IBM

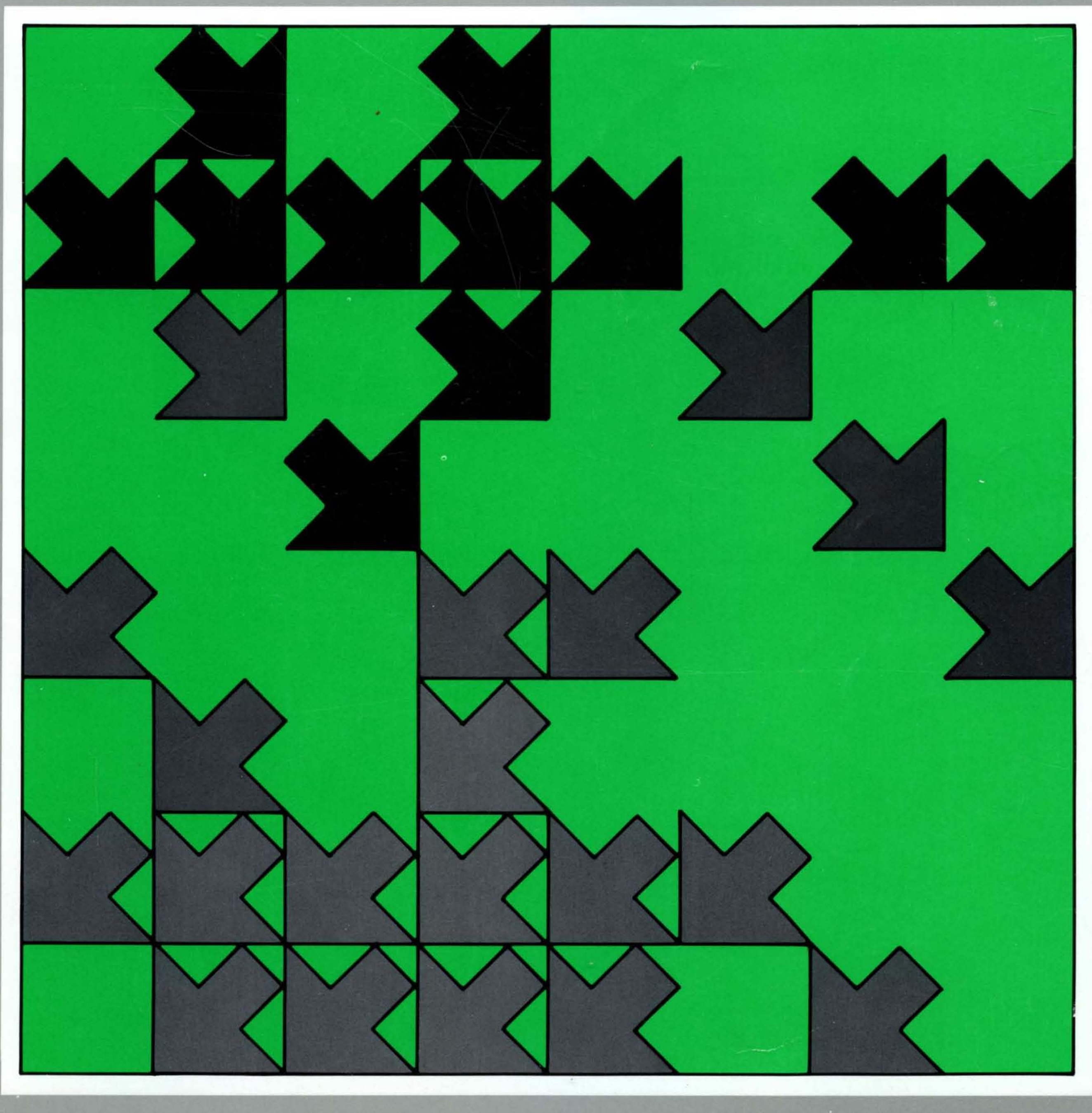
# 5394 Remote Control Unit

SY27-0311-01

## Maintenance Library

## Maintenance Analysis Procedures
## Maintenance Information
## Parts Catalog

Release 1 and Release 2



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| | |
|---|---|
| **U.S. English** | You can find translated safety notices in the multilingual safety notice book, GA27-3823. |
| **Belgian Dutch** | De vertaalde veiligheidsinstructies vindt u in het meertalige boekje GA27-3823. |
| **Canadian French** | Vous trouverez les consignes de sécurité en français dans le manuel multilingue GA27-3823. |
| **Danish** | Oversatte sikkerhedsbestemmelser kan findes i den flersprogede sikkerhedsbog, GA27-3823. |
| **Finnish** | Turvaohjeet ovat myös suomeksi monikielisessä julkaisussa. GA27-3823. |
| **French** | Vous trouverez les consignes de sécurité traduites dans la brochure multilingue *Safety Notice Book*, GA27-3823. |
| **German** | Übersetzte Sicherheitshinweise sind dem mehrsprachigen Safety Notice Book, IBM Form GA27-3823, zu entnehmen. |
| **Italian** | Le informazioni di sicurezza tradotte si trovano nel manuale: 5394 Unité di controllo remota - Informazioni di sicurezza. GA27-3823. |
| **Japanese** | 日本語の「安全に関するご案内」は各国語に翻訳された安全に関する記述を一冊にまとめた「I BM 5394 Remote Control Unit Safety Notice Booklet,GA27-3823」にありますのでご参照ください。 |
| **Norwegian** | Du finner oversatte sikkerhetsmeldinger i den flerspråklige sikkerhetsboken GA27-3823. |
| **Portuguese** | As informações de segurança traduzidas estão incluídas no Manual de Indicações de Segurança GA27-3823 (multilíngue). |
| **Spanish** | Puede hallar la información sobre seguridad traducida en el manual multilingüe correspondiente, GA27-3823. |
| **Swedish** | Svenska översättningar av de varningstexter som riktar sig till användaren finns i det flerspråkiga dokumentet med nummer GA27-3823. |

**Second Edition (October, 1989)**



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**United States**

**Federal Communication Commission (FCC) Statement**

**Warning:** This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause interference to radio communication. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

**Instructions to User:** Properly shielded and grounded cables and connectors must be used for connection to peripherals in order to meet FCC emission limits. Proper cables are available from IBM authorized dealers. IBM is not responsible for any radio or television interference caused by using other than the recommended cables or by unauthorized modifications to this equipment. It is the responsibility of the user to correct such interference.

**CAUTION:**
**This product is equipped with a 3-wire power cord and plug for the user's safety. Use this power cord in conjunction with a properly grounded electrical outlet to avoid electrical shock.**

**United Kingdom**

**Warning:** This IBM product is made to high Safety standards. It complies inherently with Telecommunication safety standards. It is not designed to provide protection from excessive voltages appearing externally at its interfaces. Therefore, when this product is connected to a public telecommunication network via any other equipment, and you connect to this product items not supplied by IBM United Kingdom Ltd., you must comply with mandatory telecommunication safety requirements.

You may do this either by choosing products which also are approved as complying to BS6301 or British Telecom Technical Guide No. 26, or by the use of approved safety barriers. Consult the local office of your public telecommunication operator, for advice and permission to make the connections.

**Far East**

This equipment is Class 1 Equipment (information equipment to be used in commercial and industrial districts) which is in conformance with the standard set by Voluntary Control for Interference by Data Processing Equipment and Electronic Office Machines (VCCI) with an aim to prevent radio interference in commercial and industrial districts.

This equipment could cause interference to radio and television receivers when used in and around residential districts.

Please handle the equipment properly according to the instruction manual.

## Canada

This equipment does not exceed Class A limits per radio noise emissions for digital apparatus, set out in the Radio Interference Regulation of the Canadian Department of Communication. Operation in a residential area may cause unacceptable interference to radio and TV reception requiring the owner or operator to take whatever steps are necessary to correct the interference.

Cet équipement ne dépasse pas les limites de Classe A d'émission de bruits radioélectriques pour les appareils numériques, telles que prescrites par le Règlement sur le brouillage radioélectrique établi par le ministère des Communication du Canada. L'exploitation faite en milieu résidentiel peut entraîner le brouillage des réceptions radio et télé, ce qui obligerait le propriétaire ou l'opérateur à prendre les dispositions nécessaires pour en éliminer les causes.

## Safety

Throughout this book, the word DANGER is used to inform you of an action that is potentially lethal or extremely hazardous to people. The word CAUTION is used to inform you of an action that is potentially hazardous to people. The word WARNING is used to inform you of an action that could damage the control unit or affect how a customer program runs.

### Danger Notices

The following DANGER notices apply to the IBM 5394:

**DANGER**

> **Do not connect AC voltage to the power supply when it is removed from the control unit. Severe electrical shock could result. Safe grounding of the power supply is ensured only when the power supply is securely fastened in the control unit.**

**DANGER**

> **Line voltage is always present at the power supply when the AC line voltage LED is on. Disconnect the power cord from the customer's AC supply before disassembling the 5394 power supply.**

The following DANGER notice applies to the removal and replacement procedures:

**DANGER**

> **Make sure that you have disconnected the power cord from the control unit.**

The following DANGER notice applies to the testing of cables and twinaxial ports:

**DANGER**

> **Do not use the port tester during electrical storms.**

### Caution Notice

A caution notice appears in "MAP 0500: Power Problem" on page 2-37.

### Warning Notices

Warning notices appear in the following maintenance procedures:

- Dedicated Mode Tests on page 3-50
- Concurrent Mode Screens on page 3-63.

### Safety Inspection

If a safety inspection is required, start the procedure with the control unit power switched off and the electrical power cord removed from the power outlet.

See the following for information on safety inspections:

- All service memorandums, engineering change announcements (ECAs), and service aids (SAs) for this control unit type
- *IBM 5394 Remote Control Unit Introduction and Installation Planning Guide*, SK2T-0316
- *Electrical Safety for IBM Service Representatives*, S229-8124
- *General Safety Course*, 80001.

#### How To Conduct This Safety Inspection

This inspection guide helps identify unsafe conditions on control units that you are inspecting. Each control unit, as it was made, had all the necessary safety items installed to protect the owners, operators, and service personnel from injury. This inspection addresses only those items. You should use good judgment to identify possible safety hazards not covered by this inspection guide.

If unsafe conditions are present, contact your field manager for the suitable action to be taken before you service the control unit.

Also, consider the following safety hazards that can be present:

1. Electrical hazards, especially primary power. For example, a frame without a good ground can cause serious or lethal electrical shock.
2. Exploding hazards. For example, a damaged CRT face or distorted capacitors can explode and cause serious injury.
3. Chemical hazards. For example, the use of solvents not specified by IBM may result in electrical, mechanical, or toxic hazards.

This guide contains a safety inspection procedure for the following:

- External inspection
- Internal inspection.

"Safety Labels" on page vii shows the locations of the safety labels on the 5394. Refer to this figure as you do the safety inspection.

## External Inspection

Do the following checks:

1. Are the external covers present, installed correctly, and in good condition?
2. Is the control unit power cord in good condition? Is the power cord part number correct for this unit? Refer to Chapter 6, "Parts Catalog" on page 6-1.
3. Does the control unit have the correct approved power plug for your country? (See Chapter 6, "Parts Catalog" on page 6-1 for the correct plug type.)
4. Is the power connector at the back of the control unit damaged?
5. Is the AC ground connection good from one end of the power cord to the other? The resistance of this conductor should be less than 0.1 ohm.
6. Is the customer's line voltage the correct voltage for the power supply in the control unit? (See the *Corporate Electrical Safety Handbook*, S229-8124-3.)
7. Does the control unit voltage label at **A** in "Safety Labels" on page vii match the customer's AC line voltage?

