the address of the device IOB, which the main MPU uses to locate the IOB. The device IOB defines the I/O operation that the device performs.

*Device IOBs*

The main MPU loads the I/O instruction into the device IOB and loads the address of the device IOB into the device IOB pointer. Then the main MPU activates an attention line to the appropriate device MPU. The attention line is a signal from the main MPU to the device MPU to begin working.

When the device MPU detects an active device attention line, it checks the device IOB pointers in the common area until it finds an IOB pointer that has an IOB address. The device MPU then goes to that address and does the work described in the device IOB.

The following illustration shows the device IOB pointers and associated device IOBs in main storage:




When more than one device IOB is assigned to an I/O device such as the diskette or printer, an IOB chain is created. Each device IOB contains the address of the next assigned device IOB. IOB chains can be either in the same partition or they can address additional device IOBs in another partition. In either case, the last device IOB on the chain points back to the first IOB.

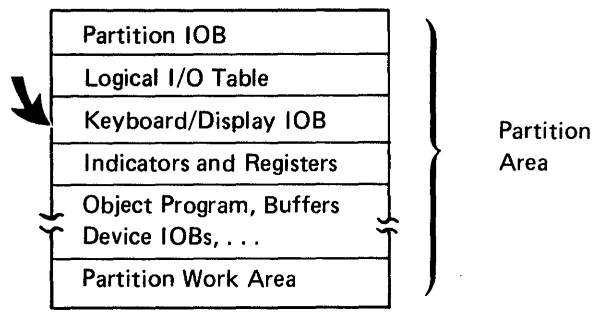
### Keyboard/Display IOB

I/O control for keyboard/display operations is in the keyboard/display IOB. Each partition associated with a keyboard/display unit contains a keyboard/display IOB.

Information in this IOB includes the address of the I/O buffer and the address of the screen format object code. The keyboard/display MPU uses these addresses to control the format of records on the display and in the I/O buffer.

The keyboard/display IOB also includes the address of tables located in keyboard/display storage. This storage area is not a part of main storage. It is read/write storage used to contain keyboard tables, display buffers, and other keyboard/display control information. This storage is discussed later in this section. The keyboard/display MPU accesses this storage area to process keystrokes and to display characters on the screen.

The following illustration shows the location of the keyboard/display IOB in the partition area of main storage:




### Indicators and Registers

Indicators and registers are located in the partition area following the keyboard/display IOB. This area stores the application-program specified indicators, system indicators, binary registers (used for binary arithmetic and logical operations), and decimal registers (used for decimal arithmetic and logical operations).

### Partition Work Area

The last 256 bytes of a partition are used by the main MPU as a work area. The application program does not access this work area.

## System Logic Overview

Logic diagram *LD00* in the *System Logic Manual* shows the FRU (field replaceable unit) logic cards for the IBM 5285. Card boundaries are indicated by bold lines. Card locations are indicated in the upper right corner of each card.

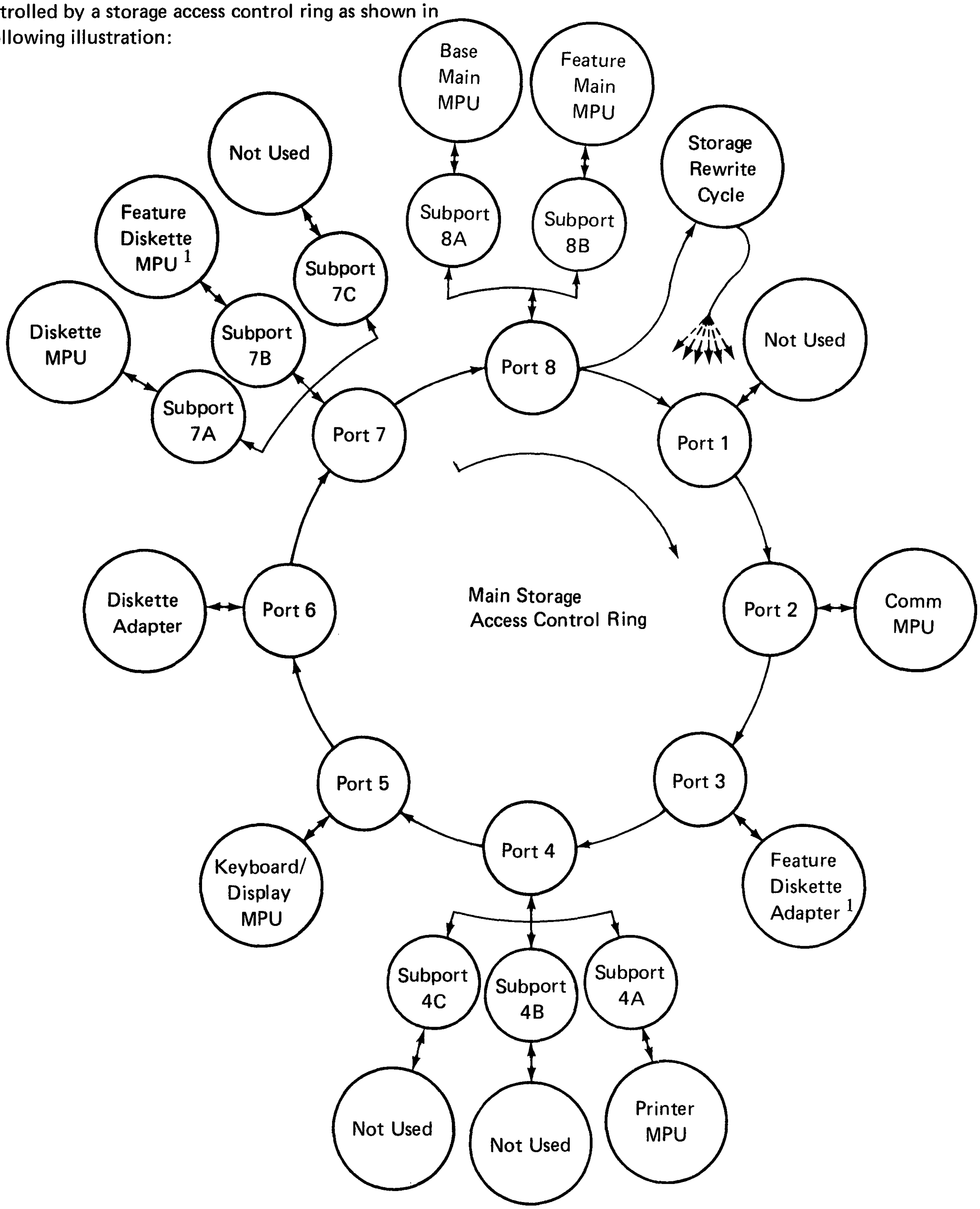
The diagram shows all of the MPUs for the system. As explained previously, all system functions are performed by the MPUs. For example, to enter data on the keyboard and write it on diskette, a program is required in main storage. The program and the MPUs perform the functions required to read the data from the keyboard, format it as required, and write it on diskette as follows:

1. The main MPU reads an instruction in the application program requesting key input (ENTR or KEYACCPT). When the main MPU executes the instruction, it places the instruction in the keyboard IOB and turns on the attention line to the keyboard/display MPU.
2. The keyboard/display MPU reads the data from the keyboard, formats it as specified in the format control string object code (if the instruction is an ENTR), and places it in the I/O buffer in main storage by means of the address and data bus.
3. When the I/O buffer is full, the program in main storage issues a write instruction to write the data to diskette.
4. When the main MPU executes the write instruction, it places the instruction in the diskette IOB.
5. The diskette MPU reads the command in the IOB, then writes the data into diskette as instructed. As with the keyboard/display MPU, the diskette MPU accesses main storage by means of the address and data bus to read the data from the buffer and write it on diskette.

These functions are described in more detail in the following descriptions of main storage addressing and attachment functions.

## Main Storage Accessing

All of the MPUs in the IBM 5280 system share the same main storage. Because of this, the access to main storage is controlled by a storage access control ring as shown in the following illustration:




[1] Not used by the IBM 5285.

Each MPU is assigned a port on the storage access control ring. The storage access control ring tests each port, one-by-one, to determine if an MPU is requesting access to main storage. When an MPU requests a storage cycle, the access control ring grants the request, then advances the ring to the next sequential port.

The storage access control ring can also contain subrings. Each subring can have three ports. Each port on a subring can have an MPU attached.

The main storage used in the IBM 5280 is a degenerating type of storage; therefore, it must be rewritten periodically. After the storage access control ring has serviced port 8 (main MPU), main storage is rewritten. During the rewrite cycle, the storage access control ring continues to advance until another MPU requests access; however, access is inhibited until the rewrite cycle is complete.

## STORAGE ACCESS EXAMPLE

The following example of a diskette MPU main storage read operation shows how an MPU accesses main storage. Refer to logic diagram *LD01-1* in the *System Logic Manual* while you read the following description:

1. Data is read from the diskette bit-by-bit until a complete byte is read.

2. The diskette adapter requests storage access by activating the '-bit req 6' line (there are eight bit request lines: one for each access ring port).

3. When the polling ring reaches the port 6 position, storage access control activates the '+dev sel 6' line (there are also eight device select lines: one for each port).

4. When the '+dev sel 6' line is activated, the adapter activates the '-storage req dot' line.

5. The '-storage req dot' line gates the '-SAR bit 0 dot' through '-SAR bit 15 dot' lines, the '-stg data bit 0 dot' through '-stg data bit 7 dot' lines, and the '+read/-write' control line to main storage. The '-storage req dot' line also activates the '-feat stor sel' line (to access storage located on the feature storage cards), which activates the '-strobe' line to gate the storage data bits to the '-stg data bit 0 dot' through '-stg data bit 7 dot' lines.

6. Storage access control accesses main storage and indicates a completed cycle to the adapter by activating the '-T comp' line.

7. The diskette adapter uses the '-T comp' line to latch data onto the '-stg data bit 0 dot' through '-stg data bit 7 dot' lines. The adapter then deactivates the -storage req dot' line.

8. Access control deactivates the '-T comp' line, which causes the adapter to deactivate the '-bit req 6' line. The '-T comp' line also deactivates the '-strobe' and the '-SAR bit 0 dot' through '-SAR bit 15 dot' lines.

9. Storage access control deactivates the '+dev sel 6' line.

10. Storage access is complete and the polling ring is advanced to the next port with the '+adv bit ring' line.

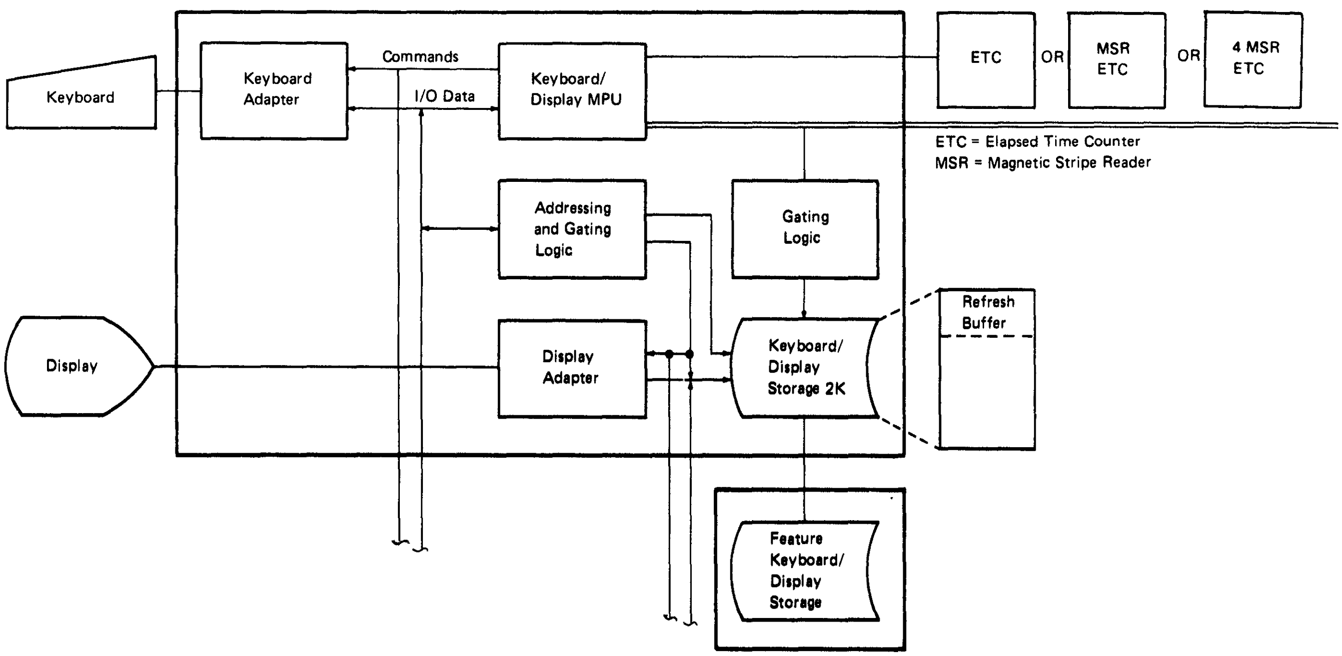
11. After the storage access control has serviced port 8, storage control activates the '-regen' line to rewrite storage.

All MPUs access main storage in this manner, which permits the MPUs to share the same main storage.

## Keyboard/Display Attachment

The keyboard/display attachment is used to connect keyboards, displays, magnetic stripe readers, and an elapsed time counter to the IBM 5285. The attachment consists of the keyboard/display MPU card, keyboard and/or keyboard/display adapter cards, and feature keyboard display/storage cards. The keyboard/display MPU card contains an MPU, one keyboard adapter, one display adapter, and keyboard/display storage. Additional adapter and keyboard/display storage cards can be installed to allow up to three keyboards and displays to be attached (see diagram *LD00* in the *System Logic Manual).*

The following diagram shows the components of the attachment. Each keyboard and display is controlled by an adapter. Because a dual data station contains only one display, it requires only one display adapter (the display is split by mirrors to form two operator stations). In addition to the keyboard/displays, four magnetic stripe readers and one elapsed time counter can be controlled by the attachment.



## KEYBOARD/DISPLAY MPU

The keyboard/display MPU services each of the attached devices sequentially. For example, when a key is pressed on a keyboard, the MPU determines on which keyboard the key was pressed, analyzes the keystroke data, and processes the data. The MPU uses data in keyboard/display storage and main storage to process the data as specified by the application program. The following are some of the functions performed by the keyboard/display MPU:

- Translate keyboard scan code data to EBCDIC data.
- Access the appropriate main storage partition to process keyboard/display data.
- Translate keyboard or main storage data to display code and store the code in the appropriate area of keyboard/display storage.
- Activate the speaker on the keyboard when instructed by the application program.
- Move data, such as prompts, to the appropriate display buffer in keyboard/display storage.

Read only storage (ROS) in the MPU contains micro-instructions that are executed by the keyboard/display microprocessor to control the attached devices.

Keyboard/display storage is read/write storage that is used to store translate tables, display buffers, and control information for the keyboard and displays. This storage is described later in this section.

## KEYBOARD ADAPTER

The keyboard adapter connects the keyboard to the keyboard/display MPU. The adapter contains two or three keystroke buffers to store data from the keyboard. The adapter for keyboard 0 has two buffers and can store two bytes of data. The adapters for keyboards 1 through 3 have three buffers and can store three bytes of data. The adapter also deserializes the data from the keyboard and signals the MPU when data is available.

The keyboard adapter interfaces with the keyboard/display MPU through I/O registers in the MPU.

## DISPLAY ADAPTER

The display adapter handles the physical functions of the display. The adapter performs the following functions:

- Transfers data from keyboard/display storage to the display screen
- Controls the timing of the horizontal and vertical movements of the electron beam on the display screen
- Provides video control for the characters displayed on the screen
- Controls the video for field attributes for data on the screen

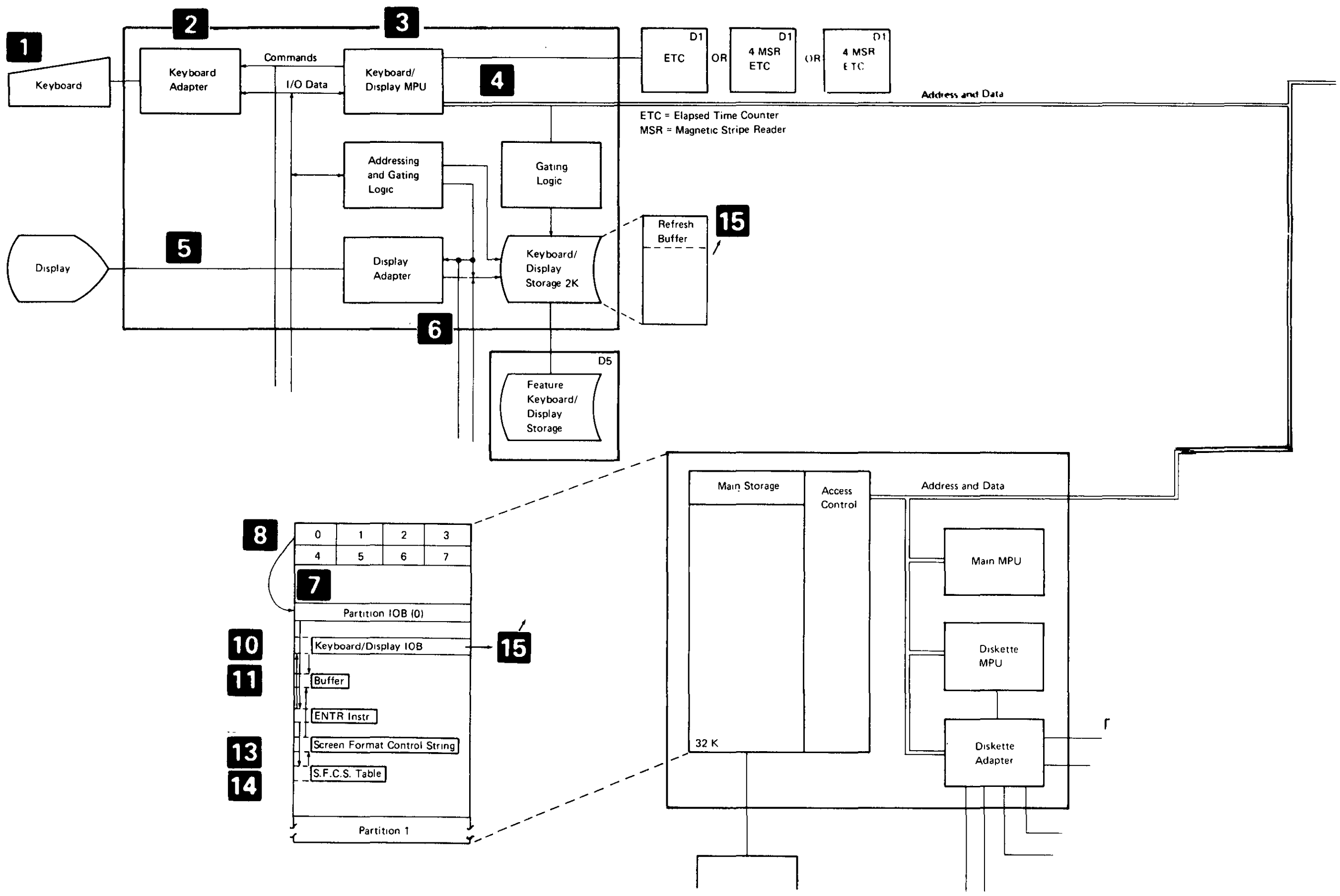
## KEYBOARD/DISPLAY MPU I/O REGISTERS

There are four 1-byte I/O registers in the keyboard/display MPU. The registers and their functions are described as follows:

- A sense register (IOS) that the MPU polls to determine which keyboard activated service request. The IOS register is also used to receive the attention signal from the main MPU.
- A command register (EAR) that the MPU uses to send commands to the device adapters.
- A data register (IOD) that the MPU uses to send data to and receive data from the attached devices.
- A data buffer register (IODB) that the MPU uses to store the number of keyboards attached and to send the attention signal to the main MPU.

## KEYBOARD/DISPLAY DATA FLOW

The following example shows how the keyboard/display attachment, main MPU, and a program in main storage read data from the keyboard, store it in the I/O buffer in main storage, and display it on the screen. Refer to the following diagram while you read the example:




1. When the main MPU executes a keyboard I/O instruction, it sets up the keyboard/display IOB **10** in the partition, and signals the keyboard/display MPU **3**.(by the attention line) that it has work to do. The main MPU then flags the partition pointer **8** to indicate that a keyboard operation is pending for this partition.

2. The keyboard/display MPU checks the partition pointer to determine which partition has the keyboard operation pending. When it finds the partition, it resets the flag in the partition pointer and checks the keyboard/display IOB to determine the work required. If the operation does not require operator input (for example moving data from main storage to keyboard/display storage), the keyboard/display MPU performs the operation, signals the main MPU that the operation is complete, and checks other partitions for work.

3. If the operation requested requires operator input, the keyboard/display MPU sets bits in the partition pointer and keyboard/display IOB to indicate that there is a pending command requiring operator input. The keyboard display MPU then continues checking other partitions for work.

4. When the operator presses a key **1**, the scan code for the key is stored in the buffer in the keyboard adapter **2** (see *Keyboard* in this section for keyboard to buffer data flow).

5. The adapter requests service from the keyboard/display MPU 3.

6. The service request identifies the keyboard number (0, 1, 2, or 3) that requested service. The keyboard/display MPU moves the scan code for the key pressed into the MPU I/O data buffer, then checks the partition pointer for the partition to which this keyboard is assigned to determine if a program is in the partition.

7. If no program is in the partition, a 1110 error code is posted, the scan code is ignored, and the keyboard/display MPU continues with other work. If a program is in the partition, the keyboard/display MPU checks the keyboard/display IOB 10 in the partition to determine how to process the scan code.

8. The keyboard/display MPU checks the scan code to determine if it is a data key, a function key, or a command key sequence.

9. If the key is a data key and the operation requested is a KACCPT command, the MPU translates the scan code to an EBCDIC character and stores it in main storage as specified in the IOB. If the command is an ENTR, the MPU checks the screen format control string 13 in main storage to determine if the character is valid for this field. (The keyboard display MPU finds the screen format control string through a table 14 in main storage.) If the key is not valid for the field, an error is indicated. If the key is valid, the MPU translates the scan code to an EBCDIC character and stores it in the buffer 11 in main storage.

10. The keyboard/display MPU translates the character for the key pressed to a display code and stores it in the appropriate display buffer in keyboard/display storage 15. The display adapter 6 then accesses keyboard/display storage to display the character on the screen 5. The display adapters periodically access the display buffer to read data from the buffer and display it on the screen. The display code and its position in the buffer determine how and where the character is displayed on the screen.

11. Through the speaker in the keyboard, the keyboard/display MPU signals the operator that the operation is complete.

**Function Keys**

If the operator presses a function key without pressing the command key, the keyboard/display MPU checks the key scan code to determine if it should perform the function requested or if the key is to be processed by a program in main storage.

If the keyboard/display MPU is to process the key, it performs the function requested, signals the operator through the speaker (when required) that the operation is complete, then continues with other work.

If the function is to be handled by the program in main storage, the keyboard/display MPU moves the scan code and the EBCDIC character to the keyboard/display IOB in main storage. The keyboard/display MPU then sets up bits in the IOB and the partition pointer to indicate the status of the operation, and signals the main MPU (by the attention line) that the operation is not complete.

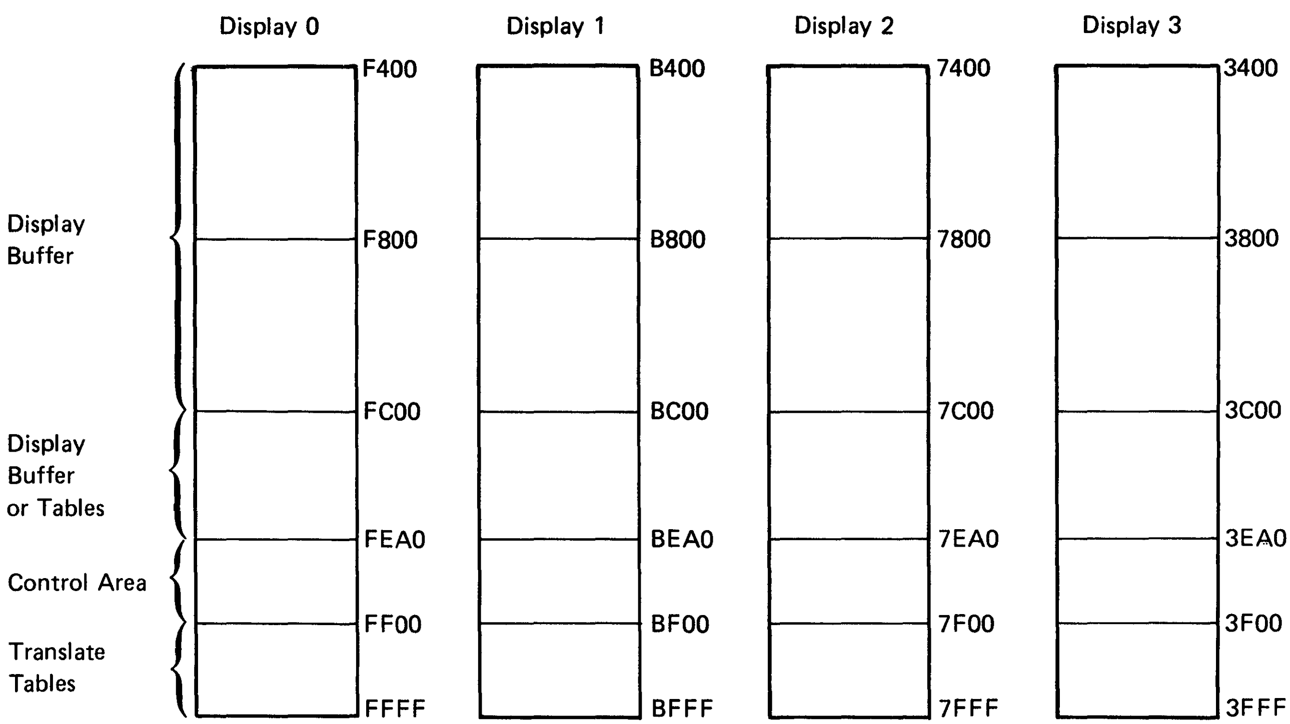
**Command Key Sequence**

When the operator presses the command key, the keyboard/display MPU sets a bit in the keyboard/display IOB to indicate that the command key was pressed. When the next key is pressed, the MPU checks this bit to determine if this is a command key sequence (command key bit is on). If it is a command key sequence, the keyboard/display MPU moves the scan code and the EBCDIC character for the key that was pressed into the keyboard/display IOB, sets bits in the IOB and partition pointer, and signals the main MPU by the attention line. The main MPU then reads the command in the IOB and processes the requested command.

## KEYBOARD/DISPLAY STORAGE

The keyboard/display storage contains the display buffers, translate tables, and control information, such as display attributes, for each keyboard/display attached. The size of the storage varies depending on the display sizes and the number of displays attached to the system. Access to the keyboard/display storage is handled by keyboard/display storage access control logic for up to four keyboard and display adapters.

Each display is assigned a partition of keyboard/display storage as shown in the following illustration:




Each partition contains a control area, translate tables, and a display buffer for its assigned keyboard/display.

### Keyboard/Display Storage Addressing

The keyboard/display adapters selectively address a partition of storage for information that is used by the keyboard/display assigned to that partition. For example, as shown in the previous figure, display 1 uses the information at addresses hexadecimal BEA0 through BEFF and display 2 uses the information at addresses 7EA0 through 7EFF.

### Accessing Keyboard/Display Storage

The following example shows how a display adapter accesses keyboard/display storage to read data from the display buffer. For this example, assume a dual data station is attached to the IBM 5285. Therefore, a dual data station adapter card is installed in location E1 (Refer to logic diagram *LD00).* Refer to diagram *LD05-2* while reading the following description.

1. The raster timing and storage interface logic on the E1 card *(LD05-2)* requests a storage cycle by activating the '-bit req 3 I/O' line (see the chart on *LD05-2).*

2. Keyboard/display storage control (KB/disp on *LD05-1)* selects display adapter 1 by activating the '+sel dev 3 I/O' line.

3. The raster timing and storage interface logic *LD05-2* responds by activating the '-storage req (I/O)' line. The storage interface logic then puts the selected keyboard/display storage address on the storage address bus ('-I/O SAR bit 0 dot' through '-I/O SAR bit 15 dot' lines).

4. The '-storage req (I/O)' line initiates a storage cycle. During the cycle, the addressed data is put on the storage data bus (-I/O stg data bit P dot' through '-I/O stg data bit 7 dot' lines). At the end of the storage cycle, KB/disp storage control activates the '-T comp I/O' line. This signals the storage interface logic that the data is on the bus and ready to read.

5. The storage interface logic reads the data and deactivates the '-storage req I/O' line.

6. The KB/disp storage control deactivates the '-T comp I/O' line, which deactivates the '-dev sel 3 I/O' line. The storage cycle is complete and the KB/disp storage control can respond to another request.

## KEYBOARD

The keyboard has three major parts: key modules, the pad printed circuit board, and the logic printed circuit board. Key modules contain the switches that are pressed by the operator. The pad printed circuit board below the key senses a pressed key by capacitive coupling. The logic printed circuit board, attached to the pad printed circuit board, contains a scan counter. The scan counter tests each position on the pad printed circuit board one position at a time. When a change of capacitance is detected, a scan code is generated for the key pressed. The scan code is sent serially to the data select logic in the keyboard adapter on the '+ serial data A' line. The keyboard also generates a clock signal and a strobe signal and sends them to the adapter on the '+ ser data clk A' and '+ strobe A' lines to synchronize the transfer of data from keyboard A.

The adapter then signals the keyboard/display MPU by activating a service request line. The service request line indicates to the keyboard/display MPU that a keyboard has data to be transferred. During the time the keyboard/display MPU is responding to the service request, the adapter is transferring the data to the serial to parallel register. The data is deserialized in this register then read by the MPU and processed as specified by the application program (see *Keyboard Data Flow* in this section).

The first keyboard adapter (adapter 0) contains two buffers. All other adapters contain three buffers. If a keystroke occurs and all buffers are full, the data in the first buffer is set to all 1's. This indicates to the keyboard/display MPU that a keystroke has been lost and the keyboard/display MPU detects an overrun condition. An overrun can occur from extra clock pulses or noise on the clock line. The MPU also detects an overrun condition if it receives a scan code with bits one through seven on. This can occur if the serial data line remains active during a serial keyboard data transfer.

## MAGNETIC STRIPE READER

The magnetic stripe reader (MSR) allows rapid entry of data constants read from credit-card-like media. A maximum of four MSRs can be connected to a keyboard/display attachment. The reader contains a read head, amplifiers, and a card sensing photocell. The magnetic card contains data and control characters, which are read by the reader as follows:

- Start of message (SOM) character
- Users data
- End of message (EOM) character
- Longitudinal redundancy check (LRC) character

This information is coded using four bits to define a character and one bit to provide odd parity.

When a card is inserted into the magnetic stripe reader, the data is amplified, sent to the adapter, and stored in the adapter buffer. When the data is in the buffer, the adapter issues a service request to the keyboard/display MPU and waits for the MPU to service the request.

When the MPU detects that an MSR is waiting for service, the MPU determines which MSR is requesting service and reads a byte of data from the adapter buffer. After the MPU has processed the data, it reads another byte of data, and so on, until all the data has been read. When the final byte of data has been read, the adapter is reset to allow the reader to accept another card.

Refer to logic diagram *LD09*. *LD09* shows the logic for the MSR adapter. The keyboard/display MPU controls the adapter by sending commands on the '-EAR bit 0 dot' through '-EAR bit 7 dot' lines. The MPU reads data from the MSR on the '-IOD in bit 0 dot' through '-IOD in bit 7 dot' lines.

## ELAPSED TIME COUNTER

The elapsed time counter is used to determine elapsed real time. The counter is attached to the keyboard/display MPU through an MPU I/O register.

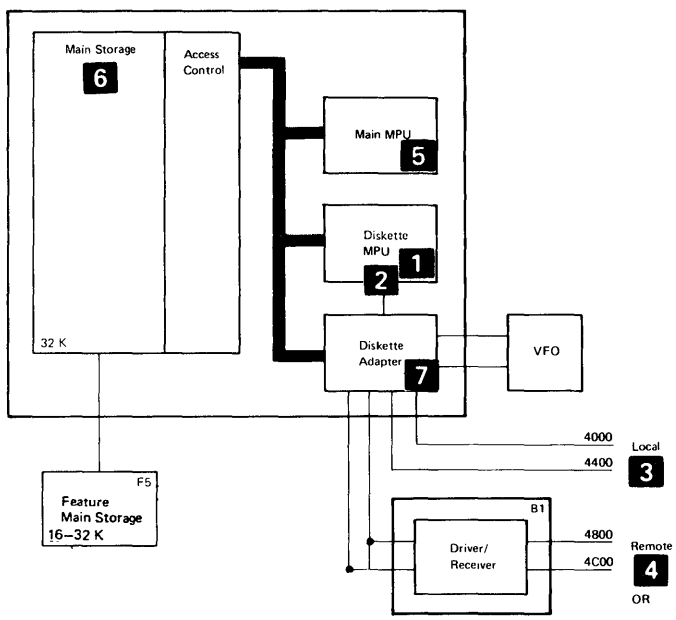
The MPU reads the time and places it in the system control area in main storage. The counter is increased in increments of 1.6 seconds. An application program reads the time and calculates elapsed time.

Refer to diagram *LD09*. *LD09* shows the logic for the elapsed time counter. The keyboard/display MPU controls the counter by sending commands on the '-EAR bit 0 dot' through '-EAR bit 7 dot' lines. The MPU reads the counter data on the 'IOD in bit 4 dot' through '-IOD in bit 7 dot' lines.

## Diskette Attachment

### DISKETTE MPU

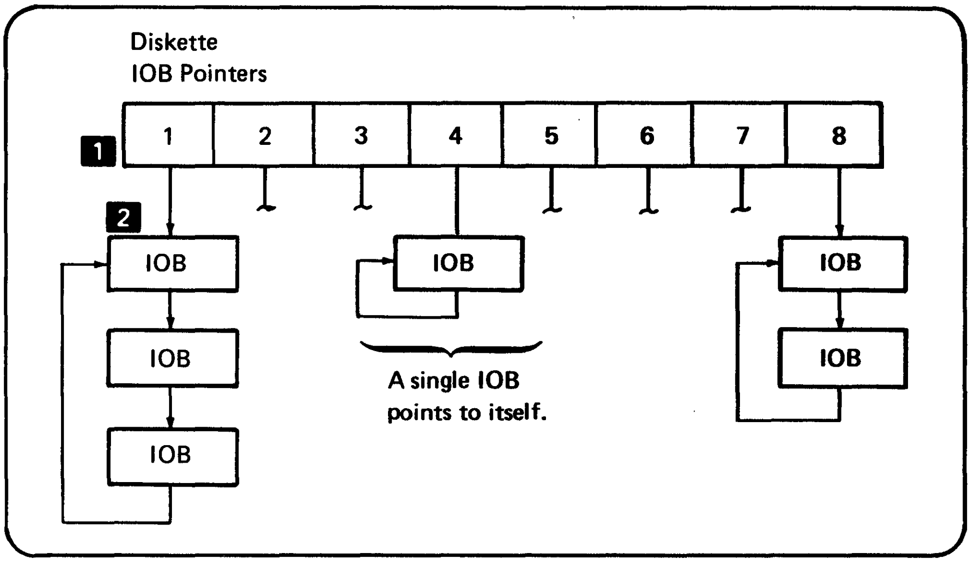
The following diagram shows the major components of the diskette attachment:




The diskette MPU (microprocessing unit) **1** controls diskette functions by using the microinstructions in diskette ROS **2** (diskette ROS is part of the diskette MPU). The diskette ROS contains the microinstructions necessary for the diskette MPU to function. The diskette MPU controls up to four diskette drives. The diskette drives can be local **3** (contained in the controller) or remote **4** (contained in the auxiliary data stations). The diskette MPU communicates with the main MPU **5** by reading the diskette IOBs in main storage **6** and by reading the attention bit in the I/O interface register (the registers are described later in this section).

## DISKETTE IOB POINTERS AND IOBS

The following diagram shows the relationship of the diskette IOB pointers and the diskette IOBs. The diagram also shows how the IOBs are linked together:




Eight of the IOB pointers in the main storage system control area **1** are assigned to diskette drives: one for each drive that can be installed on the system. Byte 3 of the IOB pointer is set to hexadecimal 00 if a drive is not installed for that IOB pointer. The diskette MPU uses the IOB pointers to find the IOBs **2**.

There is an IOB for each diskette data set that is being used by the system. If there is more than one data set being used on a diskette, then there is more than one IOB for that diskette drive. When there is more than one IOB, an address in the IOBs is used to chain the IOBs together. The diskette MPU uses an address in the IOB pointer to find the first IOB on the chain. The address in the first IOB points to the location of the next IOB, and that IOB points to the next, and so on, until the last IOB is reached. The address in the last IOB points back to the first, indicating that it is the last IOB on the chain.

## DISKETTE ADAPTER

The diskette adapter controls the physical activities of the diskette drive, such as moving and loading the heads. These physical activities depend upon commands from the diskette MPU. The diskette MPU uses registers to send commands and data to the diskette adapter and to receive status and data from the diskette adapter (these registers are described later in this section).

The diskette adapter performs the following functions:

- Multiplexes all read and write control and data lines for up to four diskette drives.
- Permits one diskette drive to either read or write while another drive is seeking.
- Permits both 31SD and 51TD drives to be attached.
- Establishes physical record lengths during initialization of the diskette. FM record lengths are 128, 256, or 512 bytes per sector. MFM record lengths are 256, 512, or 1024 bytes per sector.
- Performs reading, writing, and read verify operations.

For information about the diskette header and record formats, see the *IBM 5280 Diskette Drive Maintenance Information Manual.*

## DISKETTE MPU TO ADAPTER COMMANDS

The diskette MPU uses registers to interface with the adapter (see *Diskette Adapter Registers* in this section). One of these registers, the command register, is loaded by the MPU to control the adapter. The command register is the last register loaded during a seek, read, or write operation.

You can exercise the diskette drive with each of the commands by using MDI2050. See 961 for a description of this MDI.

### Write/Read-Check Command

This command compares diskette data to data stored in main storage. The command is issued following a read data or write data command to verify that the read or write data was moved correctly. If a cyclic redundancy check error or a write verify compare error occurs, the sector is completed and the read/write busy condition is reset.

### Seek Command

**Before performing a seek operation, the diskette MPU determines the present location of the read/write heads and the cylinder to which the read/write heads must move. The MPU loads the seek length counter with the number of cylinders to seek. A maximum of 16 cylinders and a minimum of 1 cylinder can be moved with one seek command.**

The MPU determines the direction of the seek by comparing the present head location to the seek-to location. If the seek-to location is larger than the present location, seek forward commands are issued. If the seek-to location is smaller than the present location, seek reverse commands are issued.

After the MPU determines the length and direction of the seek and loads the seek length register, it issues a seek command to move the read/write head(s) to the specified location. The last seek command issued seeks the final (less than sixteen) number of cylinders and engages the head(s).

Because of read/write head settling time, a read or write operation cannot begin until 80 milliseconds after a head engage operation or 40 milliseconds after a seek operation.

*Example Seek Operation*

The diskette adapter controls the seek operation by controlling the two access lines to the file control card. The following is an example of the seek operation. Refer to logic diagrams *LD01-1* through *LD01-3* in the *System Logic Manual* while you read the following description. LD01-1 contains the logic for main storage, the main MPU, and the diskette adapter. LD01-2 contains the logic for local diskette drives. The chart on LD01-2 shows the line names, pin numbers, and test points for each line connecting the drives to the adapter (LD01-1). LD01-3 contains the logic for remote diskette drives (drives in auxiliary data stations).