## Internal Inspection

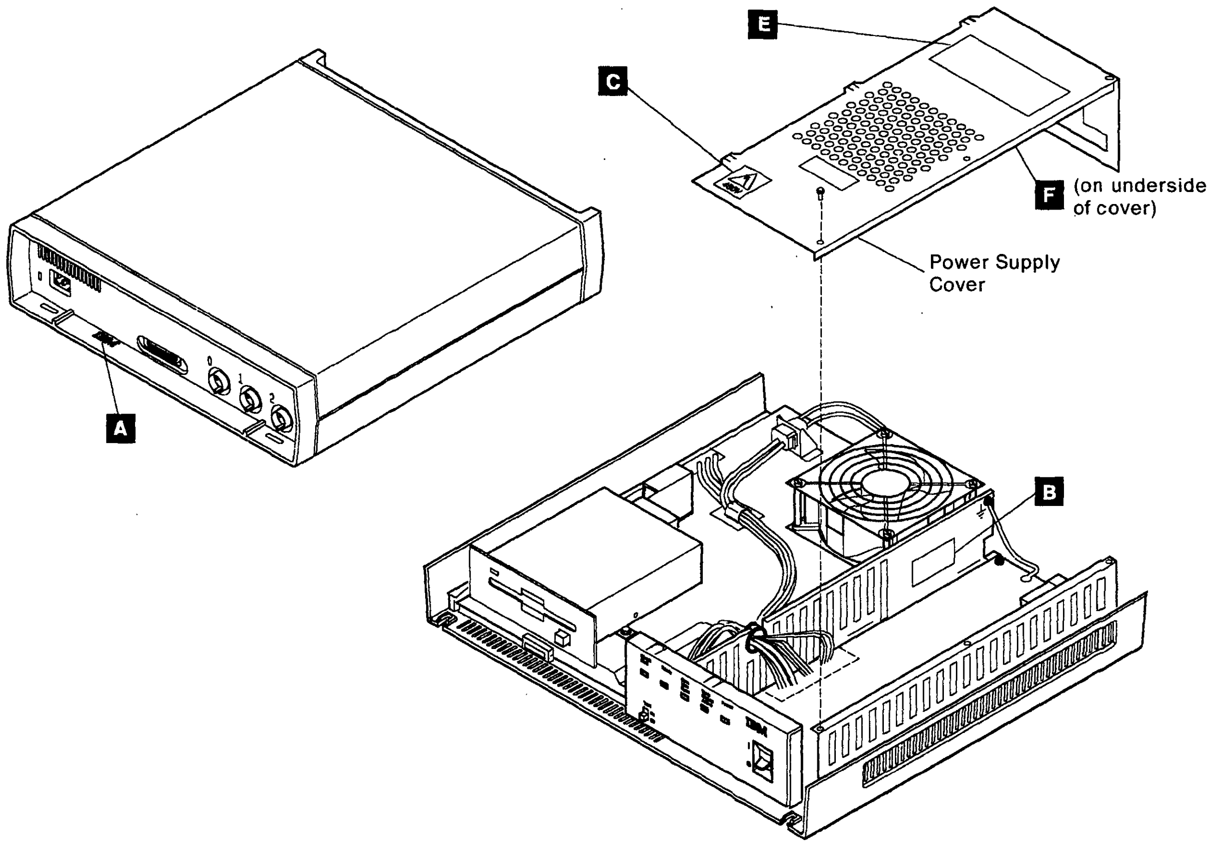
Do the following checks:

1. Is the power supply cover present and securely fastened?
2. Are there any obvious non-IBM engineering changes? If the answer to this question is yes, complete the *Non-IBM Alteration Attachment Survey*, G150-0197.
3. Are there any loose screws, contaminating chemicals, signs of water or moisture, signs of fire or smoke damage, metal particles or dust, or any other internal conditions that look hazardous?
4. Are any cables visibly worn, pinched, or damaged in any way? Check the primary power area for broken wires.
5. Does the control unit frame have a good ground? The grounding circuits are shown in "Grounding Circuits" on page viii. Measure the resistance from the ground pin on the AC power plug to any portion of the metal frame that does not carry electrical current. Resistance must be less than 0.1 ohm.
6. Are any of the capacitors in the power area leaking or distorted?

## Safety Labels

Check the safety labels as shown in the following figure.

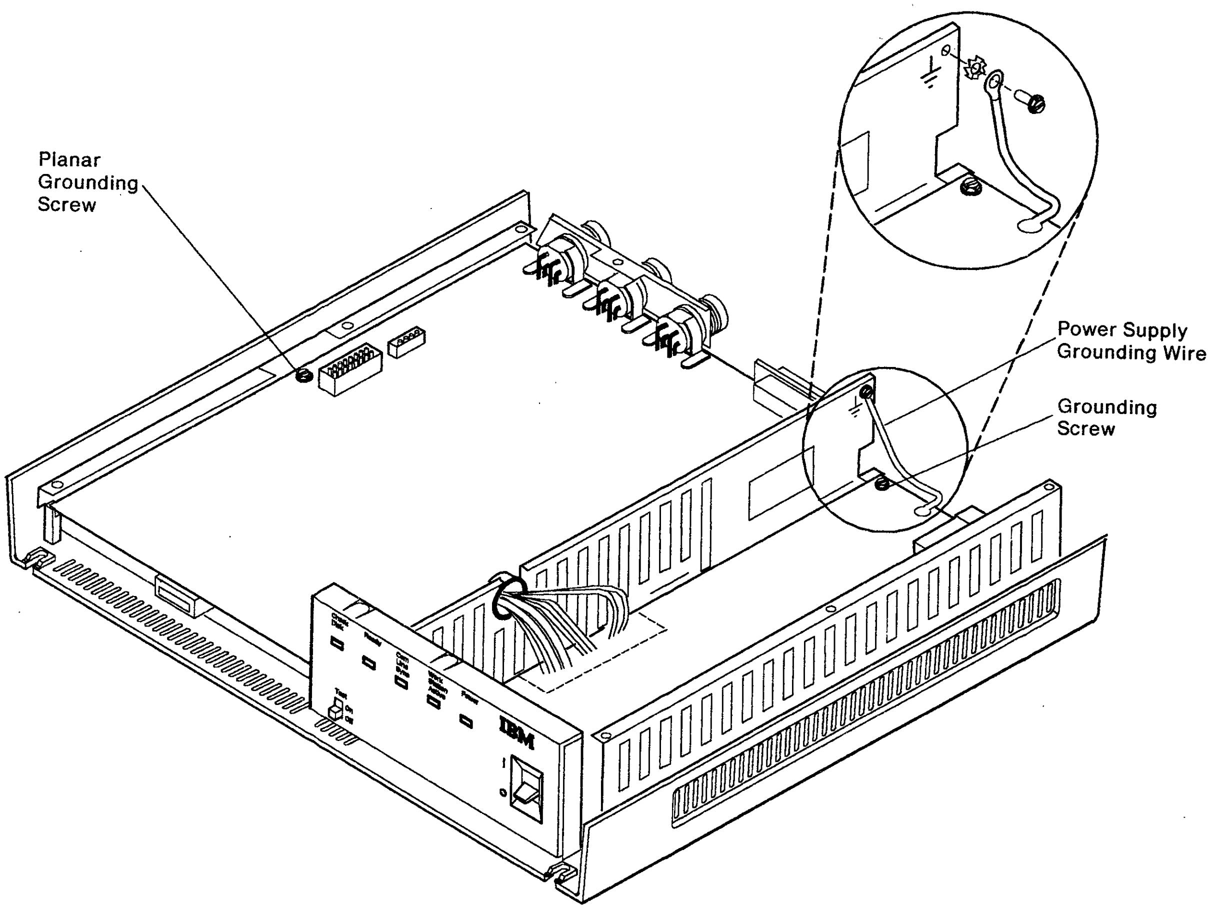
- Is there a line voltage warning label at location B ?
- Is there a 450-volt warning label on the power supply at location C ?
- Is there a hazardous area warning label at location E ?
- Is there a fuse warning label at F ?
- Are all parts installed in place securely?



## Grounding Circuits

Make sure that the grounding circuits shown in the following figure are present and secure.

- Are the grounding screws present and secure?
- Is the power supply grounding wire securely attached to the chassis?



# About This Book

This book contains information about how to isolate and repair failures in the IBM 5394 Remote Control Unit. This book also contains information about how to verify that the control unit is operating correctly after the repair action is made.

## Who Should Read This Book

This book is for qualified maintenance personnel who service the 5394. Maintenance personnel should have completed the 5394 education course.

## How This Book Is Organized

The chapters in this book are organized as follows:

**Chapter 1, Overview** - This chapter contains the following information:

- How to use this book
- Comparison of IBM 5294 and 5394
- General information about the control unit
- The maintenance philosophy used in this book.

**Chapter 2, Maintenance Analysis Procedures (MAPs)** - This chapter contains the maintenance analysis procedures (MAPs) you use to isolate a failure to a specific field-replaceable unit (FRU).

**Chapter 3, Maintenance Information** - This chapter contains information used with the MAPs to isolate and repair control unit failures. This chapter contains the following:

- The location of FRUs in the control unit
- Descriptions of the FRUs
- FRU removal and replacement procedures
- A description of the communication functions used by the control unit
- Removal and replacement procedures
- Diagnostics and test information
- A description of the System Reference Codes (SRCs)
- A description of the service aids you can use for isolating failures.

**Chapter 4, Service Aids** - This chapter describes the test equipment you use to isolate a failure, and supplies special maintenance instructions that apply to some versions of the 5394.

**Chapter 5, Theory** - This chapter describes the functions of the major components of the 5394. This chapter also describes the operation of the communication interfaces.

**Chapter 6, Parts Catalog** - This chapter shows parts in the control unit and supplies a complete list of part numbers.

**Appendix A, CE Log** - This appendix provides a form for recording problems and repairs.

**Appendix B, Supported Attachments** - This appendix lists the host systems, work stations, modems, and DCEs that can be attached to the 5394.

## Associated Publications

- *IBM 5394 Remote Control Unit Introduction and Installation Planning Guide*, SK2T-0316
- *IBM 5394 Remote Control Unit User's Guide*, GA27-3852
- *IBM 5394 Remote Control Unit Functions Reference*, SC30-3488
- *IBM 5394 Remote Control Unit Safety Notice Book*
- *IBM Synchronous Data Link Control General Information*, GA27-3093
- *IBM Systems Network Architecture Handbook, Customer Service Division*, S229-4522
- *Systems Network Architecture, Format and Protocol Reference Manual: Architectural Logic*, SC30-3112
- *Systems Network Architecture, Technical Overview*, GC30-3073
- *Basic Oscilloscope Operation*, SR28-0465-0
- *Electrical Safety for IBM Service Representatives*, S229-8124
- *General Safety Course*, 80001

- *Corporate Electrical Safety Handbook*, S229-8124
- *Introduction to X.25 SNA Interconnection*, SV24-0333
- *The X.25 Interface for Attaching SNA Nodes to Packet-Switched Data Networks General Information Manual*, GA27-3345
- *1984 X.25 Interface for Attaching SNA Nodes to Packet-Switched Data Networks General Information Manual*, GA27-3761
- *IBM Implementation of X.21 Interface General Information Manual*, GA27-3287
- *IBM Cabling System Planning and Installation Guide*, GA27-3361
- *IBM 5299 Terminal Multiconnector Model 3 Planning, Setup, and Maintenance Guide*, GA27-3749
- *Non-IBM Alteration Attachment Survey*, G150-0197.

# Summary of Changes

This edition contains information for IBM 5394 Remote Control Units using either the Release 1 or the Release 2 system diskette. Information that applies only to Release 2 is noted in the text.

Information has been added for the following:

- V.35 interface
- V.25 bis auto-dial
- Offline copy-to-printer
- Single SVC, answer only
- Special maintenance topics.

Technical changes or additions are indicated by a vertical line to the left of the change.

# Contents

# Figures

# Tables

# Chapter 1. Overview

This chapter describes the contents of this book and contains the following:

- How to use this book
- General information about the 5394 Remote Control Unit
- Comparison of the IBM 5294 and IBM 5394
- A description of the maintenance philosophy used in this book.

## How to Use This Book

This book contains the information you need to isolate and repair failures in the 5394. Most of this book is reference material and is used as follows:

- Use Chapter 1, "Overview" as a general introduction to the 5394.
- Use Chapter 2, "Maintenance Analysis Procedures (MAPs)" beginning at "MAP 0100: Start Of Call" to diagnose failures of the 5394.
- Use Chapter 3, "Maintenance Information" as reference material when directed to it by the MAPs.
- Use Chapter 4, "Service Aids" for reference information about test equipment and special maintenance topics that apply to some versions of the 5394.
- Use Chapter 5, "Theory" to gain an understanding of the operation of the 5394 and its functions within a data communication system.
- Use Chapter 6, "Parts Catalog" to get the information you need to order replacement parts.

## General Product Information

The 5394 (shown in Figure 1-1 on page 1-2) connects multiple work stations to a data communication system. The control unit manages the operation of attached work stations and allows a remote work station to communicate with the host system.

These work stations may be either display stations or printers. The host system may be an IBM System/36, an IBM System/38, or an IBM AS/400™. Figure 1-2 on page 1-3 shows an example of how the 5394 fits into a data communication system. For more information, see "Data Flow" on page 5-11.

Differences between the models of the 5394 are as follows:

- **Models 01A and 02A** support up to four work stations.
- **Models 01B and 02B** support up to 16 work stations.
- **Model 01** supports any one of the following interfaces:
  - ANSI EIA 232D
  - ANSI EIA 232D with V.25 bis auto-dial
  - V.35
  - X.21 bis.
- **Model 02** has an X.21 communication interface.

**Note:** The terms *Model 01* and *Model 02* are used as a shorthand reference when the level of work station support is not specifically being discussed.

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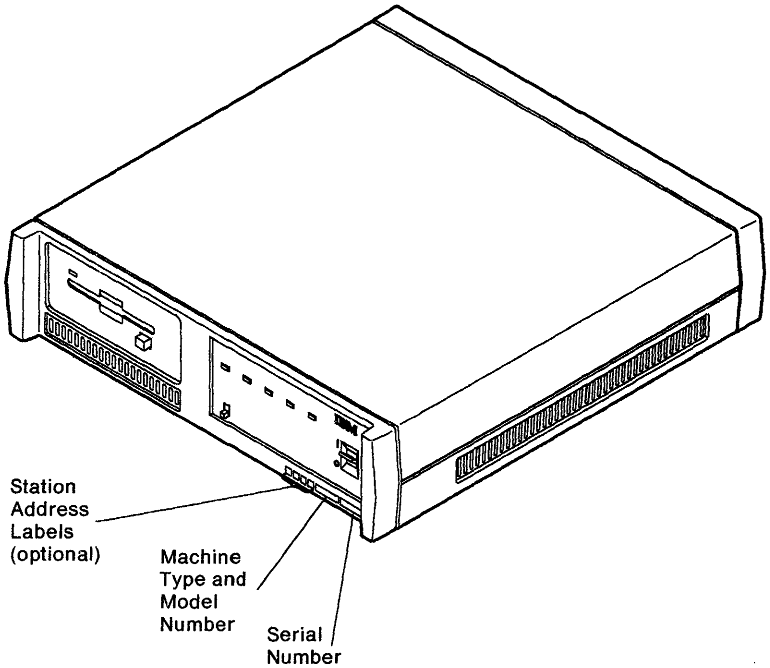


Figure 1-1. IBM 5394 Remote Control Unit

The 5394 has three twinaxial ports for work station connection. Up to seven work stations can be connected to each port, but no more than 16 work stations can be connected to the control unit. The work stations can be connected to the control unit using cable-thru, the IBM Cabling System, or the IBM 5299 Terminal Multiconnector Model 3. The last work station must be correctly terminated and within 1525 meters (5000 feet) total cable length from the control unit. Twisted-pair cable runs should not exceed 305.8 meters (1000 feet).

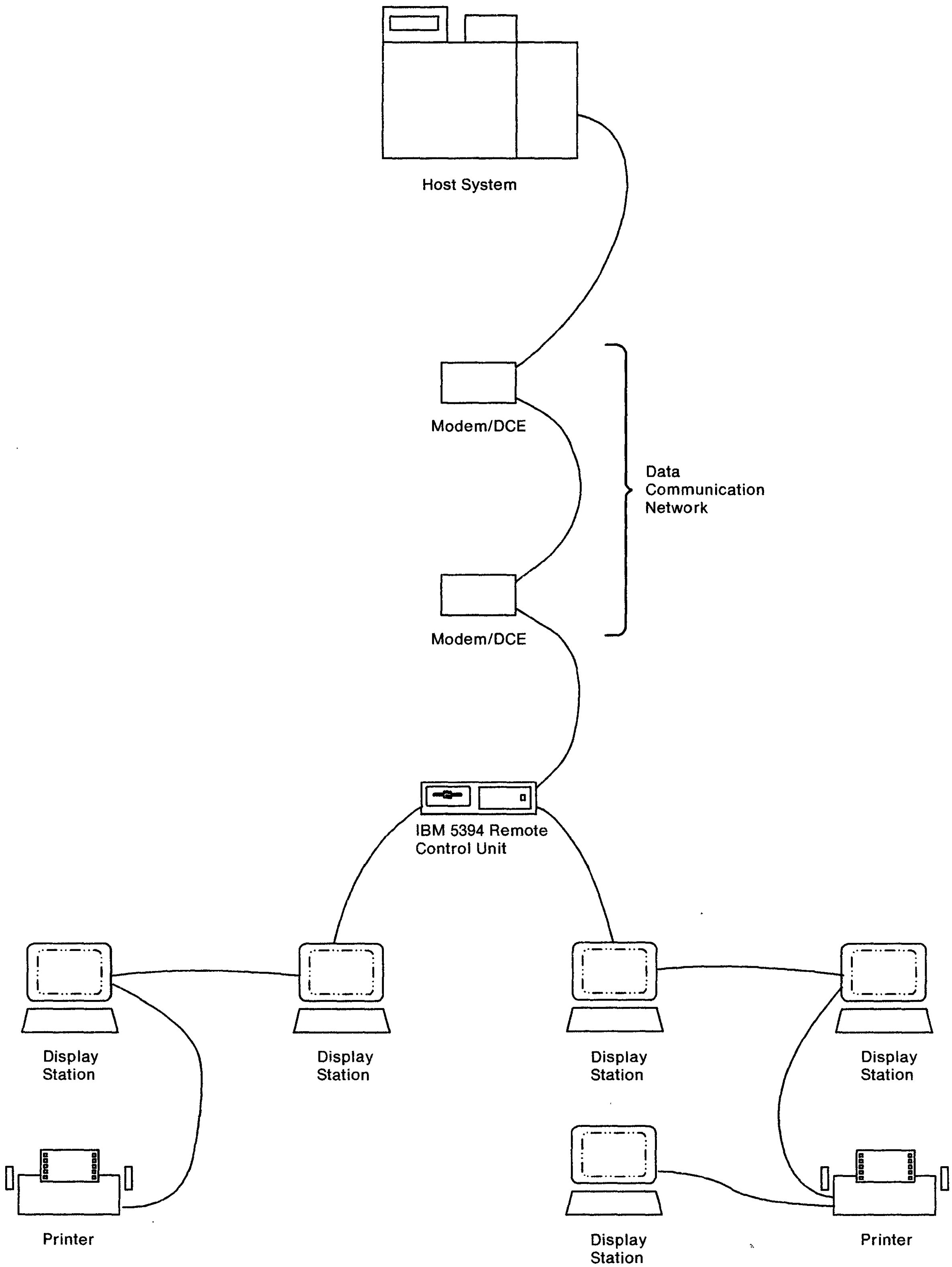


Figure 1-2. Sample Data Communication System Using the 5394

## Comparison of the IBM 5294 and 5394

This section compares the 5294 control unit and the 5394. The purpose is to help the customer engineer (CE) already trained in servicing the 5294 understand the difference between the two units.

These two units do essentially the same functions within a communication system. The 5394 is a replacement for the 5294, and contains fewer FRUs. See Table 1-1 and Table 1-2 for a detailed comparison.

Table 1-1. Model Comparison

| IBM 5294 | IBM 5394 |
|---|---|
| Model 001 - Base unit<br><br>Model K01 - Kanji<br><br>Model S01 - Southeast Asia<br><br>All 5294 models have base support for four work stations. Support for eight work stations is available as a feature. | Model 01:<br>Supports the EIA 232D, X.21 bis interface, or V.35 interface<br><br>Model 02:<br>Supports the X.21 interface<br><br>Models 01A and 02A:<br>Support attachment of up to four work stations<br><br>Models 01B and 02B:<br>Support attachment of up to 16 work stations |

Table 1-2 (Page 1 of 3). Functional Comparison

| Function | IBM 5294 | IBM 5394 |
|---|---|---|
| • Text Assist Entry<br>• Multinational Character Set<br>• Extended National Language Support (ENLS)<br>• Self-Check<br>• Magnetic Stripe Reader (MSR)<br>• Selector Light Pen (SLP)<br>• IBM Enhanced Keyboard<br>• Expanded Function<br>• Extended Function A | Feature ROS modules | Contained on system diskette for all models |
| Ideographic Support | Model K01 | Contained on system diskette for all models |
| Support for IBM System/38, System/36 host systems | All modes of operation | 5294 emulation with support for 8 work stations |
| Support for IBM AS/400 host system | Compatible | 5294 emulation or full 16 work station support |

| Function | IBM 5294 | IBM 5394 |
|---|---|---|
| Copy-to-Printer | ROS modules on feature ROS card or host assist (online operation only) | Support for online operation contained on Release 1 system diskette<br><br>Support for both online and offline operation contained on Release 2 system diskette |
| EIA 232D Interface | Communication feature card | Model 01 |
| Digital Data Service Adapter | Communication feature card | Not supported |
| X.21 Physical Interface | XLCA communication feature card | Model 02 |
| X.21 Physical Interface with X.21 Switched Protocols | Feature ROS plus XLCA communication feature card | Model 02; protocols contained on system diskette |
| X.25 Protocol | Feature ROS | Contained on system diskette for all models |
| V.25 bis auto-dial function | Not supported | Model 01 using Release 2 system diskette and SDLC communication mode |
| V.35 interface | Not supported | Model 01 |
| Twinaxial Interface | Two ports in base unit; four available as extended cluster feature | Three ports available on all models |
| Display Station Functions | Supports only standard display stations | Support for standard and pass-thru display stations contained on system diskette for all models |
| Printer Functions | SCS print data stream supported by the base unit. IPDS data stream support requires installation of a feature ROS module. | Both SCS and IPDS data stream support are contained on system diskette for all models. |
| Error Logging | PLE, HE, and error log buffer are stored in NVRAM. The error log buffer is periodically sent to the host system. | PLE, HE, and error log buffer are stored in the DRAM. The error log buffer is periodically sent to the host system. The PLE and HE logs are periodically written to the diskette. |
| Configuration Data | Stored in NVRAM | Stored on diskette. This data is loaded into DRAM of the 5394 after the functional microcode during power-on sequence. |
| Microcode Sources | ROS | ROS and system diskette |
| Microcode Engineering Changes | Microcode changes received from the host system | Microcode changes either loaded from the diskette or received from the host system |

Table 1-2 (Page 2 of 3). Functional Comparison

Table 1-2 (Page 3 of 3). Functional Comparison

| Function | IBM 5294 | IBM 5394 |
|---|---|---|
| Communication Wrap Tests | Wrap plugs used with CE dedicated tests. Wrap levels 1 through 6 are available. | Test/Oper switches on the end of the host communication cable used with CE dedicated tests for wrap level 3. Wrap levels 2 and 5 are not available on the 5394. An EIA wrap plug is available as a branch office tool. |
| Twinaxial Interface Tests | Continuous transmit test available | Twinaxial interface tester available as a branch office tool. Continuous transmit test not available |

## Maintenance Philosophy

Maintenance on the 5394 is done only when a failure or suspected failure occurs in the control unit. The customer must first do the problem determination procedures (PDPs) to determine if a control unit problem exists. The *IBM 5394 Remote Control Unit User's Guide* and a display station attached to the control unit are used to do these procedures. The customer's PDPs may produce a system reference code (SRC) or symptom. The customer provides the SRC or symptom to IBM customer service.