1. The main MPU executes a read or write instruction in the application program.
2. The main MPU places the instruction into the diskette IOB and turns on the attention line to the diskette MPU.
3. When the diskette MPU senses the attention line, it reads the instruction in the IOB and performs the work specified.
4. Before reading or writing, the diskette MPU must move the read/write heads to the proper cylinder by issuing seek commands.

5. The diskette MPU issues the seek command to the adapter command register after loading the seek length register. The adapter then sets the seek busy bit (bit 5 in sense register 1).

6. The adapter activates the '+access 0' and '+access 1' lines to increment the stepper motor which moves the head/carriage to the proper cylinder.

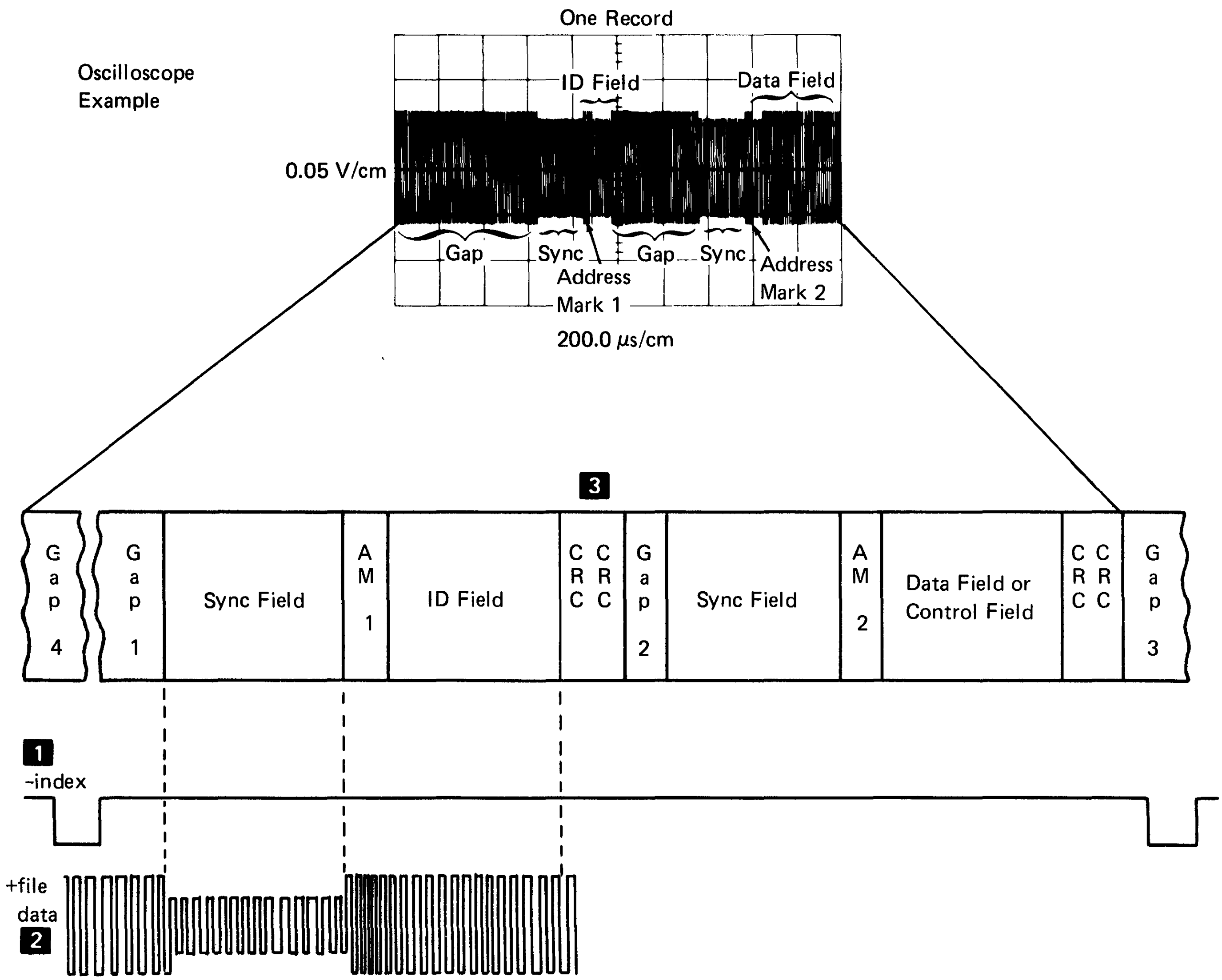
7. The adapter activates the '+head engage' line to load the heads. The seek is now complete and the adapter resets the seek busy bit.

**Recalibrate Seek**

A recalibrate seek operation must be performed whenever the present cylinder location is unknown. A recalibrate seek operation is similar to the seek operation described previously except that the diskette MPU issues seek reverse commands to move the read/write heads to cylinder 0.

**Read ID Command**

A read ID operation is required before each read or write operation. The read ID operation reads the identification of the track to be read from or written to. Before the read ID command is issued, the diskette MPU must issue seek commands to move the read/write heads to the proper cylinder. See *Seek Command* for a description of a seek operation. The following is an example of a read ID operation. Refer to the following illustration of record format and to logic diagrams *LD01-1* through *LD01-3* while you read the following description:



1. The diskette MPU issues a read ID command to the diskette adapter. The adapter then turns on the read/write busy bit (bit 4 in sense register 1).

2. The diskette adapter monitors the '+file data' line **2** for a sync field and an AM (address mark) 1 field. The sync field synchronizes the diskette control circuitry with the data being read. The AM 1 field identifies the field following the AM 1 field as an ID (identification) field. The ID field contains the track address, head number, sector address, and the sector length.

3. The adapter monitors the '+index' line **1** for index pulses. If three index pulses occur before the read ID operation is complete, the read ID operation is terminated and a command-not-complete error is set (sense register 2, bit 6). The command-not-complete error is set for any command that does not complete before the three index pulses.

4. While the ID field is being read, two CRC (cyclic redundancy check) bytes are generated by the diskette adapter. The bit structure of the CRC bytes is dependent on the bit structure of the data in the ID field being read.

5. After the ID field is read, two CRC bytes **3** are read from the diskette. These CRC bytes are compared to the CRC bytes generated during the read ID operation. If the CRC bytes are different, the read ID operation is terminated and a CRC error is set (sense register 2, bit 0).

6. The read ID operation is complete. The adapter resets the read/write busy condition (sense register 1, bit 5).

**Read Data Command**

Before the diskette MPU issues a read-data command, it issues a seek command and a read ID command. The seek and read ID operation must be successful before the diskette MPU issues the read command. The read operation reads data from diskette and writes the data into main storage. The following is an example of a read data operation. Refer to logic diagrams *LD01-1* through *LD01-3* while you read the following description:

1. After a successful read ID operation, the diskette MPU issues a read data command to the adapter and the adapter sets the read/write busy bit (sense register 1, bit 4).

2. The diskette adapter monitors the '+file data' line (LD01-2) for the data to be read. When the record is found, the adapter initiates a 352 microsecond delay. The next data field read after the delay is AM 2. AM 2 identifies the information following the AM 2 field as either data or control. If the information is data, the data is read from the diskette and written to main storage (see *Main Storage Accessing* in this section). If the information is control, the field is processed as follows:
   a. If the adapter detects a control field, and an inhibit-control-data-AM command did not precede the read-data command, a sense bit is turned on, the control information read from the diskette is written to main storage, and the read operation is terminated at the end of the sector.
   b. If an inhibit-control-data-AM command was issued before the read-data command, the data is handled as with a normal read operation. The inhibit-control-data-AM command prevents the sense bit from being turned on.

3. While the data is being read, two CRC bytes are generated. After the data has been read, the CRC bytes generated are compared with the CRC bytes read from the diskette following the data. If the bytes are the same, the read operation is successful and the operation is complete. If the bytes are not the same, a CRC error is set (sense register 2, bit 0) and the operation is terminated.

4. The diskette adapter resets the read/write busy condition (sense register 1, bit 4) to indicate that the read operation is complete.

**Write-Data Command**

Before issuing the write-data command, the diskette MPU issues a seek command and a read ID command. If the seek and read ID operations are performed successfully, the diskette MPU issues a write-data command (see *Seek Command* and *Read ID Command).* The write operation reads data from main storage and writes that data onto the diskette. The following is an example of a write-data operation. Refer to logic diagrams *LD01-1* through *LD01-3* while you read the following description:

1. The diskette adapter finds the correct sector on which the data will be written in the same manner as a read data operation.

2. When the correct sector is found, the adapter activates the '+write gate' line and the '+erase gate' lines (see *LD01-2).*

3. The data from main storage, the sync field, and the address mark are sent to the diskette on the '+write data' line.

4. While the data is being written, two CRC bytes are generated. The two bytes are written on the diskette in the last two bytes of the data field.

5. The diskette MPU issues a verify-read command. During the verify-read operation, the data written previously is read from the diskette and two CRC bytes are generated. At the same time, a bit-by-bit compare of the data just written into main storage and the read data is performed. The two generated CRC bytes are compared to the two bytes written in step 4. If the bytes are the same, the write operation is complete. If the bytes are not the same, the verify-read operation is ended and a CRC error is set. If the bit-by-bit compare fails, a write-verify error is set.

**Write-ID Command**

The write-ID command is used when initializing a diskette. The diskette is initialized one track at a time. A gap is written, followed by the sync field, an address mark, and an ID field.

**Write-Control-Data Command**

The write-control-data command writes a control address mark at the beginning of a data field to indicate a controlled record.

**Set-Mode/Select Command**

The set-mode/select command has two functions as follows:

- The set-mode function sets the diskette adapter to MFM mode. For an initialized diskette, the diskette MPU determines if the command is needed after reading the index track and before any read or write operation is performed. If the command is not issued, the adapter defaults to FM mode.

- The select function selects sense register 3 information status for the diskette drive being used.

**Read-Diagnostic Command**

The read-diagnostic command tests the diskette adapter read circuitry.

**Inhibit-Control-Data-AM Command**

This command is issued prior to a write/read-check command to prevent a control-address-mark-check error during a write/read-check operation.

**Set-Ready Command**

If the selected diskette drive is at normal speed, the set-ready command is issued to make the drive ready and disengage the heads. The command is issued to make the drive ready after power on and after a diskette is inserted into the drive.

**Reset-Access-Counter Command**

This command is used to reset the stepper motor logic to a starting point before a recalibrate-seek command. The command is issued after power on and each time a diskette is inserted into a drive.

## DISKETTE ADAPTER REGISTERS

The diskette MPU uses registers to interface with the diskette adapter. You can display three sense registers and the command register using MDI2050 (drive MAP support exerciser). The following is an example of the data displayed:

```
82  02  21  33
|   |   |   |
|   |   |   └──── Command Register
|   |   |
|   |   └──────── Sense Register 3
|   |
|   └──────────── Sense Register 2
|
└──────────────── Sense Register 1
```

### Sense Register 1

Sense register 1 contains diskette drive and diskette adapter status. The following are the meanings of the status bits in sense register 1:

**Bit(s) Meaning**

0-3 Diskette drive ready status:
0=Drive not ready
1=Drive ready

The following conditions are required to maintain drive-ready status:
- A diskette must be properly inserted in the drive.
- The drive must be rotating at the proper speed.
- The drive locking lever must be closed.

4 A read or write command is being executed.

5 A seek operation is being executed.

6 The diskette type is as follows:
0=diskette 1
1=diskette 2 or 2D

7 Not used.

### Sense Register 2

Sense register 2 contains error and exception status conditions that occur during read or write operations. The following are the meanings of the sense register bits:

**Bit(s) Meaning**

0 A cyclic redundancy check error occurred while the attachment was reading either the data or ID field.

1 All IDs specified were found during the previous operation.

2-3 01 = A sector was labeled with an address mark of hexadecimal F8 (control address mark). The first character in the field following the AM is a control flag that identifies one of the following types of control records:

C4 = The sector has been logically deleted.

C6 = The sector surface is defective. The data has been written as a logical record at the next higher logical address.

4B = The sector surface is defective. The data has been written as a logical record in an alternative space previously allocated.

10 = A data or control field address mark following a verified ID field is missing.

11 = Bad track: all positions of the ID field contain hexadecimal FF indicating a defective track.

4 Storage overrun: the diskette adapter cannot get main storage access cycles fast enough to keep up with the data transfer to or from the diskette.

5 Write verify error: the logical record on the diskette did not compare correctly with the logical record in main storage.

6 A command was terminated before the operation was successfully completed.

7 The active or inactive condition of the '+erase gate' or '+write gate' line did not match the current sensed at the read/write head.

### Sense Register 3

Sense register 3 contains the physical operating status of the drive in use. The following are the meanings of the sense register 3 bits:

**Bit(s) Meaning**

0 The drive speed is too fast.

1 An index pulse is sensed.

2 The head settle latch is set.

3 The AM detected latch is set.

4-5 Not used.

6-7 11 = A head current mismatch error occurred.

**Command Register**

The diskette MPU uses the command register to send commands to the diskette adapter. The following are the meanings of the command register bits:

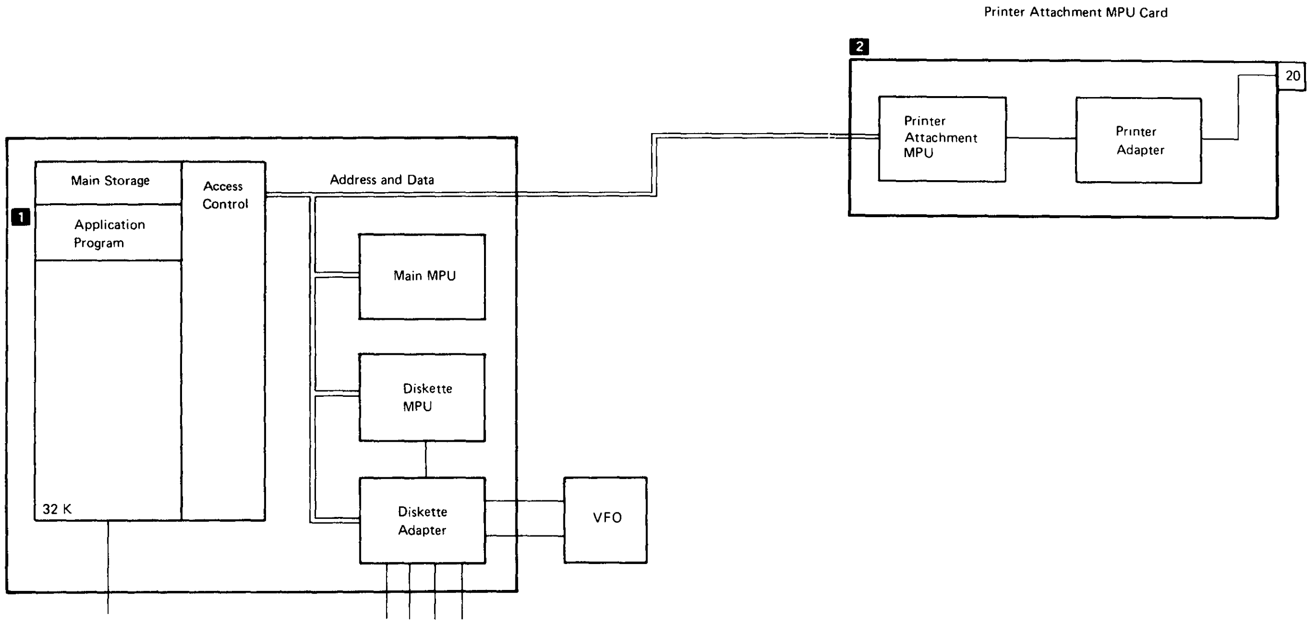
| Bit(s) | Meaning |
|---|---|
| 0-3 | The command that will be executed by the adapter as follows:<br>0000 = No operation<br>0001 = Write/read check<br>0010 = Read ID<br>0011 = Read data<br>0101 = Write data<br>0110 = Write ID<br>0111 = Write control data<br>1000 = Set mode/select<br>1001 = Seek<br>1010 = Read diagnostic<br>1011 = Inhibit control data AM<br>1101 = Set ready<br>1110 = Reset access counter |
| 4-5 | The selected diskette drive as follows:<br>00 = Drive A<br>01 = Drive B<br>10 = Drive C<br>11 = Drive D |
| 6-7 | Command modify bits as follows:<br>For read or write operations, bit 6 activates the '+switch filter' line to minimize the amount of bit shift on inner tracks as follows:<br>0 = Tracks 0 through 59<br>1 = Tracks 62 through 76<br>For read or write operations, bit 7 activates the '+inner tracks' line to increase the write current for data written on the outer tracks as follows:<br>0 = Tracks 0 through 41<br>1 = Tracks 45 through 76<br>For seek operations, bits 6 and 7 have the following meanings:<br>00 = Seek forward<br>01 = Seek reverse<br>10 = Last seek forward<br>11 = Last seek reverse<br>For set mode/select operations, bit 7 has the following meaning:<br>0 = Select sense register 3 status for the drive in use.<br>1 = Set the adapter to MFM mode. |

**Drive Configuration Register**

The drive configuration register is set by the switches on the diskette/main MPU card (303).

# Printer Attachment

The following diagram shows the components required to permit the IBM 5285 to print information on an attached printer.




The components required are an application program in main storage **1** and the printer MPU card **2**.

The application program prepares the data to be printed. For example, the program might read data from diskette and send it to the printer to print a user's report.

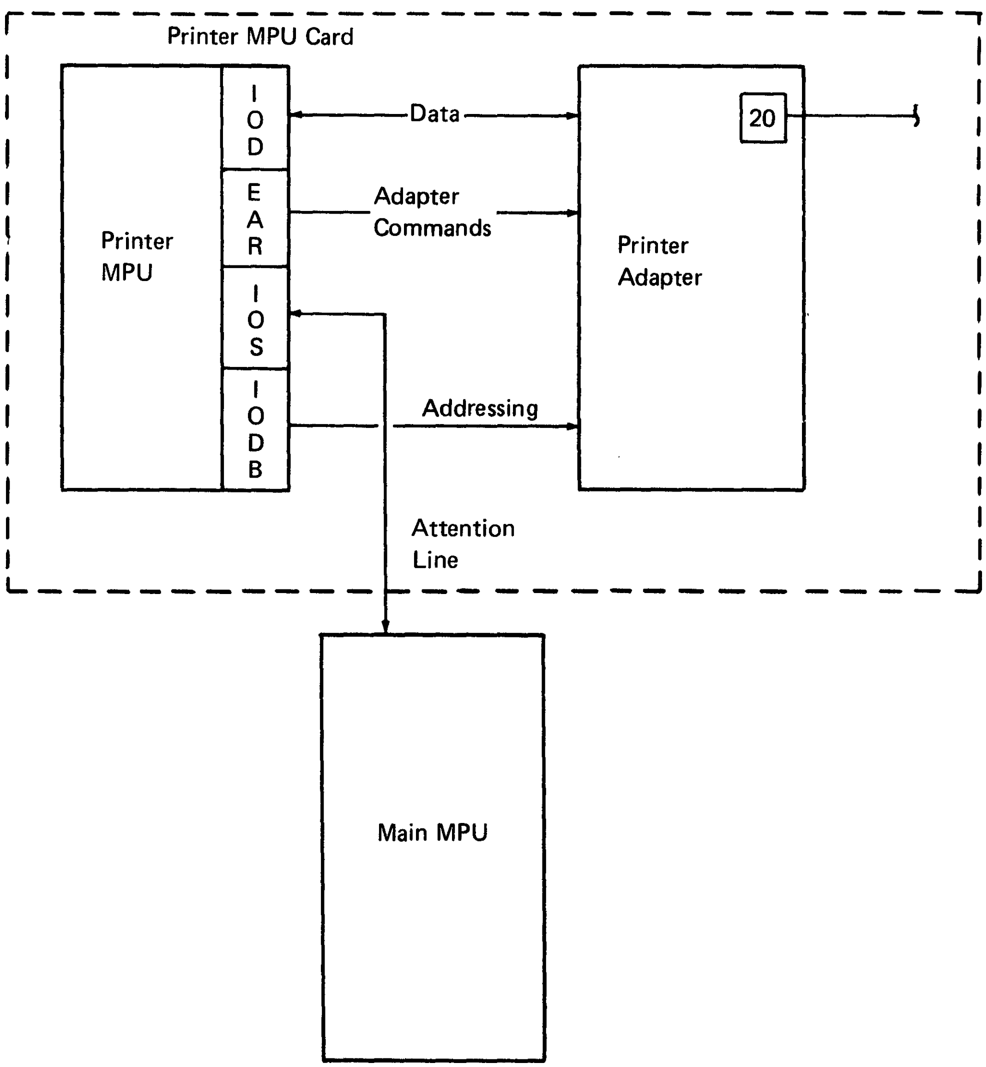
The printer MPU card is the interface between the application program in main storage and the printer. The card contains the printer MPU and the printer adapter, which permit the system to control the printers.

## PRINTER MPU

The printer MPU controls the printer adapter by issuing commands to the adapter and by reading status from the adapter. The printer MPU exchanges this information with the adapter in four I/O interface registers as follows:

- The IOD (I/O data) register is used to send data to and read data from the adapter.
- The EAR (external address) register is used to issue commands to the adapter.
- The IOS (I/O sense) register is used to check the status of the adapter and to send the attention signal to and receive the attention signal from the main MPU.
- The IODB (I/O data buffer) register is used to provide the printer adapter with the port and printer station addresses.

The following illustration shows the interface registers in the printer MPU and how they link the printer MPU to the main MPU and to the printer adapter.



## PRINTER ADAPTER

The printer adapter controls the transfer of data and commands to the printer as instructed by the printer attachment MPU. Printers are attached by twinaxial cable.

The adapter sends commands and data to the printer and receives status information from the printer in a 16-bit frame. The 16-bit frame is described later in this section (see *16-Bit Frame Concept).*

Refer to logic diagram *LD07* in the *System Logic Manual* while you read the following description.

The components of the printer adapter are as follows:

- Driver/receivers (one for each port)
- Timing logic
- Port control logic
- Transmit data multiplex logic
- Receive data multiplex logic
- Serdes (serializer/deserializer)
- Control logic

### Driver/Receivers

The driver/receivers provide the interface between the printer adapter and the twinaxial cable. One driver/receiver circuit is provided for each port. In transmit mode, the driver/receiver drives the twinaxial cable to the printers with data to be transmitted. In receive mode, the driver/receivers receive the data from the cable.

### Timing Logic

The timing logic allows the attachment to synchronize with the printer by generating a clocking signal from the received data.

### Port Control Logic

The port control logic provides the timing and control to convert binary data to bi-phase data for transmit operations or to convert bi-phase data to binary data during receive operations. This logic is driven by the 6 MHz signal on the '+6 MHz' line.

### Transmit Data Multiplexor

The transmit data multiplexor prepares the printer adapter to transmit data by selecting the proper port when a transmit command is issued by the printer MPU.

### Receive Data Multiplexor

The receive data multiplexor gates the adapter to receive data from the selected port when a receive command is issued by the printer MPU.

### Serdes

The serdes (serial/deserializer) accepts data from the IOD register and converts the data from parallel to serial. The serdes also formats the data into a 16-bit frame by adding the printer station address, parity bits and sync bits to the data for transmission to the printer. The serdes converts the serial data received from the printer to parallel data.

### Control Logic

The control logic uses the adapter commands to determine adapter functions. The logic provides adapter status and control functions for the multiplexors and the serdes.

## EXAMPLE OPERATION

The following example shows how data is sent from main storage to an attached printer:

1. When the main MPU reads a printer write instruction, it places the instruction in the printer IOB and turns on the attention line to the printer attachment MPU.

2. The printer MPU senses the attention line and reads the instruction in the IOB (see *Main Storage Accessing* in this section for an example of how an MPU accesses main storage to read or write data).

3. The printer MPU issues a write-command-frame command to the adapter.

4. The control logic decodes the command and selects transmit mode by activating the transmit enable signal. After a delay, the control logic allows the port address to be selected through the transmit data multiplexor.

5. The contents of the IOD register and the station address from the IODB register are loaded into the serdes. The serdes serializes the data, converts it into a 16-bit frame, and sends it to the port control logic.

6. The port control module converts the data to bi-phase encoded data for transmission to the printer on the twinaxial cable. The port control logic provides a pattern of five 1-bits and a code violation to synchronize the printer with the adapter. The printer can then decode the bi-phase encoded data.

7. The driver/receiver (for the appropriate port) drives the data onto the twinaxial cable to the printer.

The following example shows how status is received from a printer:

1. The printer sends bi-phase encoded status data to the printer attachment over the twinaxial cable.

2. The data is received by the driver/receiver in the adapter.

3. From the driver/receiver, the data goes to the receive data multiplexor. The multiplexor gates the data to the port control logic.

4. The port control logic converts the bi-phase data to binary and sends it to the serdes.

5. The timing logic uses the received data to generate a clocking signal to control the serdes.

6. The serdes stores the data until the printer MPU issues a receive-read command.

7. When the printer MPU issues the receive-read command, the contents of the serdes are loaded into the IOD register to be read by the printer MPU.

## PRINTER ADAPTER COMMANDS

The following is a description of each command issued by the printer MPU to the printer adapter.

### Transmit Commands

*Write-Command-Frame Command*

This is the first command issued in a transmit operation. It initiates a transmission to the printer as follows:

1. Sets the adapter to transmit mode

2. Loads the serdes with the IOD register contents, the station address from the IODB register, and the synchronization bit for the frame

3. Transmits the contents of the serdes and adds a parity bit if needed

*Write-Data-Frame Command*

This command follows either the write-command-frame command or another write-data-frame command. It loads the serdes with data, the station address, and the frame synchronization bit. A parity bit is added if needed.

*Write-Last-Frame Command*

This command is the last of a series of transmit commands. It is the same as a write-data-frame command except that it sets the station address to all 1-bits. This indicates to the printer that this is the last frame to be transmitted. A parity bit is added if needed.

### Receive Commands

*Receive-Mode Command*

This command sets the printer adapter into receive mode. The adapter is then ready to receive data from the printer.

*Receive-Read Command*

This command loads the contents of the serdes (received data) into the IOD register.

### Reset and Diagnostic Commands

*Reset Command*

To the printer adapter, this command performs the same function as power-on reset.

*Diagnostic-Mode Command*

This command starts a diagnostic test for the printer attachment. Data is not transmitted during this test. The data from the output of the serdes is wrapped back to the input of the serdes, where it is checked as during a normal read operation. This checks the adapter transmit and receive circuitry for proper operation.

*Diagnostic-Reset Command*

This command is used with the diagnostic mode command. It resets the serdes, but it leaves the adapter in transmit mode.

## PRINTER ADDRESSING

The printer attachment MPU selects a printer by placing the printer address into the IODB register. The following are the meanings of the IODB register bits:

| Bit(s) | Meaning |
|---|---|
| 0-2 | Not used. |
| 3-4 | Port address (used to select ports 20 through 23 for the four-port adapter; or port 20 for the one-port adapter). |
| 5-7 | Printer address: These bits are loaded into the serdes for each transmission. In receive mode, these bits are compared with the address received from the printer. |

For a description of the printer addresses that can be assigned to each port, see 705 in the maintenance section.

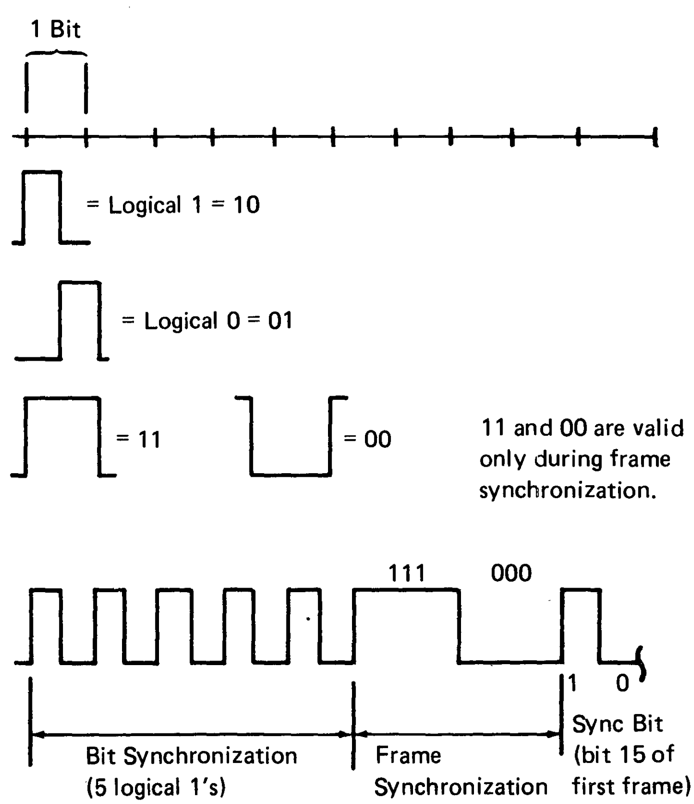
## 16-BIT FRAME CONCEPT

Information between the printer and the printer attachment is transmitted by a 16-bit frame.

### Bi-Phase Encoding

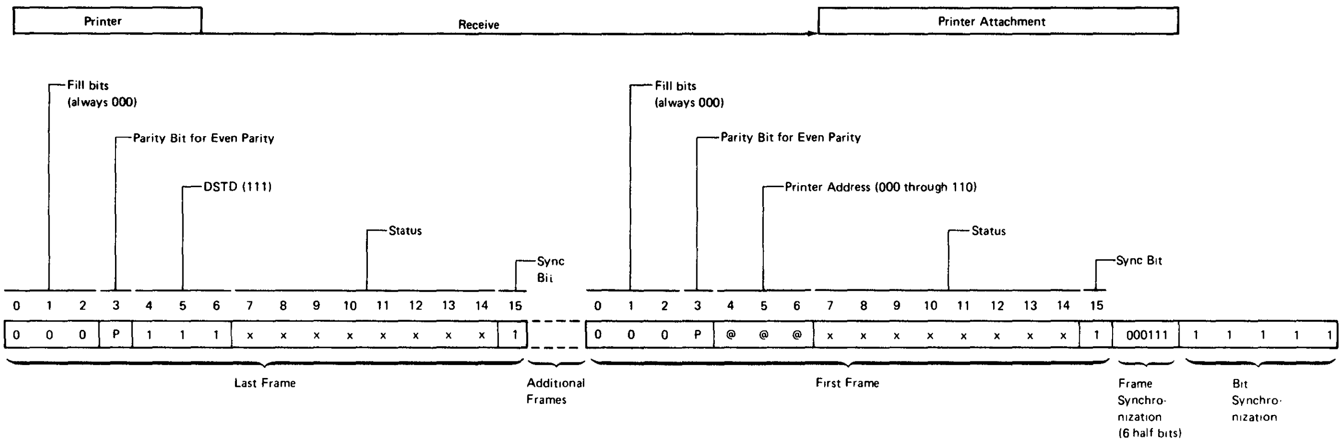
Each bit of the 16-bit frame to and from the printer is bi-phase encoded to ensure that a transition occurs during each bit time (a 0 to a 1 transition for a 0 bit and a 1 to a 0 transition for a 1 bit). Because the transition divides the bit into two parts, the term half bit is used in the following description. No transition during a bit time is called a *code violation.*

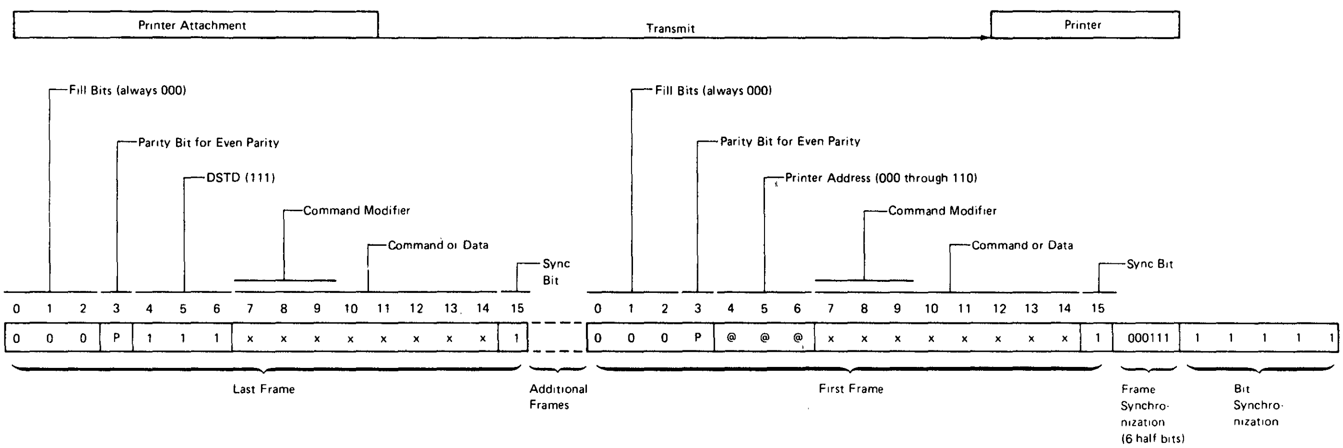
When information is to be sent on the cable, a pattern of five 1-bits (1010101010 half bits) are sent to establish bit synchronization. Immediately after the 1-bits, the code violation (three half-bit 1's and three half-bit 0's) is sent to establish frame synchronization. After the frame synchronization, the frame is sent starting with the sync bit as shown in the following illustration:



**Transmission Sequence**

As shown in the following illustration, the 16-bit frame carries 12 bits of information:




The fill bits, always 000, act as a timing delay. The parity bit makes the number of active bits in the frame even. The printer decodes the address bits (4 through 6) and responds to the address by sending a response frame that contains the address. Printer address bits of 111 indicate a DSTD (data stream termination delimiter), which indicates the end of the message and causes a line turnaround. A line turnaround extends from the time a printer receives the last bit of a frame until the same printer starts sending bit and frame synchronization bits. Bits 7 through 14 are the data or command sent by the printer or the printer attachment. Bit 15 (always 1) is the synchronization bit for both the printer attachment and the printer.

The transmission rate is 1.0 MHz (16 microseconds per frame). The frame bit assignment during both transmit and receive operations is shown in the previous illustration.

**Printer Commands**

The following commands are generated by the printer attachment MPU and sent through the printer adapter to the printer in the command frame. These commands are not programmed by the user.

*Activate-Read Command (0000 0000)*

The activate-read command is inserted between a read status command and the data frame that follows it. The activate-read command is issued when a not-busy, no-exception, and no-line-parity response is returned to a poll command following the read command.

*Activate-Write Command (0000 0001)*

The activate-write command is inserted between a write-data command and the data frames. This command initiates the start of the data transfer that follows a write-data command. The activate-write command is not issued until a not-busy, no-exception, and no-line-parity error response is returned to a poll command following the write command.

*Clear Command (0001 0010)*

The clear command is issued by the printer MPU to cause the printer to clear all printer buffers. This command does not move the forms.

*Poll Command (xxx1 0000)*

The poll command is issued by the printer attachment to the printer to initiate the transfer of two status words. At power-on time, a single frame response is made until the printer receives a set mode command. The *xxx* shown in the command bit configuration is a command modifier. The bit configuration of the command modifier bits is as follows:

| Bit(s) | Meaning |
|---|---|
| 0xx | Not used. |
| x1x | Acknowledges and resets the line parity error response bit in the printer. This bit is effective after a not-busy status is received from the printer. |
| xx1 | Acknowledges the last status transmission to allow new status to be sent. With this bit on, updated responses from the printer will be transmitted when they are available. |
| xx0 | Acknowledges the last status transmission to allow new status to be sent. With this bit off, the previous response frames from the printer are retransmitted. |

*Read-Status Command (1000 1000)*

The read-status command initiates the transfer from the printer of one status word that contains information about the condition of the printer. If poll response frame 1 has bit 10 on (indicating outstanding status), the printer MPU responds with a read-status command.

*Reset Command (0000 0010)*

The printer MPU issues the reset command when the MPU detects an invalid combination of IOB bits. Printing is completed for any line that was being printed when the reset command was received. The printer responds as follows:

- Runs the power-on check
- Sets default options
- Clears the mode that was set
- Gates the twinaxial cable driver and receiver (printer goes on line)
- Sends the power-on transition status response to the printer attachment

*Set-Mode Command (0001 0011)*

The set-mode command causes the printer to accept one mode control byte that specifies the number of times an 8-bit fill increment will be repeated between frames. The printer MPU specifies nine bytes of fill between frames. The fill bytes are used to adjust response timing. The set-mode command is issued after power-on reset when the main MPU places an OPEN instruction in the printer IOB.

*Write-Control-Data Command (0000 0101)*

This command causes the printer to use the following frame to conditionally reset outstanding and exception status.

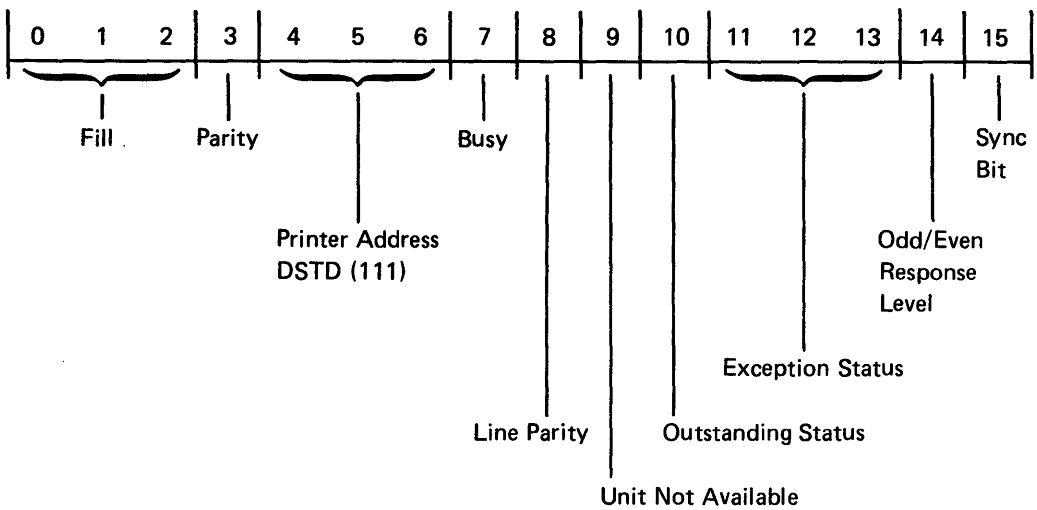
*Write-Data Command (0001 1110)*

The write-data command causes the printer to store all the data frames that follow the next activate-write command.