The CE confirms that the customer did the PDPs. If the PDPs indicate a 5394 failure, the CE goes to the customer's site with the information needed to identify the failing FRU.

The *IBM 5394 Remote Control Unit Maintenance Library* is designed for you (the on-site CE) to use in resolving the majority of 5394 problems quickly and efficiently. Begin all 5394 problem analysis at "MAP 0100: Start Of Call" on page 2-3 and continue as directed from that point.

The following information is described in this book to aid you in on-site problem isolation:

- Power-on diagnostics
- Concurrent mode diagnostics
- Dedicated mode diagnostics
- Online tests
- Error logs
- ERAP information
- Cable signal quality check and other service aids.

When you complete the FRU replacement, use "MAP 0400: Verify" on page 2-35 to verify that the 5394 is repaired and operating correctly.

If you cannot resolve the problem using this book, request technical assistance. The problem may require special tools or procedures that are only available through the CE support structure.

# Chapter 2. Maintenance Analysis Procedures (MAPs)

Maintenance analysis procedures (MAPs) are used by CEs to service the IBM 5394.

These MAPs are designed to use with Chapter 3, "Maintenance Information" on page 3-1. Definitions of terms and abbreviations that are not common, but are used in the MAPs, are in the glossary of this book.

## MAP Organization

The organization of the MAPs in this book is shown in Figure 2-1.

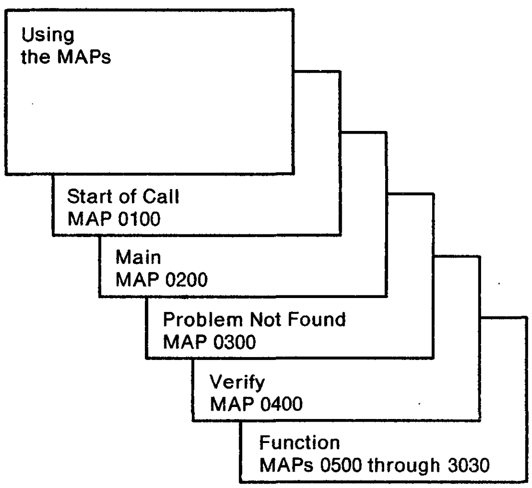


Figure 2-1. MAP Organization

**MAP 0100: Start Of Call.** - This MAP is the starting point for each service call. This MAP contains a symptom index, which is a list of single indications that are grouped by major units. These indications lead either directly to a repair action in Chapter 3, "Maintenance Information" on page 3-1 or in "MAP 0200: Main MAP" on page 2-11.

**MAP 0200: Main MAP.** - This MAP generates symptoms from indications. This MAP selects one indication at a time, with the most important and least difficult indication first, which results in the quickest path to a repair action.

**MAP 0300: Problem Not Found.** - This MAP generates symptoms from indications, similar to MAP 0200: Main MAP, but uses fewer indications. As a result, this MAP does not isolate the failure as close to the failing field replaceable unit (FRU) as MAP 0200: Main MAP does. This MAP relies on either reports from the customer or indications of intermittent failures (failures that were present, but may not be present now).

**MAP 0400: Verify.** - Use this MAP after you make a repair action to make sure that the control unit operates correctly.

**MAPs 0500 through 3030: Function MAPs** - Use these MAPs with the circuit diagrams and the procedures in Chapter 3, "Maintenance Information" on page 3-1.

## Map Flow

The relationship of the MAPs to each other is shown in Figure 2-2 on page 2-2.

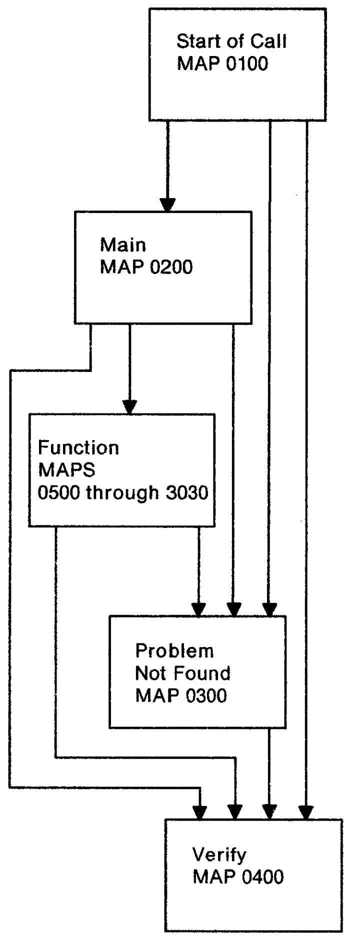


Figure 2-2. MAP Flow

## Using the MAPs

When you use the MAPs, you must:

- Read carefully. The MAPs produce reliable results only if you follow instructions and answer the questions accurately.
- Follow the sequence. Always do the procedure one step at a time. Some steps have additional information that pertains to that step.
- Follow the instructions. Carry out the instructions exactly and in sequence. Questions rely on instructions given immediately before the questions. Do not change the conditions resulting from the instructions before you answer the questions.

# MAP 0100: Start Of Call

**Attention!**

Make sure that all sessions on a display station are logged off before you use that display station for Concurrent mode diagnostics. Make sure that **all** sessions are logged off before you do any of the following:

- Run Dedicated mode diagnostics.
- Switch the control unit power off.
- Disconnect any cable from the control unit.

1. Before you use this MAP, record all symptoms if the failure is still on the control unit.
2. Make sure that all controls on the attached work stations, the 5394, the communication cable, and the modem or DCE are in the correct positions for the intended operation.
3. Make sure that at least one display station is attached, its power is switched on, and it is in a ready condition. Use any display station; however, the display station nearest the control unit is the most convenient. Do not use an IBM PC or Personal System/2® with AS/400 PC Support or an IBM Personal System/55 using 5250 PC/2 AD Support for this purpose.
4. If this MAP or the other MAPs do not isolate the failure, go to "MAP 0300: Problem Not Found" on page 2-27.

System reference code (SRC) is a general term and includes operator error codes, diagnostic error codes, and operator or CE message codes.

**Note:** Some versions of the 5394 have special maintenance requirements. Read "Special Maintenance Topics" on page 4-6 before replacing any components.

One or more of the following indicates an **error condition**:

- An SRC appeared on an attached display station. See "System Reference Codes" on page 3-88.
- 5394 Power LED is off.
- 5394 Ready LED is off or flashes.
- 5394 Check Disk LED is on or flashes.
- 5394 Work Station Active LED is off when one or more work stations are attached and the work station power is switched on.

**001**

**Is there an error condition?**

**Yes No**

**002**

Go to Step 004.

**003**

Go to Step 011 on page 2-4.

---

**004**

(From step 002)

**Is there any failure present on the control unit or the attached work stations?**

**Yes No**

**005**

— Go to Step 007 on page 2-4.

**006**

— Record all the symptoms you have, then go to Step 020 on page 2-7.

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**007**

(From step 005)

**Did the customer report an SRC?**

**Yes No**

**008**

- If the failure is intermittent, do one of the following:

If all functions operate correctly at present, check all error logs for logged errors. Refer to "Error Logs" on page 3-83 and "Concurrent Mode Screens" on page 3-61. Continue at "MAP 0300: Problem Not Found" on page 2-27 and use "Error Log Analysis" on page 2-32 to determine the probable failing FRU.

– or –

If you do not know if the control unit is operating correctly, go to "MAP 0200: Main MAP" on page 2-11.

**009**

- Switch the control unit power off.
- Wait 5 seconds, then switch the control unit power on.

The correct power-on sequence with the Test switch set to Off is:

- All LEDs come on for about 1/2 second (lamp test).
- All LEDs except Power LED go off.

The Ready LED comes on when the power-on sequence completes. This takes approximately 2 minutes.

The Work Station Active LED comes on if the power at any attached work station is switched on and responds to polling from the 5394.

The 5394 is now ready to operate once the communication link to the host is established and the 5394 is varied on.

(Step **009** continues)

**009** (continued)

**Is an error condition still present?**

**Yes No**

**010**

Go to Step 014.

**011**

(From step 003)

**Is an SRC displayed?**

**Yes No**

**012**

Go to "MAP 0200: Main MAP" on page 2-11.

**013**

Locate the SRC in Table 2-1 on page 2-5, Table 2-2 on page 2-6, or Table 2-3 on page 2-7.

- Go to Step 017 on page 2-7 after locating the SRC.

---

**014**

(From step 010)

**Did the customer report a D1xxxx or D73xxx SRC?**

**Yes No**

**015**

Locate the SRC in Table 2-1 on page 2-5, then go to Step 017 on page 2-7.

**016**

Go to "MAP 0300: Problem Not Found" on page 2-27.

---

## System Reference Code (SRC) Index

Table 2-1 (Page 1 of 2). Operator-Reported Error/Message Codes

| Code | Additional Information | Action |
|---|---|---|
| 004x or 005x | Communication error. If an 0040 or 0042 code appears, check that the modem or DCE is connected to the control unit, its power is switched on, and it is in normal operating mode. | Go to MAP 0200 step 114 on page 2-21. |
| 0060 thru 0078 | For displayed SRCs only: Probable operator error. | Go to MAP 0200 step 086 on page 2-18. |
| 008x | A configuration setup error occurred when trying to enter the configuration. | Check the SRC and correct the error. |
| 0099 | Occurs when trying to communicate with the host system. Make sure that the Test switch is set to Off. | Go to Step 114 on page 2-21. |
| xxxx | Includes any other four-character SRC that occurs during correct operation that is not listed above. | Check the definition of the code; see "SRC Summary Table" on page 3-89. Go to MAP 0200 step 060 on page 2-16. |
| 100000 thru 10FFFF | X.25 operator error or X.25 configuration error. See Table 3-31 on page 3-108 and "Control Unit Configuration Procedure" on page 3-6. | If the operation is correct: Possible microcode problem. Contact your support structure. |
| 110000 thru 1FFFFF | X.25 communication error | Check the definition of the code; see Table 3-32 on page 3-110. Go to "MAP 3010: X.25 Online Communication" on page 2-65. |
| 200000 thru 20FFFF | X.21 operator error or X.21 configuration error. See Table 3-39 on page 3-117 and "Control Unit Configuration Procedure" on page 3-6. | If the operation is correct: Possible microcode problem. Contact your support structure. |
| 210000 thru 2FFFFF | X.21 communication error | Check the definition of the code; see Table 3-40 on page 3-118. Go to "MAP 3020: X.21 Switched Online Problems" on page 2-71. |
| 300000 thru 30FFFF | V.25 bis operator error. Check definition in Table 3-41 on page 3-120. | If the operation is correct: Possible microcode or modem problem. Contact your support structure. |
| 310000 thru 31FFFF | V.25 bis call indication codes. Check definition in Table 3-42 on page 3-120. | Possible configuration or modem problem. Go to Step 114 on page 2-21. |
| 320000 thru 32FFFF | V.25 bis circuit-terminating errors | Possible configuration, modem, or network problem. Go to Step 114 on page 2-21. |
| 500000 thru 50FFFF | Diskette drive or diskette problem<br>Defined in Table 3-44 on page 3-121. | Try the backup diskette. If the failure occurs again, go to "MAP 0700: Diskette Drive Problem" on page 2-41. |

| Table 2-1 (Page 2 of 2). Operator-Reported Error/Message Codes | | |
|---|---|---|
| **Code** | **Additional Information** | **Action** |
| 510000 thru 51FFFF | Microcode change error | Try the microcode change again. If the failure continues, contact your support structure. |
| 520000 thru 52FFFF | Copy-to-printer error | Check the definition of the code; see "Copy-to-Printer SRCs" on page 3-123. Go to MAP 0200 step 079 on page 2-18. |

| Table 2-2 (Page 1 of 2). Diagnostic SRCs | | |
|---|---|---|
| **Code** | **Additional Information** | **Action** |
| **Note: Some SRCs are generated by the customer's problem determination procedures (PDPs) and are not displayed.** | | |
| D10001<br>D10002<br>(see note) | All LEDs are off. | Go to "MAP 0200: Main MAP" on page 2-11. |
| D11001<br>(see note) | Power LED is on and all other LEDs are off. | Go to "MAP 0200: Main MAP" on page 2-11. |
| D13002<br>(see note) | Power LED is on, Ready LED is on, Work Station Active LED is off. | Go to "MAP 0200: Main MAP" on page 2-11. |
| D13003<br>(see note) | Power LED is on, Ready LED is off, Work Station Active LED is on. | Go to MAP 0200 step 014 on page 2-12. |
| D13004<br>(see note) | Power LED is on, Ready LED is flashing. | Go to Step 014 on page 2-12. |
| D13005<br>(see note) | Check Disk LED is on or flashing. | Go to "MAP 0700: Diskette Drive Problem" on page 2-41. |
| D13007<br>(see note) | All work stations on a single port fail. At least 1 work station attached to control unit is not failing. | Go to "MAP 0910: Twinaxial Cabling System" on page 2-45. |
| D410xx<br>D510xx<br>D610xx<br>D710xx | Twinaxial interface power-on diagnostic failure | Replace the planar. See "Planar Removal and Replacement Procedure" on page 3-32. |
| D73yxx<br>y = 1 thru 7<br>1 = port 0<br>2 = port 1<br>4 = port 2 | Twinaxial driver/receiver test failure. | The attached work station, the connecting cable, or the planar is failing. Go to MAP 0200 step 021 on page 2-12 to isolate FRU. |
| D810xx | Communication adapter level 1 test | Replace the planar. See "Planar Removal and Replacement Procedure" on page 3-32. |
| D91010 | Hardware is not compatible with V.35 interface. | Go to Step 022 on page 2-12. |

| Table 2-2 (Page 2 of 2). Diagnostic SRCs | | |
|---|---|---|
| **Code** | **Additional Information** | **Action** |
| Any other Dxxxxx error code | Wait 5 seconds between when you switch the control unit power off and when you switch the control unit power on to avoid false error symptoms. | Go to Step 021 on page 2-12. |

| Table 2-3. Errors Detected During Normal Operation | | |
|---|---|---|
| **Code** | **Additional Information** | **Action** |
| Exxxxx | Hardware parity or bus timeout errors during operation | Replace the planar. See "Planar Removal and Replacement Procedure" on page 3-32. |
| Fxxxxx | Microcode error detected during operation | Make sure that the microcode is at latest level, then replace planar. See "Planar Removal and Replacement Procedure" on page 3-32.<br>If the failure continues, suspect a microcode problem and contact your support structure. |

**017**

(From steps 013 and 015)

**Did you find the SRC in the SRC index?**

**Yes No**

**018**

- Go to "MAP 0200: Main MAP" on page 2-11.

**019**

Do the indicated repair action. Go to "MAP 0400: Verify" on page 2-35.

---

**020**

(From step 006)

- See Table 2-4 on page 2-8 and find the symptom that best matches the reported or observed symptom.

## Failure Symptom Index

Table 2-4 (Page 1 of 2). Failure Symptoms

| Major Symptom | Minor Symptom | Action |
|---|---|---|
| | **Communication** | |
| Communication with the host system were lost or cannot be established. | 1. Always in Customer Setup (CSU) mode<br>2. 004x, 005x, or 0099 may appear | Possible test switch circuit failure. Make sure that the Test switch is set to Off and go to "MAP 0400: Verify" on page 2-35. If the problem continues, go to "MAP 0200: Main MAP" on page 2-11.<br>Possible configuration errors. Go to MAP 0200 step 147 on page 2-24. |
| Communication is slow. | Input Inhibit indicator remains on longer than usual. An increase in the host system workload may cause this symptom. | Go to "MAP 3030: Online Intermittent Problems" on page 2-77. |
| | **Operator Panel** | |
| One LED fails to come on at the start of power-on sequence or one LED (other than Power) remains on permanently after the lamp test. | | Operator panel or planar failure. Disconnect the operator panel plug and use an ohmmeter to test the operator panel LEDs and the Test switch. If a failure is found, replace the operator panel (see "Operator Panel Removal and Replacement Procedure" on page 3-37). If the operator panel is good, replace the planar (see "Planar Removal and Replacement Procedure" on page 3-32). |
| Two or more LEDs fail to come on at the start of power-on sequence. | | Power supply or planar failure. Go to MAP 0500 step 014 on page 2-38 to isolate the failing FRU. |
| Two or more LEDs (other than Power) remain on permanently after the lamp test. | | Power supply or planar failure. Go to MAP 0200 step 009 on page 2-11 to isolate failing FRU. |

| Table 2-4 (Page 2 of 2). Failure Symptoms | | |
|---|---|---|
| **Major Symptom** | **Minor Symptom** | **Action** |
| You cannot run the CE tests and you cannot select the CSU mode. | The control unit will not go into Test mode. | Operator panel or planar failure. Disconnect the operator panel plug and use an ohmmeter to test the operator panel LEDs and the Test switch. If a failure is found, replace the operator panel (see "Operator Panel Removal and Replacement Procedure" on page 3-37). If the operator panel is good, replace the planar (see "Planar Removal and Replacement Procedure" on page 3-32). |
| The control unit always goes into CSU mode when you switch the power on. | The control unit remains in Test mode. | Operator panel or planar failure. Disconnect the operator panel plug and use an ohmmeter to test the operator panel LEDs and the Test switch. If a failure is found, replace the operator panel (see "Operator Panel Removal and Replacement Procedure" on page 3-37). If the operator panel is good, replace the planar (see "Planar Removal and Replacement Procedure" on page 3-32). |
| | **Attached Work Station Problems** | |
| System Available indicator off | No Free Key mode | Go to "MAP 0200: Main MAP" on page 2-11. |
| The characters that appear on the screen do not match the key that was pressed. | System Available indicator on | Go to "MAP 0200: Main MAP" on page 2-11. |
| Free Key mode fails. | System Available indicator on | Go to "MAP 0200: Main MAP" on page 2-11. |
| Magnetic stripe reader (MSR) and light pen, or light pen only, does not operate correctly. | | Go to MAP 0200 step 094 on page 2-19. |
| Self-check does not operate correctly. | | Go to MAP 0200 step 089 on page 2-19. |
| Copy-to-printer function does not operate. | System Available indicator on | Go to MAP 0200 step 075 on page 2-17. |

(Step **020** continues)

**020** (continued)

**Did you find the symptom in the table?**
**Yes No**

**021**

Go to "MAP 0200: Main MAP" on page 2-11.

**022**

Do the indicated repair action and go to "MAP 0400: Verify" on page 2-35.

# MAP 0200: Main MAP

**001**

- Switch the control unit power off.
- Set the Test switch to Off.
- At least one display station must be attached and its power must be switched on.
- If you remove the covers, reconnect all cables at the rear of the control unit. See "Cover Removal and Replacement Procedure" on page 3-26.
- Switch the control unit power on and wait about 2 minutes for the power-on sequence to complete.

**Is the Ready LED on constantly (not flashing)?**
**Yes No**

**002**

- Go to Step 014 on page 2-12.

**003**

**Is the fan running?**
**Yes No**

**004**

- Measure the voltage at the fan DC connector. See Figure 3-21 on page 3-19.

**Is the voltage present?**
**Yes No**

**005**

Replace the power supply. See "Power Supply Removal and Replacement Procedure" on page 3-33.

- Go to "MAP 0400: Verify" on page 2-35.

**006**

Replace the fan. See "Fan Removal and Replacement Procedure" on page 3-29.
(Step **006** continues)

**006** (continued)

- Go to "MAP 0400: Verify" on page 2-35.

**007**

Switch the control unit power off and read the following steps before proceeding:

- Watch the LEDs on the operator panel.
- Switch the control unit power on.

The following indications should occur within 3 seconds:

1. All LEDs come on for about 1/2 second.
2. The Power LED remains on.
3. The Com Line Sync LED flashes a second time.

**Do any indications fail?**
**Yes No**

**008**

- Go to Step 052 on page 2-15.

**009**

(From MAP 0100 step 020 on page 2-8)

The signal '— POR' may be failing.

- Measure the voltage (5 VDC scale) between connector P1-6 (-POR) and P1-4 (GND). See Figure 3-21 on page 3-19.

**Is the voltage less than one volt?**
**Yes No**

**010**

Replace the planar. See "Planar Removal and Replacement Procedure" on page 3-32.

- Go to "MAP 0400: Verify" on page 2-35.

**011**

- Switch the 5394 power off and remove the diskette.
- Unplug connector P1.
- Switch the 5394 power on and measure the voltage between P1-6 and P1-4, at the free end of the cable.

**Is the voltage greater than 4 volts?**
Yes No

012

Replace the power supply. See "Power Supply Removal and Replacement Procedure" on page 3-33.

– Go to "MAP 0400: Verify" on page 2-35.

013

Replace the planar. See "Planar Removal and Replacement Procedure" on page 3-32.

– Go to "MAP 0400: Verify" on page 2-35.

---

014

(From page 2-6)
(From step 002)

**Is the Ready LED off (not flashing)?**
Yes No

015

DRAM module failure.

The Ready LED flashes on 1, 2, 3, or 4 times, goes off for 2 seconds, and then repeats the sequence to indicate which DRAM module is failing.

– Count the number of flashes before the pause.

Replace DRAM module in position 1, 2, 3, or 4 according to the number of flashes counted. See "DRAM Removal and Replacement Procedure" on page 3-31.

– Go to "MAP 0400: Verify" on page 2-35.

016

**Is the Check Disk LED off (not flashing)?**
Yes No

017

Go to "MAP 0700: Diskette Drive Problem" on page 2-41.

018

(Step **018** continues)

**018** (continued)

**Is SRC Dxxxxx displayed?**
Yes No

019

Go to Step 033 on page 2-13.

020

**Is SRC D4xxxx, D5xxxx, D6xxxx, D8xxxx, or D91010 displayed?**
Yes No

021

(From page 2-6)

– If the SRC is D7xxxx, go to Step 041 on page 2-14.