**Poll Response Frames from the Printer**

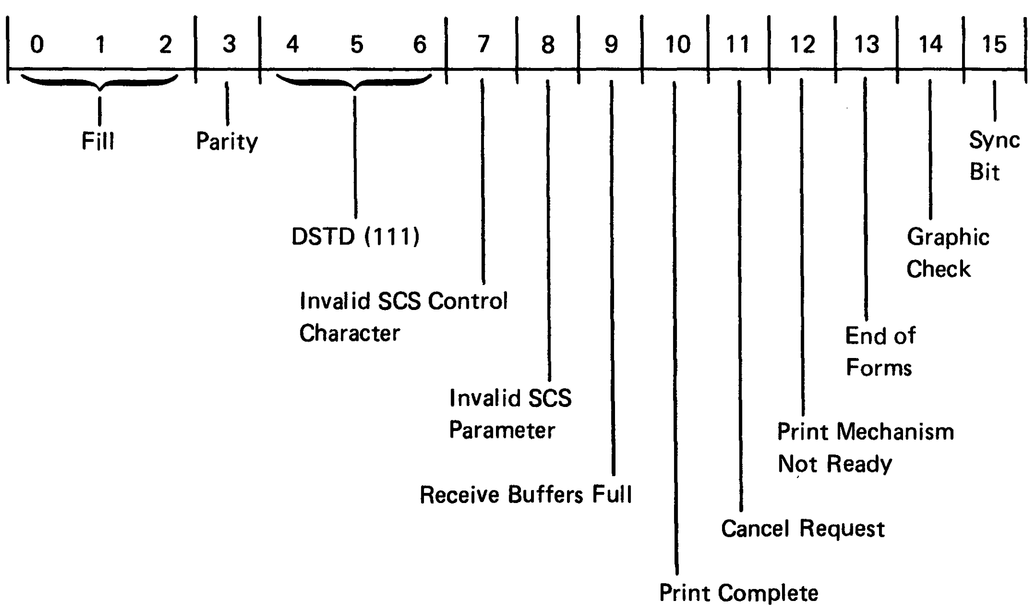
*Frame 1*

Frame 1 is a one-frame response sent to the adapter after the printer has been polled following a power-on reset. The adapter receives frame 1 and the printer MPU returns a set-mode command. Poll response frame 1 contains the following information:



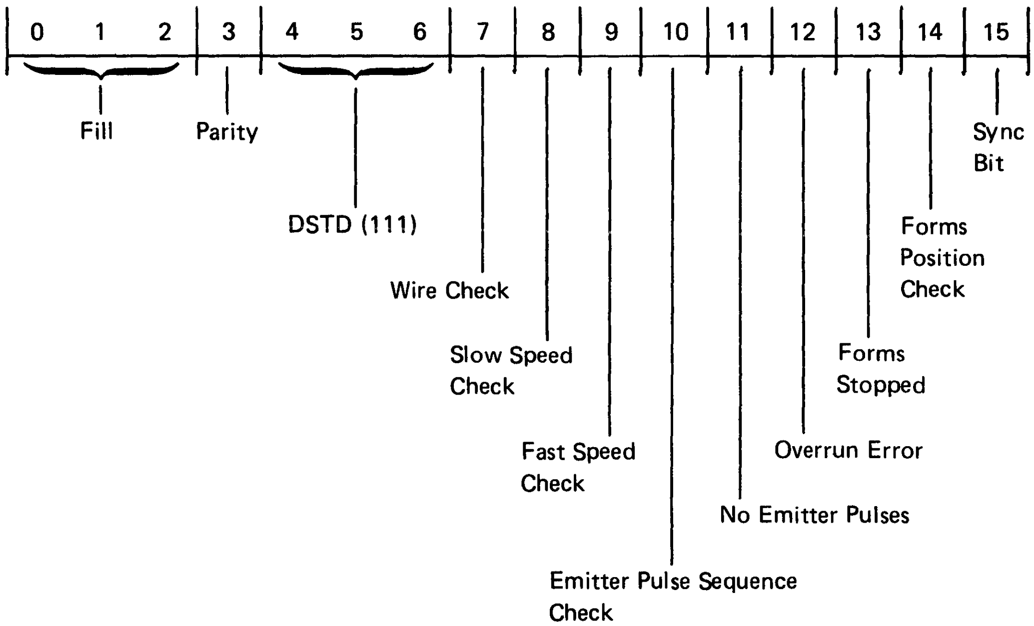

*Frame 2*

A frame 2 response is sent for every poll command following a set-mode command defining the interframe fill length. Poll response frame 2 contains the following information:



*Read-Status Response Frame*

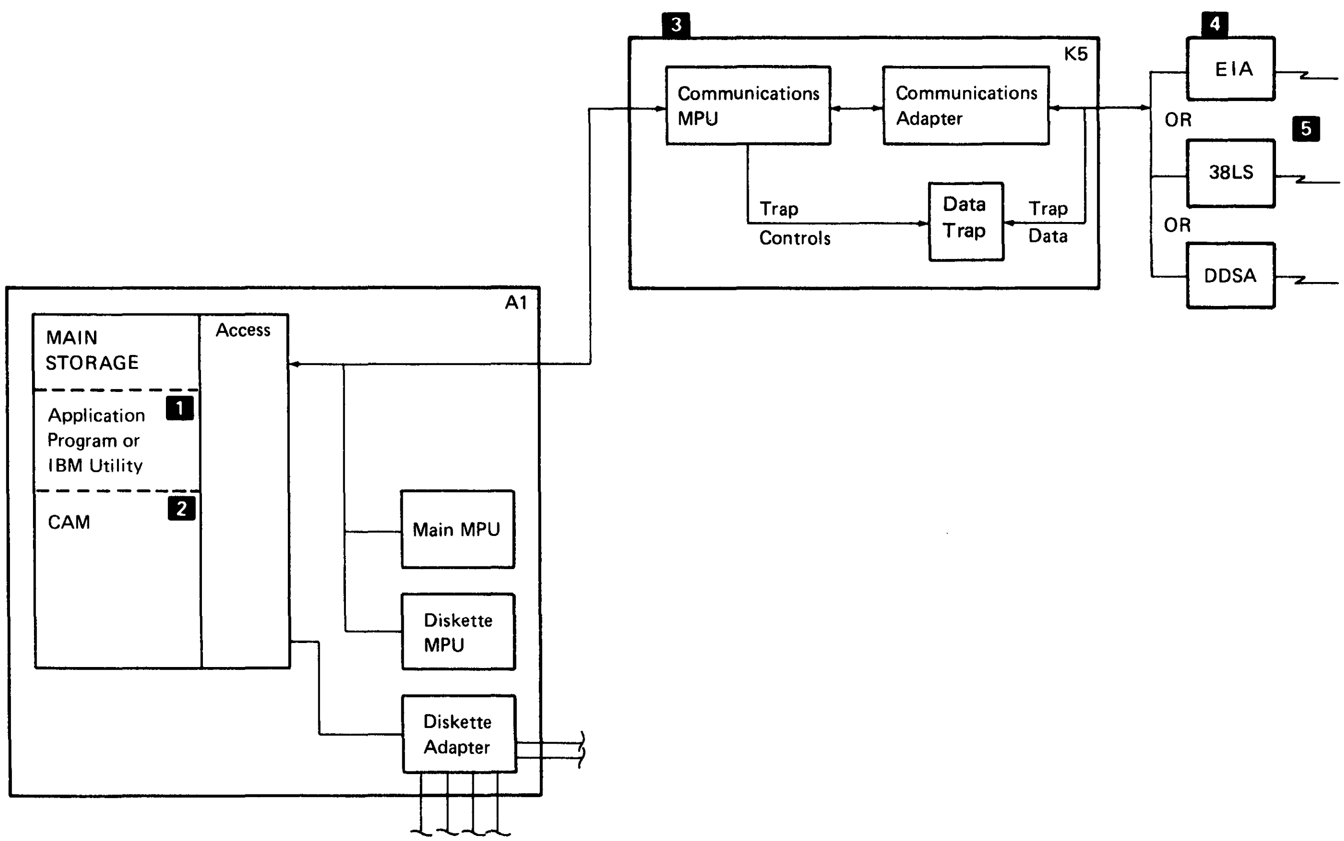
One response frame is returned for every read-status command. The response frame, returned only after the activate-read command is received, contains the following information:



## Communications Attachment

As shown in the following diagram, the major components required to permit the IBM 5280 to communicate with a remote station are:

1. An application program in main storage (user written or IBM utility)
2. A CAM (communications access method) program in main storage
3. A communications MPU card
4. A line adapter card
5. Data communications equipment



**1** The application program manages data for the user's job. For example, if the user is transmitting data from diskette to the remote station, the application program reads the data from the diskette and writes it to the CAM (communications access method) program. When data is being received, the application program reads the data from the CAM program and writes it on diskette, prints it on the printer, or displays it on the screen.

**2** The CAM program is the interface between the application program and the communications MPU. This program is stored on diskette and loaded into a foreground or background partition before communications can begin. The CAM is loaded either by the CAM loader program or automatically when certain communications utilities are loaded.

There are several versions of the CAM program. The version used depends on whether the protocol is BSC or SNA and upon the host subsystem type, such as RJE (remote job entry) or DB/DC (data base/data communications). For a complete description of the CAM programs, see the *Communications Utilities Reference Manual.*

For BSC, the CAM adds and removes control characters and performs blocking and deblocking of data as specified by the user.

For SNA, the CAM handles all of the SNA protocol required by the remote station. This includes adding and removing transmission headers and controlling SNA sessions with the remote station.

**3** The communications MPU card is the interface between the CAM and the line adapter card. The card contains an MPU (microprocessing unit), an adapter, and an internal data trap.

The communications MPU and the communications adapter handle the link level protocol and error recovery for both BSC and SDLC. For example, the MPU and the adapter:

- Check vertical redundancy and generate parity bits for ASCII data
- Check and generate block check characters (BCC)
- Serialize transmit data
- Deserialize received data
- Handle BSC link-level protocol
- Send SDLC commands and handle SDLC responses
- Control and monitor modem operation
- Insert 0-bits and remove 0-bits in SDLC data
- Check synchronization and control character sequence

The internal data trap stores the last 4 K of transmitted or received data. This data can then be read from the trap and analyzed as an aid for problem determination.

When the 38LS is installed, the communications MPU card also contains programmable transmit-level attenuators (United States and Canada only). The attenuators are set by the MPU as specified in the configuration record.

**4** The line adapter card converts the VTL levels from the communications MPU card to the appropriate levels for the data communications equipment to which the IBM 5280 is attached. For example, the EIA/CCITT card converts the VTL levels to EIA/CCITT interface levels so that the IBM 5280 can be connected to an external modem that conforms to the EIA/CCITT interface standards.

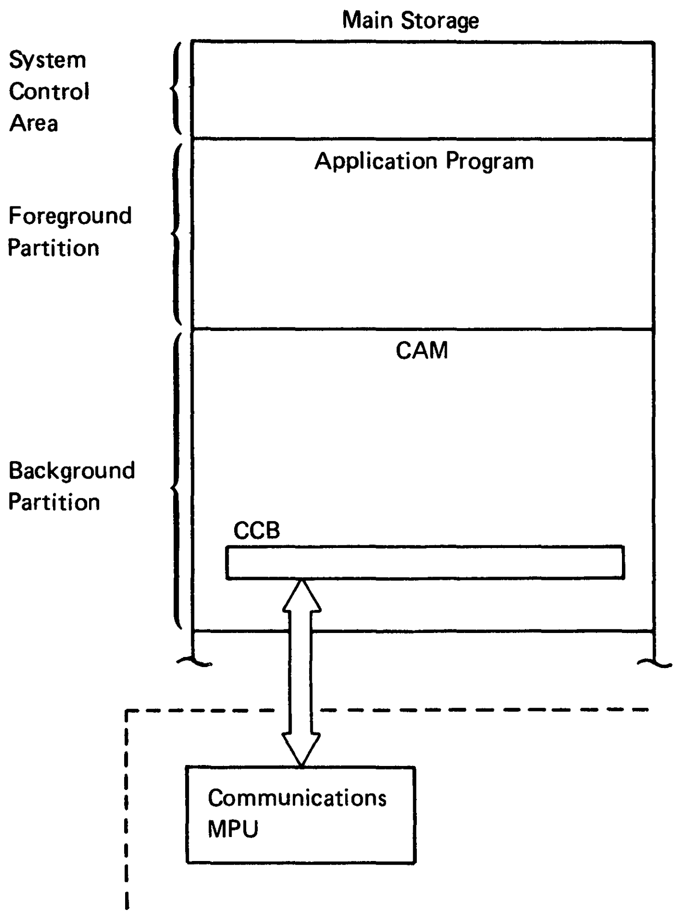
For more information about each line adapter card and connection to the data communications equipment, see *Line Adapter Cards* in this section.

**5** The data communications equipment is the equipment used to connect the IBM 5280 to the communications lines, such as line couplers and external modems.

### TYPICAL OPERATION

Before the IBM 5280 can communicate with a remote station, the application program and the communications access method program must be loaded into main storage. The user loads the application program into a foreground or background partition using the standard load prompt. The application program loads the CAM program into a background partition, or the user loads the CAM program with the CAM loader utility either before or after loading the application program.

When the CAM program is loaded, a communications configuration record specified for this session is read from diskette. The user builds the configuration record using the communications configuration utility, or specifies an IBM-supplied configuration record. The information in the configuration record is placed into a CCB (communications control block) in the CAM partition. The CCB is the interface between the CAM program and the MPU as shown in the following illustration:




Network information in the CCB is used by the CAM and the MPU during a communications session. For example, information in the CCB indicates whether the operation is transmit or receive, or whether the line control protocol is BSC or SDLC.

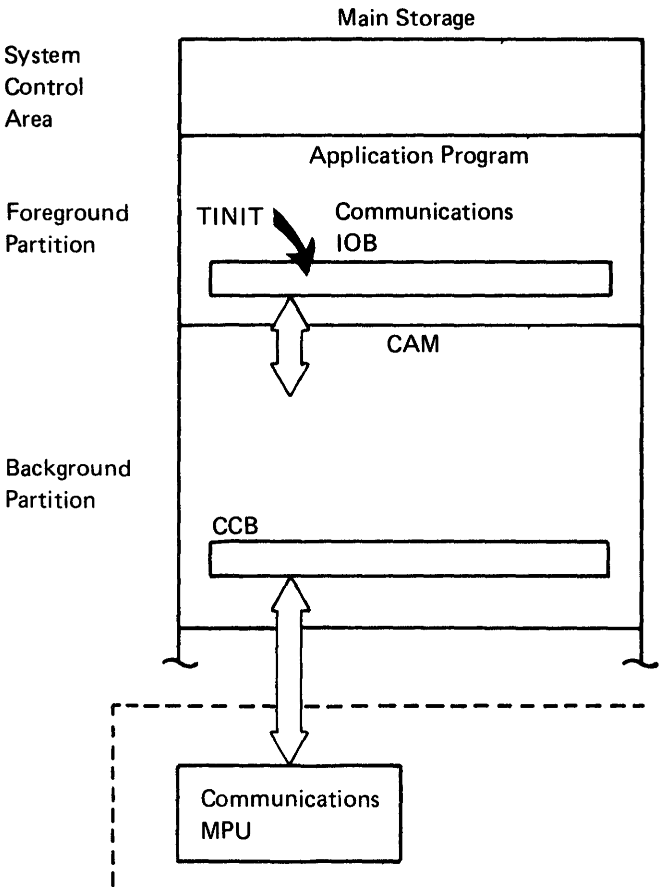
Other bytes in the CCB contain status information about the communications session and error counters for errors that the MPU detected during the session. Also, an address in the CCB points to an error history table that the CAM uses to log errors that it detects during a session. These error counters and the error table can be printed or displayed for communications problem analysis. See 993 in the maintenance section for more information.

The CAM program also uses the CCB to send commands to the MPU and to receive responses from the MPU. After the CCB has been properly set up, the CAM program places the address of the CCB in the CCB pointer (in the system control area) and the CCB pointer is marked as a valid pointer. That is, the communications MPU can now read the CCB and perform the work specified by the command in the CCB.

To begin communications, the application program must contain instructions to establish a data link with the remote station and instructions to read or write data. The following are the instructions that the application program uses to control the CAM:

- TINIT Initializes the CAM: the CAM initializes the buffers in the CAM partition and prepares to establish a session with the remote station.
- TOPEN Opens the communications IOB.
- TCLOZ Closes the communications IOB.
- TWRT Transmits one logical record from the logical buffer in the application program partition.
- TREAD Receives one record from the CAM and places it in the logical buffer.
- TTERM Terminates communications.
- TCTL Specifies control of the CAM program, for example, turn on trace, turn off trace, set transparency (BSC only), and reset transparency (BSC only).

The first instruction that the application program must issue to the CAM program is the TINIT instruction. When the main MPU executes a communications instruction, it places the instruction in the communications IOB as shown in the following illustration. The main MPU then turns on a status bit in the IOB to indicate that an instruction is to be read by the CAM.




When the CAM reads the TINIT instruction, it completes setting up the CCB and buffers, then turns off the status bit in the IOB and waits for the next instruction.

If an error is detected during execution of the TINIT instruction, the communications access method reports the status (called external status) to the application program by placing an external status code in the IOB. The application program can then read the status code to determine why the TINIT instruction was not completed.

If the TINIT instruction was successfully executed, the application program then issues the TOPEN instruction. The TOPEN instruction opens the IOB for input and output operations with the CAM.

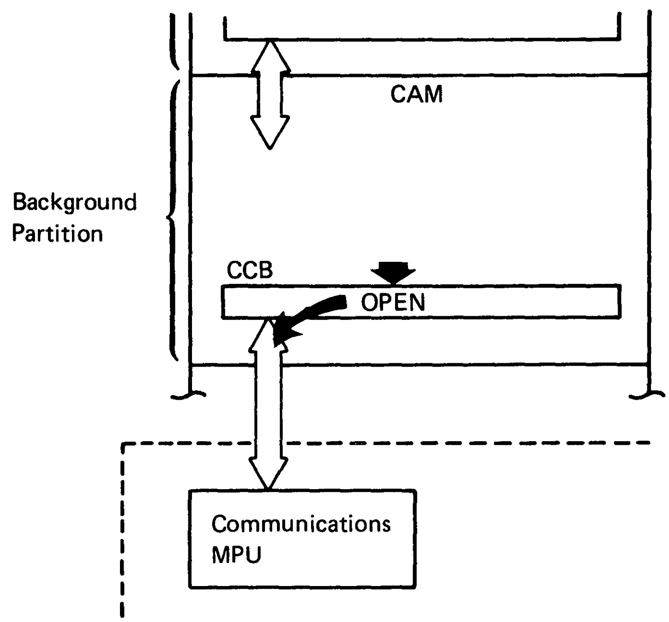
**Operation Examples**

For the following examples, assume that the IBM 5280 and the communications equipment are configured as follows:

- The protocol is BSC.
- The line adapter card is the EIA/CCITT card.
- The data link is point-to-point nonswitched.

*Transmit Example*

Before data can be transmitted, the CAM must issue an OPEN command to the MPU. The communications access method does this by placing the command into the CCB. The access method then turns on bit 7 in byte 1 of the CCB.




When the communications MPU reads the bit indicating a new command is in the CCB, it reads the command (in this case the OPEN command) and performs the operation specified as follows. Refer to logic diagram *LD11* in the *System Logic Manual* while you read the following description.

**Note:** For a list and a description of all of the commands that the CAM issues to the MPU, and responses that the MPU returns to the CAM, see *MPU Commands and Responses* later in this section.

1. The MPU first turns on the '–data term rdy' line using a bit in the network configuration register and the enable circuits. The VTL signal on the '–data term rdy' line is converted to EIA/CCITT voltage by the VTL EIA/CCITT voltage level converters on the EIA card. The signal is then amplified by the line drivers on the EIA/CCITT card and sent back to the communications MPU card, through the connector on the communications MPU card, and out to the modem through the internal cable and the external EIA/CCITT cable.

2. The MPU waits for the modem to turn on its data-set-ready line. The signal is sent to the EIA/CCITT card through cables and the MPU card, then converted to a VTL level and sent to the communications MPU card. The data-set-ready signal sets a bit in the transmit status register in the adapter.

   On a nonswitched point-to-point line, the IBM 5280 is now ready to receive data. If the IBM 5280 is in transmit mode (as specified in the CCB), the MPU proceeds as follows:

3. When the MPU senses the data-set-ready signal in the transmit status register, it turns on the '–req to send' line, which sends a request-to-send signal to the modem in the same manner the data-terminal-ready signal was sent in step 1.

4. The modem then sends a clear-to-send signal back to the MPU by the same route the data-set-ready signal was sent in steps 2 and 3. The MPU can now begin transmitting data.

*Transmitting Data*

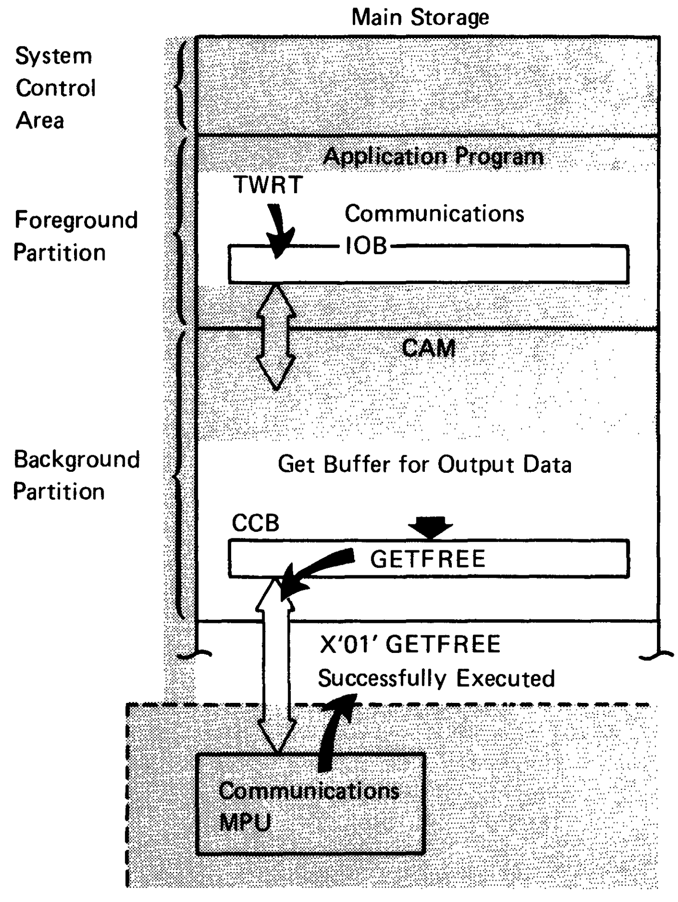
Once the data link has been established, the IBM 5280 can begin to transmit data as follows:

1. The application program loads the logical I/O buffer with data from the keyboard or diskette.

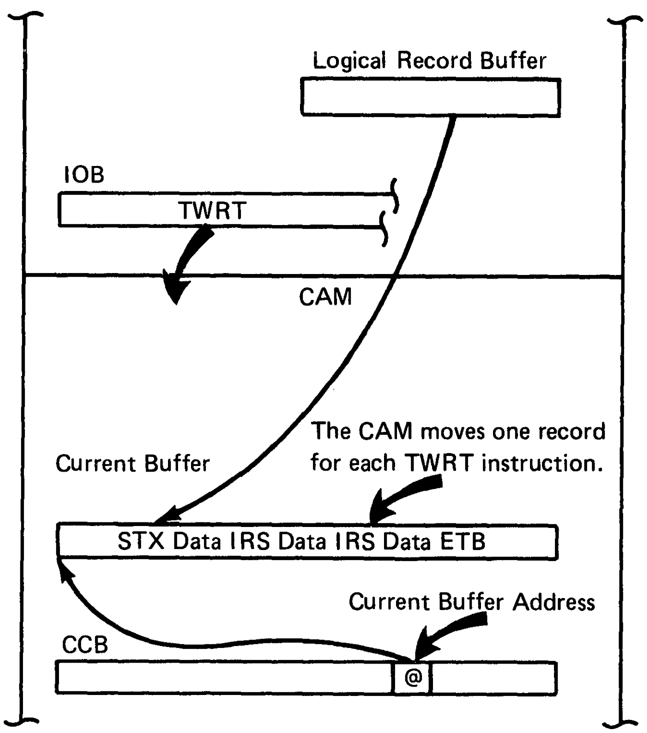
2. The application program issues a TWRT instruction to the CAM as shown in the following illustration.

3. The CAM program reads the TWRT instruction in the IOB. The CAM program must now move the data in the logical buffer to the CAM buffer in the CAM partition; however, before the data can be moved, a buffer must be assigned.

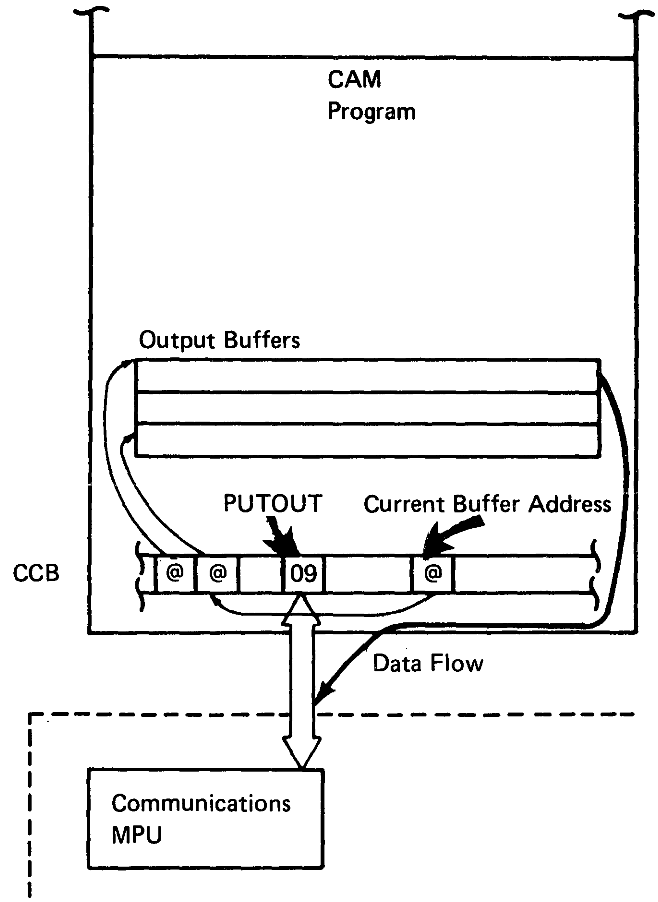
4. The MPU handles all buffer management. The CAM program must request a buffer from the MPU by issuing a GETFREE command. When the MPU reads the GETFREE command, it checks the free queue empty indicator to determine if a free buffer is available. If a buffer is available, it places the address of the buffer in the current buffer field and returns a hexadecimal 01 response to the CAM program. If a buffer is not available, the MPU returns a hexadecimal 04 response to indicate that the free queue is empty.



5. Once the CAM program acquires a buffer, it can move the data from the logical buffer into the buffer pointed to by the current buffer field address as shown in the following illustration. As the CAM moves the data, it adds the control characters (STX, IRS, and so on) for data transmission and blocks the data in the buffer. The CAM program moves one logical record from the logical buffer to the CAM buffer for each TWRT instruction issued; therefore, the application program must move a record to the logical buffer before issuing the TWRT instruction.




6. When the buffer is full and ready to transmit, the CAM program issues a PUTOUT command to the MPU. The MPU then places the current buffer address on the bottom of the output queue. At least one output buffer is required; however, if storage is available, there can be more than one buffer. The communications MPU transmits the data from the buffer on the top of the output queue as shown:




Refer again to diagram *LD11* in the *System Logic Manual* while you read the following description:

7. The communications MPU reads the data from the output buffer one byte at a time and places the data into the transmit data register.

8. When a byte of data is placed in the register, the adapter moves the data to the serializer, serializes it, and sends it to the EIA/CCITT card by the '-xmit line data' line. The adapter also performs the BCC CRC generation (EBCDIC only) and checking when instructed by the MPU. (VRC checking and parity generation for ASCII data are performed by the communications MPU.) Zero bit insertion and NRZI encoding are performed only for SDLC, and are performed by the adapter.

9. **The EIA/CCITT logic converts the data to EIA/ CCITT voltage levels and sends it to the modem.**

   For information about line protocol and message format, see *Line Protocols* in this section.

*Receiving Data*

Refer to logic diagram *LD11* in the *System Logic Manual* while you read the following description:

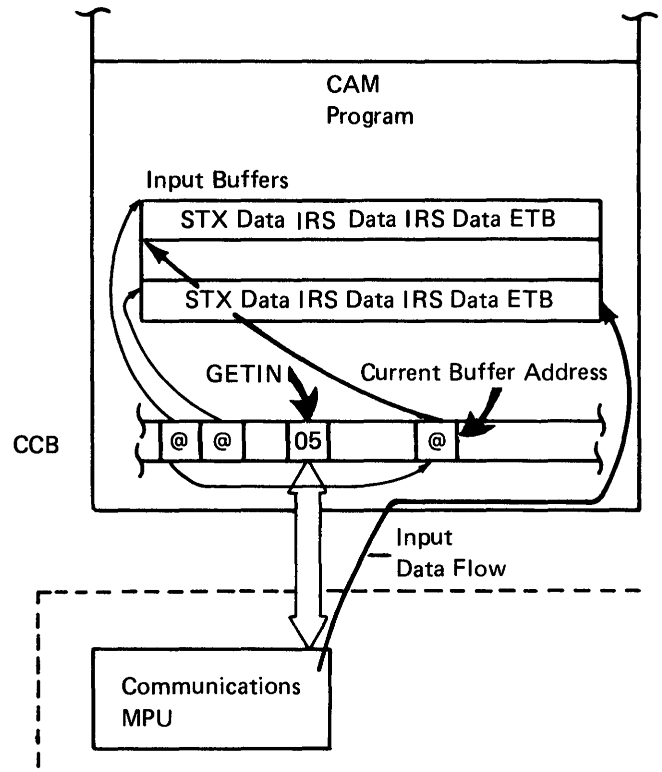
1. Data is received by the IBM 5280 on the '+rec line data (cable)' line at J140, and feeds through the internal cable and the communications MPU card to the EIA/CCITT card.

2. The data is converted to VTL levels by the EIA/ CCITT card and passed to the communications MPU card by the '+rec line data' line.

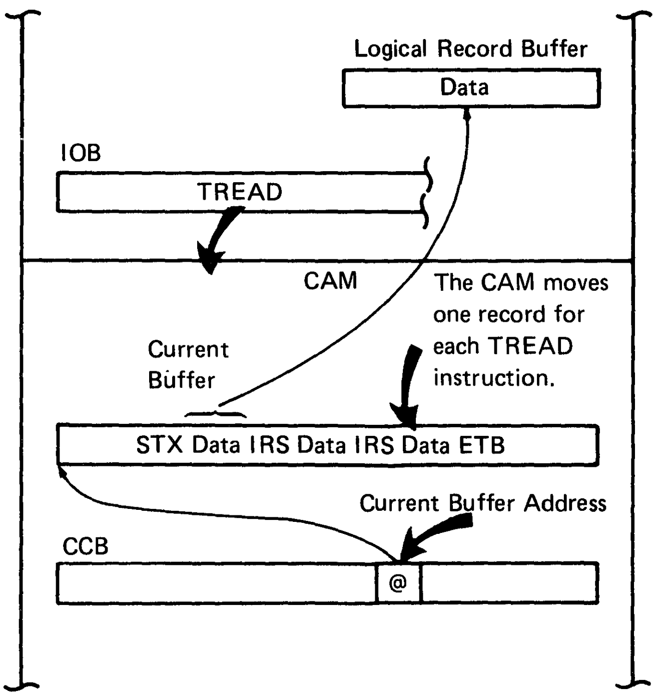
3. The data goes through the NRZI decoding and zero bit delete circuits to the deserializer and error checking circuits.

4. Data is deserialized by the adapter and placed in the adapter receive buffer and then into the receive data register. The communications MPU sends the data back to the adapter through the xmit data register for BCC and CRC validity checking. (While the adapter checks the data, transmission is inhibited.) If the data is correct, the MPU can move the data into the input buffer in main storage.

5. Once the MPU has filled the input buffer, it places the buffer on the bottom of the input queue. (There must be at least two input buffers; however, if storage is available, there may be more than two.) To read data from the input buffer, the CAM program issues a GETIN command to the MPU as shown in the following illustration. This causes the MPU to move the address of the buffer on the top of the input queue to the current buffer field.



6. The application program can now read the data from the buffer one record at a time. It does this with the TREAD instruction. The application program must issue one TREAD instruction for each logical record. When the CAM program reads the TREAD instruction, it places one logical record (from the buffer acquired by the GETIN command in step 5) into the logical record buffer as shown in the following illustration:




7. The application program can then write the data on diskette, print it on the printer, or display it on the screen. The receive operation continues in this manner until all data has been received.

## COMMUNICATIONS MPU COMMANDS AND RESPONSES

The following charts show the communications microprocessing unit commands that the communications access method places in the CCB (communications control block) at hexadecimal displacement 1C from the beginning of the CCB during communications or diagnostics, and the responses that the MPU places in the CCB at hexadecimal displacement 1D to indicate the result of the commanded operation.

### Commands

| Hex Command | MPU Value | Action | Possible Responses |
|---|---|---|---|
| OPEN | 01 | Establishes the data link | 01<br>02<br>20<br>30<br>40<br>80 |
| CLOSE | 02 | Disconnects the data link | 01<br>03<br>07<br>20 |
| HALTCMD | 03 | Terminates the session immediately | 01<br>03<br>20 |
| GETFREE | 04 | Takes the address from the top of the free queue and places it in the current buffer field | 01<br>04<br>50 |
| GETIN | 05 | Takes the relative address of the first buffer on the input queue and places it in the current buffer field | 01<br>04<br>50 |
| PUTFREE | 08 | Takes the address of the buffer in the current buffer field and places it on the bottom of the free queue | 01<br>50 |
| PUTOUT | 09 | Takes the address of the buffer in the current buffer field and places it on the bottom of the output queue | 01<br>09<br>50 |
| PUTTOP | 0A | Takes the address of the buffer in the current buffer field and places it on the top of the output queue | 01<br>09<br>50 |

| Hex Command | MPU Value | Action | Possible Responses |
|---|---|---|---|
| RDTRAP | 0B | Reads the data from the data trap storage and places it in main storage | 01<br>02<br>05<br>40<br>0A<br>F0 |
| TRAPCTRL | | | |
| Start Trap | 8C | Starts storing data in the data trap | 01<br>05<br>06<br>F0 |
| Stop Trap | 4C | Stops storing data in the data trap | |
| Diagnose Trap | 2C | Runs trap diagnostics | |
| SENSE | 0D | Reads the following adapter registers:<br>• Command<br>• Receive status<br>• Receive data<br>• Transmit status<br>• Diagnostic return<br>• DCE control return | 01 |
| DIAGNOSE | 0E | Runs communications MPU and adapter diagnostics | 01<br>08<br>40<br>F0 |
| PUTCLEAR | 0F | Moves the contents of the interim queue and the output queue to the input queue | 01 |

**Responses**

| Hex Response | Hex Command | Description |
|---|---|---|
| 01 | All Commands | The command was completed successfully. |
| 02 | 01 and 0B | The open status bit in byte 00 of the CCB was already on when the command was issued. |
| 03 | 02 and 03 | The open status bit in byte 00 of the CCB was off when the command was issued. |
| 04 | 04 and 05 | The free queue empty indicator (byte 00, bit 0 of the CCB) was on when the command was issued. |
| 05 | 0B | The RDTRAP command was issued after the start trap command and before the stop trap command. |
| | 0C | The start trap command was issued and the trap was already started. |
| 06 | 4C | The stop trap command was issued and the trap was already stopped. |
| 07 | 02 | The CLOSE command was issued before the output queue, interim queue, or the input queue was empty. |
| 08 | | An invalid command was issued. |
| | 0E | The open status bit (byte 00, bit 6 of the CCB) was on when the command was issued. |
| 09 | 09 and 0A | An SNRM command was received before the PUTTOP or PUTOUT command was issued. |
| 0A | 0B | The read trap buffer in main storage is too small. The specified amount of data has not been read. |
| 20 | 01 | On a switched line, the data-set-ready line was on before the data-terminal-ready line turned on. |
| | 02 and 03 | On a switched line, the data-set-ready line did not turn off within the time specified in the CCB after the data-terminal-ready line turned off. |
| 30 | 01 | The keylock switch is set to the disable communications position. |
| 40 | 01, 0B and 0E | There is an invalid specification in the CCB. |
| 50 | 04 | A buffer address of zero was detected on the free queue. |
| | 05 | A buffer address of zero was detected on the input queue. |
| | 08, 09 and 0A | A buffer address of zero was detected in the current buffer field. |
| 80 | 01 | The communications power-on diagnostics were not successful. |
| F0 | 0B | When reading the data trap, valid data was not found. |
| | 0E | A hardware error occurred during diagnostics |
| | 8C, 4C and 2C | An error occurred while running the data trap diagnostics. |

## COMMUNICATIONS MPU TO ADAPTER REGISTERS

The following registers are the link between the communications microprocessing unit and the communications adapter. Refer to logic diagram *LD11* in the *System Logic Manual* while reading the descriptions.

### Transmit Data Register

The MPU uses this register to send data to the adapter for transmission. The register handles one byte at a time.

### Command Register

The MPU uses this register to set transmit or receive mode, to reset the timer, and to control block check circuitry.

### Command Return Register

Commands issued by the MPU using the command register are returned to the MPU by the command return register and checked by the MPU to verify that the command was issued correctly.

### Receive Status Register

The MPU uses this register to determine the status of adapter receive circuitry and received data. For example, the MPU reads the register to check for receive-buffer-full, for BCC errors, and SDLC frame status.

### Receive Data Register

When data is received, the adapter loads the data in this register. The MPU then reads the data from the register.

### Diagnostic Register

The MPU uses this register to check adapter circuitry. For example, by turning on bit 0 in the register, the MPU can send data through the adapter serializer, through the diagnostic wrap logic and back through the deserializer to the receive data register. The MPU then checks the data received with the data transmitted to verify that the adapter logic functioned correctly.

### Transmit Status Register

The MPU uses this register to check the status of adapter and modem signals during transmit operations. For example, the adapter turns on bit 0 when the transmit data register is empty, which signals the MPU to load another byte of data into the register. The MPU also checks the register for signals from the modem, such as clear-to-send, and ring indicator when autoanswer is used.

### Diagnostic Return Register

The MPU uses this register to check adapter and modem signal status. For example, the adapter signals the MPU if the carrier-detect signal, clear-to-send signal, or the data-set-ready signal goes off when it should be on. The MPU also uses the register to check that the clock is running.

### Network Configuration Register

The MPU uses this register to control the data communications equipment. For example, the MPU turns on bits in this register to turn on the '-data term rdy' line and '-req to send' line to the modem. The MPU also uses this register to control diagnostic wrap tests.

### DCE Control Return Register

When the MPU turns on bits in the network configuration register, the bits are wrapped back to the MPU by this register to verify that the information in the network configuration register is correct.

### Timer Register

The MPU uses the timer register to set or reset the timer, which is used for protocol and DCE timeouts. For example, when receiving data, the MPU uses the timer to check receive timeouts.

## LINE ADAPTER CARDS

### 38LS Integrated Modem

The 38LS operates at speeds of 600 or 1200 bps on non-switched or switched communications lines. Line speed is specified in the configuration record.

The 38LS integrated modem card is a FRU. The card is available in five different types to allow the IBM 5280 to be attached in different configurations. The card types are:

- Switched network with manual answer or autoanswer (United States and Canada)
- Nonswitched (United States and Canada)
- Nonswitched with manual answer or autoanswer SNBU (United States and Canada)
- Nonswitched (World Trade countries)
- Switched (World Trade countries)

Modulation of the carrier is frequency shift keying (FSK). A frequency of 1300 Hz represents a mark level or 1 bit and a frequency of 2100 Hz represents a space level or 0 bit.

The 38LS integrated modem conforms to CCITT (Consultive Committee International Telegraph and Telephone) but does not have the CCITT halfspeed frequencies of 1300 Hz and 1700 Hz.

World Trade modems that meet the CCITT V.23 requirements are compatible with the 38LS.

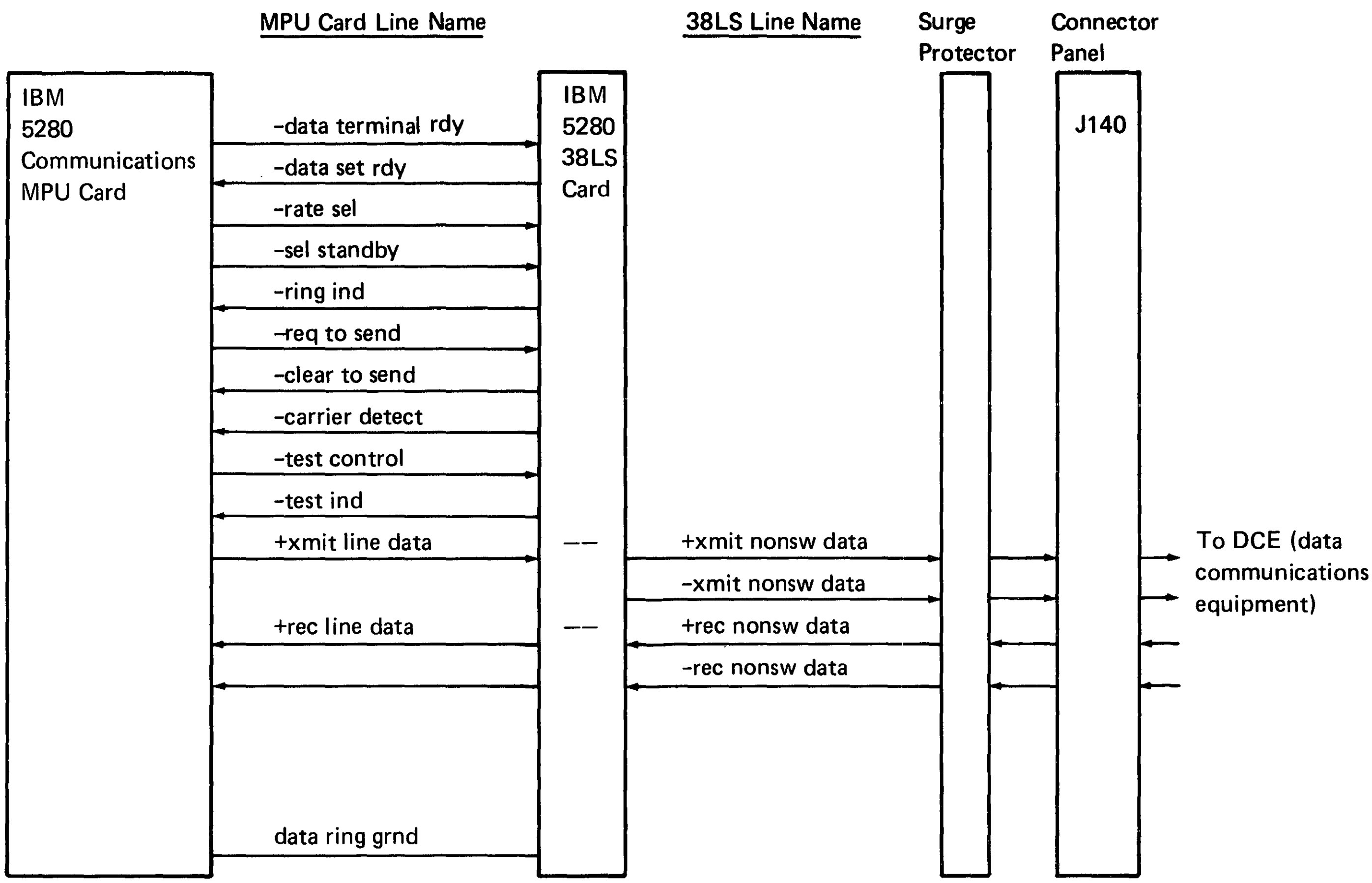
Personalization switches set up the 38LS to match the communications network. In the United States and Canada only transmit level is specified in the configuration record. The communications MPU sets the specified level with attenuators located on the communications MPU card. The transmit level switches on the 38LS card must be set to 0 dBm.

The connection between the 38LS and the communications facility depends upon the application. The 38LS for Canada switched networks is attached to a data access arrangement (DAA) such as a CBS or CDT type coupler. In the United States, the DAA can be a CBS or CDT type coupler, a permissive coupler, a fixed loss coupler, or a programmable coupler. The CDT coupler accommodates manual answer and the CBS coupler accommodates auto-answer. The 38LS for United States nonswitched networks is connected to the line through a lightning protection device. Some countries require additional isolation devices between the line and the 38LS modem for World Trade nonswitched networks. These devices are supplied by the user or the PTT.

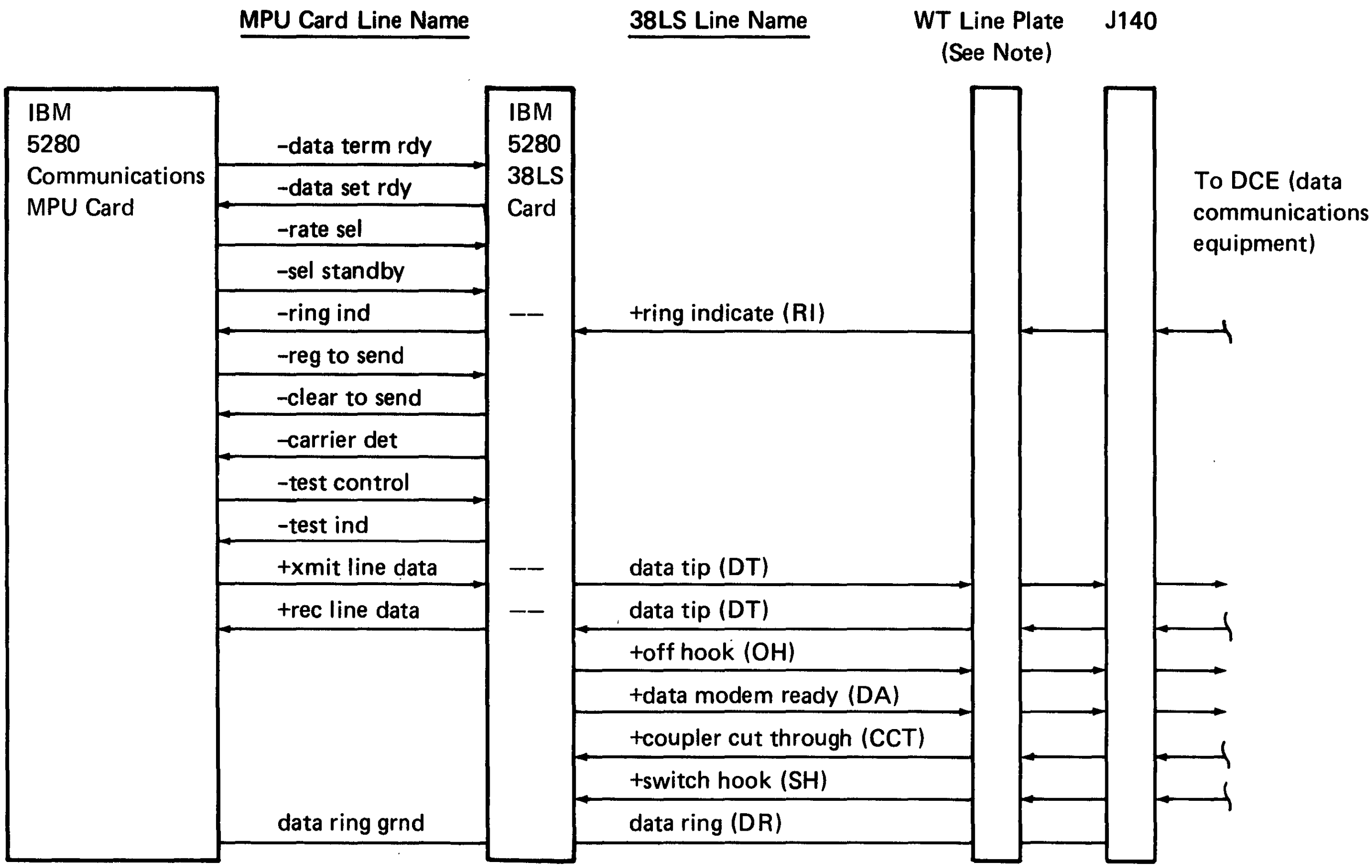
*Communications MPU Card to 38LS Interface*

The following lines connect the communications MPU card to the 38LS integrated modem. Refer to the following figures and to logic diagram *LD13* in the *System Logic Manual* while you read the following line descriptions.

*38LS Nonswitched*



*38LS Switched*




**Note:** See *38LS To Line Plate Interface Lines* in this section for a description of the WT line plate.

*'data term rdy.:* This line is activated by the communications MPU to control the 38LS-to-line connection. The active level indicates that the IBM 5280 is ready for communications.

*'req to send':* This line is activated by the communications MPU card to turn on the modulator circuits in the 38LS. When the 'data set rdy' and 'req to send' lines are both active, the carrier is immediately sent on the transmission line. When either is inactive, no carrier is sent.

*'test control':* This line is activated by the communications MPU card for test purposes. When the 'test control' line is active, the data from the 38LS line driver is passed through a wrap-test line-simulator circuit to the line receiver circuit in the 38LS. The line simulator attenuates and distorts the signal to test the receive circuits. The receive circuits send the data back to the communications MPU card for verification.

*'sel standby':* This line is activated by the communications MPU card to select SNBU operation. If the 38LS does not provide switched network backup, the 'sel standby' line is not used.

*'xmit line data':* This line is activated by the communications MPU card to modulate the 38LS carrier signal. An inactive level (+) on the '+xmit line data' line selects the mark frequency (1300 Hz), and the active level (–) selects the space frequency (2100 Hz).

*'rec line data':* This line is activated by the 38LS. While a space frequency is received, the '+rec line data' line is at an active level. While a mark frequency is received, the '+rec line data' is at an inactive level. When the received signal is below the threshold setting of the carrier detect circuit, the '+rec line data' line is clamped to the inactive level.

*'ring ind':* This line is activated by the 38LS with auto-answer to indicate to the communications MPU card that a calling signal is being received. (The line is activated on the third ring when the 38LS with the line plate is installed.)

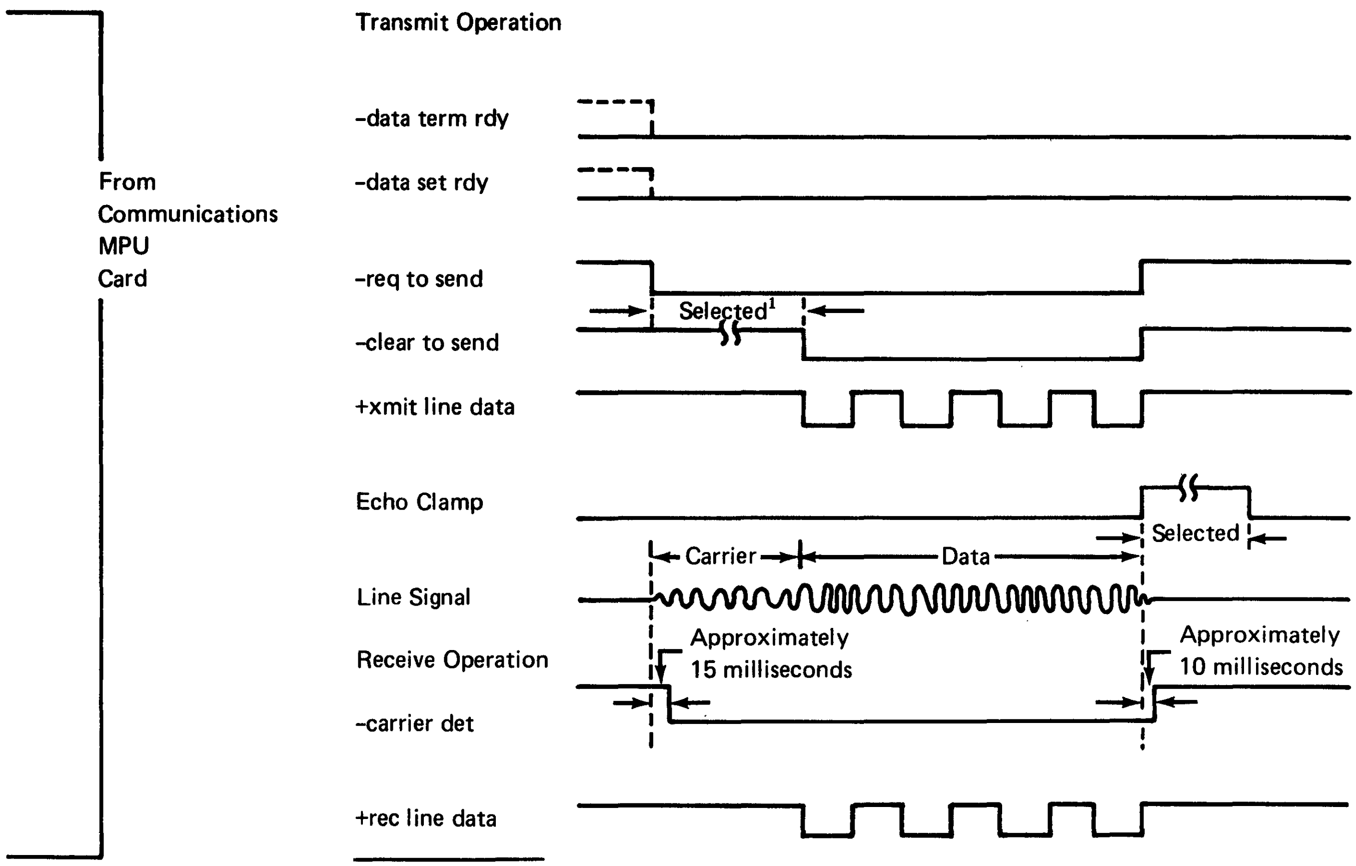
*'data set rdy':* This line is activated by the 38LS. For nonswitched network modems and the switched network manual answer 38LS card, the active '–data set rdy' line indicates that power is on. For autoanswer switched network modems, the active line indicates that the modem is connected to the line.

*'carrier det':* This line is activated by the 38LS after a carrier signal has been present on the receive input for between 10 to 20 milliseconds. The 'carrier det' line goes inactive between 5 to 15 milliseconds after the carrier signal ends or drops below the threshold of the carrier detect circuit.

*'clear to send':* This line is activated by the 38LS to indicate that the modem is ready to send data. For modems with switched networks and for nonswitched networks with 2-wire facilities, the active level on the 'clear to send' line is a delayed response to the request-to-send signal from the communications MPU card. The delay allows time for the network to stabilize.

*'test ind':* This line is activated by the 38LS to indicate that the 38LS is in test mode.

The following chart represents the timing and the sequence of interface line activity during data transmission. Notice that the internal echo clamp action is also shown. You should also notice the absence of clock lines both to and from the 38LS. The 38LS does not require a clocking pulse from the communications MPU card nor does the 38LS provide a clock pulse to the communications MPU card. When the 38LS is prepared to transmit data, the signal level on the '+xmit line data' line keys the modulator circuit in the 38LS. Likewise, the discriminator circuit in the 38LS keys the '+rec line data' line going to the communications MPU card during receive operations and wrap test operations.




[1] Specified in the communications configuration record.

### Switched Network Connections

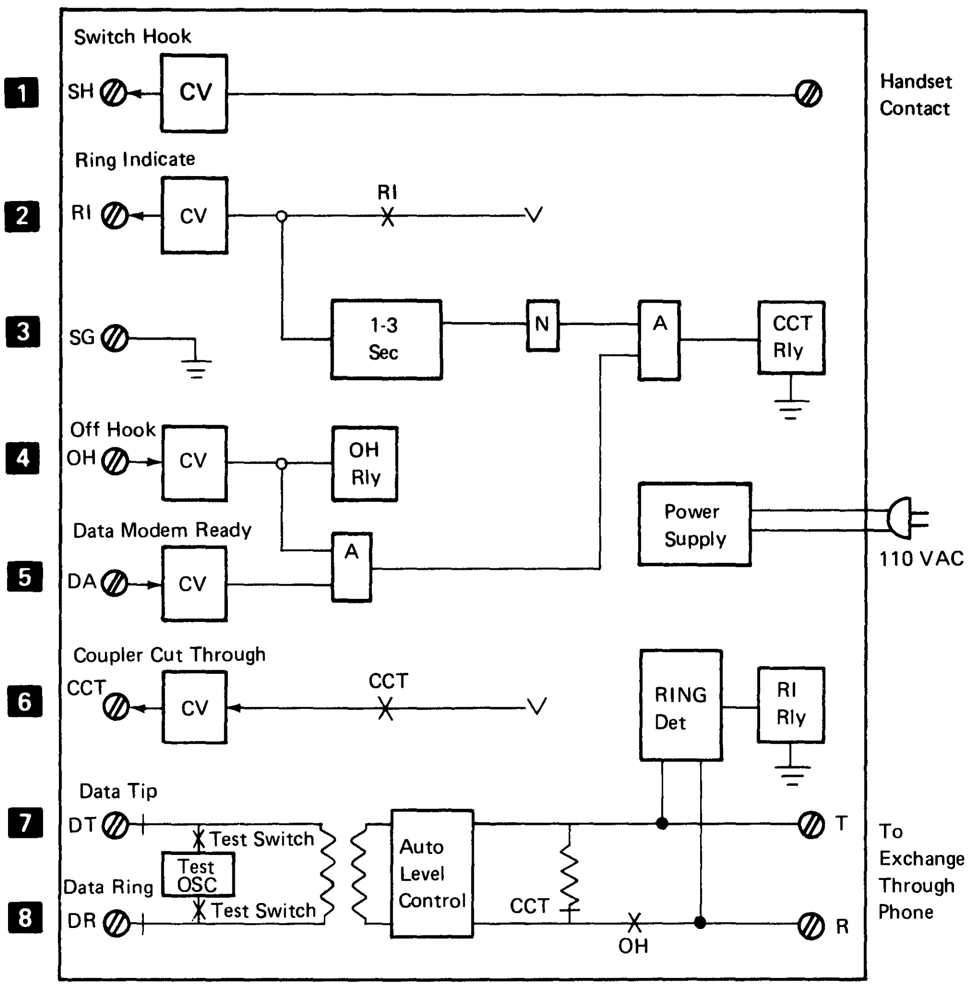
Attachment of the 38LS integrated switched line modem to United States or Canada network facilities requires an FCC registered data access arrangement (DAA) type CBS (autoanswer), type CDT (manual answer), or equivalent, more commonly known as a line coupler. A line coupler is an isolation or protection device for telephone company circuits.

The couplers provide DC voltage isolation between the IBM 5280 and a telephone company's local loop into the switched network, and contain a limiting circuit that monitors and attenuates the 38LS modem signal power level if it goes over the tolerances specified by the coupler type. A third function accommodates modems with auto-answer interface functions.

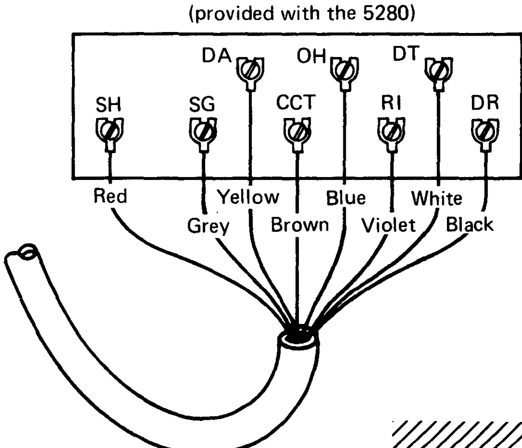
*CBS Type Coupler Interface*

The following diagram shows the connections and signals required for the CBS coupler. Control line voltage levels conform to the EIA (Electronics Industry Association) RS-232-B interface standards.

CBS Coupler

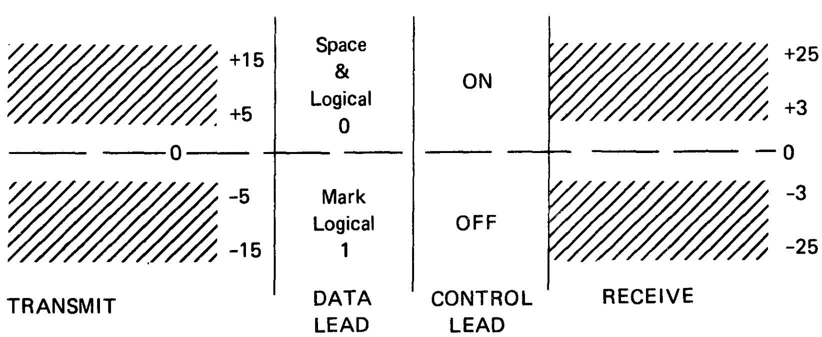



Line Adapter Cable
(provided with the 5280)




Line Coupler Cable

| Cable | |
|---|---|
| Data Tip | (DT) |
| Coupler Cut Through | (CCT) |
| Signal Ground | (SG) |
| Ring Indicate | (RI) |
| Switch Hook | (SH) |
| Data Modem Ready | (DA) |
| Data Ring | (DR) |
| Off Hook | (OH) |



*Data Tip (DT) and Data Ring (DR)* **7** **8** *:* These lines are used to provide an analog data signal path between the customer's modem and the coupler.

*Off Hook (OH)* **4** *:* This line provides off-hook and on-hook signals to the coupler. An active signal on this line activates the ring delay in the serving central office and stops the ringing current to the modem.

*Data Modem Ready (DA)* **5** *:* This line and OH (off hook) are required to request the coupler to connect the modem data path to the local telephone channel.

*Ring Indicate (RI)* **2** *:* This line indicates to the modem that the station is being rung.

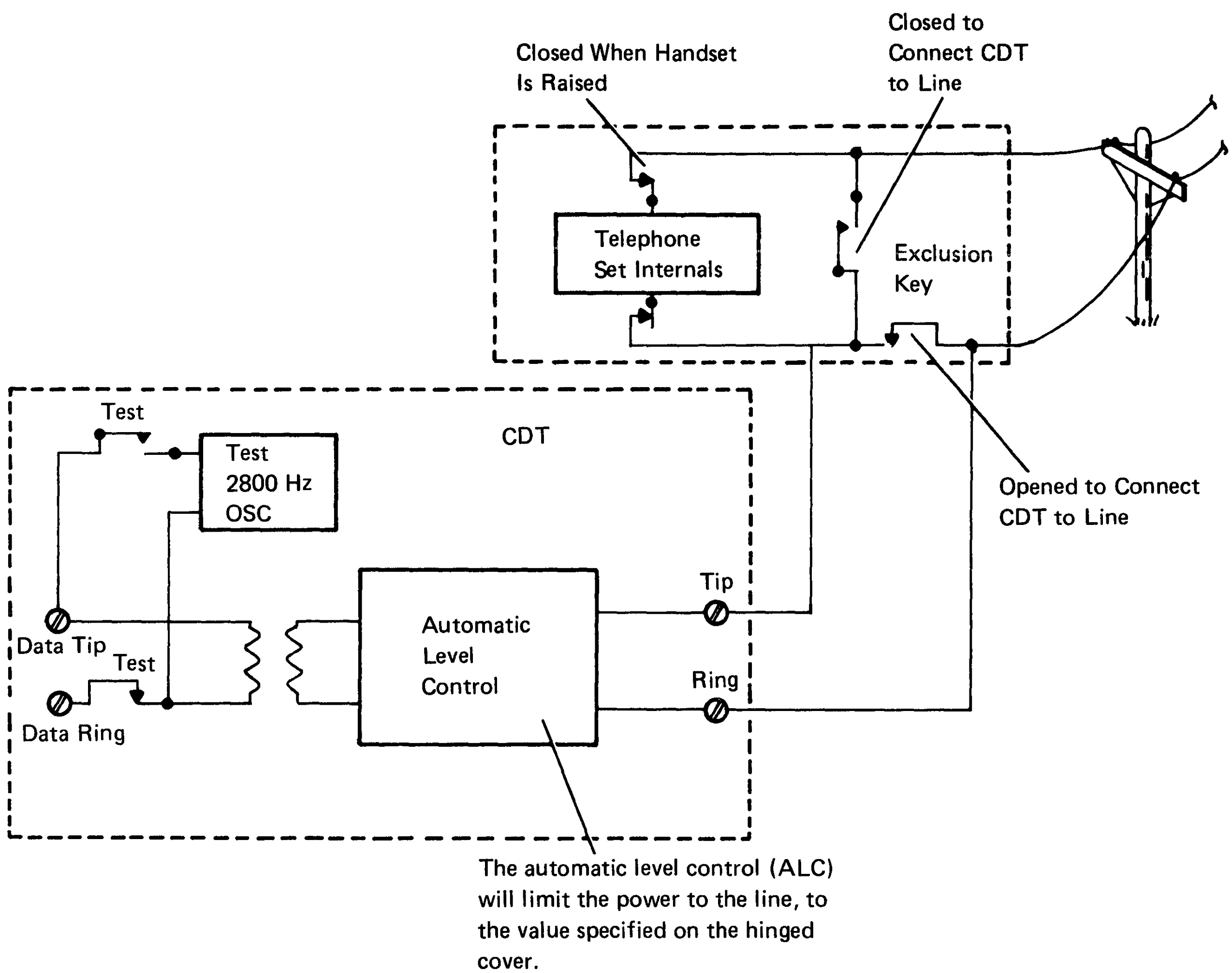
*Signal Ground (SG)* **3** *:* This line is the common reference point for all interface line signals.

*Coupler Cut Through (CCT)* **6** *:* An active level on this line indicates to the modem that the modem data path is connected through the coupler to the local telephone line.

*Switch Hook (SH)* **1** *:* This line indicates whether the handset of the related telephone, if provided, is on-hook or off-hook. It does not indicate whether the exclusion key has been operated for talk or data transfer. The active condition indicates that the handset is off-hook.

*CDT Type Coupler Interface*

The following diagram shows the connections and signals required for the CDT coupler. Signal voltage levels required by the coupler conform to the EIA RS-232-B interface standards.

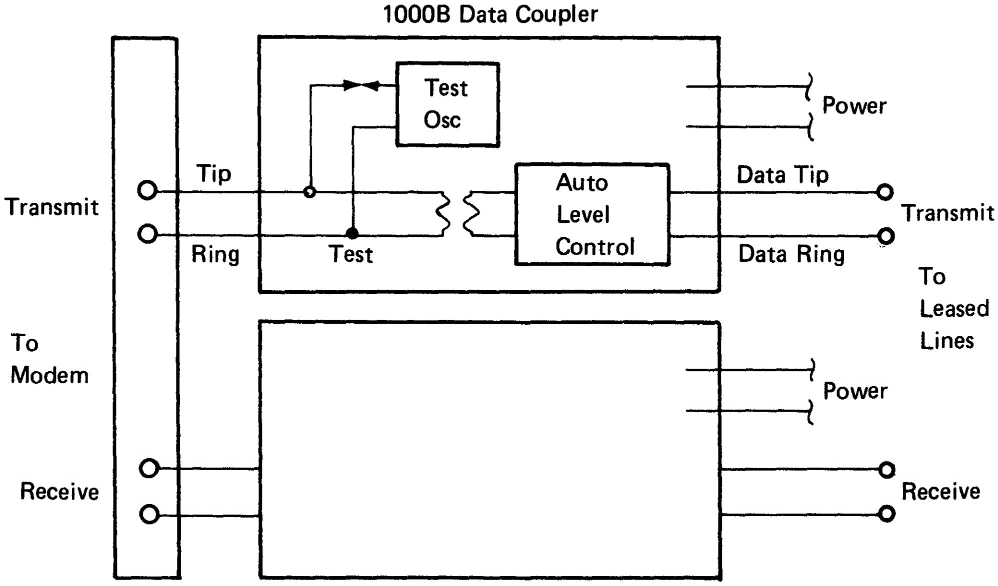


*Programmable Data Couplers*

Programmable data couplers may be used on switched lines with the IBM 5280. These couplers supply the same functions as the CBS or CDT type couplers. In addition, the programmable coupler receives a dBm level that has been already determined (usually 0 dBm) by the IBM 5280 and automatically matches the dBm level needed by the local loop.

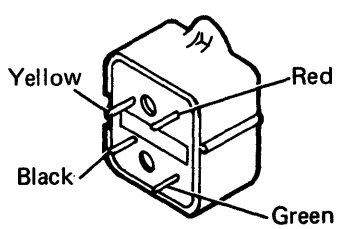
**Nonswitched Network Connections**

Attachment of the 38LS integrated nonswitched modem to nonswitched lines does not need a DAA. Direct attachment to common carrier industries is provided by an IBM-supplied interface cable; with others, a DAA or line coupler type 1000B or equivalent is needed. This coupler needs a 115 Vac power source. It should not affect online system operation in any way; however, the isolated condition is still ensured. The interface attachment to this coupler is usually a type 404B, 549A, or the same type four-pin jack. The following is a functional diagram of a 1000B coupler:




*Data Tip (DT) and Data Ring (DR):* These lines are used to provide an analog data signal between the user's modem and the coupler.

| | |
|---|---|
| 4W-Transmit/2W | Red |
| 4W-Transmit/2W | Green |
| 4W-Receive | Black |
| 4W-Receive | Yellow |



### Communications Facilities Characteristics

The characteristics of the switched communications facilities between the couplers and the local telephone central office should be equal to (or better than) those of the Type II local loop. The following list is a summary of Type II local loop characteristics.

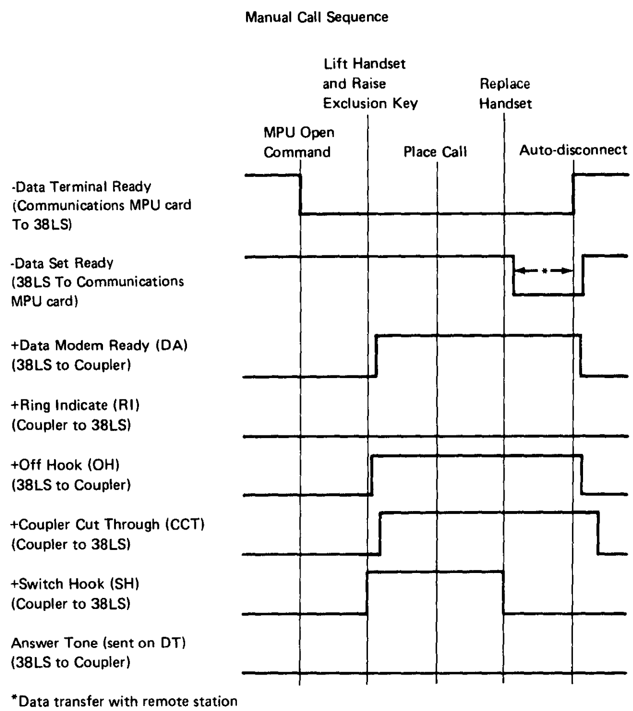
| | |
|---|---|
| Loss | Less than 10 dB at 1004 Hz |
| Slope | No more than 3 dB difference in loss between 1000 Hz and 2800 Hz |
| Envelope Delay Distortion | No greater than 100 microseconds between 100 Hz and 2400 Hz |
| Impulse Noise | No more than 15 counts in 15 minutes at 59 dBrnC, referred to the local central office |
| Message Circuit Noise | No more than 20 dBrnC |

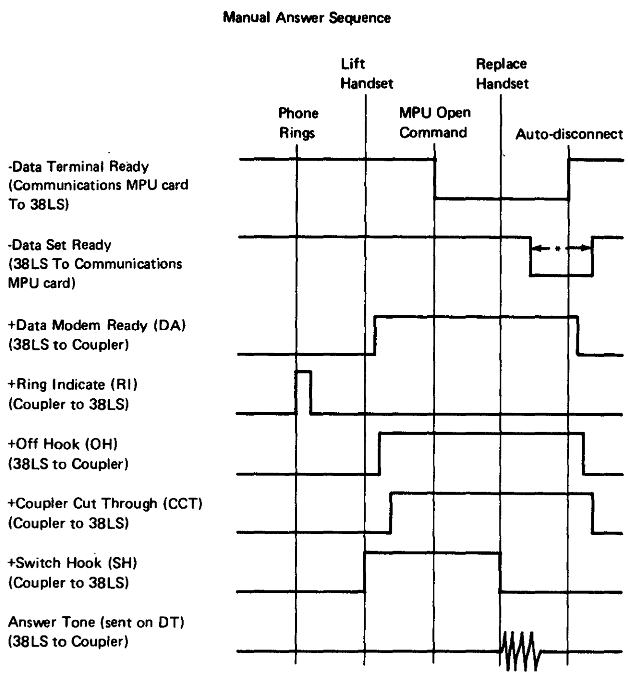
Because of the nature of the switched telephone network, it may not be possible to achieve a level of performance satisfactory to the customer on some connections and/or at some locations.

### Call and Answer Sequences

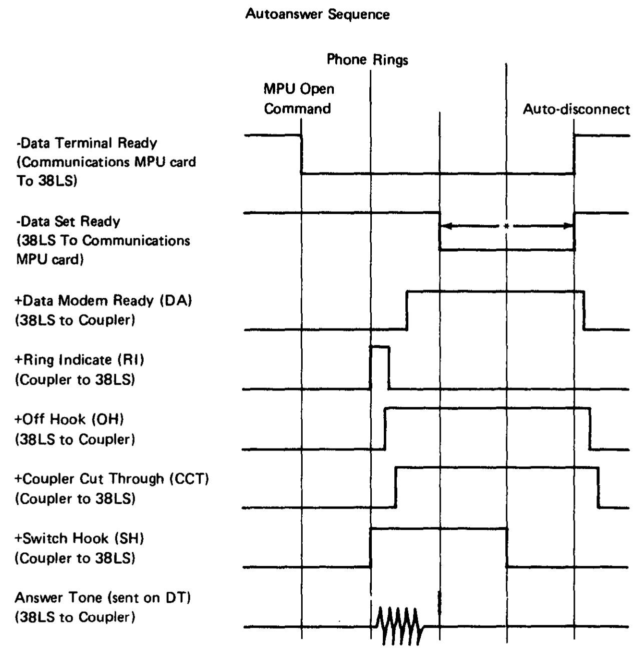
The following three sequence charts show the relationships that are typical during the placing of a phone call to a remote station and during manual answer and autoanswer operations.

Notice that in each sequence *MPU open command* is identified as an action, which causes the '–data term rdy' line to go active. The open command enables the communications MPU to establish a logical connection with the remote station.





Manual Answer Sequence
Lift Handset
Replace Handset
Phone Rings
MPU Open Command
Auto-disconnect
-Data Terminal Ready (Communications MPU card To 38LS)
-Data Set Ready (38LS To Communications MPU card)
+Data Modem Ready (DA) (38LS to Coupler)
+Ring Indicate (RI) (Coupler to 38LS)
+Off Hook (OH) (38LS to Coupler)
+Coupler Cut Through (CCT) (Coupler to 38LS)
+Switch Hook (SH) (Coupler to 38LS)
Answer Tone (sent on DT) (38LS to Coupler)

Autoanswer Sequence
Phone Rings
MPU Open Command
Auto-disconnect
-Data Terminal Ready (Communications MPU card To 38LS)
-Data Set Ready (38LS To Communications MPU card)
+Data Modem Ready (DA) (38LS to Coupler)
+Ring Indicate (RI) (Coupler to 38LS)
+Off Hook (OH) (38LS to Coupler)
+Coupler Cut Through (CCT) (Coupler to 38LS)
+Switch Hook (SH) (Coupler to 38LS)
Answer Tone (sent on DT) (38LS to Coupler)

## 38LS for WT Switched Networks (PSN Adapter)

The 38LS for switched networks in Word Trade countries (except Canada) requires a public switched network (PSN) adapter, called a line plate, for connecting the 38LS and the associated telephone set to a telephone line.

The major functions of the line plate are:

1 Routes AC from the telephone line through the line plate transformer to the 38LS modem.

2 Causes the 'data indicator' line to become active when transfer relay R1 is energized.

3 Detects the current in both directions and activates the 'current detection 1' or 'current detection 2' line. When a ringing current is present, both CD1 and CD2 are active and have signals of opposite polarity.

4 Connects the telephone line to either the 38LS modem or to the telephone set and current detectors, depending on the status of the transfer relay, R1. When R1 is not energized, the telephone set current detectors are connected to the line.

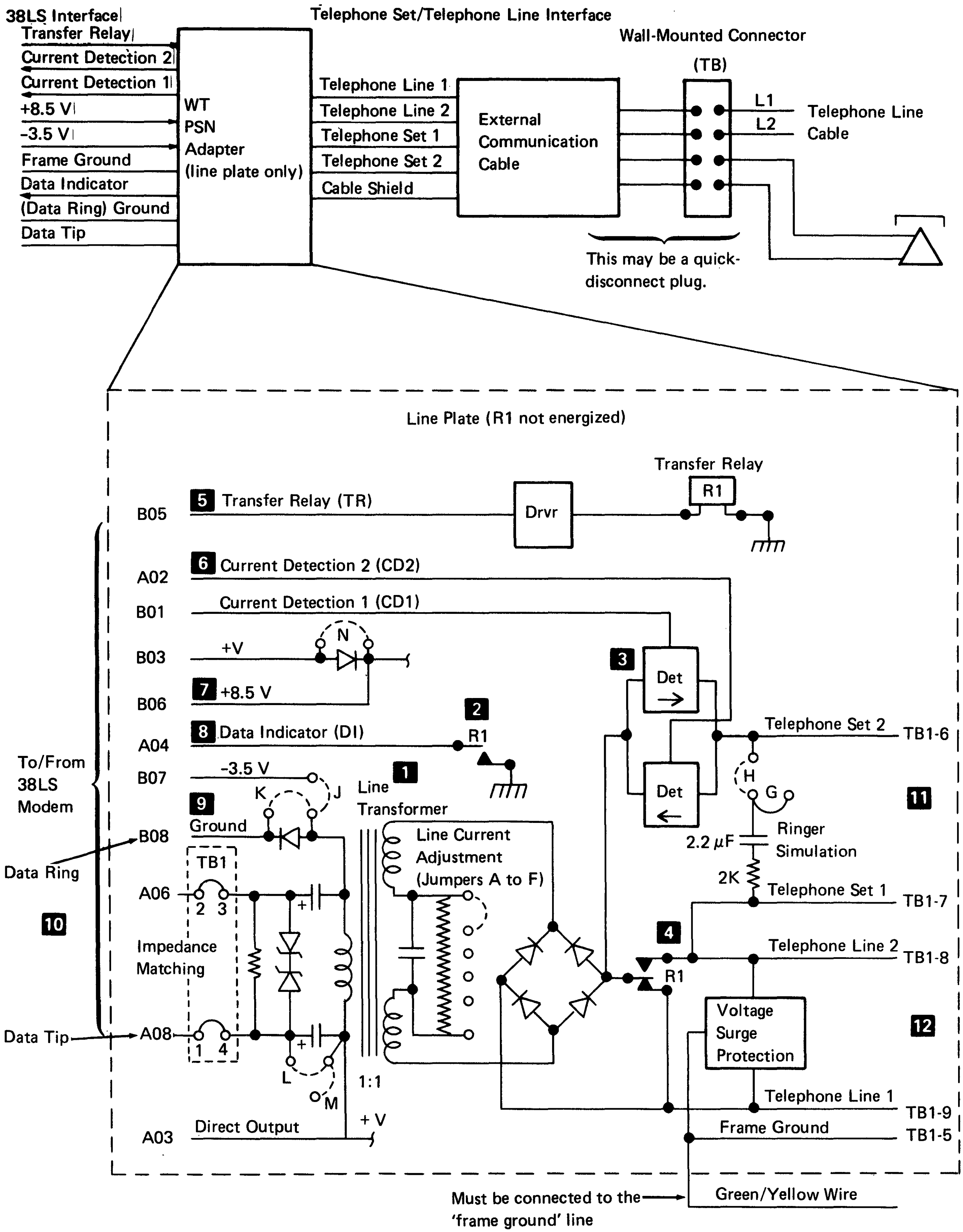
### *38LS to Line Plate Interface Lines*

*'data tip' and 'data ring'* 10*:* These lines are used to provide an analog data signal path between the 38LS and the line plate.

*'transfer relay'* 5*:* The state of the signal (from the 38LS) on this line determines whether the 38LS or the telephone set is connected to the telephone line. When the 38LS is connected to the line (transfer relay is operated), the voltage level on the 'transfer relay' line is approximately -2.7 volts (referenced to the 38LS signal ground). When the telephone set is connected to the line, the voltage level is approximately -4.5 volts to 38LS signal ground.