– If the SRC is not D7xxxx, see if the SRC is listed in "MAP 0100: Start Of Call" on page 2-3 or "MAP 0300: Problem Not Found" on page 2-27. If the SRC is not listed in "MAP 0100: Start Of Call" or "MAP 0300: Problem Not Found" do the following:

Make sure that all power supply voltages are in tolerance for voltage and ripple. See "DC Power Supply Voltage Level Check" on page 3-20 and "DC Power Supply Ripple Level Check" on page 3-20. If the voltages are out of tolerance, replace the power supply. See "Power Supply Removal and Replacement Procedure" on page 3-33.

If all the voltages are correct, replace the planar. See "Planar Removal and Replacement Procedure" on page 3-32. Go to "MAP 0400: Verify" on page 2-35 after replacing any FRU.

022

**Is SRC D91010 displayed?**
Yes No

023

Replace the planar. See "Planar Removal and Replacement Procedure" on page 3-32.

– Go to "MAP 0400: Verify" on page 2-35.

**024**

– Enter the Concurrent mode and use values from the J and KK fields in line 3 of screen C1 to answer the following question. See “Concurrent Mode Screens” on page 3-61.

**Do values in the J and KK fields indicate that this 5394 is a Model 01 connected to an EIA 232D cable?**

**Yes No**

**025**

**Do these values indicate that this is a Model 01 5394 with a V.35 cable?**

**Yes No**

**026**

If this 5394 is a Model 02 with an X.21 cable, the planar is failing. Replace the planar. See “Planar Removal and Replacement Procedure” on page 3-32.

– or –

This 5394 is not compatible with the attached communication cable.

**027**

– Check field F.F in line 3 of screen C1. See “Concurrent Mode Screens” on page 3-61.

**Is the ROS ID 1.1 or greater?**

**Yes No**

**028**

Notify the customer that this 5394 is not compatible with the V.35 interface.

**029**

– Go to Step 030.

**030**

(From step 029)

– Disconnect the communication cable from the rear of the 5394.

(Step **030** continues)

**030** (continued)

– At the 5394 end of the communication cable, measure pin-to-pin resistances shown in Table 2-5.

Table 2-5. Cable ID Check

| Pin | Pin | Resistance |
|---|---|---|
| 14 | 7 | <0.1 Ω |
| 16 | 7 | open |

**Are resistances as indicated?**

**Yes No**

**031**

If this is an EIA 232D cable, the planar is failing. Replace the planar. See “Planar Removal and Replacement Procedure” on page 3-32.

– or –

If this is a V.35 cable (three wrap switches), it is defective.

**032**

Replace the planar. See “Planar Removal and Replacement Procedure” on page 3-32.

– Go to “MAP 0400: Verify” on page 2-35.

**033**

(From step 019)

**Is the Power LED on?**

**Yes No**

**034**

**Is the AC power indicator at the rear of the 5394 on?**

**Yes No**

**035**

The line cord is failing or unplugged or the customer’s AC power is failing.

Replace the line cord.

– or –

Report the AC voltage problem to the customer.

036

Go to "MAP 0500: Power Problem" on page 2-37

037

**Is the fan running?**
**Yes No**

038

– Measure the voltage at the fan DC connector. See Figure 3-21 on page 3-19.

**Is the voltage present?**
**Yes No**

039

Replace the power supply. See "Power Supply Removal and Replacement Procedure" on page 3-33.

– Go to "MAP 0400: Verify" on page 2-35.

040

Overheating caused by a fan failure has also caused a logic failure.

Replace the fan. See "Fan Removal and Replacement Procedure" on page 3-29.

– Return to step 001 of this MAP.

041

(From step 021)

**Is the Work Station Active LED on?**
**Yes No**

042

Switch the control unit power off and read the following steps before proceeding:

– Watch the LEDs on the operator panel.

– Switch the control unit power on.
(Step **042** continues)

**042** (continued)

The following indications should occur within 3 seconds:

1. All LEDs come on for about 1/2 second.
2. The Power LED remains on.
3. The Com Line Sync LED flashes a second time.

**Are all indications correct?**
**Yes No**

043

Go to MAP 0500 step 014 on page 2-38.

044

Replace the planar. Refer to "Planar Removal and Replacement Procedure" on page 3-32.

– Go to "MAP 0400: Verify" on page 2-35.

045

While you do the procedure that follows, observe the operator panel LEDs. The '– POR' line causes all LEDs to come on for about 1/2 second for a lamp test.

– Ignore the condition of the LEDs after the first 3 seconds.

– Switch the control unit power off.

– Wait 5 seconds, then switch the control unit power on.

**During the power-on sequence, does the Power LED come on and remain on and do the other LEDs come on for approximately 1/2 second and then go off?**
**Yes No**

046

If only the Ready LED fails to come on for about 1/2 second, use "Operator Panel (Including LEDs and Test Switch)" on page 3-21 to isolate the cause of the Ready LED failure.

– Go to "MAP 0400: Verify" on page 2-35.
(Step **046** continues)

**046** (continued)

— or —

If other LEDs (except Power) fail to come on for about 1/2 second, go to MAP 0500 step 014 on page 2-38.

**047**

- Switch the control unit power off.
- Disconnect all twinaxial connectors at the I/O panel of the control unit.
- Switch the control unit power on.

**Is the Ready LED on now?**
**Yes No**

**048**

- Measure the voltage between connector P1-8 (-12 VDC) and P1-4 (GND). See Figure 3-21 on page 3-19.

**Is the voltage correct?**
**Yes No**

**049**

- Replace the power supply. See "Power Supply Removal and Replacement Procedure" on page 3-33.
- Go to "MAP 0400: Verify" on page 2-35.

**050**

- Replace the planar. See "Planar Removal and Replacement Procedure" on page 3-32.
- Reconnect all cables to the twinaxial connectors.

Go to "MAP 0400: Verify" on page 2-35.

**051**

Either an attached work station is failing or the cable from the control unit to the work station is defective.
(Step **051** continues)

**051** (continued)

- Connect the cables, one at a time. Switch the control unit power on after each connection. The cable that causes an error when connected or one of the work stations connected to that cable is the cause of the problem.

Possible causes are:

- Open or short in cable
- Open or short in station protector (if used)
- Cable not terminated
- A work station transmitting continuously.

- Switch the power off at each work station attached to the failing cable, one at a time. Then switch the control unit power off, wait 5 seconds, and switch the control unit power on to locate the failing work station. If the problem is still present with the power switched off at all attached work stations, suspect a cable, work station termination, or environmental noise problem.

If twinaxial cable is used, go to "MAP 0910: Twinaxial Cabling System" on page 2-45.

— or —

If the IBM Cabling System is used, go to "MAP 0920: IBM Cabling System" on page 2-51.

**052**

(From step 008)

When a display station begins receiving polls from the 5394:

- The cursor moves from the upper right to the upper left side of the screen.
- A System Available indicator appears at the bottom of the screen. (The location and appearance of this indicator depends on the type of display you are using.)

**Does at least one display station have these indications?**
**Yes No**

**053**

Go to Step 109 on page 2-20.

**054**

(Step **054** continues)

**054** (continued)

When the 5394 fails to communicate properly with the host system, one of the following occurs:

- No signon screen appears on attached display stations.
- An SRC (004x, 005x, 0099, 1xxxxx, or 2xxxxx) appears on display stations.

Attempt to establish communication with the host system.

**Does a signon screen appear on at least one display station?**

**Yes No**

**055**

Go to Step 112 on page 2-21.

**056**

– Reset any displayed SRC.

A failing work station is a work station that has one or more of the following conditions:

- System Available indicator off
- Failure in Free Key mode
- An operator-reported keyboard, display, or printer problem.

Answer NO to the following question if the only problem is a failure to communicate with the host system; or a 004x, 005x, 0099, 1xxxxx, or 2xxxxx SRC appears.

**Are one or more attached work stations failing?**

**Yes No**

**057**

– Go to Step 112 on page 2-21.

**058**

**Is the System Available indicator continuously on at the failing work station?**

**Yes No**

**059**

– Go to Step 109 on page 2-20.

**060**

(From page 2-5)
(Step **060** continues)

**060** (continued)

**Is the failing work station a display station?**

**Yes No**

**061**

**Does failure involve the copy-to-printer function?**

**Yes No**

**062**

– Check the address switch setting on the printer and check the configuration. Refer to "Control Unit Configuration Procedure" on page 3-6.

If a failure is still present, it is probably a problem within the printer.

Repair the failing printer, or report the problem to the customer for printers that do not have IBM on-site service.

**063**

– Go to Step 075 on page 2-17.

---

**064**

**Does Free Key mode operate on the failing display station?**

**Yes No**

**065**

**Is the problem "wrong characters displayed"?**

**Yes No**

**066**

Replace the planar. Refer to "Planar Removal and Replacement Procedure" on page 3-32.

– Go to "MAP 0400: Verify" on page 2-35.

**067**

(Step **067** continues)

**067** (continued)

The failure is in the attached work station. Repair the work station, or report the problem to the customer for work stations that do not have IBM on-site service.

- Go to "MAP 0400: Verify" on page 2-35.

**068**

**Is the problem "wrong characters displayed"?**
**Yes No**

**069**

- Go to Step 086 on page 2-18.

**070**

- Switch the control unit power off.
- Set the Test switch on the control unit to On.
- Switch the control unit power on.
- After the Ready LED comes on, press the Test Request key sequence for the attached display station. See "Key Sequences" on page 3-40.

The configuration screen appears.

- Obtain Remote Work Station Setup Worksheets from the customer and make sure that the keyboard code for each display station is correct. See Figure 3-10 on page 3-12.

**Does the displayed configuration match the actual configuration of the attached display stations?**
**Yes No**

**071**

Correct the configuration screen and attempt the failing operation again.

- Press the Return key twice to save the new configuration.
- Press the Error Reset key on the display station to exit CSU mode.
- Set the Test switch on the control unit to Off.
- Switch the control unit power off.
- Go to "MAP 0400: Verify" on page 2-35.

**072**

- Exit the CSU mode.
- See the display station maintenance books and check the display station for correct scan code generation.

**Is the display station scan code generation correct?**
**Yes No**

**073**

The failure is in the attached work station. Repair the work station, or report the problem to the customer for work stations that do not have IBM on-site service.

- Set the Test switch on the control unit to Off.
- Switch the control unit power off.
- Go to "MAP 0400: Verify" on page 2-35.

**074**

Replace the planar. Refer to "Planar Removal and Replacement Procedure" on page 3-32.

- Go to "MAP 0400: Verify" on page 2-35.

**075**

(From MAP 0100 step 020 on page 2-9)
(From step 063)

**Is an SRC of 52XXXX displayed?**
**Yes No**

**076**

- Enter the Concurrent mode and check row 24 of screen C1. See "Concurrent Mode Screens" on page 3-61.

**Does a printer selection field on the right hand side of the screen appear with either _ _ or a printer address?**
**Yes No**

**077**

The Release 1 system diskette does not support off-line operation of the copy to printer function.

**078**

(Step **078** continues)

**078** (continued)

- See Appendix B, "Supported Attachments" on page B-1.

If the printer in question is listed as a supported device, suspect a microcode problem. Contact your support structure for assistance.

---

**079**

(From page 2-6)

**Is the SRC either 520000 or 520002?**
**Yes No**

**080**

**Is the SRC 520001?**
**Yes No**

**081**

The print operation was interrupted by one of the following:

- Printer power was set off.
- The printer Cancel key was pressed.
- There is a problem with the twinaxial cabling. Go to Step 109 on page 2-20.

**082**

The device designated for the copy-to-printer function is not a printer.

For online operation, notify the host system operator that the address selected for the copy-to-printer function is not correct.