*'current detection 1' and 'current detection 2'* 6*:* These two signal lines from the line plate indicate current in the telephone set. The detection circuits detect current in the opposite directions. When there is no current in the telephone set, the signal level on both lines is approximately +1.0 volt (referenced to the 38LS signal ground).

When direct current is present in the telephone set (the telephone handset is uncradled), only one of the two 'current detection' lines becomes active (voltage level of approximately -3.5 volts referenced to the 38LS signal ground).


38LS Interface
Transfer Relay
Current Detection 2
Current Detection 1
+8.5 V
-3.5 V
Frame Ground
Data Indicator
(Data Ring) Ground
Data Tip
WT PSN Adapter (line plate only)
Telephone Set/Telephone Line Interface
Telephone Line 1
Telephone Line 2
Telephone Set 1
Telephone Set 2
Cable Shield
External Communication Cable
Wall-Mounted Connector
(TB)
L1
L2
Telephone Line Cable
This may be a quick-disconnect plug.
Line Plate (R1 not energized)
Transfer Relay
R1
B05
5 Transfer Relay (TR)
Drvr
A02
6 Current Detection 2 (CD2)
B01
Current Detection 1 (CD1)
B03
+V
N
B06
7 +8.5 V
3
Det
2
A04
8 Data Indicator (DI)
R1
B07
-3.5 V
K
J
1
Line Transformer
9
Ground
B08
To/From 38LS Modem
Data Ring
TB1
A06
2 3
Impedance Matching
10
Line Current Adjustment (Jumpers A to F)
Data Tip
A08
1 4
L
M
1:1
+V
A03
Direct Output
Telephone Set 2
TB1-6
H
G
11
2.2 μF
Ringer Simulation
2K
Telephone Set 1
TB1-7
4
Telephone Line 2
TB1-8
R1
Voltage Surge Protection
12
Telephone Line 1
TB1-9
Frame Ground
TB1-5
Must be connected to the 'frame ground' line
Green/Yellow Wire

During ringing, the 'current detection 1' and 'current detection 2' lines become alternatively active.

*'data indicator'* **8**: This signal line (from the line plate) indicates that the transfer relay is operated (38LS is connected to the telephone line) when the voltage level is -3.5 volts referenced to the 38LS signal ground.

*'+8.5 volts'* **7**: This line supplies 8.5 volts, which is developed by the 38LS, to power the line plate.

*'-3.5 volts'* **9**: This line from the 38LS is used within the line plate as line plate signal ground.

*Line Plate to PTT Equipment Interface Lines*

*'telephone line 1' and 'telephone line 2'* **12**: These lines connect the line plate to the telephone line.

*'telephone set 1' and 'telephone set 2'* **11**: These lines connect the line plate to the telephone set.

**Line Plate Operating Modes**

The 38LS PSN line plate permits autoanswer, manual answer, and manual call operating modes.

**Following is a description of the actions in each of these operating modes. These actions are numbered to correspond to the signal line paths in the figure.**

*Autoanswer*

**1** The IBM 5280 is ready to receive data. The detectors on the line plate are connected to the line (relay R1 is not energized).

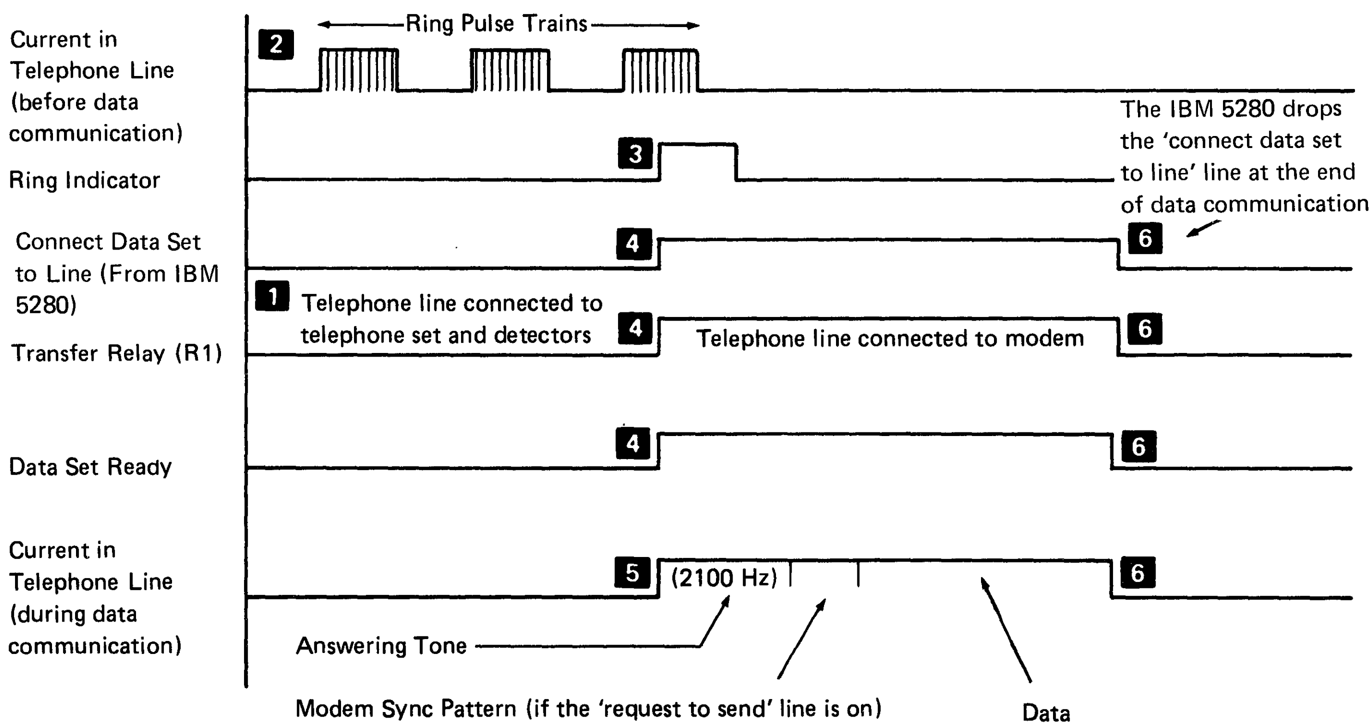
**2** Ring pulse trains are received from the telephone exchange over the telephone line.

**3** The 'ring indicator' line becomes active on the second or third train of pulses.

**4** The IBM 5280 activates the 'connect data set to line' line, relay R1 is energized, and the modem is connected to the line. The 38LS modem activates the 'data set ready' line.

**5** The 38LS modem generates the answer tone (2100 Hz) for 3.5 seconds. Data communications can start.

**6** At the end of data communications, the telephone line is automatically disconnected from the 38LS modem when the 'connect data set to line' line becomes inactive.



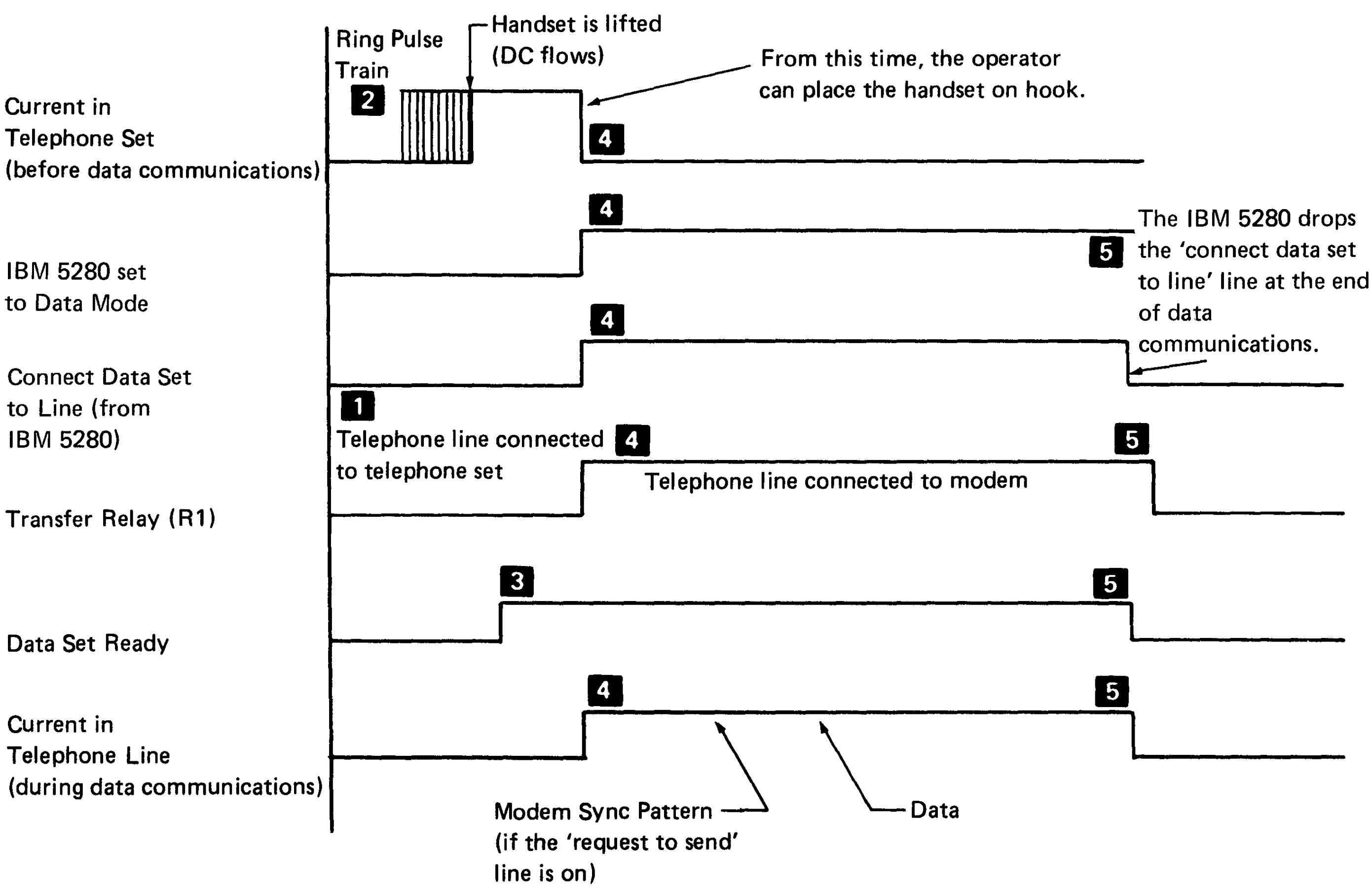
**1** The IBM 5280 is not in data mode. The detectors on the line plate and the telephone set are connected to the line (relay R1 is not energized).

**2** Ring pulses are received from the telephone exchange over the telephone line.

**3** The telephone set rings, the operator lifts the handset to answer, and direct current flows in the telephone line. Direct current is detected by the 38LS, which activates the '–data set rdy' line.

**4** At the end of the conversation, the operator causes the application program to continue, which causes the CAM to issue an OPEN command to the MPU. The IBM 5280 activates the 'connect data set to line' line, relay R1 is energized, and the 38LS modem is connected to the line. The operator returns the handset on-hook. Data communications starts.

**5** At the end of data communications, the telephone line is automatically disconnected from the 38LS modem when the 'connect data set to line' line becomes inactive.



*Manual Call*

**1** The IBM 5280 is not in data mode. The telephone set is connected to the line (relay R1 is not energized).

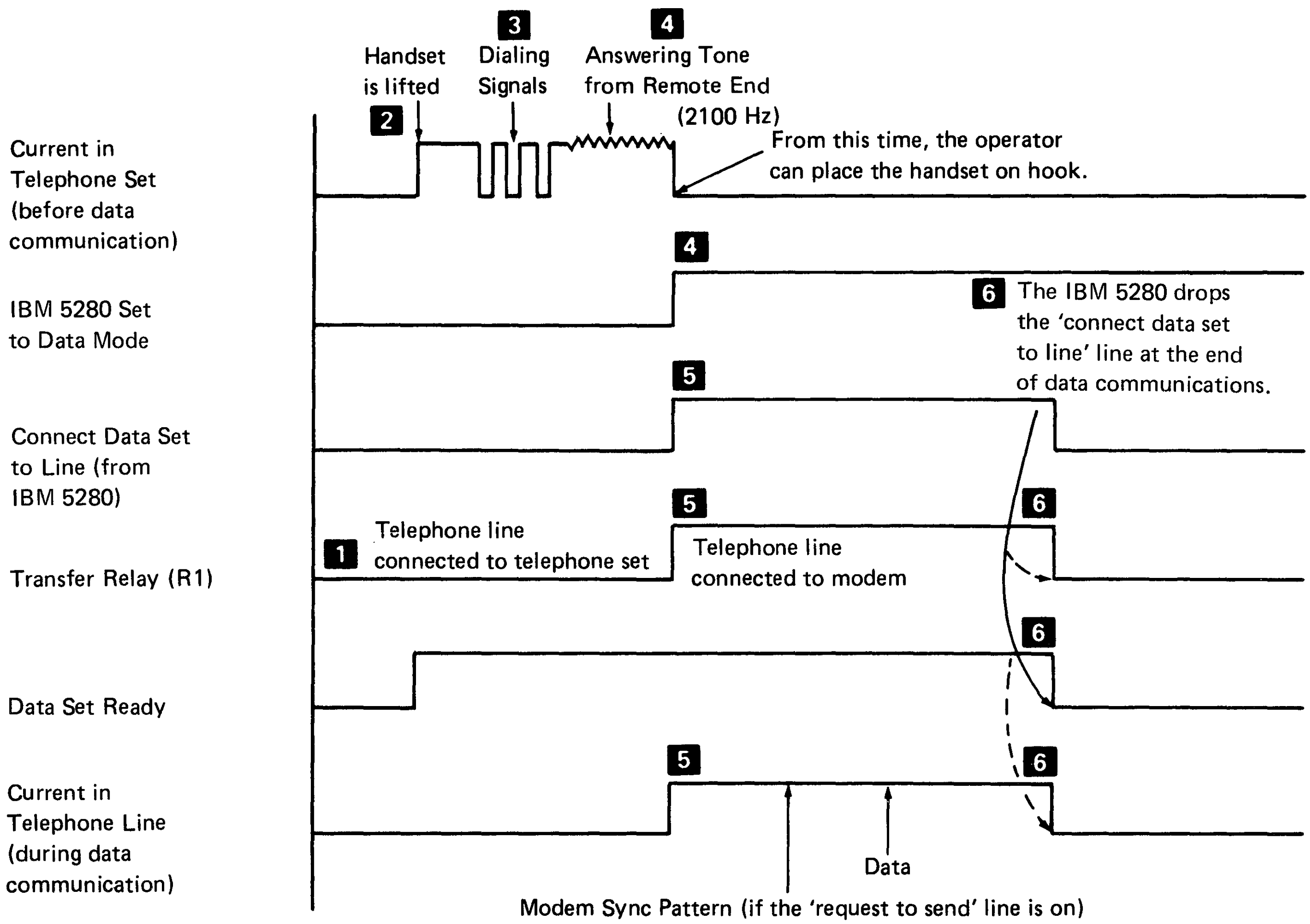
**2** The operator picks up the handset. Direct current flows in the telephone line. Direct current is detected by the 38LS modem, which activates the '-data set rdy' line.

**3** The operator dials the remote display station, which answers either manually or automatically.

**4** At the end of the conversation (if manual answer) or at the end of the answer tone (if autoanswer), the operator causes the application program to continue and then returns the handset on-hook.

**5** The IBM 5280 activates the 'connect data set to line' line, relay R1 is energized, and 38LS modem is connected to the line. Data communications starts.

**6** At the end of data communication, the telephone line is disconnected from the 38LS modem when the 'connect data set to line' line becomes inactive.



**Communications Facilities Characteristics**

The 38LS modems for nonswitched networks can be used with telephone lines that have characteristics equal to (or better than) those of the basic 3002 data channel without added conditioning. Basic 3002 data channel characteristics are summarized in the following chart.

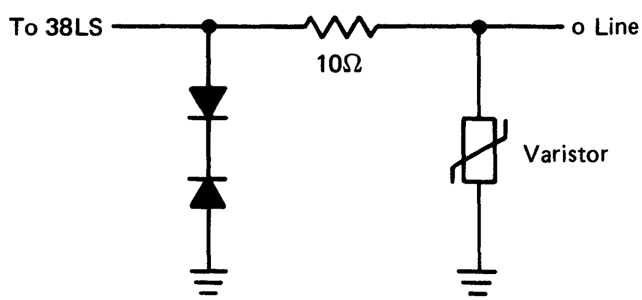
| **Use**<br>**Interstate Tariff**<br>**FCC No. 260** | **Alternate Voice/Data or Data Only** |
|---|---|
| General Characteristics<br>Type of service<br>Mode of operation<br>Method of termination<br>Imped. source and load<br>Maximum signal power | <br>2-point or multipoint<br>Half- or full-duplex<br>2-wire or 4-wire<br>600-ohm-resistive-bal.<br>0 dBm for composite data |
| Attenuation Char.<br>Meas. between 600-ohm impedances at lineup<br>Expected maximum variation<br>Frequency response (ref. 1004 Hz)<br><br>Frequency error | <br>16 dB ± 1 @ 1004 Hz<br>Short-term ±3 dB<br>Long-term ±4 dB<br>Freq. range var. -dB<br>300-3000, -3 to +12<br>500-2500, -2 to +8<br>±5 Hz |
| Delay Characteristics<br>Absolute delay<br>Envelope delay distortion | <br>Not specified<br>Less than 1750 micro-seconds over band from 800 to 2600 Hz |
| Noise Characteristics<br>Message circuit noise<br>Impulse noise | <br>15 counts in 15 minutes<br>68 dBrnC (69 dBrn VB) |

The attachment of the 38LS Word Trade integrated nonswitched network modem to dedicated (private leased) lines may or may not require an interface device.

**Voltage Surge Protection**

The voltage surge protection circuit protects the 38LS nonswitched integrated modem from high voltage that might occur on telephone lines from sources such as lightning.

The protection circuit is in series with each of the transmit and receive signal lines and is integrated into the internal communications cable. The circuit contains varistors. A varistor is a two-element solid-state device, which has a very low resistance to high voltages such as lightning and high resistance to low voltages such as data signals. Refer to the following diagram of a single leg of the surge protection device.




The circuit passes the low-voltage data signals through the 10-ohm resistor. If a high voltage surge occurs on the telephone line, the protection circuit shunts the circuit to ground, protecting the 38LS in most cases.

**Digital Data Service Adapter**

The Digital Data Service Adapter (DDSA) is an integrated adapter that provides an interface to AT&T's digital data network through a channel service unit. The channel service unit is similar to the data access arrangements used with the IBM 1200 bps integrated modems. The digital data network is a 4-wire, full-duplex network that operates in synchronous mode.

The DDSA also allows the IBM 5280 to be directly attached to another device that supports the DDS protocol. Attachment is provided by a special direct attach cable.

Data is transmitted serially by bit and serially by character over the digital data network. The DDSA card supplies the clock for clocking the data to and from the IBM 5280. The DDSA card clock is synchronized with the received data by the signal from the network.

*Transmission Rates*

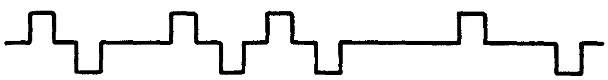
In the IBM 5280, the DDSA card operates at either 2400 bps or 4800 bps. The rate is determined by the user's telephone company's central office as requested by the user, and the DDSA must be configured with jumpers to match the requested rate.

*Transmission Signal*

The signal transmitted from the DDSA to the digital data network is a bipolar, return-to-zero signal. When a 0-bit is transmitted, the signal is at 0 volts. However, when a 1-bit is transmitted, the signal is either positive or negative, depending on the polarity of the last 1-bit transmitted. For example, if a negative 1-bit is transmitted, the next 1-bit will be positive as shown in the following figure.

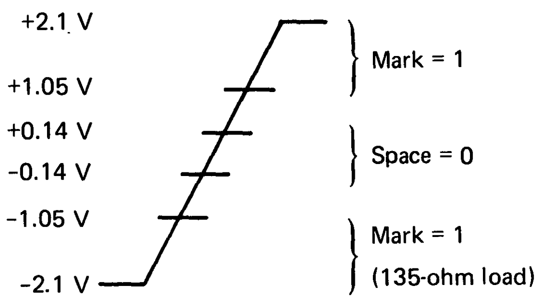
Bit Stream 1 1 0 1 1 1 1 0 0 1 0 1

Transmitted Signal



*Transmit Levels*

The DDSA transmit levels are shown in the figure below.




The DDSA interprets receive voltage levels more positive than +1.05 V and more negative than -1.05 V as mark levels.

The DDSA is clocked by the data from the line. Both transmit and receive operations within the DDSA are synchronized to the received signal. To maintain clocking and to inform the receiving DDSA's of status, the DDSA generates violation sequences or characters. These characters are violation characters because two consecutively transmitted 1-bits have the same polarity (either negative or positive). The violation characters are idle, zero suppression, and out of service.

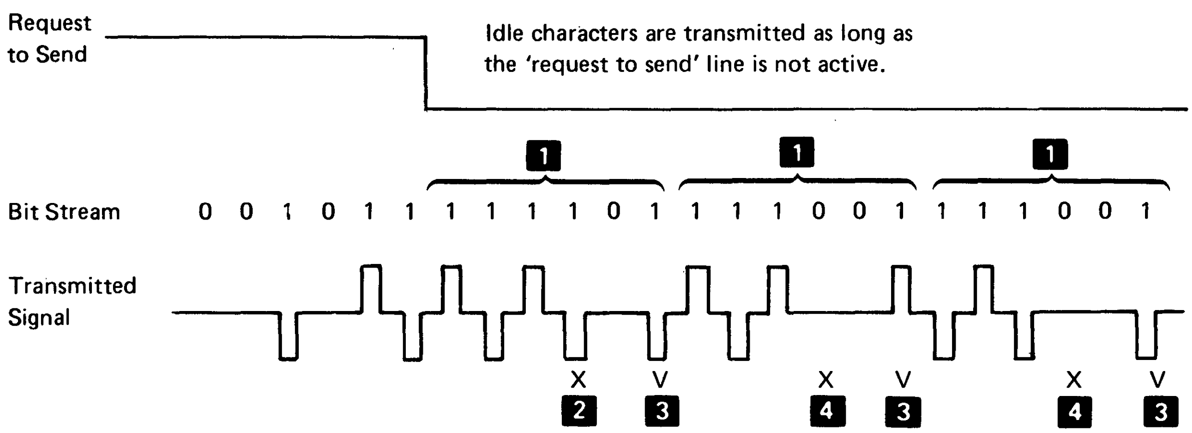
*Idle Characters*

The idle character is generated and transmitted by the transmitting DDSA when the '-req to send' line on the communications MPU card is inactive. This character informs the receiving DDSA that the transmitting DDSA is in an idle state.

The bit sequence for the idle character is 111X0V, where:

X = 0 or 1, whichever ensures an odd number of 1-bits since the last violation bit.

V = 1, a violation bit that ensures the same polarity as the preceding 1-bit.




**1** Three transmitted idle characters.

**2** First X-bit is opposite in polarity to the preceding 1-bit.

**3** All V-bits are of the same polarity as the 1-bit that precedes them.

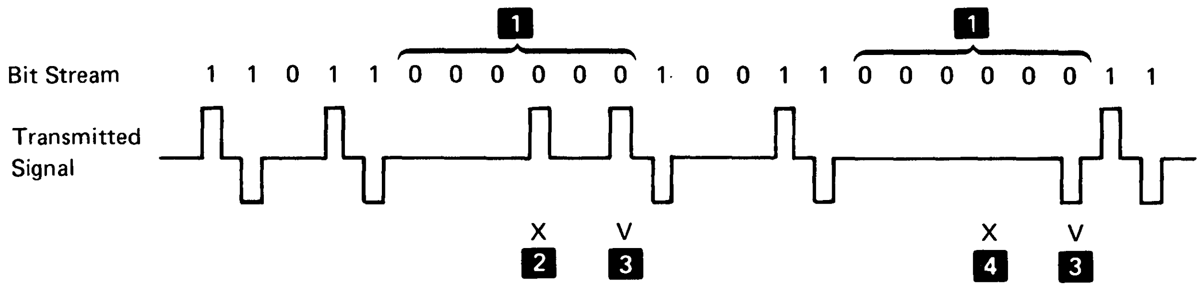
**4** Both of these X-bits are at 0 volts to ensure an odd number of 1-bits since the last violation bit.

*Zero-Supression Characters*

The zero suppression character is transmitted by the transmitting DDSA to help maintain bit synchronization. This character ensures that at least one 1-bit gets transmitted when the data contains six consecutive 0-bits. Six consecutive 0-bits are transmitted as 000X0V, where:

X = 0 or 1, whichever ensures an odd number of 1-bits since the last violation bit.

V = 1, a violation bit that ensures the same polarity as the preceding 1-bit.




**1** Zero suppression sequences.

**2** First X-bit is opposite in polarity to the preceding 1-bit.

**3** Both V-bits are of the same polarity as the 1-bit that precedes them.

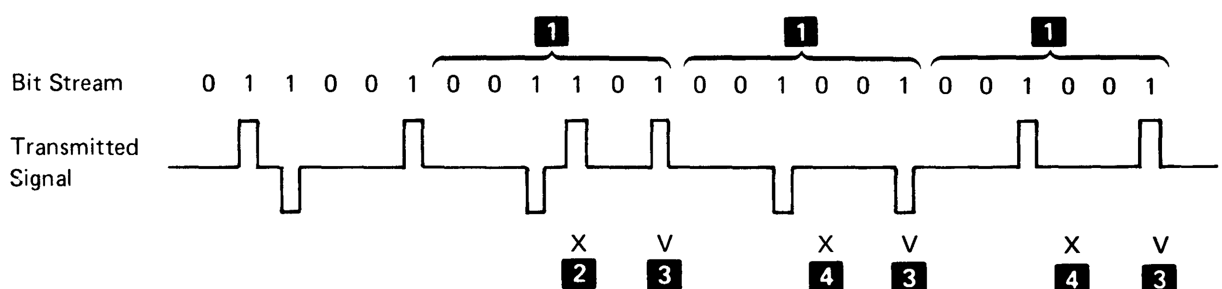
**4** Second X-bit is at 0 volts to ensure an odd number of 1-bits since the last violation bit.

*Out-of-Service Characters*

The out-of-service character is generated and transmitted by the digital data network. The character is sent to the receiving adapter and to the transmitting DDSA to indicate a problem in the network. The bit sequence for the out-of-service character is 001X0V, where:

X = 0 or 1, and ensures an odd number of 1-bits since the last violation bit (see the following figure).

V = 1, a violation bit that ensures the same polarity as the preceding 1-bit.




**1** Out-of-service characters.

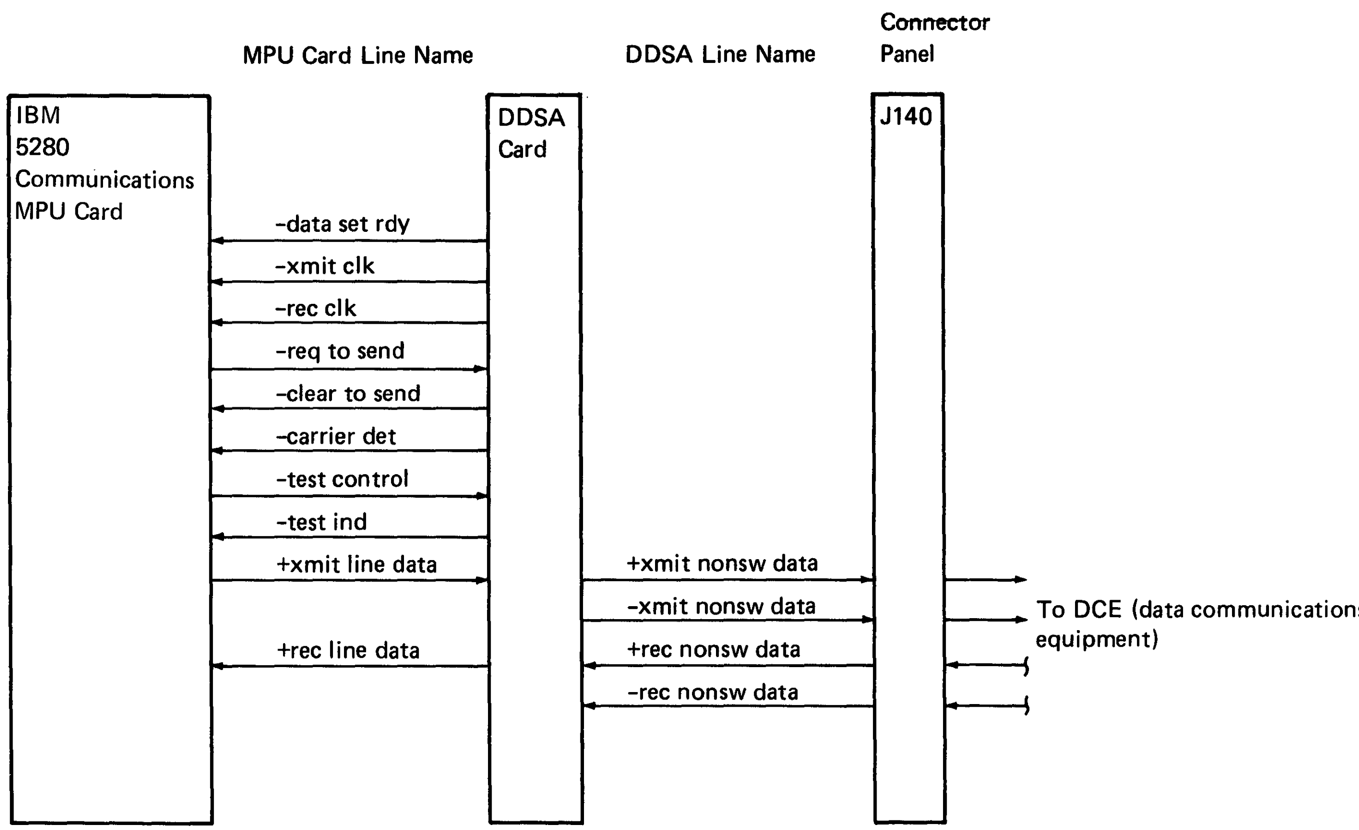
**2** First X-bit is opposite in polarity to the preceding 1-bit.

**3** All V-bits are of the same polarity as the 1-bit that precedes them.

**4** Both of these X-bits are at 0 volts to ensure an odd number of 1-bits since the last violation bit.

*Interface Lines*

The following interface lines are between the communications MPU card and the DDSA. Refer to the following figure and to logic diagram *LD15* in the *System Logic Manual* while you read the descriptions.




*'+xmit line data':* This line is activated by the communications MPU card in sync with the transmit clock. A mark (1-bit) is sent as a positive (+5 V) signal, and a space (0-bit) is sent as 0 volts.

*'+rec line data':* This line is activated by the DDSA in response to the signal from the digital data network.

*'-req to send':* This line is activated by the communications MPU card to enable the DDSA to enter transmit mode. If this line is not active, the DDSA sends idle characters.

*'-clear to send':* This line is activated by the DDSA in response to the '-req to send' line going active. The 'clear to send' line goes active in approximately a 20-bit interval after the 'req to send' line goes active. When the '-req to send' line goes inactive, the '-clear to send' line goes inactive in approximately a 1-bit interval. The clear-to-send delay is approximately 8 milliseconds for 2400 bps and 4 milliseconds for 4800 bps.

When the '-clear to send' line is inactive, the communications MPU does not send any data to the DDSA.

*'-carrier det':* This line is activated by the DDSA to indicate that the last 12-bit interval represented data (not out-of-service or idle violation characters). The '-carrier det' line goes inactive when three consecutive idle or out-of-service characters are received, or when three consecutive characters containing all 0's are received from the digital data network.

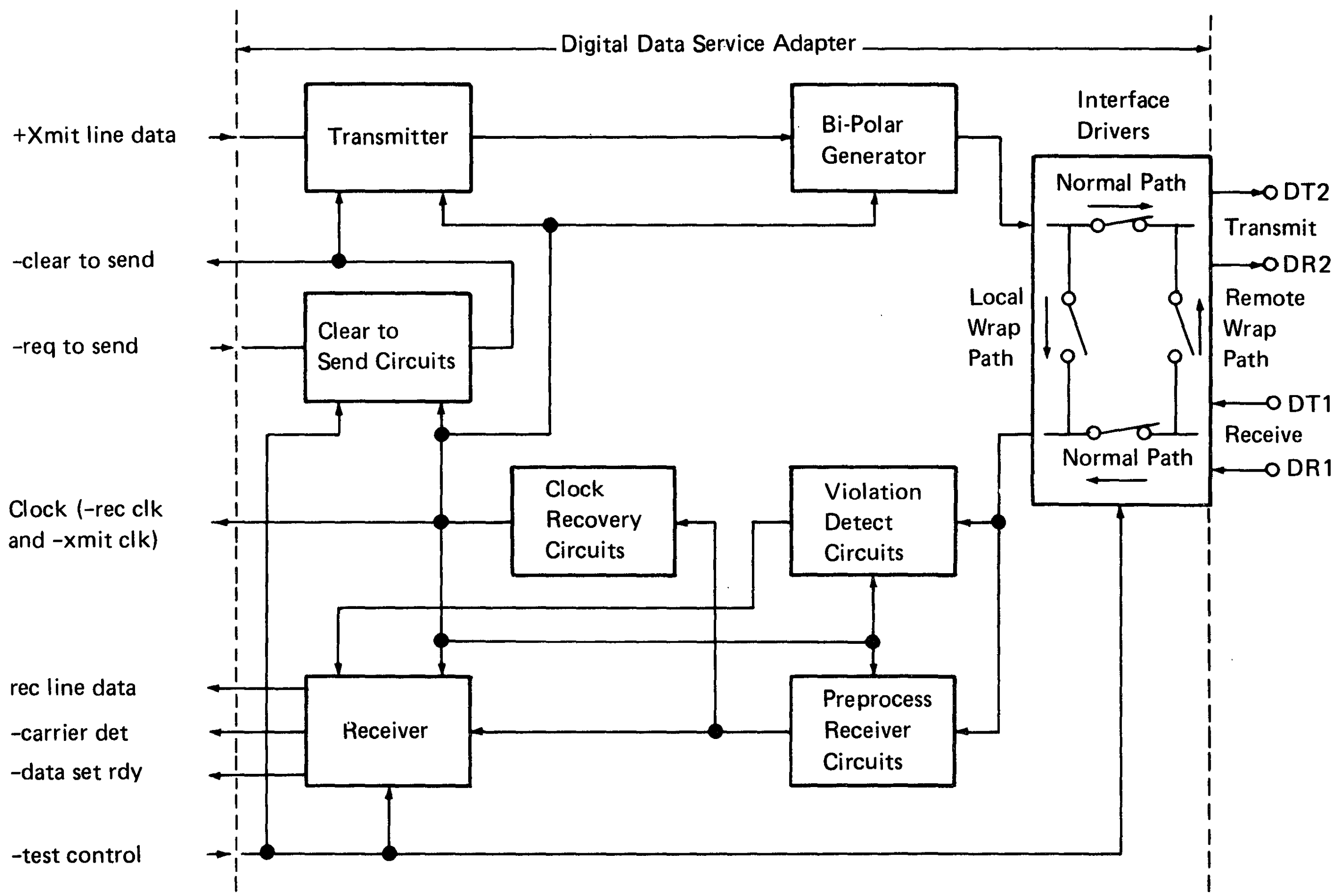
When the '-carrier det' line is inactive, the '+rec line data' line is held at a mark level (all 1's).

*'-data set rdy':* This line is activated by the DDSA to indicate that active signals are on the communications line. The '-data set rdy' line goes inactive in an 18-bit interval if three consecutive out-of-service characters containing all 0's are received.

*'-rec clk':* This line is activated by the DDSA to supply timing information to the communications MPU card for clocking received data.

*'-xmit clk':* This line is activated by the DDSA to supply timing information to the communications MPU card for clocking transmitted data.

*'-test control':* This line is activated by the communications MPU card for local and remote data wraps. For local wraps, the transmitter's output in the DDSA is looped back to the receiver. For remote wraps, the signal from the digital data network is looped back to the digital data network (see the following figure). (When the IBM 5280 is connected to a multipoint network, a jumper must be installed on the DDSA card to disable the remote wrap. If the jumper is not installed, interference will be transmitted on the line, which will degrade the performance of the network.)



## EIA/CCITT

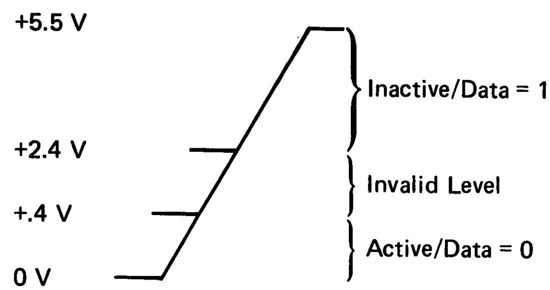
The external modem can be either an IBM modem or a non-IBM modem, but the modems must be compatible at each end of the communications line.

United States and Canada modems must meet the characteristics of EIA Standard RS-232C, and World Trade modems must meet the PTT Mandatory Service requirements and the characteristics of CCITT V.24/V.28. Non-IBM World Trade modems are chosen by the government of each World Trade country.

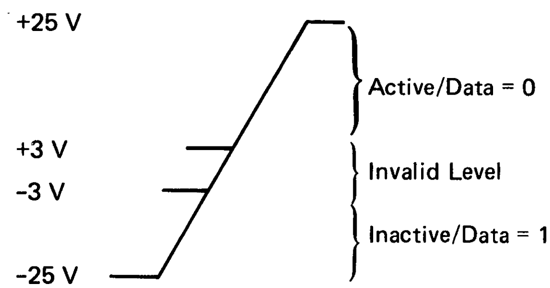
The EIA/CCITT card is a 2-wide, 3-high card. Also included is a -8.5 volt feature power supply, a 6-meter (20-foot) or 12-meter (40-foot) communications cable, and a wrap connector.

The EIA/CCITT communications card uses eight signal drivers and eight signal receivers to convert signal levels between the IBM 5280 and the external modem. Signal levels from the communications MPU card are converted to EIA/CCITT signal levels for the external modem, and EIA/CCITT signal levels from the external modem are converted to signal levels for the communications MPU card. The following figure shows the signal level conversion that takes place between the IBM 5280 and the external modem.

Communications MPU card
Signal Levels (VTL Levels)

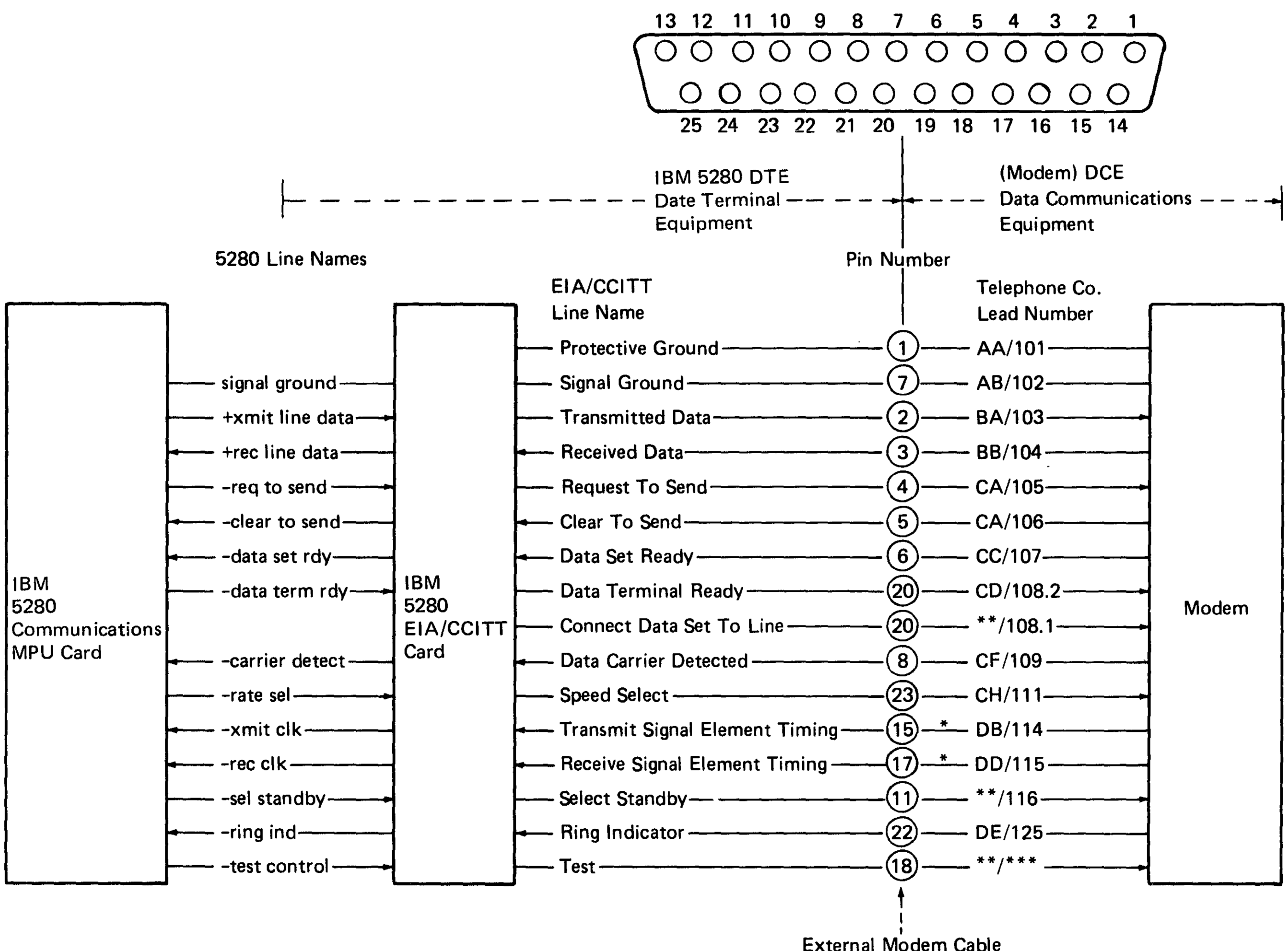



EIA/CCITT Signal Levels



*EIA/CCITT Interface Lines*

The following circuits, described in the specifications of RS-232C and CCITT V-24, are supported by the IBM 5280 Communications feature. The descriptions that accompany the circuit names apply to typical applications. These interface lines are shown in the following diagram and also on logic diagram *LD11* in the *System Logic Manual.*




*Not used when business machine clocking is used.
**Not standardized by EIA (Electronics Industry Association).
***Not standardized by CCITT (World Trade Interface).

***protective ground (PG):*** **A machine or frame ground for protection of operators.**

***signal ground (SG):*** **The common ground reference potential for all interface circuits.**

*transmitted data (TD)/+xmit line data:* Signals on this circuit are produced by the IBM 5280 and they key the modulator section of the modem. They also cause modulation of the carrier signal to meet the specifications of the transmitted mark and space levels.

*received data (RD)/+rec line data:* This line is driven by the demodulator section of the modem. When space frequency is being received over the transmission line, the '+rec line data' line is at its active level. When mark frequency is being received, the receive line is at its inactive level. When the received signal (mark or space) is below the threshold position of the carrier detect circuits, the receive data line will be clamped to its inactive level.

*request to send (RTS)/-req to send:* This lead controls the modem modulator turn-on and turn-off. When data set ready (DSR) is active, RTS brings up the carrier. In half-duplex operation, the active condition maintains the modem in the transmit mode and inhibits the receive mode of operation.

*clear to send (CTS)/-clear to send:* Signals to this lead are controlled by the modem to indicate whether or not it is ready to transmit data. The signal is a response to a request-to-send signal. When CTS is active, the IBM 5280 can key its transmitted data (TD) line.

There are three modem delay options on most nonswitched line modems. They are usually selected by the straps related to the clear-to-send line. Each delay is identified as the time between the active level being put on the request-to-send line and an active level appearing on the clear-to-send line. CTS delay times usually range from about 20 to 250 milliseconds. Switched line modems, operating in half-duplex mode, are normally strapped for approximately 180 to 200 milliseconds RTS/CTS delay.

*data set ready (DSR)/-data set rdy:* For nonswitched lines, this lead indicates that the modem is powered on and is operationally ready. For switched lines, the active condition of this lead indicates that the modem is connected to the telephone line and is ready to exchange further control of data.

The inactive condition indicates that the modem is not ready to operate. The inactive condition does not prevent the operational function of the ring indicator (RI) lead.

*data terminal ready (DTR)/-data term rdy:* The active condition of this lead indicates that the IBM 5280 is ready to operate. It also prepares the Autoanswer feature to answer an incoming call and connect the modem to the telephone line. When the active condition is established, DTR maintains the connection until DTR is again placed in the inactive condition.

*connect data set to line (CDSTL):* This lead is *not* standardized by EIA RS-232 Specifications. CDSTL is normally used with World Trade modems (CCITT 108.1). CDSTL functional use is the same as the DTR lead and is physically the same lead as DTR. CDSTL will not be activated however, until the ring indicate (RI) signal is active or the operator selects data mode on the modem, which causes DSR to be activated.

*receive line signal detector (CD)/-carrier det:* the active condition of this lead indicates to the IBM 5280 that a remote carrier frequency of enough quality is present on the modem's receive input. The inactive condition indicates that no signal is being received, or that the signal can not be accepted for demodulation. The inactive condition also clamps the received data (RD) lead to a mark level. On half-duplex channels, this circuit lead is held inactive whenever the request-to-send (RTS) signal is active, and for a short delay (approximately 100-millisecond echo clamp) following the active-to-inactive change on the request-to-send lead.

*data signal rate selector/-rate sel:* This circuit is required by all modems that provide two data transmission speeds over the same communications facility. The EIA active condition of this lead selects the higher speed rate. Modems with the same speed in BPS are *not* compatible if one modem is operating at its normal base rate and the other modem is operating at its half-speed rate.

*transmitter signal element timing/-xmit clk:* This circuit provides signal timing pulses to the IBM 5280 that are used for strobing out the transmitted data (TD) signals. The timing of the transmitted data signals should appear at the time when the clock signals transfer from active to inactive. The clock signals are provided on the serial clock transmit lead. The clock signals should be present on this circuit whenever the modem is powered on.

*receiver signal element timing/-rec clk:* This circuit provides signal timing pulses to the IBM 5280 that are used to strobe in the received data (RD) signals. The timing of the serial clock receive pulses should indicate the center of each received data (RD) element (bit) time.

*ring indicator/-ring ind:* Signals on this circuit indicate whether a calling signal is being received. Used with the Autoanswer feature, an active condition indicates that a calling signal is being received; an inactive condition indicates that no calling signal is being received.

*select standby/-sel standby:* Select standby is not standardized by EIA, but may be used as CCITT circuit 116. This circuit is required on a modem that is designed for operation on nonswitched networks and also provides switch network backup (SNBU) operation. When the circuit is held in the inactive condition by the IBM 5280, the IBM 5280 and the modem will operate in their normal-mode over the nonswitched facilities.

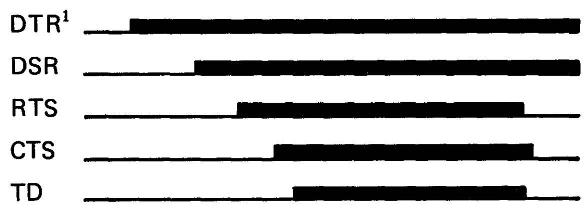
*test/-test control:* Test is not standardized by EIA or CCITT. This line, when active, can be used to start a modem wrap function from the business machine. (The modem must support this function. The transmitter output is looped back to the receiver input on the analog [line] side of the modem.)

*Timing Sequences*

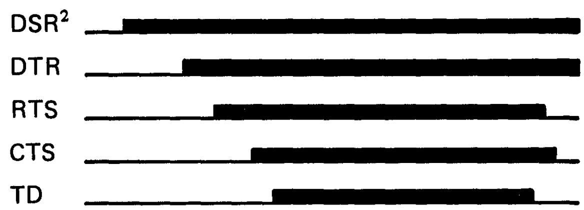
The following bar graphs represent normal timing sequences of operation during the establishment of communications for both switched and nonswitched networks.

Switched Timing Sequence – Data Terminal Ready Mode

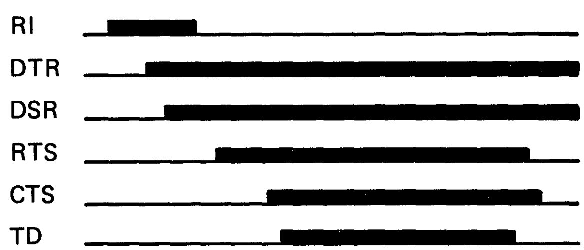
Ring Indicator (RI)
Data Terminal Ready (DTR)
Data Set Ready (DSR)
Request To Send (RTS)
Clear To Send (CTS)
Transmitted Data (TD)




Nonswitched Timing Sequence




Switched Timing Sequence – Connect Data Set To Line Mode




[1] DSR must be *off* for DTR to come *on*.
[2] DSR may be permanently on (typical of nonswitched line modems).

## LINE PROTOCOLS

### Binary Synchronous Communications (BSC)

The IBM 5280 Communications feature can use either IBM 3741 protocol or IBM 3780 protocol. The user selects the protocol with his configuration record.

Protocol, for BSC, refers to conventions for the use of control and text-framing character sequences that are exchanged between the communicating terminals or systems. Within the protocol structure, the control characters are defined for both message transfer state and control state.

Control state refers to the data link status during which message transmission is arranged. Message transfer state describes the status of the data link while the message is transferred. Message transfer state starts with the first start-of-text (STX) or start-of-header (SOH) character and ends with the end-of-transmission (EOT) or disconnect (DISC) character.

See the *BSC Control Characters* chart for a list of the BSC control characters and their meanings.

### BSC Control Characters

**Note:** These characters are for communications control only. They are added to the data stream output from the user's program into the line, and deleted from the line data stream input into the user's program.

| | | Character Meaning | | Character Structure | |
|---|---|---|---|---|---|
| Control Character | Character Name | Control State | Message-Transfer State | EBCDIC | ASCII |
| ENQ* | ENQuiry | Can you accept transmission? (point-to-point) | Between blocks: Please respond or repeat last response. Terminating a block: Remove this block and respond with NAK acknowledgment. | ENQ (hex 2D) | ENQ (hex 05) |
| ACK 0* | Even positive acknowledgment | I can accept transmission. | Even block received and accepted as valid. | DLE 70 (hex 1070) | DLE 0 (hex 1030) |
| ACK 1* | Odd positive acknowledgment | (Not a valid ACK in control state.) | Odd block received and accepted as valid. | DLE / (hex 1061) | DLE 1 (hex 1031) |
| STX | Start of text | Change to message-transfer state and start computing block check. | Clear block check value and start computing new check value. | STX (hex 02) | STX (hex 02) |
| SOH | Start of Header | Change to message-transfer state and start computing block check. | Clear block check value and start computing new value. | SOH (hex 01) | SOH (hex 01) |
| NAK* | Negative acknowledgment | I cannot accept transmission. | Text block *not* accepted as valid, but can accept a retransmission. | NAK (hex 3D) | NAK (hex 15) |
| TTD* | Temporary text delay | Transmission will begin again shortly. Respond NAK and wait. | Transmission will continue again shortly. Respond NAK and wait. | STX ENQ (hex 022D) | STX ENQ (hex 0205) |
| WACK* | Wait before transmit, positive acknowledgment | Enquire again later, and delay transmission until a positive acknowledgment is received. | Enquire again later and delay further transmission until a positive ACK 0 or ACK 1 is received. The previous block was received and accepted as valid. | DLE (hex 106B) | DLE ; (hex 103B) |
| ETB* | End of text block | (Not valid in control state.) | Block check value follows, then turnaround and response. Another text block to follow. | ETB (hex 26) | ETB (hex 17) |
| ITB | Intermediate transmission block | (Not valid in control state.) | A block check value follows. An ITB completes an intermediate text block for error checking but does not turn the line around. | ITB (hex 1F) | ITB (hex 1F) |
| ETX* | End of text | (Not valid in control state.) | Block check value follows, then turnaround and response. This completes the last text block of a job, but does not release the data link. | ETX (hex 03) | ETX (hex 03) |
| RVI* | Reverse interrupt | Valid in control state only if a selected (multipoint) station wants to transmit. | Positive acknowledgment and signal that system processor (presently a slave station) wants to become the master station. Local machine (presently master station) should give up control of the line as soon as possible. | DLE @ (hex 107C) | DLE < (hex 103C) |
| EOT | End of transmission | Drop synchronization and return to standby control state. Negative acknowledgment to multipoint poll. | Drop synchronization and return to standby control state. Not valid character if included in text (will cause abort to occur, unless transparency is specified). | EOT (hex 37) | EOT (hex 04) |
| PAD | Leading pad | Establish bit synchronization. | Establish bit synchronization. | PAD (hex 55) —Alternating Bit (01010101) | |
| PAD | Trailing pad | Last character transmitted before line turnaround. Ensures second to last character is fully transmitted. . | Last character transmitted prior to line turnaround. Ensure second to last character is fully transmitted. | PAD (hex FF) All one bits (11111111) | |
| SYN | Synchronous idle | Establish or ensure character synchronization, or used as a time fill character. At least two SYNs are required to ensure character synchronization. | Establish or ensure character synchronization, or used as a time fill character. At least two SYNs are required to ensure message synchronization. Automatically inserted at period of $\sim$1 second on long message blocks to maintain synchronization. | SYN (hex 32) | SYN (hex 16) |

*These control characters are used at line turnaround times.

Synchronization is required prior to the transmission or reception of control characters. The *Synchronization Initiating and Terminating Sequences* chart shows the character sequences that are used to initiate and to terminate synchronization.

**Synchronization Initiating and Terminating Sequences**

| | | |
|---|---|---|
| ENQ | P S S E P<br>A Y Y [ID] N A<br>D N N Q D | Response request. (May be a line bid, including a terminal ID character.) |
| | Or | |
| | S E P<br>T text N A<br>X Q D | Incomplete ending when transmitter cannot complete a block. Correct acknowledgment is NAK from remote station. |
| ACK 0<br>Or<br>ACK 1 | P S S D O (X'70') P<br>A Y Y (ID) L or A<br>D N N E / (X'61') D | Positive acknowledgment to even or odd block, or to a line bit. (ACK 0 is the only valid line bid ACK.) X = HEX |
| STX | P S S S<br>A Y Y T text<br>D N N X | Text block beginning. The block check circuits are cleared, and computation of a new block check value at both transmitter and receiver begins. Also serves as a positive acknowledgment in conversational mode of operation. |
| NAK | P S S N P<br>A Y Y A A<br>D N N K D | Negative acknowledgment made by the receiver when not accepting the last received transmission or when not accepting the line bid. |
| TTD | P S S S E P<br>A Y Y T N A<br>D N N X Q D | Transmitter transmission delay sequence. This sequence replaces STX and text when the transmitter needs time to make itself ready to transmit. The receiver responds with NAK and waits for text transmission to begin. If still not ready, the transmitter repeats TTD after 2 seconds. |
| WACK | P S S D, (X'6B') P<br>A Y Y L A<br>D N N E D | Receiver transmission delay sequence. This sequence replaces an ACK response when the receiver needs time to make itself ready to receive. The transmitter enquires (ENQ) again immediately, and the receiver repeats WACK after 2 seconds if still not ready to receive. |
| ETB | E B B P<br>text T C C A<br>B C C D | ETB signals that the transmitter's computed check value BCC (block check character) follows after which a turnaround and response is expected. More text is coming. |
| STX<br>text<br>ETX | P S S S E B B P<br>A Y Y T text T C C A<br>D N N X X C C D | STX text ETX signals that the BCC follows, after which a turnaround and response is expected. |
| RVI | P S S D, (X'7C') P<br>A Y Y L @ A<br>D N N E D | In IBM 3741 mode, the RVI is treated as a positive acknowledgment, and the job is not aborted. In IBM 3780 mode, the RVI is again a positive acknowledgement, and one block of data may be transmitted following the reception of the RVI and before the transmission of the EOT. |
| EOT | P S S E P<br>A Y Y O A<br>D N N T D | Data link termination. All stations that receive this sequence drop synchronization and return to the control state, waiting for a new data link to be established by a line bid and response. An EOT, to be valid, must also use the first 4 bits of trailing PAD character. |
| DISC | P S S D E P<br>A Y Y L O A<br>D N N E T D | Disconnect sequence used on a switched line to cause the line to be dropped. Can be sent instead of EOT on a switched line. |

**Notes:**

1. Synchronization is dropped at each line turnaround. The PAD SYN SYN sequence after turnaround reestablishes synchronization.
2. The trailing PAD character (hex FF) may not be completely received during line turnaround and may overlap in time with the first portion of the leading PAD character. Thus, the first portion of the leading PAD may also not be received.

*Time-Outs*

As a companion to the use of character sequences, the BSC features time-outs as part of the protocol structure. The time-outs are to prevent indefinite data link tieups caused by machine malfunctions or trouble on the communications line. The time-outs establish a fixed time interval within which a particular operation must occur. Four specific time-out functions are used by the BSC protocol. The time-outs and their durations are:

| | |
|---|---|
| • Transmit time-out | 1 second |
| • Receive time-out | 3 seconds |
| • Continue time-out | 2 seconds |
| • Disconnect time-out | 20 seconds |

*Transmit Time-Out:* The transmit time-out is used during text transmissions. After each second of the text transmission, the communications MPU card inserts the SYN SYN synchronization pattern (DLE SYN during transparency transmission) into the text to maintain character synchronization.

If the IBM 5280 is transmitting in transparency mode and is configured for internal clocking with half-speed selected, the transmit time-out period is 1 second.

*Receive Time-Out:* The receive time-out is a 3-second time-out and is used as follows:

- Limits the waiting time tolerated by a transmitting station to receive a reply from the receiving station.

- Allows the receiving station to end its operation if it does not receive two SYN characters from the line within the 3-second interval. After three seconds, the receiving station transmits an ENQ.

- Limits the time any tributary station on a multipoint network remains in control mode while monitoring the line for its address. The time-out runs whenever the station is in control mode. It is reset and restarted each time an end signal is recognized (EOT, ENQ, TTD, RVI, NAK, WACK, ACK 0/1).

*Continue Time-Out:* The continue time-out is used by stations when data is temporarily unavailable for transmitting and when a receiving station is temporarily unable to receive additional data. The continue time-out allows a 2-second delay before the transmitting station sends a TTD (temporary text delay) character sequence when the data is not immediately available for transmission. Similarly, the continue time-out allows a 2-second delay before the receiving station sends a WACK response to a data block when the receiving station cannot accept more data. The continue time-out ensures that the transmitting and receiving stations send and receive responses (TTD or WACK) within the 3-second receive time-out period to keep the line active.

*Disconnect Time-Out:* The disconnect time-out is used optionally on the switched network. It is used to prevent a station from holding a connection for prolonged periods of inactivity. After a user-specified time of no activity on the line, the station disconnects (hangs up) from the switched network. The time-out is specified in the configuration record as number of receive retries and/or number of line bid retries.

## Control Sequences

### *Point-to-Point*

**The point-to-point control sequences are shown in the following chart. The leading and trailing PAD characters, SYN characters, and BCC characters are not shown.**

Normal Message Transmission

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Transmitting station sends: | ENQ | | STX (TEXT) ETB | | STX (TEXT) ETB | | STX (TEXT) ETB | | STX (TEXT) ETX | | EOT |
| Receiving station sends: | | ACK 0 | | ACK 1 | | ACK 0 | | ACK 1 | | ACK 0 | |

Unanswered Line Bid

| | | | | |
|---|---|---|---|---|
| Transmitting station sends: | ENQ (3-second receive time-out) | ENQ (3-second receive time-out) | ENQ (3-second receive time-out) | EOT |

**Note:** For switched network operation, the number of retries is specified by the user's configuration record. For nonswitched operation, the maximum number of bid retries is specified by the user.

Terminal-to-Terminal Retransmission Accepted

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Transmitting station sends: | ENQ | | STX (TEXT-A) ETB | | STX (TEXT-A) ETB | | STX (TEXT-B) ETX | | EOT |
| Receiving station sends: | | ACK 0 | | NAK | | ACK 1 | | ACK 0 | |

Terminal-to-Terminal Retransmission Rejected

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Transmitting station sends: | ENQ | | STX (TEXT-A) ETB | | STX (TEXT-A) ETB | | STX (TEXT-A) ETB | | STX (TEXT-A) ETB | | EOT |
| Receiving station sends: | | ACK 0 | | NAK | | NAK | | NAK | | NAK | |

Terminal-to-Processor Retransmission Rejected

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Terminal station sends: | ENQ | | STX (TEXT-A) ETB | | STX (TEXT-A) ETB | | (Repeat N times, counted by processor program.) | STX (TEXT-A) ETB | |
| Processor station sends: | | ACK 0 | | NAK | | NAK | | | EOT |

Processor-to-Terminal Retransmission Rejected

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Processor station sends: | ENQ | | STX (TEXT-A) ETB | | STX (TEXT-A) ETB | | (Repeat N times, counted by processor program.) | STX (TEXT-A) ETB | | EOT |
| Terminal station sends: | | ACK 0 | | NAK | | NAK | | | NAK (Repeat n times as specified by the user.) | |

Receive Initiated Transmission Delay

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Transmitting station sends: | ENQ | | STX (TEXT) ETB | | STX (TEXT) ETB | | STX (TEXT) ETB | | ENQ | | ENQ | | STX (TEXT) ETB etc. |
| Receiving station sends: | | ACK 0 | | ACK 1 | | ACK 0 | | (2-second continue time-out) WACK | | (2-second continue time-out) WACK | | ACK 1 | |

**Note:** Allows receiver to clear buffer block. ENQ may be an immediate response to WACK.

Transmitter-Initiated Transmission Delay

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Transmitting station sends: | ENQ | | STX (TEXT) ETB | | STX (TEXT) ETB (2-second continue time-out) | | TTD | | TTD (2-second continue time-out) | | TTD | | STX (TEXT) ETX | | EOT |
| Receiving station sends: | | ACK 0 | | ACK 1 | | ACK 0 | | (2-second continue time-out) NAK | | NAK | | NAK | | ACK 1 | |

**Note:** Allows transmitter to fill buffer block. If the transmitter is unable to continue, it sends EOT instead of TTD and transmission ends incomplete.

STX Format Error, Data Ignored by Slave Station

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Transmitting station sends: | ENQ | | STX (TEXT-A) ETB | | (TEXT-B) ETB (3-second receive time-out) | (No response) | ENQ | | STX (TEXT-B) ETB | | STX (TEXT-C) ETX | | EOT |
| Receiving station sends: | | ACK 0 | | ACK 1 | | | | ACK 1 | | ACK 0 | | ACK 1 | |

**Note:** Receiver did not synchronize nor did it receive TEXT-B the first time. The transmitter retransmits.

**Note:** Line bid acknowledgments are always even, the first text block is always odd.

**Response Not Matched to Odd-Even Block Count**

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Transmitting station sends: | ENQ | | STX | (TEXT-A) | ETB | | STX | (TEXT-B) | ETB | | ENQ | | ENQ | | ENQ | | EOT |
| Receiving station sends: | | ACK0 | | | | ACK1 | | | | ACK1 | | ACK1 | | ACK1 | | ACK1 | |

**Note:** Number of retries specified by user's configuration record.

---

Data Link Aborted on No-Response from Receiver

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Transmitting station sends: | ENQ | | STX | (TEXT) | ETB (3-second receive time-out) | ENQ (3-second receive time-out) | ENQ (3-second receive time-out) | ENQ (3-second ENQ receive time-out) | EOT |
| Receiving station sends: | | ACK0 | | | (No response) | (No response) | (No response) | (No response) | |

Number of retries specified by user's configuration record. The 3-second time-out also limits time between turnarounds and length of uninterrupted transmission. In these cases, synchronism is dropped and the transmission is ignored by the receiver.

---

Data Link Stalemated on No-Continuation by Transmitter

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Transmitting station sends: | ENQ | | STX | (TEXT) | ETB | | (No continuation) |
| Receiving station sends: | | ACK0 | | | | ACK1 | (Indefinite wait for continuation. On switched networks, the BSC feature disconnects after 20 seconds.) |

---

Transmitter Device Error or Input Check

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Transmitting station sends: | ENQ | | STX | (TEXT) | ETB | | TTD | | EOT |
| Receiving station sends: | | ACK0 | | | | ACK1 | | NAK | |

Receiver Buffer Check or Device Error

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Transmitting station sends: | ENQ | | STX | (TEXT) | ETB | | STX | (TEXT) | ETB | |
| Receiving station sends: | | ACK0 | | | | ACK1 | | | | EOT |

Buffer Overflow at Receiver

| | | | | | | |
|---|---|---|---|---|---|---|
| Transmitting station sends: | ENQ | | STX | (TEXT-A) | ETB | |
| Receiving station sends: | | ACK0 | | | | EOT |

*Multipoint*

The user specifies multipoint in the configuration record. The IBM 5280 can be a tributary station only. The control station is the focal point of the network and maintains an orderly flow of network traffic by initiating and participating in all data transfers.

**The control station precedes each poll or select sequence with an EOT character to ensure that all stations are in control state and monitoring the line. Then it transmits one of the two addressed line-bid sequences to alert a particular station.**

A *selection* sequence alerts a tributary station that it is to receive; a *polling* sequence invites a tributary station to transmit. The station address in the line-bid sequence is an alphabetic character preceding the line-bid ENQ, encoded in uppercase for a poll or lowercase for a selection (the same alphabetic address character is transmitted twice to ensure data security). Each tributary station has its own alphabetic-character address. The user specifies the IBM 5280 station address in the configuration record. The following multipoint control sequence chart shows the sequences that are required for multipoint control.

```
Normal Selection and Data Transmission
Control station sends:  E          E        S            E        S            E         E
                        O   **¤    N        T (TEXT-A)   T        T (TEXT-B)   T         O
                        T          Q        X            B        X            X         T
IBM 5280 sends:                     A                     A                     A
                                    C0                    C1                    C0
                                    K                     K                     K
---------------------------------------------------------------------------------------------
Selection with NAK Response
Control station sends:  E          E
                        O   **¤    N
                        T          Q
IBM 5280 sends:                     N     (Selected station cannot accept transmission.)
                                    A
                                    K
---------------------------------------------------------------------------------------------
Selection with WACK Response
Control station sends:  E          E
                        O   **¤    N
                        T          Q
IBM 5280 sends:                     D     (Temporarily not ready to receive, inquire
                                    L,    again later.)
                                    E
---------------------------------------------------------------------------------------------
Selection with RVI Response
Control station sends:  E          E
                        O   **¤    N
                        T          Q
IBM 5280 sends:                     D     (Cannot accept transmission because of data in buffer.
                                    L@    Poll to receive data in buffer and then select.)
                                    E
---------------------------------------------------------------------------------------------
Normal Polling and Data Transmission
Control station sends:  E          E              A                  A            E         E
                        O   **¤    N              C1                 C0           O   **¤   N
                        T          Q              K                  K            T         Q
IBM 5280 sends:                    S            E         S             E      E
                                   T (TEXT-A)   T         T (TEXT-B)    T      O    (IBM 5280 does not answer
              Notes:               X            B         X             X      T    another station's address.)
```

1. The IBM 5280 accepts only EOT, STX, or its own station address following synchronization in the control state. EOT preceding polling or selection drops synchronization throughout the network, but no pad characters are used because there is no turnaround. Two SYNs precede the station address after the EOT.
2. If the station being polled has nothing to transmit, it responds with EOT.

** Station alphabetic address, lowercase for selection or uppercase for polling (the same character is transmitted twice). The IBM 5280 checks that both received address characters are the same: if they are not, the IBM 5280 ignores the poll or selection sequence.

¤ IBM 3780 numerical unit selection (not supported by the CAM in multipoint). Numerical unit selection is ignored if received.

**Transparent Data**

The IBM 5280 can transmit and receive data in transparency mode. This mode allows all 256 possible EBCDIC combinations to be computed as data, including the BSC control characters.

The MPU in the IBM 5280 generates control characters for transparent data communications by inserting a DLE ahead of standard BSC control characters that are sent in message-transfer state. Otherwise (with no preceding DLE as identification), any bit configurations that are equivalent to those of control characters are sent as text data. The exception is the DLE character itself, which is identified as data by a preceding DLE. Thus, transparency causes the transmitter to add, and the receiver to delete DLEs to identify a following character that must be specifically treated. All others are always treated as data, and only data is passed to the application program.

```
        Control DLE Character\        /Data DLE Character        /Data ETX Character
                              \      /                          /
D S                            D D                             E     D E
L T                            L L                             T     L T
E X                            E E                             X     E X
     \___________________________________________________________/
                           Transparent Data
```

**Differences between IBM 3741 Mode and IBM 3780 Mode**

Although the general protocol used by the IBM 5280 is the same for both IBM 3741 mode (IBM 3741 BSC emulation) and IBM 3780 mode (IBM 3780 BSC emulation), there are several differences between the two modes in data handling and capabilities.

When the IBM 5280 is receiving in IBM 3741 mode, the record length is determined by the length of the first record received. When the IBM 5280 is transmitting in IBM 3741 mode, for example, the record length (1 to 128 bytes) in a file is determined by the length specified in the configuration record. Records that are shorter than the specified length are padded to the fixed length (as specified) with blanks before transmission, and each record is followed by an IRS (interchange record separator) character (unless unblocked format is used).

To identify the end of the file, the IBM 5280 sends a null record. The format of the null record, complete with synchronization and termination characters, follows:

```
P P S S S E B B P
A A Y Y T T C C A
D D N N X X C C D
```

In IBM 3780 mode, records within a block can be of variable length. Each record in the block is again followed by an IRS character (hex 1E).

In IBM 3780 mode, blank truncation or space compression/expansion allows the trailing blanks to be dropped from the data prior to transmission. The blanks are not replaced at the receiving station.

With space compression specified, the transmitting station replaces from 2 to 63 contiguous spaces within a record with an interchange group separator (IGS) character (hex 1D) immediately followed by a byte that designates the number of spaces replaced. With space expansion, the receiving station restores the spaces into the record.

The byte that follows the IGS character has the following structure:

| | |
|---|---|
| 01XX XXXX | where XX XXXX is the binary representation of the number of spaces replaced. |

Therefore, the IGS character followed by hexadecimal 7F represents 63 spaces, and the IGS character followed by hexadecimal 45 represents 5 spaces.

In either IBM 3741 mode or IBM 3780 mode, the IBM 5280 exchanges security identification with the remote station during the initial bid for the line for a switched network communications session. The identification character sequence (ID) is provided by the user for both the local and remote stations in the configuration record. A 4-character sequence is required for the local ID in IBM 3741 mode, and a 5-character sequence is required for IBM 3780 mode. A remote ID can be up to 15 characters long. The security identification character sequence is positioned between the SYNs and the ENQ character in a bid and between the SYNs and the response (ACK or NAK) in a bid response.

In IBM 3780 mode, the IBM 5280 can respond to special forms-control character sequences, which are passed to the user in receive mode as the first two bytes in a data record. These characters are part of the data supplied by the remote system user.

**Synchronous Data Link Control**

SDLC (synchronous data link control) is a protocol for the management of data transfer over a data communications link. SDLC determines:

- The definition of primary and secondary station responsibilities
- The definition of the transmission states that affect information transfers
- The design of information grouping for control and checking
- The design of the format for the transfer of information and the control of data

Primary stations are the commanding stations. They have the responsibility of controlling all transmissions to or from any secondary (responding) station on the data link.

Only a station operating as a primary station can initiate transmissions, and all transmissions must go to or from the primary station.

A station can be assigned as a primary station for one portion (data link) of a teleprocessing network, and as a secondary station for another data link in the same network. The IBM 5280 is always a secondary station.

*SDLC Transmissions*

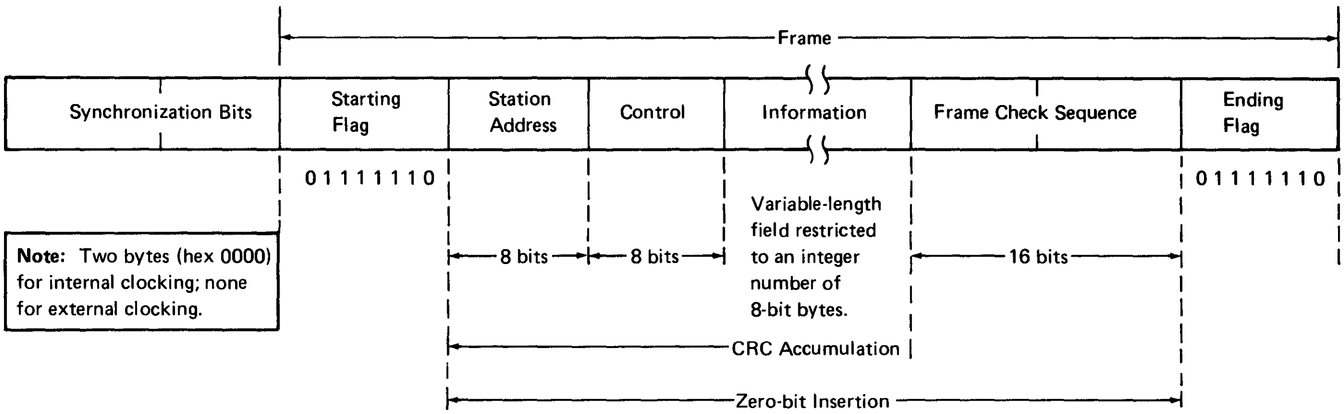
All transmissions using SDLC are carried in a basic level called a frame. The frame contains all the commands, responses, and information that is being transmitted. Frames can be transmitted one at a time, or grouped together and sent in a sequence.

If frames are transmitted one at a time, and if the poll bit is on, a response frame is returned by the receiving station for each frame received. If a sequence of frames is transmitted, and if the poll bit is on, the receiving station sends a response frame only after reception of the last frame.

When transmitting sequenced frames, the transmitting station counts and numbers each frame. This count is the Ns count. The station receiving the sequenced frame counts each error-free frame it receives. This count is the Nr count.

The Ns and Nr counters start at 0 and count through 7. When the counter is at 7 and another frame is counted, the counter advances to 0.

*SDLC Frame Format*




*Synchronization Bits:* This field, although not a part of the SDLC frame, is shown here because of its relationship with the frame. When the Internal Clock feature is used, the SDLC adapter inserts two synchronization bytes into the data stream before the starting flag sequence. These two bytes are used to obtain or maintain synchronization of the clock following a line turnaround. An additional two bytes can be inserted as specified in the configuration record. When the Internal Clock feature is installed, NRZI must be used (see *NRZI (Nonreturn to Zero Inverted)* later in this section).

*Starting Flag:* The starting flag starts the frame. The starting flag also causes transmission error checking to begin with the first nonflag character following. It is composed of eight bits with a configuration of hexadecimal 7E (01111110). This flag serves as a reference to show the position of the address and control fields.

*Station Address:* This 8-bit field always identifies the IBM 5280, whether it is transmitting to or receiving from the primary station. The IBM 5280, in addition to recognizing its own address, is capable of recognizing the broadcast address of 11111111. The address field must be recognized before a frame can be received.

*Control:* The control field carries the commands and responses necessary to control a data link. It comprises eight bits.

*Information:* This field is not present in all frames. The information (I) field is not restricted to any bit sequence, but it is restricted to an integer number of 8-bit bytes and by the buffering limits of the stations communicating with each other. The information field contains the data to be moved, via the data link, from place to place in the system. The data contained in this field is checked for validity by the frame check field.

*Frame Check Sequence:* This field contains 16 bits. The configuration of these bits depends on a mathematical computation of the digital value of all the bits within the station address field, the control field, and the information field. The transmitter performs the computation and sends the binary complement of the result, in the frame check sequence field, to the receiver. The receiver computes the value for the received frame. If the transmission is error free, the receiving station should show a remainder of hexadecimal F0B8 (including the received CRC FCS). This type of checking is referred to as cyclic redundancy checking (CRC).

**Note:** Inserted zeros are not included in the CRC accumulation.

*Ending Flag:* The ending flag ends the frame and transmission error checking. It is composed of eight bits with a configuration of hexadecimal 7E (01111110). When more than one frame is transmitted, the ending flag of one frame can also be the starting flag of the next frame.

**Commands and Responses**

The commands and responses in the SDLC frame are contained in the control field. The following charts show both the supported and nonsupported commands and responses.

| Format[1] | Sent Last ↓ | Binary Configuration | Sent First ↓ | Acronym | Command | Response | I-field Prohibited | Resets Nr and Ns | Confirms Frames Through Nr-1 | Definitions |
|---|---|---|---|---|---|---|---|---|---|---|
| NS | 100 | P | 0011 | SNRM | X | | X | X | | Set normal response mode; transmit on command. |
| NS | 000 | F | 1111 | DM | | X | X | | | This station is offline. DM is the same as ROL. |
| NS | 010 | P | 0011 | DISC | X | | X | | | Enter normal disconnect mode (go on hook if switched). |
| NS[2] | 011 | F | 0011 | UA/NSA[2] | | X | X | | | Acknowledge NS commands. |
| NS[2] | 100 | F | 0111 | FRMR/ CMDR[2] | | X | | | | Invalid command received; must receive SNRM or DISC to reset FRMR condition. |
| NS | 101 | P/F | 1111 | XID | X | X | | | | Solicits station ID. |
| NS | 111 | P/F | 0011 | TEST | X | X | | | | Tests a link. The I-field may contain test data. |
| S | Nr | P/F | 0001 | RR | X | X | X | | X | Ready to receive. |
| S | Nr | P/F | 0101 | RNR | X | X | X | | X | Not ready to receive. The IBM 5280 has no buffers available. |
| I | Nr | P/F | Ns 0 | I | X | X | | | X | Sequenced I-frame. |

[1] NS = nonsequenced, S = supervisory, I = information

[2] The ISO/ANSI terms for the NS commands and responses differ from those shown. The NS is referred to as the U (unnumbered) format. The acronyms are changed as follows:

| From | To |
|---|---|
| NSA | UA |
| CMDR | FRMR |

### Commands and Responses Not Supported

**Note:** Any of the following commands received by an IBM 5280 will cause a FRMR response to be sent to the host system.

| Format[1] | Sent Last ↓ | Binary Configuration | Sent First ↓ | Acronym | Command | Response | I-Field Prohibited | Resets Nr and Ns | Confirms Frames Through Nr-1 | Definitions |
|---|---|---|---|---|---|---|---|---|---|---|
| NS[2] | 000 | F | 0111 | RIM/RQI[2] | | X | X | | | Initialization needed; expect SIM. |
| NS | 000 | P | 0111 | SIM | X | | X | X | | Set initialization mode; the using system prescribes the procedures. |
| NS[2] | 010 | P/F | 0011 | RD/RQD[2] | | X | | | | Request disconnect. |
| NS[2] | 000 | P/F | 0011 | UI/NSI[2] | X | X | | | | Command or response that contains nonsequenced information. |
| S | Nr | P/F | 1001 | REJ | X | X | X | | X | Transmit or retransmit, starting with frame Nr. |

[1] NS = nonsequenced, S = supervisory.