– or –

For local operation, this address is selected by a field in CSU or Concurrent mode screens. See "Control Unit Configuration Procedure" on page 3-6 or "Common Data Fields" on page 3-63.

---

**083**

(Step **083** continues)

**083** (continued)

**Is the 5394 in session with the host system?**
**Yes No**

**084**

Check for one of the following:

- A problem with the twinaxial cabling. Go to Step 109 on page 2-20.
- The selected printer is offline, powered off, or in an error state.

**085**

Contact the host system operator and ask what address is selected for the copy-to-printer function. Check the printer at that address. If the printer is currently in session, retry the operation after the print job finishes.

– or –

If the printer is not in session, make sure that it is powered on, online, and has the System Available indicator on.

If the copy-to-printer function continues to fail, go to Step 109 on page 2-20.

- Go to "MAP 0400: Verify" on page 2-35.

---

**086**

(From page 2-5)
(From step 069)

**Does correct operation of the Text Entry Assist Function result in an operator SRC of 0072 through 0078? (This function is described in "Text Entry Assist" on page 5-11).**
**Yes No**

**087**

- Go to Step 089 on page 2-19.

**088**

Contact your support structure to determine if a microcode change is available for this problem.

---

**089**

(From MAP 0100 step 020 on page 2-9)
(Step **089** continues)

**089** (continued)
(From step 087)

**Is the reported problem a self-check failure?**
**Yes No**

**090**

- Go to Step 094.

**091**

- Select Specified Input Field on the Display Verification Menu.
- Field advance to the self-check fields.
- Type AF127656 in the first self-check field and press Enter.
- Type AF127655 in the second self-check field and press Enter.

**Is SRC 0015 displayed after entering either self-check field number?**
**Yes No**

**092**

The failure is caused by entry of the wrong check digits or by a host system programming problem.

- Go to "MAP 0400: Verify" on page 2-35.

**093**

Contact your support structure to determine if a microcode change is available for this problem.

---

**094**

(From MAP 0100 step 020 on page 2-9)
(From step 090)

**Is the reported problem an MSR failure?**
**Yes No**

**095**

- Go to Step 099.

**096**

- Pass the MSR test card through the reader while in Free Key mode or with the Prime Option Menu displayed.

(Step **096** continues)

**096** (continued)

**Does the MSR test card read correctly when used in Free Key mode or in the Free Key field on the Display Verification Menu?**
**Yes No**

**097**

The failure is probably in the attached work station.

Repair the work station, or report the problem to the customer for work stations that do not have IBM on-site service.

– or –

If no failure is found, contact your support structure to determine if a microcode change is available for this problem.

- Go to "MAP 0400: Verify" on page 2-35.

**098**

The failure is caused by an operator error, a defective MSR card, or a host system programming problem.

- Go to "MAP 0400: Verify" on page 2-35.

---

**099**

(From step 095)

**Is the reported problem a light pen failure?**
**Yes No**

**100**

- Go to Step 104 on page 2-20.

**101**

- Type a line of characters while in Free Key mode or with the Display Verification Menu displayed. Place the light pen tip on any character. An error code of 0036 should appear.
- Remove the light pen from the screen.
- Press the Reset key.
- Press the Field Exit key.
- Place the light pen tip over a row of characters and slowly move along the row.

(Step **101** continues)

**101** (continued)

The cursor should follow the light pen movement + or - 2 positions.

- Place the light pen tip over a character and press the light pen tip against the screen to activate the tip switch. An SRC of 0037 should appear.

**Did the light pen check good?**
**Yes No**

**102**

The failure is probably in the attached work station.

Repair the work station, or report the problem to the customer for work stations that do not have IBM on-site service.

– or –

If no failure is found, contact your support structure to determine if a microcode change is available for this problem.

- Go to "MAP 0400: Verify" on page 2-35.

**103**

The failure is caused by an operator error or a host system programming problem.

- Go to "MAP 0400: Verify" on page 2-35.

---

**104**

(From step 100)

**Does correct operation result in an operator SRC of 0000 through 0029, 0060 through 0066, or 0071?**
**Yes No**

**105**

If the SRC is 0067, 0068, or 0069, the cause is probably a host system programming problem.

– or –

If the SRC is any other valid SRC (refer to Table 3-21 on page 3-89) go to "MAP 0100: Start Of Call" on page 2-3.

– or –
(Step **105** continues)

**105** (continued)

If the SRC is not listed in Table 3-21 on page 3-89, replace the planar. See "Planar Removal and Replacement Procedure" on page 3-32.

- Go to "MAP 0400: Verify" on page 2-35.

**106**

- Read the SRC definition. Refer to "SRC Summary Table" on page 3-89.
- If the attempted operation needs a feature installed on the display station, make sure that the feature is installed.
- Check that the attempted operation works correctly for the online tests. Refer to "Online Tests" on page 3-78 or "Free Key Mode" on page 3-50.

**Does the failing operation work correctly in the online verification test of Free Key mode?**
**Yes No**

**107**

The failure is in the attached work station.

Repair the work station, or report the problem to the customer for work stations that do not have IBM on-site service.

**108**

Probable host programming problem.

---

**109**

(From steps 053, 059, 081, 084, and 085)

- Switch the control unit power off.
- Disconnect all twinaxial connectors at the I/O panel of the control unit.
- Move the cable for the failing work station to a different port on the control unit.
- Switch the control unit power on.

**Is the failing work station System Available indicator on (not blinking)?**
**Yes No**

**110**

(Step **110** continues)

**110** (continued)

– Restore the cabling to the original position.

Either an attached work station is failing or the cable from the control unit to the work station is defective.

If twinaxial cable is used, go to "MAP 0910: Twinaxial Cabling System" on page 2-45.

– or –

If IBM Cabling System is used, go to "MAP 0920: IBM Cabling System" on page 2-51.

**111**

Replace the planar. See "Planar Removal and Replacement Procedure" on page 3-32.

– Go to "MAP 0400: Verify" on page 2-35.

---

**112**

(From steps 055 and 057)

Switch the control unit power off and read the following steps before proceeding:

– Watch the LEDs on the operator panel.

– Switch the control unit power on.

The following indications should occur within 3 seconds:

1. All LEDs come on for about 1/2 second.
2. The Power LED remains on.
3. The Com Line Sync LED flashes a second time.

**Are all indications correct?**

**Yes No**

**113**

If all LEDs (except Power) fail to come on for about 1/2 second, remove the diskette from the drive and go to MAP 0500 step 014 on page 2-38.

– or –

If some LEDs fail to respond correctly, use an ohmmeter to check the failing LEDs. See "Operator Panel (Including LEDs and Test Switch)" on page 3-21.

If a problem is found, replace the operator panel. See "Operator Panel Removal and Replacement Procedure" on page 3-37.

– or –

If no problem is found, replace the planar. See "Planar Removal and Replacement Procedure" on page 3-32.

– Go to "MAP 0400: Verify" on page 2-35.

**114**

(From page 2-5)

A Model 01 5394 can be connected to either an EIA 232D cable or a V.35 cable. A Model 02 5394 must be connected to an X.21 cable.

**Is this 5394 connected to an X.21 or an EIA 232D cable?**

**Yes No**

**115**

– Go to Step 123 on page 2-22

**116**

– Switch the control unit power off.

– Set the Test/Oper switch at the DCE end of the communication cable to the Test position.

**Notes:**

1. For Model 02, the DCE power must be switched on and in Normal Operating mode so that it can supply the clock signals required for the following test.
2. If an EIA 232D communication cable has two Test/Oper switches, both switches must be set to the Test position.

The control unit Test switch should be Off.

– Switch the control unit power on.

– Enable wrap level 3 by selecting CE test 63 and the Continuous loop option (see "Dedicated Mode Tests" on page 3-50).

– Press the Enter key to start the test.

A 630004 SRC appears to indicate that the communication cable Test/Oper switch must be in the Test position.

– Press the Enter key again.

– Wait until the test has run 10 times or until an error occurs before you answer the question.

(Step **116** continues)

**116** (continued)

**Is SRC 63xxxx (not 630000 or 630007) displayed?**
**Yes No**

**117**

**Does the Com Line Sync LED flash while the test is running?**
**Yes No**

**118**

Replace the planar. See "Planar Removal and Replacement Procedure" on page 3-32.

- Go to "MAP 0400: Verify" on page 2-35.

**119**

- Go to Step 131 on page 2-23.

**120**

- Measure the voltage between connector P1-9 (+12 VDC) and P1-4 (GND). See Figure 3-21 on page 3-19.

**Is the voltage correct?**
**Yes No**

**121**

- Replace the power supply. See "Power Supply Removal and Replacement Procedure" on page 3-33.
- Go to "MAP 0400: Verify" on page 2-35.

**122**

Use Table 3-47 on page 3-124 with Figure 3-38 on page 3-59 or Figure 3-40 on page 3-61 to determine if communication signal wires are failing. If Table 3-47 on page 3-124 indicates failing communication signal wires, use your ohmmeter to check these wires for opens or shorts to ground. Repair or replace the communication cable.

– or –

If no cable fault is found, replace the planar. See "Planar Removal and Replacement Procedure" on page 3-32.
(Step **122** continues)

**122** (continued)

- Go to "MAP 0400: Verify" on page 2-35.

**123**

(From step 115)

- Switch the control unit power off.
- Place the control unit Test switch in the Off position.
- Switch the control unit power on and wait for the Ready LED to come on.
- Enter the Dedicated mode. Use the Cursor Up key to select test 63 with the Continuous loop option. See "Dedicated Mode Tests" on page 3-50.
- Press the Enter key to start the test.

When a 630004 1 code appears:

- Disconnect the communication cable from the modem or DCE.
- Place cable switches 1 and 3 in Test position.
- Place cable switch 2 in Oper position.
- Press the Enter key to start the test.

**Does this test run continuously?**
**Yes No**

**124**

Either the cable or the planar is failing. See Figure 3-39 on page 3-60 to identify specific components affected. Use an ohmmeter to check the cable.

**125**

**Does the Com Line Sync LED flash while the test is running?**
**Yes No**

**126**

Replace the planar. See "Planar Removal and Replacement Procedure" on page 3-32

- Go to "MAP 0400: Verify" on page 2-35.

**127**

(Step **127** continues)

**127** (continued)

- Press the Error Reset key to stop this phase of the test.
- Press the Enter key to start the next phase of the test sequence.

When a 630004 2 code appears:

- Place cable switch 2 in the Test position.
- Place cable switch 3 in the Oper position.
- Press the Enter key.

**Does this test run continuously?**

**Yes No**

**128**

Either the cable or the planar is failing. See Figure 3-39 on page 3-60 to identify specific components affected. Use an ohmmeter to check the cable.

**129**

**Does the Com Line Sync LED flash while the test is running?**

**Yes No**

**130**

Replace the planar. See "Planar Removal and Replacement Procedure" on page 3-32.

- Go to "MAP 0400: Verify" on page 2-35.

**131**

(From step 119)

- Press the Error Reset key to stop the test.
- If you disconnected the communication cable from the modem or DCE, reconnect it before continuing the procedure.
- Set the Test/Oper switch at the DCE end of the communication cable to the Oper position.
- To do this test, set the DCE for a local wrap by using the operator control on the DCE operator panel.
- If the DCE does not have a local wrap function, answer NO to the following question.

(Step **131** continues)

**131** (continued)

- If the DCE does have a local wrap function, enable wrap level 4 by selecting CE test 64. See "Entering the Dedicated Mode" on page 3-50.
- Press the Enter key to start the test.

A 640005 SRC appears to indicate that the DCE must be set for local wrap.

- Press the Enter key again.