[2] The ISO/ANSI terms for the NS commands and responses differ from those shown. The NS is referred to as the U (unnumbered) format. The acronyms are changed as follows:

| From | To |
|---|---|
| RQI | RIM |
| RQD | RD |
| NSI | UI |

## SDLC COMMANDS AND RESPONSES IN HEXADECIMAL NOTATION

Nonsequenced Commands

| | P | P |
|---|---|---|
| SNRM | 93 | 83 |
| DISC | 53 | 43 |
| SIM | 17 | 07 |
| UI/NSI | 13 | 03 |
| NSP | 33 | 23 |
| XID | BF | AF |
| TEST | F3 | E3 |
| CFGR | D7 | C7 |
| RGA | 57 | 47 |

Nonsequenced Responses

| | F | F |
|---|---|---|
| UA/NSA | 73 | 63 |
| DM | 1F | 0F |
| FRMR/CMDR | 97 | 87 |
| RIM/RQI | 17 | 07 |
| UI/NSI | 13 | 03 |
| XID | BF | AF |
| TEST | F3 | E3 |
| BCN | FF | EF |
| RD/RQD | 53 | 43 |
| CFGR | D7 | C7 |

Legend

Hexadecimal digit for X

| Nr= | P/F | P/F |
|---|---|---|
| 0 | 1 | 0 |
| 1 | 3 | 2 |
| 2 | 5 | 4 |
| 3 | 7 | 6 |
| 4 | 9 | 8 |
| 5 | B | A |
| 6 | D | C |
| 7 | F | E |

Hexadecimal digit for Y

| NS= | Hex |
|---|---|
| 0 | 0 |
| 1 | 2 |
| 2 | 4 |
| 3 | 6 |
| 4 | 8 |
| 5 | A |
| 6 | C |
| 7 | E |

Supervisory Commands/Responses
(see *Legend* for X)

| | |
|---|---|
| RR | X1 |
| RNR | X5 |
| REJ | X9 |

Information Commands/Responses
(see *Legend* for Y)

| | |
|---|---|
| 1 | XY |

*Control Field Format*

The control field contains eight bits with the following bit assignments.

*Bits 0 through 2:* Bits 0 through 2 of the information transfer and supervisory formats contain the sequence number of the next expected frame. This is the Nr count.

*Bit 3:* Bit 3 of all formats is the poll/final (P/F) bit. The poll bit, sent by the primary station, permits the transmission of data from the secondary station. The secondary station sends a final bit when it has completed the transmission of data.

*Bits 4 through 6:* Bits 4 through 6 of the information transfer format contain the sequence number of the frames that have been sent. This is the Ns count. Bit 6, in the supervisory and nonsequenced formats, is also used with bit 7 for format identification.

*Bit 7:* Bit 7 in the information format (bits 6 and 7 in the supervisory and nonsequenced formats) identifies the three control field formats: supervisory, information transfer, and nonsequenced.

Bits that are not used, as stated above for the format, are used to encode the commands and responses necessary to control a data link. The commands and responses are described later.

*Control Field for the Information Transfer Format*

| Bit | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| | | Nr | | P/F | | Ns | | 0 |

The information transfer format is used to transfer information over a data link. The transmitting station increments its Ns count and, if the receiving station receives a valid sequenced frame, the receiving station increments its Nr count.

*Control Field for the Supervisory Format*

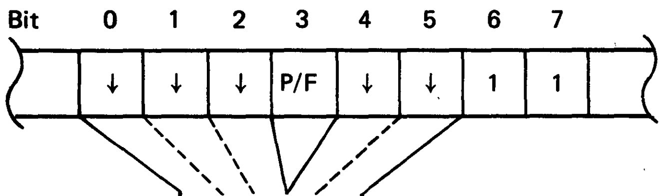
| Bit | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| | | Nr | | P/F | ↓ | ↓ | 0 | 1 |
| | | | | | 0 | 0 | Receive Ready (RR) | |
| | | | | | 0 | 1 | Receive Not Ready (RNR) | |

The supervisory format is used to acknowledge information frames, to request retransmission of information frames, and to report a busy condition. The commands and responses of the supervisory format are:

- Receive ready (RR): This is a command or a response (sent by the primary station or by the secondary station) that indicates that the originating station is ready to receive data and has no data to transmit. Receive ready also acknowledges information frames with sequence counts through Nr minus 1.

- Receive not ready (RNR): This is a command or a response (sent by the primary station or by the secondary station) that indicates that the station has a busy condition and cannot receive additional information frames. Receive not ready also acknowledges information frames with sequence counts through Nr minus 1.

*Control Field for the Nonsequenced Format*




| | |
|---|---|
| 0 1 0 0 0 | Disconnect (DISC) |
| 1 0 0 0 0 | Set Normal Response Mode (SNRM) |
| 0 1 1 0 0 | Unnumbered Acknowledgment (UA) |
| 1 1 1 0 0 | Test |
| 1 0 0 0 1 | Frame Reject (FRMR) |
| 0 0 0 1 1 | Disconnected Mode (DM) |
| 1 0 1 1 1 | Exchange Station Identification (XID) |
| X X X X X | All remaining bit combinations are not used. |

The nonsequenced format is used to perform data link control functions. The commands and responses for the nonsequenced format are:

- Disconnect (DISC): This is a command from the primary station that places the secondary station in a disconnected state. The secondary station lets the primary station know that it has received the command by responding with an UA (unnumbered acknowledgement) if in the normal response mode, and a DM (disconnected mode) if in the disconnected mode. In either case the IBM 5280 gets on hook if attached to a switched line.

- Set normal response mode (SNRM): This command from the primary station places the secondary station in a normal response mode. The response to SNRM is UA (unnumbered acknowledgement). When an SNRM command is received, the sequence count (Ns and Nr) are reset to zero at both stations.

- Unnumbered acknowledgement (UA): This is an affirmative response to a DISC or SNRM command. It indicates that the command has been accepted.

- Test: This is a command and a response. The primary station transmits a test command that usually has test data in the I-field. The test data sent with the command is returned in the response from the secondary station. However, if the amount of test data is more than the amount of data that can be put into the received buffer, or if no test data is sent, only the control field is returned in response.

- Frame reject (FRMR): This is a response to an invalid command received by the secondary station. A FRMR response includes an information field that gives the reason for rejecting the command.

- Disconnected mode (DM): This is a response from the secondary station, which indicates that the station is in a disconnected state and that it wants an online status.

- Exchange station identification (XID): The primary station uses XID as a command to request station identification from the secondary station. The primary station also has the option of giving its own identification. The secondary station sends XID only in response to an XID command.

### XID Format

The following is the XID information that the IBM 5280 sends to the primary station:

| Hex Displ | Length in Bytes in Hex | Description |
|---|---|---|
| 00 | 1 | X'12' – Variable format (PU type 2). |
| 01 | 1 | X'14' – The length of the XID. |
| 02 | 4 | X'032xxxxx' – '032' = Block number for the IBM 5280. 'xxxxx' = The ID specified by the user in the CCU. |
| 06 | 2 | X'0000' – Not used. |
| 08 | 1 | X'00' – The secondary station is the sender (Slow connect, HDX). |
| 09 | 1 | X'B0' – The PU can receive FMD RUs. (Segments are not allowed.) |
| 0A | 2 | X'0100' – RU size (256 bytes). |
| 0C | 1 | X'00' – SNA set. |
| 0D | 1 | X'00' – SREJ, SARM, SIM, and RQI are not supported. |
| 0E | 2 | X'0000' – Not used. |
| 10 | 1 | X'07' – The maximum link out count. |
| 11 | 1 | X'00' – Not used. |
| 12 | 1 | X'00' – No address assignment. |
| 13 | 1 | X'00' – No dial digits. |

#### *SDLC Response Modes*

There are two response modes for a secondary station using SDLC protocol: NRM (normal response mode) and NDM (normal disconnect mode).

In normal response mode, the secondary station can transmit if it has received a frame with the poll bit on. Single or sequential frames can be transmitted. The last frame transmitted has the final bit on. Once a frame is transmitted with the final bit on, the secondary station cannot transmit until it receives another frame with the poll bit on.

In normal disconnect mode, the secondary station normally responds with DM (disconnected mode) unless it receives an SNRM, TEST, or XID command.

### *SDLC Transmission States*

There are four transmission states for an SDLC data link: active, disconnect, idle, and transient. Only one of these states can exist at any one time.

*Active State:* When the data link is in the active state, a station is transmitting or receiving data. Flags are used to initiate or maintain the active state. Once the secondary station is in the active state, it must remain active until it sends a frame with the final bit.

*Disconnect State (Switched Lines Only):* In the disconnect state, when the data link is inoperative by specific intent of the primary station, no transmissions are possible. The primary station does not monitor the data link for incoming transmissions.

*Idle State:* In the idle state, the data link is operational but no transmissions are in progress. Whenever a station does not have the priority to transmit, that station reverts to the idle state. Also, when 15 or more contiguous 1-bits are detected, the data link reverts to the idle state.

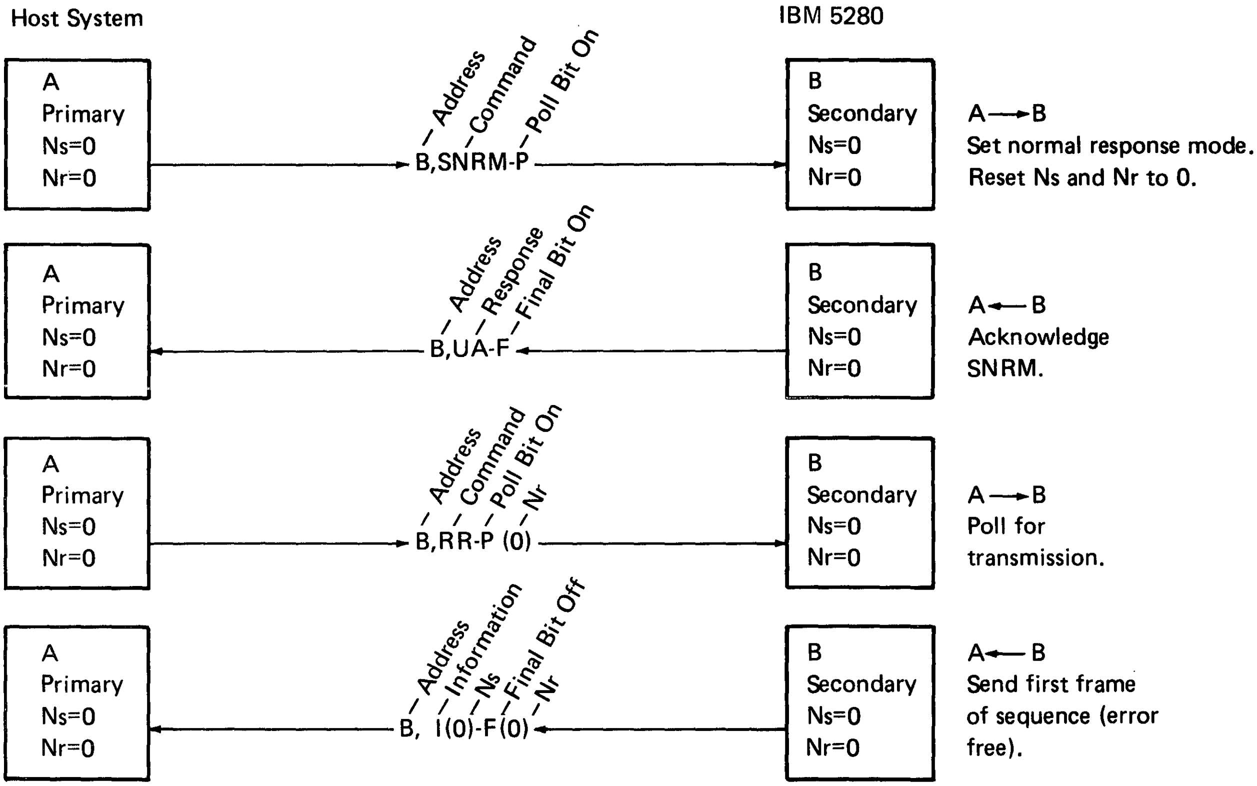
*Transient State:* When the data link is in the transient state, a station is preparing to transmit. This is called turnaround delay. The delay begins when a station initiates the request-to-send signal and ends when the modem provides the clear-to-send signal.

For more information on SDLC, see *IBM Synchronous Data Link Control General Information,* GA27-3093.

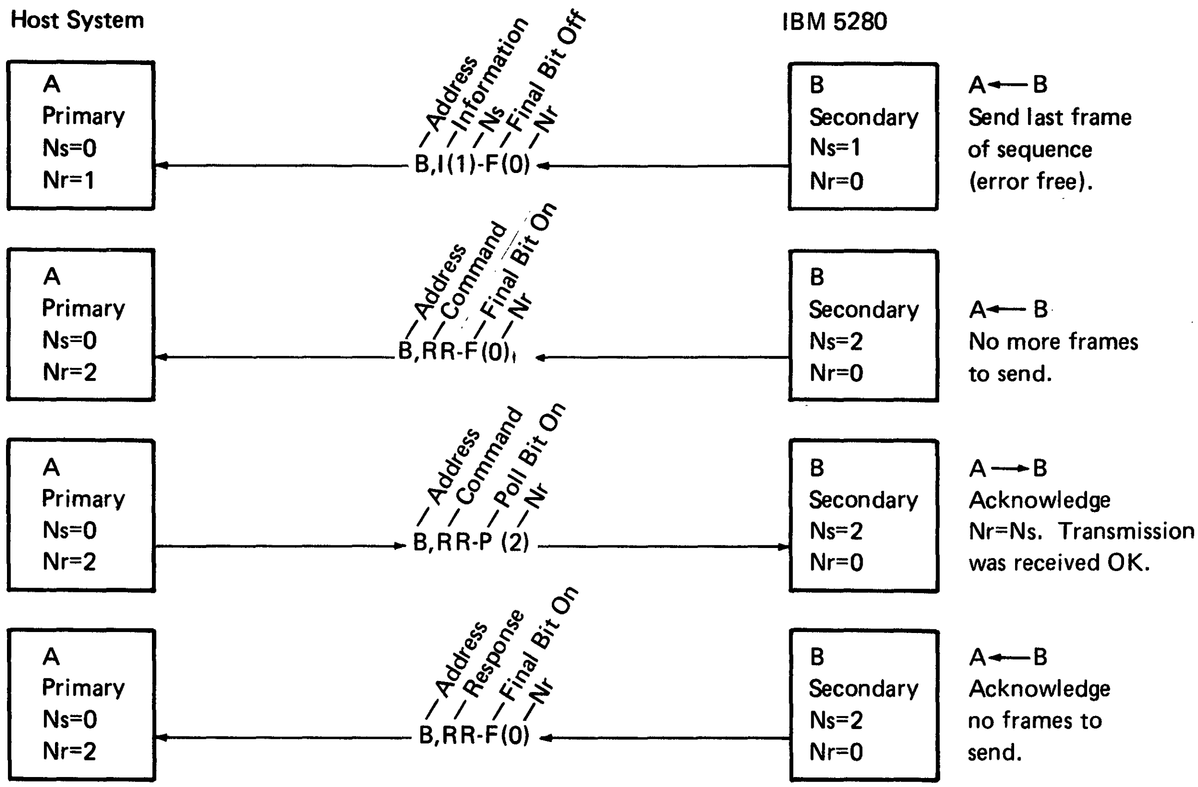
### Transmission Examples

The following figures show examples of frame transmissions: transmissions that occur error free followed by transmissions that occur with errors.

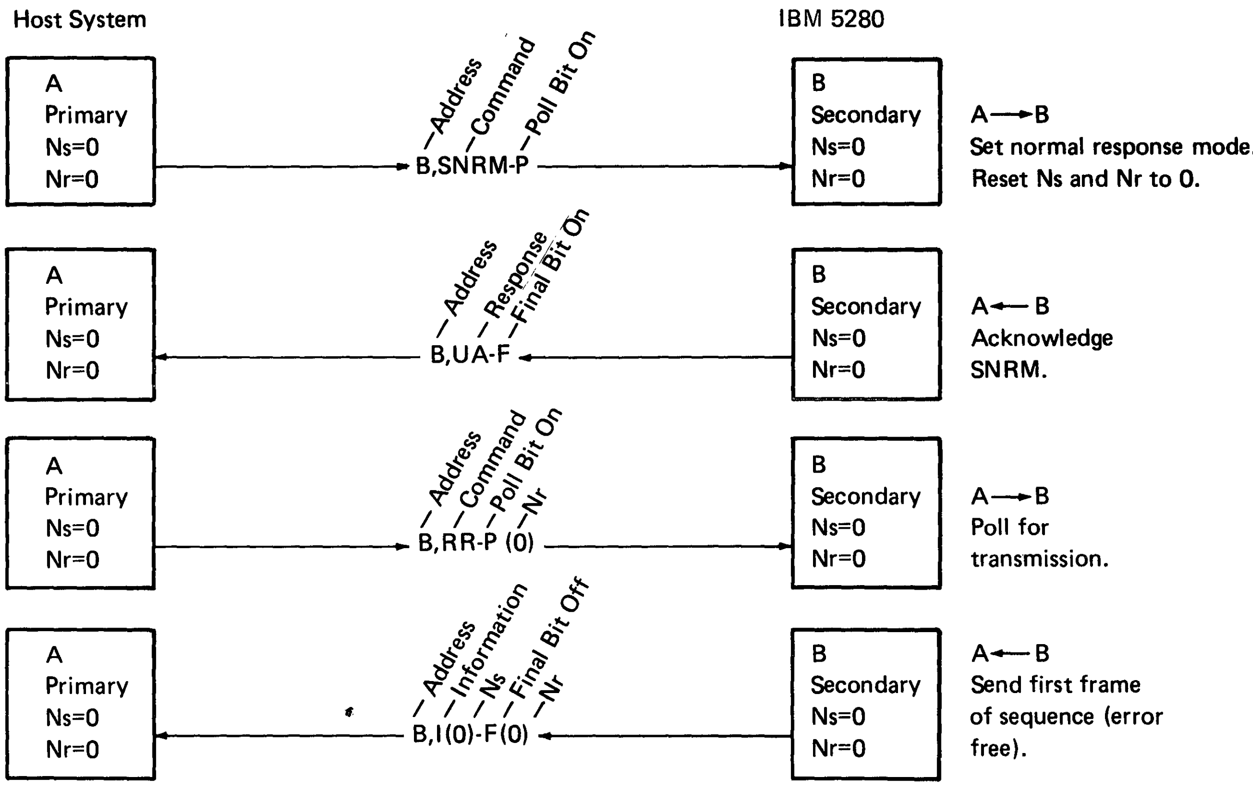
*Transmission Example (Error Free)*



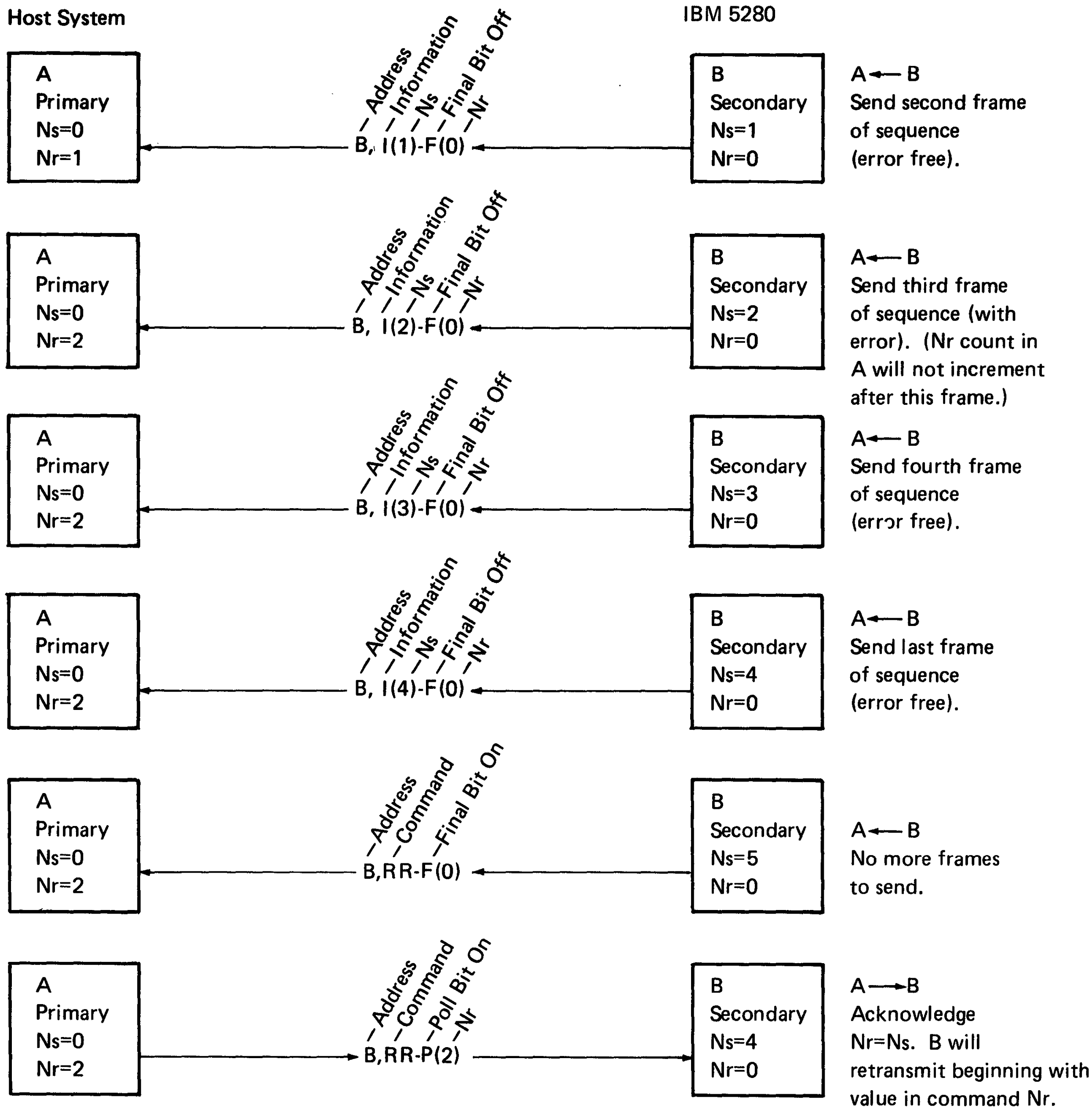
*Transmission Example (Error Free)*



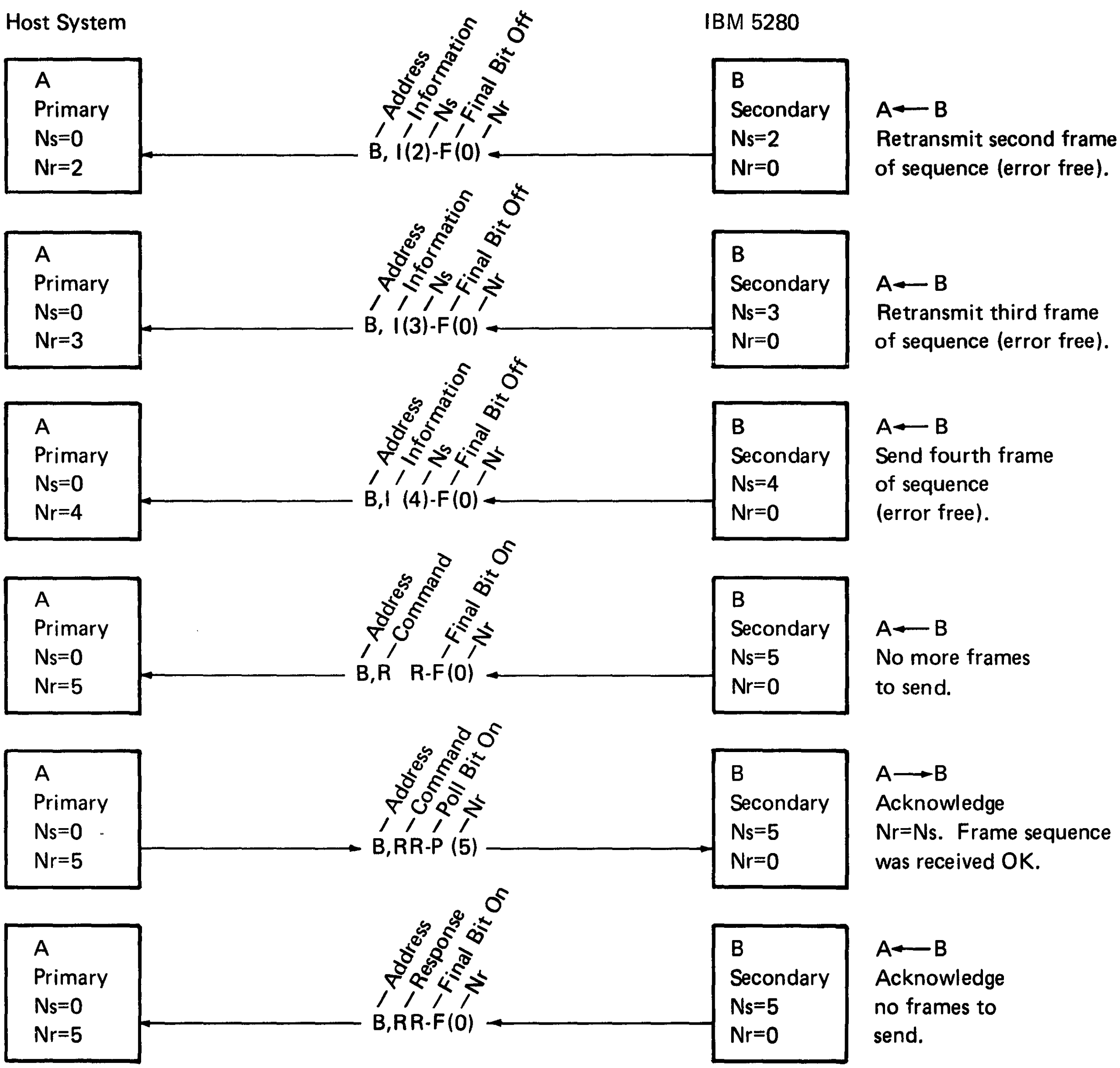
*Transmission Example (With Errors)*



*Transmission Example (With Errors)*



*Transmission Example (With Errors)*



### Zero Bit Insertion/Deletion

The only time more than five contiguous 1-bits are allowed on the data link is when a flag is intended.

Because some data requires more than five contiguous 1-bits, the transmitting station inserts a zero after every five contiguous 1-bits. The receiving station removes the inserted zeros. For example, if the primary station has the following bits to be sent:

```
First Bit                                        Last Bit
Transmitted                                      Transmitted
|                                                    |
v                                                    v
00 001100111 10001111 10111111 11111111 11 ...
```

zeros would be inserted and the actual transmission would be:

```
First Bit                                        Last Bit
Transmitted                                      Transmitted
|                                                    |
v                                                    v
00 001100111 10001111 1001111101 111101111 101 ...
                        ^       ^     ^
                        └─inserted zeros┘
```

The receiving station deletes the inserted zeros when it receives the data; therefore, the data is the same as that transmitted.

Counting of the contiguous 1-bits is not concerned with byte or character boundaries. Zero bit insertion/deletion is done for the address, control, information, and CRC bytes. However, the inserted zeros are not included in the computation of the CRC bytes.

An inherent characteristic of zero bit insertion/deletion is that it provides full transparency at all times. Any bit pattern can be sent as data without any special action because zero bit insertion/deletion is active for everything except flags.

### NRZI (Nonreturn to Zero Inverted)

Data clocking that depends on transitions in the data to stay in sync would have trouble staying in sync with a long string of zeros or ones. SDLC uses zero bit insertion/deletion, which ensures that there will never be six contiguous 1-bits on the line except for flags or a cancel sequence. Using the NRZI option ensures that transmitting long strings of zeros will not result in the absence of line transitions. Therefore, using SDLC with the NRZI option ensures that there can never be more than five bit-times without a transition during data transmission, except for the flag or a cancel sequence. With the flag included, there can never be more than six bit-times without a transition.

NRZI is accomplished by changing the level of the send data for each 0-bit and maintaining the existing level for each 1-bit.

For example:

```
     Data:  . . . 1 1 0 0 0 0 1 1 0 0 . . .
Send Data:  + + + -  + -  + + + -  + . . .
```

or

```
     Data:  . . . 1 1 0 0 0 0 1 1 0 0 . . .
Send Data:  - - - + - + - - - + -  . . .
```

Because zero bit insertion/deletion ensures that the line can never be all ones and because NRZI changes the state of the line for each zero, the line will have transitions often enough during data transmissions for proper sync.

### Systems Network Architecture Support

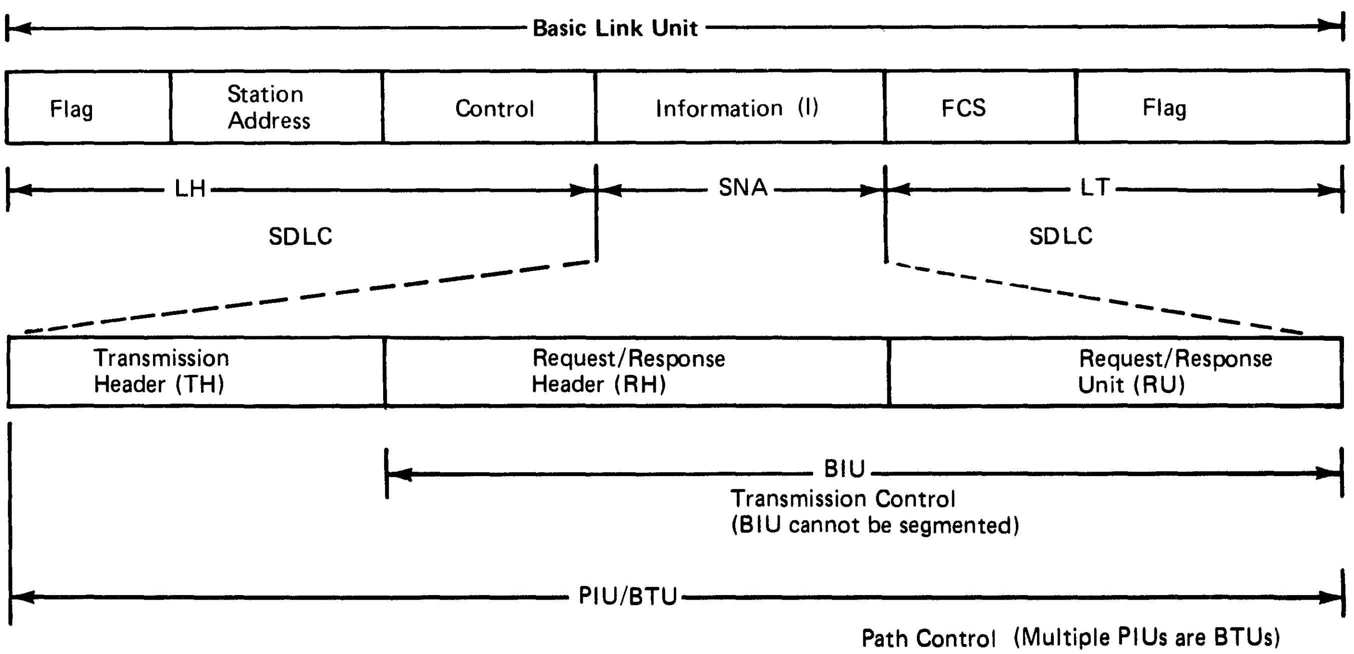
The IBM 5280 supports the following SNA definitions:

- Transmission services (TS) profile 3
- Function management (FM) profile 3
- Function management header (FMH) type 1
- Logical unit (LU) type 1
- Physical unit (PU) type 2
- Format identification (FID2)

*SNA Commands and Responses Supported*

ACTLU-Receive only
ACTPU-Receive only
BID-Receive only
BIND-Receive only
CHASE-Transmit and receive
CLEAR-Receive only
DACTPU-Receive only
DACTLU-Receive only
LOGON-Transmit only
LUSTAT-Transmit only
RECFMS-Transmit only
REQDISCONT-Transmit only
REQMS-Receive only
REQTEST-Transmit only
RSHUTD-Transmit only
SDT-Receive only
SHUTC-Transmit only
SHUTD-Receive only
SIGNAL-Transmit and receive
UNBIND-Receive only

*SNA Information Field*




The SNA information field contains the TH (transmission header), RH (request/response header), and RU (request/response unit). The following tables show the format of the headers, commands, and responses supported by the 5280.

**SNA Transmission Header Format**

| Hex Displ | Length in Bytes in Hex | Description |
|---|---|---|
| 0 | 1 | Transmission header byte 0 (TH0):<br>*Bit* *Function*<br>0-3 Format identification — must be 0010<br>4-5 Mapping field — must be 11<br>6 Not used<br>7 1 = Expedited flow<br>0 = Normal flow |
| 1 | 1 | Transmission header byte 1 (TH1) — must be X'00' |
| 2 | 1 | Destination address field (DAF) — X'00' indicates a physical unit or SSCP; others must be valid logical unit numbers (X'01' for IBM 5280) |
| 3 | 1 | Origin address field (OAF) — physical or logical unit number |
| 4 | 2 | Sequence number field (SNF) |

**SNA Request Header Format**

| Hex Displ | Length in Bytes in Hex | Description |
|---|---|---|
| 0 | 1 | Request header byte 0 (RH0): |
| | | *Bit* *Function* |
| | | 0 Must be 0 (indicates request) |
| | | 1-4 Transmission type (bit 3 must be 0) |
| | | 0000 – FM data |
| | | 0001 – FM header (not allowed for user interface) |
| | | 1001 – DFC command |
| | | 1101 – SC command |
| | | 5 1 = Sense data included |
| | | 0 = No sense data included |
| | | 6-7 Chain position |
| | | 00 – Middle RU of chain |
| | | 01 – Last RU of chain |
| | | 10 – First RU of chain |
| | | 11 – Only RU of chain |
| 1 | 1 | Request header byte 1 (RH1): |
| | | *Bit* *Function* |
| | | 0-3 Requested response type (bit 1 must be 0) |
| | | x010 – Definite response request |
| | | 10x0 – Definite response request |
| | | x011 – Exception response request |
| | | 10x1 – Exception response request |
| | | 4-5 Must be 00 |
| | | 6 1 = Queued response |
| | | 0 = No queued response |
| | | 7 1 = Pacing response request |
| | | 0 = No pacing response request |
| 2 | 1 | Request header byte 2 (RH2) |
| | | *Bit* *Function* |
| | | 0 1 = Begin Bracket |
| | | 0 = No begin bracket |
| | | 1 1 = End bracket |
| | | 0 = No end bracket |
| | | 2 1 = Change direction |
| | | 0 = No change direction |
| | | 3 Not used |
| | | 4 1 = Code 1 selected |
| | | 0 = Code 0 selected |
| | | 5-7 Not used |

**SNA Response Header Format**

| Hex Displ | Length in Bytes in Hex | Description |
|---|---|---|
| 0 | 1 | Response header byte 0 (RH0): |
| | | *Bit* *Function* |
| | | 0 Must be 1 (indicates response) |
| | | 1-4 Response type (bit 3 must be 0) |
| | | 0000 – FM data |
| | | 0001 – FM header (not allowed for user interface) |
| | | 1001 – DFC command |
| | | 1101 – SC command |
| | | 5 1 = Sense data included |
| | | 0 = No sense data included |
| | | 6-7 Chain position (must be 11 – only RU of chain) |
| 1 | 1 | Response header byte 1 (RH1): |
| | | *Bit* *Function* |
| | | 0-3 Response type (bit 1 must be 0) |
| | | 0000 – Isolated pacing response when bit 7 = 1 |
| | | x010 – Positive response |
| | | 10x0 – Positive response |
| | | x011 – Negative response |
| | | 10x1 – Negative response |
| | | 4-5 Must be 00 |
| | | 6 1 = Queued response |
| | | 0 = Not queued response |
| | | 7 1 = Pacing response |
| | | 0 = No pacing response |
| 2 | 1 | Response header byte 2 (RH2) – must be 00000000 |

**SNA Response Sense Data**

| Hex Displ | Length in Bytes in Hex | Description |
|---|---|---|
| 0 | 1 | Major code: |
| | | *Bit* *Function* |
| | | 0 1 = Path error |
| | | 0 = No path error |
| | | 1 1 = RH error |
| | | 0 = No RH error |
| | | 2 1 = State error |
| | | 0 = No state error |
| | | 3 1 = Request error |
| | | 0 = No request error |
| | | 4 1 = Request reject |
| | | 0 = No request reject |
| | | 5-7 Must be 000 |
| 1 | 1 | Modifier code (see following table of codes) |
| 2 | 2 | User data (The IBM 5280 sets this field to X'0000' for transmitted responses) |

### SNA Sense Data Modifier Codes

The IBM 5280 uses the following modifier codes in the sense data field for transmitted error responses:

| Major Code | Hex Modifier Code – Meaning |
|---|---|
| X'80' – Path error | 04 – Unrecognized DAF |
| | 05 – No session |
| | 07 – Segmenting error |
| | 08 – Physical unit not active |
| | 09 – DAF not active |
| | 0F – Unknown session type |
| 40 – RH usage error | 10 – Alternate code not supported |
| 20 – State error | 01 – Sequence error |
| | 02 – Chaining error |
| | 03 – Bracket error |
| | 04 – Direction |
| | 05 – Data traffic state reset |
| 10 – Request error | 01 – RU data error |
| | 02 – RU length error |
| | 03 – Function not supported |
| | 05 – Parameter error |
| | 07 – Category not supported |
| | 08 – Invalid FM header |
| 08 – Request reject | 01 – Resource not available |
| | 02 – Intervention required |
| | 05 – Session limit exceeded |
| | 0A – Permission rejected |
| | 0B – Bracket race error |
| | 0C – Procedure not supported |
| | 11 – Break |
| | 12 – Resource not available |
| | 13 – Bracket bid reject – no RTR |
| | 15 – Function already active |
| | 1B – Receiver in transmit mode |
| | 1C – Function not executable |
| | 1D – Invalid SSCP ID |
| | 21 – Invalid session parameter |
| | 24 – Component aborted |
| | 25 – Component not available |
| | 26 – FM header not supported |
| | 31 – Component disconnected |

| | Transmission Header (hex) | | | | | Request/Response Header | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | RH0 | | | | RH1 | | | | RH2 | | | | | | |
| **Transmission type** | **TH0** | **TH1** | **DAF** | **0AF** | **SNF** | **0** | **1-4** | **5** | **6-7** | **0-3** | **4-5** | **6** | **7** | **0** | **1** | **2** | **3** | **4** | **5-7** | **Comments** |
| Positive response (+RSP) | 2C<br>2D | 00 | ** | ** | * | 1 | * | 0 | 11 | 0010<br>1000 | 00 | * | * | 0 | 0 | 0 | 0 | 0 | 000 | No sense data |
| Negative response (-RSP) | 2C<br>2D | 00 | ** | ** | * | 1 | * | 1 | 11 | 0011<br>1001 | 00 | * | * | 0 | 0 | 0 | 0 | 0 | 000 | Plus sense data |
| Isolated pacing response (IPR) | 2C | 00 | ** | ** | * | 1 | 0000 | 0 | 11 | 0000 | 00 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 000 | No sense data |
| | | | | | | | | | | | | | | | | | | | | |
| Session control request | 2D | 00 | 00<br>NN | NN | 0000 | 0 | 1101 | 0 | 11 | 1000 | 00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 000 | Plus request unit |
| Data flow control request | 2C<br>2D | 00 | 00<br>NN | NN | 0000 | 0 | 1001 | 0 | 11 | 1000 | 00 | 0 | 1<br>0 | 0 | 0 | 0 | 0 | 0 | 000 | Plus request unit |
| Request discontact | 2C | 00 | 00<br>NN | NN | SSSS | 0 | 0000 | 0 | 11 | 1000 | 00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 000 | RU = X'01021B00' |
| Log-on request | 2C | 00 | 00 | NN | SSSS | 0 | 0000 | 0 | 11 | 1000 | 00 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 000 | Plus 0-256 bytes<br>Free form request |

Key:
* — Field copied from corresponding request
NN — 2-digit hex address of destination or origin
SSSS — Sequence number
2C — Normal flow (TH0)
2D — Expedited flow (TH0)
** — Field transposed from corresponding request (received DAF = Response 0AF, etc.)

### SNA Control Functions

| RU Byte (Hex) | Function | Comment |
|---|---|---|
| 0D | ACTLU (activate logical unit) | Session control (receive only) |
| 0E | DACTLU (deactivate logical unit) | Session control (receive only) |
| 11 | ACTPU (activate physical unit) | Session control (receive only) |
| 12 | DACTPU (deactivate physical unit) | Session control (receive only) |
| 31 | BIND (bind session) | Session control (receive only) |
| 32 | UNBIND (unbind session) | Session control (receive only) |
| 83 | CANCEL (cancel chain) | Data flow control (transmit/receive) |
| 84 | CHASE | Data flow control (transmit/receive) |
| A0 | SDT (start data traffic) | Session control (receive only) |
| A1 | CLEAR | Session control (receive only) |
| C0 | SHUTD (shut down) | Data flow control (receive only) |
| C2 | RSHUTD (request shut down) | Data flow control (transmit only) |
| C8 | BID | Data flow control (receive only) |
| C9 | SIGNAL | Data flow control (transmit/receive) |

## Data Flow Controls

*Cancel Command Request Unit and Responses*

| Field | Displacement | Bytes | Description |
|---|---|---|---|
| Request unit | 0 | 1 | X'83' – CANCEL request code |
| Positive response | 0 | 9 | Positive response transmission header |
| (+RSP) | 9 | 1 | X'83' – CANCEL response code |

*Bid Command Request Unit and Responses*

| Field | Displacement | Bytes | Description |
|---|---|---|---|
| Request unit | 0 | 1 | X'C8' – BID request code |
| Positive response | 0 | 9 | Positive response transmission header |
| (+RSP) | 9 | 1 | X'C8' –BID response code |
| Negative response | 0 | 9 | Negative response transmission header |
| (-RSP) | 9 | 4 | Sense data:<br>X'08130000' = Bracket contention RTR not forthcoming<br>X'08140000' = Bracket contention RTR forthcoming |
| | D | 1 | X'C8' – BID response code |

*Chase Command Request Unit and Responses*

| Field | Displacement | Bytes | Description |
|---|---|---|---|
| Request unit | 0 | 1 | X'84' – CHASE code |
| Positive response | 0 | 9 | Positive response transmission header |
| (+RSP) | 9 | 1 | X'84' – CHASE code |

*Signal Command Request Unit and Responses*

| Field | Displacement | Bytes | Description |
|---|---|---|---|
| Request unit | 0 | 1 | X'C9' – SIGNAL request code |
| | 1 | 4 | X'00010000' = Request-to-send |
| Positive response | 0 | 9 | Positive response transmission header |
| (+RSP) | 9 | 1 | X'C9' – SIGNAL response code |

*SHUTD Command Request Unit and Responses*

| Field | Displacement | Bytes | Description |
|---|---|---|---|
| Request unit | 0 | 1 | X'C0' – Shutdown request code |
| Positive response | 0 | 9 | Positive response transmission header |
| (+RSP) | 9 | 1 | X'C0' – Shutdown response code |

*RSHUTD Command Request Unit and Responses*

| Field | Displacement | Bytes | Description |
|---|---|---|---|
| Request unit | 0 | 1 | X'C2' – Request shutdown code |

No responses

*Network Control Functions Responses*

**Note:** The IBM 5280 does not support any network control functions. If one is requested, the IBM 5280 responds with the following negative response.

| Field | Displacement | Bytes | Description |
|---|---|---|---|
| Negative response | 0 | 9 | Negative response transmission header |
| (-RSP) | 9 | 4 | Sense data: |
| | | | X'10070000' = Category not supported |
| | D | 1 | X'ss' – ss = The request code transmitted to the IBM 5280. |

*Data Flow Control Negative Responses*
*(for conditions noted in the sense data)*

| Field | Displacement | Bytes | Description |
|---|---|---|---|
| Negative response | 0 | 9 | Negative response transmission header |
| (-RSP) | 9 | 4 | Sense data: |
| | | | X'80040000' = Unrecognized DAF |
| | | | X'10020000' = RU length error |
| | | | X'10030000' = Function not supported |
| | | | X'20010000' = Sequence number error |
| | D | 1 | X'ss – First byte of RU |
| | | | (Included for sense data = X'10030000' or X'20010000' only) |

## Session Controls

*ACTPU Command Request Unit and Responses*

| Field | Displacement | Bytes | Description |
|---|---|---|---|
| Request unit | 0 | 1 | X'11' – Request code |
| | 1 | 1 | X'01' = Cold activation |
| | | | X'02' = ERP activation |
| | 2 | 1 | X'0x' = FM profile 0 |
| | | | X'x1' = TS profile 1 |
| | 3 | 6 | SSCP ID field |
| Positive response | 0 | 9 | Positive response transmission header |
| (+RSP) | 9 | 1 | X'11' – ACTPU response code |
| | A | 1 | X'01' = Cold activation |
| | | | X'02' = ERP activation |
| | B | 8 | Contents ID filed – 8 byte |
| | | | EBCDIC secondary physical unit name |
| Negative response | 0 | 9 | Negative response transmission header |
| (-RSP) | 9 | 4 | Sense data: |
| | | | X'08210000' = Invalid parameters |
| | | | X'081D0000' = Invalid SSCPID |
| | D | 1 | X,11' – ACPTU response code |

*DACTPU Command Request Unit and Responses*

| Field | Displacement | Bytes | Description |
|---|---|---|---|
| Request unit | 0 | 1 | X'12' – DACTPU request code |
| | 1 | 1 | X'01' = Final use code |
| | | | X'02' = Not final use code |
| Positive response | 0 | 9 | Positive response transmission header |
| (+RSP) | 9 | 1 | X'12' – DACTPU response code |

*ACTLU Command Request Unit and Responses*

| Field | Displacement | Bytes | Description |
|---|---|---|---|
| Request unit | 0 | 1 | X'0D' – ACTLU request code |
| | 1 | 1 | X'01' = Cold activation<br>X'02' = ERP activation |
| | 2 | 1 | X'0x' = FM profile 0<br>X'x1' = TS profile 1 |
| Positive response (+RSP) | 0 | 9 | Positive response transmission header |
| | 9 | 1 | X'0D' – ACTLU response code |
| | A | 1 | X'01' = Cold activation<br>X'02' = ERP activation |
| Negative response (-RSP) | 0 | 9 | Negative response transmission header |
| | 9 | 4 | Sense data:<br>X'08210000' = Invalid parameters |
| | D | 1 | X'0D' – ACTLU response code |

*DACTLU Command Request Unit and Responses*

| Field | Displacement | Bytes | Description |
|---|---|---|---|
| Request unit | 0 | 1 | X'0E' – DACTLU request code |
| Positive response (+RSP) | 0 | 9 | Positive response transmission header |
| | 9 | 1 | X'0E' – DACTLU response code |

*BIND Command Request Unit and Responses*

| Field | Displacement | Bytes | Description |
|---|---|---|---|
| Request unit | 0 | 1 | X'31' – BIND request code |

| Hex Displ | Length in Bytes in Hex | Description |
|---|---|---|
| 1 | 1 | *Bind RU format and type:* |
| | | *Bit(s)* *Meaning* |
| | | 0-3 0000 = Format 0 |
| | | 4-7 0001 = Cold start bind |

| Hex Displ | Length in Bytes in Hex | Description |
|---|---|---|
| 2 | 1 | FM profile |
| 3 | 1 | TS profile |
| 4 | 1 | *FM usage for PLU protocol:* |
| | | *Bit* *Meaning when 1* |
| | | 0 0 = Only single RU chains allowed from the primary station |
| | | 1 = Multiple RU chains allowed from the primary station |
| | | 1 Delayed request mode |
| | | 2 Definite response request |
| | | 3 Exception response request |
| | | 4-5 Not used |
| | | 6 Compression is not used on requests from a primary station |
| | | 7 The primary station may send an end bracket (EB) |

| Hex Displ | Length in Bytes in Hex | Description |
|---|---|---|
| 5 | 1 | *FM Usage for SLU protocol:* |
| | | *Bit* *Meaning when 1* |
| | | 0 Multiple RU chains allowed from the secondary station |
| | | 1 Delayed request mode |
| | | 2 Definite response |
| | | 3 Exception response |
| | | 4-5 Not used |
| | | 6 Compression may be used on requests from the secondary station (SDCU/SRJE only) |
| | | 7 The secondary station may send an end bracket |

| Hex Displ | Length in Bytes in Hex | Description |
|---|---|---|
| 6 | 1 | *FM usage for common protocol:* |
| | | *Bit* — *Meaning when 1* |
| | | 0 — Not used |
| | | 1 — FM headers allowed (SDCU/SRJE) |
| | | 2 — Brackets being used |
| | | 3 — Bracket termination rule 1 used during sessions |
| | | 4 — An alternative code set allowed |
| | | 5-7 — Not used |

| Hex Displ | Length in Bytes in Hex | Description |
|---|---|---|
| 7 | 1 | *FM usage for common protocol:* |
| | | *Bit(s)* — *Meaning* |
| | | 0-1 — 10 = HDX flip flop transaction mode |
| | | 2 — 0 = The primary station responsible for recovery |
| | | 3 — 0 = The secondary station is first speaker |
| | | 4-6 — Not used |
| | | 7 — 0 = Secondary station sends data first |

| Hex Displ | Length in Bytes in Hex | Description |
|---|---|---|
| 8 | 1 | *TS usage:* |
| | | *Bit* — *Meaning* |
| | | 0 — 0 = One-stage pacing |
| | | 1 = Two-stage pacing |
| | | 1 — Not used |
| | | 2-7 — The secondary transmit pacing count |
| 9 | 1 | *TS usage:* |
| | | *Bits* — *Meaning* |
| | | *0-1* — *Not used* |
| | | 2-7 — The secondary station receive pacing count |

| Hex Displ | Length in Bytes in Hex | Description |
|---|---|---|
| A | 1 | The maximum secondary transmit RU size |
| B | 1 | The maximum primary transmit RU size |
| C | 1 | *TS usage:*<br>*Bit(s)* *Meaning*<br>0 0 = Two-stage pacing<br>1 = One-stage pacing<br>1 Not used<br>2-7 The primary CPMGRS transmit pacing count |
| D | 1 | *TS usage:*<br>*Bit(s)* *Meaning*<br>0-1 Not used<br>2-7 The primary CPMGRS receive pacing count (not checked by the IBM 5280) |
| E | 1 | *PS usage—LU profile:*<br>*Bit(s)* *Meaning*<br>0 The PS usage field in basic format<br>1-7 LU type 1 (0000001) |

| Hex Displ | Length in Bytes in Hex | Description |
|---|---|---|
| F | 1 | *PS usage:*<br>*Bit(s)* *Meaning*<br>0-3 0000 = No FM headers allowed<br>0001 = FM header type 1 subset. Both FM headers and data are allowed in a chain, but only with a begin data set and an end data set indicator.<br>0010 = FM header type 1 subset, less restricted. Both FM headers and data are allowed in the same chain without the data set indicators.<br>4-7 0000 = SCS basic controls: cards cannot span RUs<br>0001 = SCS basic controls: cards can span RUs |

| Hex Displ | Length in Bytes in Hex | Description |
|---|---|---|
| 10 | 1 | *PLU usage—FMH flags:* |
| | | *Bit(s)* *Meaning* |
| | | 0 0 = Two destinations can be pending |
| | | 1 0 = Compacted data cannot be transmitted |
| | | 2 0 = PDIR is not allowed |
| | | 3-7 Not used |
| 11 | 1 | *PLU usage—FMH flags* |
| | | *Bit(s)* *Meaning* |
| | | 0-2 Not used |
| | | 3 0 = FMH9 error recovery procedure not supported |
| | | 4-7 Not used |

| Hex Displ | Length in Bytes in Hex | Description |
|---|---|---|
| 12 | 1 | *PLU usage—Data stream flags:* |
| | | *Bit(s)* *Meaning when 1* |
| | | 0 BS, CR, INP, ENP, LF, HT, and VT can be transmitted |
| | | 1 SHF can be transmitted |
| | | 2 SVF can be transmitted |
| | | 3 SVF (channels) and SEL can be transmitted |
| | | 4 SLD can be transmitted |
| | | 5 Not used |
| | | 6 BEL can be used |
| | | 7 TRN, IRS can be used |

| Hex Displ | Length in Bytes in Hex | Description |
|---|---|---|
| 13 | 1 | *PLU usage—Data stream flags* |

| *Bit(s)* | *Meaning when 1* |
|---|---|
| 0 | The SLU does not initiate attended mode |
| 1 | The SLU alternates between attended and unattended mode |
| 2-7 | Not used |

| Hex Displ | Length in Bytes in Hex | Description |
|---|---|---|
| 14 | 1 | *PLU usage—Media flags:* |

| *Bit* | *Meaning when 1* |
|---|---|
| 0 | Document output can be sent |
| 1 | Card format allowed |
| 2 | Exchange media format allowed |
| 3 | Disk data management allowed |
| 4 | Extended card format allowed |
| 5 | Extended document format allowed |
| 6 | 0 = SLU may send CD every EDS<br>1 = SLU must send CD every EDS |
| 7 | Not used |

| Hex Displ | Length in Bytes in Hex | Description |
|---|---|---|
| 15 | 1 | *SLU usage—FMH flags:* |

| *Bit* | *Meaning* |
|---|---|
| 0 | 0 = The host allows two FMH destinations to be pending |
| 1 | 0 = Compacted data cannot be sent |
| 2 | 0 = A PDIR not allowed |
| 3 | 0 = Keyed direct data set not allowed |
| 4 | 0 = Sequential data set not allowed |
| 5 | 0 = Sequential access to an addressed direct data set not allowed |
| 6 | 0 = Series ID not allowed |
| 7 | 0 = Add replicate, replace replicate not allowed |

| Hex Displ | Length in Bytes in Hex | Description |
|---|---|---|
| 16 | 1 | *SLU usage—FMH flags:* |

| *Bit(s)* | *Meaning* |
|---|---|
| 0 | Not used |
| 1 | 0 = Query for DS not allowed |
| 2 | 0 = Create data set, scratch data set, or scratch all data sets not allowed |
| 3 | 0 = Execute program offline not allowed |
| 4-7 | Not used |

| Hex Displ | Length in Bytes in Hex | Description |
|---|---|---|
| 17 | 1 | *SLU usage—Data stream flags:* |
| | | *Bit* *Meaning* |
| | | 0 0 = BS, CR, INP, ENP, LF, HT, and VT must not be sent |
| | | 1 0 = SHF must not be sent |
| | | 2 0 = SVF must not be sent |
| | | 3 0 = SVF (channels) and SEL must not be sent |
| | | 4 0 = SLD must not be sent |
| | | 5-6 Not used |
| | | 7 1 = TRN, IRS can be used |

| Hex Displ | Length in Bytes in Hex | Description |
|---|---|---|
| 18 | 1 | *SLU usage—Data stream flags:* |
| | | *Bit* *Meaning* |
| | | 0 0 = The PLU initiates attended mode |
| | | 1 0 = The PLU does not alternate from attended to unattended |
| | | 2-7 Not used |

| Hex Displ | Length in Bytes in Hex | Description |
|---|---|---|
| 19 | 1 | *SLU usage—Media flag* |
| | | *Bit* *Meaning* |
| | | 0 0 = Document output not allowed |
| | | 1 1 = Card format allowed |
| | | 2 0 = Exchange media format not allowed |
| | | 3 0 = Disk data management format not allowed |
| | | 4 0 = Extended card format not allowed |
| | | 5 0 = Extended document format not allowed |
| | | 6 0 = The PLU may send a CD every EDS |
| | | 1 = The PLU must send a CD every EDS |
| | | 7 Not used |

| Hex Displ | Length in Bytes in Hex | Description |
|---|---|---|
| 1A | 1 | *Crypto field:* |
| | | *Bit(s)* *Meaning* |
| | | 0-3 Not used |
| | | 4-7 The length of the crypto field |
| 1B | 1 | The length of the logical unit name field |
| 1C | Variable 1-7 | Primary logical unit name |
| 1C+N | 1 | The length of the user data field |

| Field | Displacement | Bytes | Description |
|---|---|---|---|
| Positive response | 0 | 9 | Positive response transmission header |
| (+RSP) | 9 | 1 | X'31' – BIND response code |
| Negative response | 0 | 9 | Negative response transmission header |
| (-RSP) | 9 | 4 | Sense data:<br>X'08050000' = Session limit exceeded<br>X'080A0000' = Permission rejected<br>X'08150000' = Function active<br>X'08210000' = Invalid session parameter<br>X'80090000' = DAF not active |
| | D | 1 | X'31' – BIND response code |

*UNBIND Command Request Unit and Responses*

| Field | Displacement | Bytes | Description |
|---|---|---|---|
| Request unit | 0 | 1 | X'32' – Unbind request code |
| | 1 | 1 | X'01' = Normal session end<br>X'02' = Bind forthcoming |
| Positive response | 0 | 9 | Positive response transmission header |
| (+RSP) | 9 | 1 | X'32' – Unbind response code |

*CLEAR Command Request Unit and Responses*

| Field | Displacement | Bytes | Description |
|---|---|---|---|
| Request unit | 0 | 1 | X'A1' – Clear request code |
| Positive response | 0 | 9 | Positive response transmission header |
| (+RSP) | 9 | 1 | X'A1' – Clear response code |

*SDT Command Request Unit and Responses*

| Field | Displacement | Bytes | Description |
|---|---|---|---|
| Request unit | 0 | 1 | X'A0' – Start data traffic request code |
| Positive response | 0 | 9 | Positive response transmission header |
| (+RSP) | 9 | 1 | A'A0' – Start data traffic response code |
| Negative response | 0 | 9 | Negative response transmission header |
| (-RSP) | 9 | 4 | Sense data:<br>X'20070000' = Data traffic does not reset |
| | D | 1 | X'A0' – SDT response code |

## Network Services – Maintenance

*REQMS Command Request Unit and Responses*

| Field | Displacement | Bytes | Description |
|---|---|---|---|
| Request unit | 0 | 3 | X'410304' – NS header |
| | 3 | 1 | X'00' – |
| | 4 | 1 | X'00' – PU address |
| | 5 | 2 | X'0xxx' – where xxx = Procedure ID that is returned on corresponding RECFMS |
| | 7 | 1 | *Bit* *Meaning*<br>0 1 = Reset data after RECFMS is sent (valid only for link test, type = 1)<br>1 Must be 0<br>2-7 Type as follows:<br>000001 = Link test<br>000010 = Summary error data<br>000011 = Adapter data |
| Negative response (-RSP) | 0 | 9 | Negative response transmission header |
| | 9 | 4 | Sense data:<br>X'080C0000' = Procedure not supported<br>X'08120000' = Temporary lack of resources |
| | D | 3 | X'410304' – NS header |
| Positive response (+RSP) | 0 | 9 | Positive response transmission header |
| | 9 | 3 | X'410304' – NS header |

*RECFMS Command Request Unit*

| Field | Displacement | Bytes | Description |
|---|---|---|---|
| Common request block | 0 | 3 | X'410384' – NS header |
| | 3 | 1 | X'00' |
| | 4 | 1 | X'00' – PU type 2 |
| | 5 | 2 | X'0xxx' – where xxx = Procedure ID received in the REQMS command |
| | 7 | 1 | *Bit* *Meaning*<br>0 1 = Reply to REQMS<br>1 1 = Reply contained in one RU<br>2-7 Type as follows:<br>000001 – Link test data<br>000010 – Summary error data<br>000011 – Adapter data |
| | 8 | 4 | Block number and ID from bytes 2-5 of the transmission header |
| | C | 2 | X'0000' |
| Link test data only | E | 2 | Counter of the number of SDLC Test commands received by the IBM 5280 (maximum = X'00FF') |
| | 10 | 2 | Counter of the number of times the IBM 5280 has responded to the test commands (maximum = X'00FF') |
| Summary error data only | E | 1 | X'60' – Validity flags:<br>bit 0 = 0 – product error counter not valid<br>bit 1 = 1 – communications adapter error counter valid<br>bit 2 = 1 – SNA error counter valid<br>bits 3-7 must be zero (00000) |
| | F | 2 | X'0000' |
| | 11 | 2 | X'0000' – product error counter (not valid) |
| | 13 | 2 | X'00nn' – communications adapter error counter (maximum = 00FF) |
| | 15 | 2 | X'00nn' – SNA error counter (maximum = 00FF) |
| Adapter data only | E | 1 | X'01' – SDLC CCA link adapter |
| | F | 1 | X'3A' – Validity flags:<br>bit 0 = 0 – nonproductive time-out counter not valid<br>bit 1 = 0 – idle time-out counter not valid<br>bit 2 = 1 – write retry counter valid<br>bit 4 = 1 – underrun counter valid<br>bit 5 = 0 – connection problem counter not valid<br>bit 6 = 1 – FCS error counter valid<br>bit 7 = 0 – primary station abort counter not valid |
| | 10 | 1 | X'00' – Validity flags:<br>bit 0 = 0 – command reject counter not valid<br>bit 1 = 0 – DCE error counter not valid<br>bit 2 = 0 – write timeout counter not valid<br>bits 3-7 must be zero (00000) |
| | 11 | 1 | X'00' |
| | 12 | 1 | X'00' – nonproductive time-out counter (not valid) |
| | 13 | 1 | X'00' – idle time-out counter (not valid) |
| | 14 | 1 | X'nn' – write retry counter |
| | 15 | 1 | X'nn' – overrun counter |
| | 16 | 1 | X'nn' – underrun counter |
| | 17 | 1 | X'00' – Connection problem counter (not valid) |
| | 18 | 1 | X'nn' – FCS error counter |
| | 19 | 1 | X'00' – primary station abort counter (not valid) |
| | 1A | 1 | X'00' – Command reject counter (not valid) |
| | 1B | 1 | X'00' – DCE error counter (not valid) |
| | 1C | 1 | X'00' – write time-out counter (not valid) |

**Configuration Services**

*REQDISCONT Command Request Unit*

| Field | Displacement | Bytes | Description |
|---|---|---|---|
| Request unit | 0 | 1 | X'01' = Network services |
| | 1 | 1 | X'02' = Configuration services |
| | 2 | 1 | X'1B' = Request discontact request code |
| | 3 | 1 | X'00' = Normal type |

**Session Services**

*LOGON Command Request Unit*

| Field | Displacement | Bytes | Description |
|---|---|---|---|
| Request unit | 0 | 0-256 | Free form character-coded request |

**FM Header Format**

| Hex Displ | Length in Bytes in Hex | Description |
|---|---|---|
| 0 | 1 | X'06' – Length of header |
| 1 | 1 | Bit 0 = 0 – header is not concatenated<br>Bits 1-7 = 0000001 – type 1 header |
| 2 | 1 | Input/output media select:[1]<br>Output: X'00' = console<br>X'10' = exchange (RJE only)<br>X'20' = diskette<br>X'30' = line printer<br>Input: X'00' = keyboard<br>X'20' = diskette |
| 3 | 1 | X'00' – Secondary LU destination[2]<br>X'80' – Primary LU destination[2] |
| 4 | 1 | Bits 0-2: 000 – resume data set<br>001 – end data set<br>010 – begin data set<br>011 – begin and end data set<br>100 – suspend data set<br>101 – abort data set<br>110 – continue data set<br>Bit 3: 1 = Basic exchange<br>0 = Not basic exchange<br>Bit 4: Not used<br>Bit 5: 1 = Compressed (RJE only)<br>0 = Not compressed<br>Bit 6: 0 (No compaction)<br>Bit 7: Not used |
| 5 | 1 | Exchange record length (1-128) for exchange media;<br>X'00' for media = card (indicates 80-column card) |

[1] If the IBM 5280 receives a data set without an FM header, the console data stream is selected.

[2] Receiver may direct data to alternate media. (RJE only)

**μs:** Microsecond.

**AA:** Auto answer.

**absolute:** Complete.

**AC:** Alternating current.

**ACK:** Positive acknowledgement. A BSC control character.

**adr:** Address.

**address:** A name, label, or number that identifies a register, location in storage, or any other data source.

**alcohol:** A cleaning fluid.

**alter:** To change.

**AM:** Address mark.

**analog:** A method of sending information through an electrical circuit by regulating a voltage or current. Not a digital signal.

**ASCII:** American National Standard Code for Information Interchange.

**asterisk:** The character (*) usually used as a reference or in place of a character or a group of characters.

**attenuation:** A decrease in magnitude of current, voltage, or power of a signal during transmission. Expressed in decibels (dB).

**attenuator:** A device that causes attenuation.

**attribute:** A characteristic. For example, attributes of a data file include record length, label, and creation date. Attributes of a displayed field include high intensity, reverse image, and column separators.

**auto:** Automatic.

**auto answer:** In data communications, the ability of a data station to respond, without an operator, to a call received on a switched line.

**auto call:** In data communications, the ability of a data station to call another data station, on a switched network, without the need for operator intervention.

**auto dup:** Automatic duplication. The process of automatically copying the contents of a field in a previous record into the corresponding positions of the current record.

**auto enter:** Automatic enter. The characteristic of a field that simulates pressing the Enter key or the Exit key.

**auto skip:** Automatic skip. The process of automatically filling a field with blanks and advancing to the next field.

**B/M:** Bill of material.

**background:** An area of storage that is used for programs that require limited interface with a keyboard.

**batch:** An accumulation of data to be processed at one time using the same program.

**battery:** A device that serves as a source of electrical potential.

**BCC:** Block check character.

**bezel:** A face plate that covers the edges of a part or a device.

**blank:** Space. For a data area, no character. For a display screen, no display image.

**blink:** An attribute of a display field that causes the characters to pulse on and off.

**BNC:** A type of connector used on the end of a coaxial cable.

**bps:** Bits per second. A unit of measurement for data transmission speed.

**brightness limiter:** A device that prevents too much screen brightness.

**BSC:** Binary synchronous communication.

**buffer:** An area of storage that is temporarily reserved for use in performing an input/output operation, into which data is read or from which data is read.

**Cable Thru:** A feature that permits all printers on the system to be connected in series using only one twinaxial cable from the system controller.

**callout:** A character or number used to identify a specific portion of a figure.

**CAM:** Communications access method.

**CBS:** A telephone company standard ordering code. A switched type communication line coupler not manufactured by IBM.

**CCB:** Communications control block.

**CCT:** Coupler cut through.

**CDSTL:** Connect data set to line.

**CDT:** A telephone company standard ordering code. A nonswitched type communications line coupler not manufactured by IBM.

**char:** Character.

**checkout:** The process of examining and testing a function or a device to ensure correct operation.

**clk:** Clock.

**clockwise:** In the direction in which the hands of a clock rotate.

**Cmd:** Command.

**cncl:** Cancel.

**cnt:** Count.

**coaxial:** A cable consisting of one conductor, usually a small copper tube or wire, inside of and insulated from a larger conductor, usually copper tubing or copper braid.

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

**configuration:** The group of machines, devices, and programs that make up a data processing system.

**contrast:** The degree of difference between the most illuminated part of a display image and the least illuminated part of the same display image.

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

**core:** The center portion of a transformer around which wires are wound.

**counterclockwise:** In a direction opposite to that in which the hands of a clock rotate.

**coupler:** A device used to connect two units together.

**CRC:** Cyclic redundancy check.

**CRT:** Cathode ray tube.

**CTRL:** Control.

**CTS:** Clear to send.

**cursor:** A movable character on the display screen. The cursor is used to indicate where the next character entered by the operator will be displayed.

**D:** Driver.

**DAA:** Data access arrangement.

**dash:** A short line usually used to link words together.

**data station:** An I/O device that permits a person to send data to or receive data from a system. For example, a keyboard/display station or a printer.

**dB:** Decibel.

**dBm:** Decibels per milliwatt.

**DC:** Direct current.

**DCE:** Data communications equipment.

**DCP:** Diagnostic control program.

**DDSA:** Digital data service adapter.

**DE/RPG:** Data entry with RPG subroutines.

**decibel:** An expression of the ratio of two amounts of power.

**dedicated:** Having only one purpose.

**det:** Detect.

**dev:** Device.

**diacritic:** A modifying mark that changes the phonetic value of a character. When you enter a diacritic from the keyboard, the cursor does not advance until a character to combine with the diacritic is entered.

**diagram:** A figure showing the connecting points of a a cable and the levels of the signal lines contained in that cable.

**directory:** An index used by a control program to locate one or more blocks of data stored in separate areas of a data set in main storage.

**DISC:** Disconnect. An SDLC command.

**diskette:** A small, flexible, magnetic disk permanently contained in an envelope. A diskette is a removable medium used to store information until it is needed for processing.

**diskette drive:** The device used to read data from and write data on a diskette.

**diskette interchange:** A structured data exchange format that allows a diskette created on one system to be used on another system that has the same exchange format.

**displacement:** A relative, hexadecimal address that gives the distance from the start of a record, block, or segment to the start of a selected field.

**display/alter:** A function of the 5280 system that permits the operator to display and make changes to the contents of main storage.

**DLE:** Data link escape. A BSC control character.

**dly'd:** Delayed.

**DM:** Disconnected mode. An SDLC command.

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

**DTE:** Data terminal equipment.

**DTR:** Data terminal ready.

**dual:** Having two similar parts or functions.

**dump:** A function that permits the operator to copy data from main storage to another storage medium.

**EAR:** External address register.

**EBCDIC:** Extended binary coded decimal interchange code.

**EC:** Engineering change.

**echo:** In communications mode, the signal that is returned as a result of a transmitted signal.

**EIA:** Electronic Industries Association.

**EIA/CCITT:** Electronic Industries Association/Consultive Committe on International Telegraphy and Telephoney.

**elapsed:** A period or duration of time. Elapsed time is the time from the beginning of an event until the end of that event.

**ENQ:** Enquiry. A BSC control character.

**EOJ:** End of job.

**EOM:** End of message.

**EOT:** End of transmission.

**equalizer:** In communications mode, a switch that supplies equal distribution of frequency delays.

**EREP:** Environment, recording, editing, and print. A program that formats and prints the error log.

**err:** Error.

**ESD:** Electrostatic discharge.

**ETB:** End of text block. A BSC control character.

**ETC:** Elapsed time counter.

**ETX:** End of text. A BSC control character.

**extender:** A device that is used to place some other device into a more accessible position.

**extent:** Pertains to a diskette. The beginning or end of a space that is occupied by or reserved for a particular field.

**FCC:** Federal Communications Commission.

**FCS:** Frame check sequence.

**FI:** Format identification. An SDLC field.

**fiber:** A material that does not conduct electricity.

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

**filament:** The heater in the cathode-ray tube.

**fingerprint:** The combination of body oil and dirt left on a media surface after that surface has been touched by a finger.

**flyplate:** A spring-loaded plate attached to the bottom of a key module.

**FM:** Function management. Also frequency modulation.

**FMH:** Function management header.

**foreground:** An area of storage assigned to one keyboard. The program in a forward partition requires almost constant interface with a keyboard.

**FRMR:** Frame reject.

**FRU:** Field-replacable unit.

**FSK:** Frequency shift keying.

**global:** Something defined in one subroutine of a program and used in at least one other subroutine of that program.

**grn:** Green.

**halt:** The condition of a system when that system stops executing a program.

**handbook:** A technical reference manual.

**hard error:** An error that requires an action by the operator before the error can be reset.

**hex:** Hexadecimal.

**holder:** A device that locates, positions, or fastens something.

**I/O:** Input/output.

**ID:** Identification.

**implode:** To break inward suddenly.

**increment:** To move forward one step or one position.

**ind:** Indicate.

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

**interposer:** A device that extends the contacts with a connector to permit probing of the connector.

**IOB:** Input/output block.

**IOD:** Input/output data.

**IODB:** Input/output data buffer register.

**IOS:** Input/output sense register.

**IPL:** Initial program load.

**IRS:** Interchange record separator. A BSC control character.

**ITB:** Intermediate text block. A BSC control character.

**job security code:** A code that must be entered to gain access to a job.

**KBD:** Keyboard.

**keeper:** A device that holds another device tightly against a mounting surface.

**keylock:** A feature with a lock and key that is used to control access to the sytem.

**keystem:** The connecting part between the keytop and the key module.

**LED:** Light emitting diode.

**linearity:** The size of the displayed characters being of equal width.

**LRC:** Longitudinal redundancy check.

**LU:** Logical unit.

**MA:** Manual answer.

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

**manual:** A book. Also a method of doing something by hand.

**manual answer:** In data communications, an operator-answered call on a switched line to establish data communications.

**MAP:** Maintenance analysis procedure.

**MDI:** Maintenance diagnostic integration. A MAP and diagnostic test routine prompted by a menu on the display.

**menu:** A displayed list of items from which the operator makes a selection.

**MFM:** Modified frequency modulation.

**MHz:** Mega Hertz.

**microprocessor:** A processing unit that is controlled by a microprogram and that performs internal machine operations.

**MIM:** Maintenance information manual.

**MPU:** Microprocessing unit.

**MRJE:** Multi-Leaving Remote Job Entry. A communications program, used with BSC, that supplies remote job entry functions.

**ms:** Millisecond.

**MSR:** Magnetic stripe reader.

**NAK:** In data communications, a negative answer to an inquiry.

**NDM:** Normal disconnect mode. An SDLC command.

**neck:** The narrow end of the cathode-ray tube.

**net:** network.

**nonsw:** Nonswitched.

**NRM:** Normal response mode. An SDLC command.

**NRZI:** Non-return-to-zero inverted.

**NSA:** Acknowledge NS command.

**null:** A character of all zeros that takes one position in a buffer and is displayed as a blank.

**OAF:** Origin address field.

**OH:** Off hook.

**op code:** That portion of a program instruction that defines the operation to be performed by that instruction.

**option:** The selections on a display screen menu.

**overflow:** That portion of a word that will not fit in its intended storage space.

**parameter:** A constant used to represent a value.

**partition:** An area of storage in which only one program at a time can execute.

**patch:** A microcode repair to a MPU ROS unit.

**patched:** A repaired MPU ROS unit.

**patch panel:** A device that permits optional selections to be made.

**pause:** To stop temporarily.

**PC:** Printed circuit.

**personalization:** To make a multi-purpose device able to perform only one task.

**port:** An access point for receiving or transmitting data.

**programmable:** A device that can be addressed and in which programs are executed.

**programmer:** A person who designs, writes, and tests programs.

**prompt:** A message sent by a program requesting either information or an operator action before processing can continue.

**PSN:** Public switch network.

**PTT:** Public telephone and telegraph.

**quality:** The degree of ability to perform a job.

**R:** Receiver.

**raster:** The image on the CRT that is made by the action of the CRT electronic beam as it scans across the area of the CRT where data is displayed. With normal adjustment, the intensity of the raster is not high enough for it to be visible.

**rdy:** Ready.

**rec:** Receive.

**receiver:** That part of a circuit that accepts a signal from a driver.

**rectangular block:** A geometric symbol (█) with four sides of which one pair of sides are longer than the other pair of sides.

**refresh:** The continuous redisplaying of data on the display screen to prevent the data from fading out.

**register:** A storage device having a specific storage capacity such as a bit, a byte, or a word.

**related:** Having a common use or concerning the same thing.

**req:** Request.

**replace:** To put something new in the place of. Exchange.

**resolution:** Pertains to a diskette. The ability of the read/write head to read and process the magnetic flux changes on the diskette surface.

**restraining:** To limit or hold.

**retainer:** A device used to hold or keep an object in place.

**retaining:** To hold or keep in place.

**retrace lines:** The lines that can appear on the display screen when the sweep returns to the upper left corner of the display screen. The retrace lines cannot be seen at normal intensity.

**RFT:** Request for test.

**RH:** Request/response header.

**RI:** Ring indicate.

**ripple voltage:** The small AC voltage present on a DC conductor.

**RJE:** Remote job entry.

**RNR:** Receiver not ready.

**rolling:** Movement on a display screen of the displayed data. The movement can be either horizontal or vertical, or a combination of both.

**ROS:** Read only storage. Contains the microinstructions that permits the microprocessor to function.

**ROS patch card:** A card that contains microcode to replace the microcode in another associated module.

**RPG:** Report program generator.

**RR:** Receiver ready

**RTO:** Reverse timeout.

**RTS:** Request to send.

**RU:** Request/response unit.

**RVI:** Reverse interrupt. A BSC control character.

**SAR:** Storage address register.

**saturation:** Performing a job at a maximum rate. Not having the ability to contain any more.

**scancode:** A code generated by the keyboard and used by the keyboard/display MPU to determine the correct character.

**SCP:** System control program.

**SCS:** Standard character set.

**SDLC:** Synchronous data link control.

**sector:** An area on a diskette reserved for recording data. The smallest amount of data that can be transferred to or from a diskette on a single operation.

**sel:** Select.

**self-check digit:** The rightmost or leftmost digit of a self-check field.

**self-check field:** A field, such as an account number, consisting of a base number and a self-check digit. For a data entry operation, the self-check digit entered by the operator is compared to the self-check digit computed by the system.

**serdes:** Serializer/deserializer.

**SH:** Switch hook.

**shroud:** A cover or shield that is installed on the pins of a logic card.

**sign-on:** A log on procedure performed at a data station. The procedure can include entering the sign-on command, password, or other user specified information.

**SNA:** Systems network architecture.

**SNBU:** Switched network backup.

**SNF:** Sequence number field.

**SNRM:** Set normal response mode. An SDLC command.

**soft error:** An error that can be reset by the program. The program then attempts to execute the instruction again. After a programmed number of soft errors, a hard error occurs.

**soft power-on:** A restart of the power-on checkout activated by the microcode.

**SOH:** Start of header. A BSC control character.

**SOM:** Start of message.

**speaker:** A device in the keyboard that gives an audible feedback to the operator.

**stabilizer:** The part of the keyboard that holds the Spacebar stable.

**standalone:** A program that can be executed without the aid of a supervisor or control program.

**stg:** Storage.

**strobescope wheel:** A round disc used to check the speed of a diskette drive.

**STX:** Start of text. A BSC control character.

**sweep:** A curving or circular line. In the CRT, the line that is made by the electronic beams as it goes across the face of the CRT.

**T-connector:** An adapter used to connect two input or output leads to an oscilloscope.

**TB:** Terminal block.

**TDR:** Time domain reflectometry.

**terminator:** A device that puts a load on the end of a single line.

**TH:** Transmission header.

**theory:** A part of the MIM that includes data flow, functional units, and features.

**TP:** Test point.

**TRAP:** Teleprocessing recording analyzer procedure. A device used to record data on a communications line.

**tray:** A table or shelf. Used on the IBM 4288 to hold the diskette drives in the service position.

**tributary station:** In a multipoint connection, any data station other than the control station.

**TS:** Transmission services.

**TTD:** Temporary text delay. A BSC control character.

**twinaxial:** A cable made up of two wires within and insulated from another conductor of larger diameter.

**typamatic key:** A keyboard key that repeats its function when it is pressed and held down.

**UA:** Unnumbered acknowledgement.

**underscore:** A horizontal line printed or displayed below a character.

**utility:** A program in general support of system functions such as sort and merge.

**V:** Volts.

**Vac:** Volts alternating current.

**Vdc:** Volts direct current.

**VFO:** Variable frequency oscillator.

**video:** Pertains to the creation of the display image.

**VTL:** Vendor technology logic.

**WACK:** Wait before transmitting, positive acknowledgement. A BSC control character.

**WT:** World Trade.

**xmit:** Transmit.

**yoke:** A part of the CRT that controls the size and alignment of the display image.

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