**Is SRC 64xxxx (not 640000 or 640007) displayed?**

**Yes No**

**132**

- Go to Step 140 on page 2-24.

**133**

**Is the modem or DCE configured for V.25 bis operation?**

**Yes No**

**134**

- Go to Step 139 on page 2-24

**135**

- Use the Cursor Up key to select test 69.
- Press the Enter key to access Concurrent mode screens. See "Concurrent Mode Screens" on page 3-61.
- Check the values of the following fields in row 3 of screen C1:
  - G.G = 2.0 or higher
  - J = 1
  - KK = 10.

**Are these fields correct?**

**Yes No**

**136**

Notify the customer that this 5394 does support the V.25 bis function.

**137**

- Check bit 5 of the communication parameters in row 1.

(Step **137** continues)

**137** (continued)

**Is bit 5 set to 0 (DTR selected)?**
**Yes No**

**138**

CSU parameters are not correct for V.25 bis operation. Correct the configuration screen using "Control Unit Configuration Procedure" on page 3-6, and attempt the failing operation again.

– Go to "MAP 0400: Verify" on page 2-35.

**139**

(From step 134)

The DCE is failing.

Report to the customer the failure indicated by the 64xxxx SRC that you received.

– Return the control unit to its normal setup, and the DCE to normal operating mode.

---

**140**

(From step 132)

– Exit Dedicated mode and restore the DCE and control unit to normal operating mode.

– Attempt to establish communication with the host system. (Ask the host system operator to vary on the 5394.)

**Does the Com Line Sync LED flash?**
**Yes No**

**141**

Go to Step 149 on page 2-25.

**142**

– Select the Display Verification Menu from the Prime Option Menu to determine if communication with the host system is possible.

(Step **142** continues)

**142** (continued)

– To run the online test:

- At the logon screen, press the Test Request key sequence on the attached display station. See "Key Sequences" on page 3-40.
- The Prime Option Menu appears.
- Select the Link Test, if permitted by the host system for your configuration, or select the Display Verification Menu. Refer to "Online Tests" on page 3-78.

**Did the online test run correctly?**
**Yes No**

**143**

Go to Step 147.

**144**

**Does a failure occur every time the customer attempts a specific job?**
**Yes No**

**145**

No failure was found.

If the failure still occurs, use "MAP 0300: Problem Not Found" on page 2-27.

– or –

If the failure is intermittent, refer to "Concurrent Mode Screens" on page 3-61, and check the HE log (screen C1) and PLE error logs (screen C2) and go to "MAP 0300: Problem Not Found" on page 2-27.

– Return the control unit to its normal setup.

**146**

Report to the customer that the failure appears to be a host system problem, probably a programming error.

– Return the control unit to its normal setup.

---

**147**

(From MAP 0100 step 020 on page 2-8)
(From step 143)
(Step **147** continues)

**147** (continued)

- Switch the control unit power off.
- Set the Test switch on the control unit to On.
- Switch the control unit power on.
- After the power-on sequence completes, press the Test Request key sequence on an attached display station. See "Key Sequences" on page 3-40.

A configuration screen appears. See "Control Unit Configuration Procedure" on page 3-6.

- Make sure that the 5394 station address is correct and that the displayed communication configuration matches the Communications Worksheet.

**Is the configuration correct?**
**Yes No**

**148**

Correct the configuration screen, using "Control Unit Configuration Procedure" on page 3-6, and attempt the failing operation again.

- Go to "MAP 0400: Verify" on page 2-35.

**149**

(From step 141)

Online Communication failure.

- Set the Test switch on the control unit to Off.
- Switch the control unit power off, wait 5 seconds, then switch the control unit power on.
- Enter the Concurrent mode and check the communication parameters. See "Common Data Fields" on page 3-63.

**Does this 5394 use the X.25 communication mode?**
**Yes No**

**150**

For control units that use SDLC mode, go to "MAP 3000: SDLC Online Communication" on page 2-59.

– or –

For control units that use X.21 Switched mode, go to "MAP 3020: X.21 Switched Online Problems" on page 2-71.

**151**

Go to "MAP 3010: X.25 Online Communication" on page 2-65.

Notes

# MAP 0300: Problem Not Found

001

All problems must be started at "MAP 0100: Start Of Call" on page 2-3:

This MAP has three sections:

1. An index of possible causes listed by SRC in order of probability
2. An index of possible causes listed by major symptom in order of probability
3. An error log table, which uses the ERAP error log (see "Error Logs" on page 3-83) or the error log buffer (see "Concurrent Mode Screens" on page 3-61).

Each table lists probable causes for a symptom or SRC. When a probable cause is a device other than the 5394, see the documentation for that device. If the probable cause is an FRU, replace the FRU. See "Removal and Replacement Procedures" on page 3-26.

**Notes:**

1. If more than one FRU is listed in the probable cause column, do one FRU replacement per call and record the date.
2. If two or more symptoms are occurring, look for FRUs common to all symptoms or common to those that occur most often.
3. If a cable is listed as the probable cause, attempt to reseat the cable before replacing it.
4. All references to twinaxial cable in this MAP include both twinaxial cable and the IBM Cabling System cable.

– Look for the SRC in Table 2-6.

## System Reference Code Index

Table 2-6 (Page 1 of 3). System Reference Code Index

| SRC | Additional Information | Probable Cause |
|---|---|---|
| **Operator-Reported SRCs** | | |
| 0001 thru 0029 | Occurs during correct operation or entry | 1. Attached display station<br>2. Planar |
| 0031 thru 0035 | Occurs during correct operation of MSR | 1. MSR media<br>2. Attached display station<br>3. Planar |
| 0036 thru 0038 | Occurs during correct operation of the light pen with valid light pen entry fields | 1. Attached display station<br>2. Planar |
| 004x or 005x or logged 006x | | Go to "Error Log Analysis" on page 2-32. |
| 0060 thru 0071 | 0060 through 0066 during correct operation<br><br>0067 through 0071 | 1. Attached display station<br>2. Host system programming<br>3. Planar |
| 0070 thru 0078 | Normally a message appears without a code for these errors. The code appears when the Help key is used. | 1. Attached display station<br>2. Host system programming<br>3. Planar |

Table 2-6 (Page 2 of 3). System Reference Code Index

| SRC | Additional Information | Probable Cause |
|---|---|---|
| 0080 thru 0087 | Configuration error. Check work station configuration and CSU configuration entries (see "Control Unit Configuration Procedure" on page 3-6). | 1. Wrong configuration<br>2. Planar |
| 0097 thru 0099 | Occurs during correct operation. Host system or communication problem. | Record PLE log entries and go to "Error Log Analysis" on page 2-32. If no log entries, go to "MAP 3030: Online Intermittent Problems" on page 2-77 |
| 100000 thru 10FFFF | Occurs during correct operation or entry | 1. Wrong configuration<br>2. Planar |
| 110000 thru 1FFFFF | Probable network problem. See"X.25 Communication SRCs" on page 3-110 . | 1. Communication network<br>2. DCE<br>3. Planar |
| 20xxxx | Occurs during correct operation or entry | 1. Wrong configuration<br>2. Planar |
| 2xxxxx (not 20xxxx) | Probable network problem. Check SRC lists for cause definition. | 1. Communication network<br>2. DCE<br>3. Planar |
| 30xxxx | Occurs during correct operation | 1. Planar<br>2. Modem or DCE |
| 3xxxxx (not 30xxxx) | CSU parameters are correct | 1. Modem or DCE<br>2. Communication network |
| 500000 thru 50FFFF | Diskette drive or diskette problem | 1. Wrong diskette<br>2. Diskette failing or write-protected<br>3. Planar |
| 510000 thru 51FFFF | Microcode change error | 1. Communication network<br>2. Diskette problem<br>3. Host system programming |
| 520000 thru 52FFFF | | 1. Twinaxial cable<br>2. Printer<br>3. Wrong configuration |
| Other | Occurs during correct operation | 1. Attached display station<br>2. Planar<br>3. Wrong configuration |
| **Diagnostic SRCs** | | |
| D11001 | Power LED on. All other LEDs off. | 1. Planar<br>2. Power supply |
| D13002 | Power and Ready LEDs on. Work Station Active LED off. | 1. Twinaxial cable<br>2. Attached work station<br>3. Planar |

| Table 2-6 (Page 3 of 3). System Reference Code Index | | |
|---|---|---|
| **SRC** | **Additional Information** | **Probable Cause** |
| D13003 | Power and Work Station Active LEDs on. Ready LED off. | 1. Twinaxial cable<br>2. Attached work station<br>3. Planar<br>4. Power supply |
| D13004 | Ready LED flashes | DRAM module failure. Number of flashes indicates position of failing DRAM module. Replace the DRAM module at indicated position. See "DRAM Removal and Replacement Procedure" on page 3-31. |
| D13005 | Check Disk LED on or flashing | 1. Diskette<br>2. Diskette Drive<br>3. Planar |
| D13007 | All work stations on a single port fail. At least one work station attached to control unit is not failing. | 1. Work station<br>2. Cabling<br>3. Planar |
| D410xx<br>D510xx<br>D610xx<br>D710xx | Power-on sequence error | Planar |
| D73yxx | Power-on sequence error during twinaxial interface test. The y in the SRC equals 1 to 7 and identifies the failing port(s).<br>1 = port 0<br>2 = port 1<br>4 = port 3<br><br>If y is 3, 5 or 7 (multiple ports failing), the most probable cause is the planar. | 1. Attached work station<br>2. Twinaxial cable<br>3. Planar |
| D810xx | Make sure that the planar is correct type for the control unit model. | Planar |
| D91010 | 5394 is Model 01<br>Cable is V.35 | 1. The 5394 does not support V.35.<br>2. Planar<br>3. Cable |
| Dxxxxx | Any other SRC | 1. Planar<br>2. Power supply |
| Exxxxx | Hardware error detected during operation | Planar |
| Fxxxxx | Microcode error detected during operation | 1. Check microcode level for latest level.<br>2. If OK, replace planar.<br>3. If failure continues to occur, contact your support structure. |

(Step **001** continues)

**001** (continued)

– Look for the symptom in Table 2-7.

When using observed symptoms, the minor symptom column can aid in isolating the failure cause. Also, review the internal error log or the error history table for entries that can aid in defining the failure cause.

## Failure Symptom Index

Table 2-7 (Page 1 of 2). Failure Symptom Index

| **Major Symptom** | **Minor Symptom** | **Probable Cause** |
|---|---|---|
| | **Communication** | |
| Com Line Sync LED off | 1. 004X, 005X, or 0099 SRCs appear<br>2. No operator errors | See Table 2-6 on page 2-27.<br>Communication with host system lost (see below) |
| Communication slow | Input Inhibit indicator on longer than usual.<br>**Note:** This may be caused by host system workload increase. | Go to "MAP 3030: Online Intermittent Problems" on page 2-77. |
| Communication with host system lost | The Com Line Sync LED may be flashing if on a multipoint network. | Check PLE log. Use PLE log entries with "Error Log Analysis" on page 2-32. If no PLE log entries are present, go to "MAP 3030: Online Intermittent Problems" on page 2-77. |
| Communication with host system cannot be established when control unit first set up or after change in configuration | Check the following items:<br>• Same NRZ or NRZI option used at both ends<br>• Correct control unit station address used<br>• Other communication configuration entries correct<br>• This 5394 is varied on at the host system<br>• System configuration matches actual remote cluster configuration<br>• DCE properly configured for selected mode of operation. | |
| | **LED Indications** | |
| All LEDs off | | 1. Power supply<br>2. Customer AC power<br>3. Operator panel<br>4. Planar |
| Power LED on.<br>All other LEDs off. | | 1. Planar<br>2. Power supply |
| Power and Ready LEDs on.<br>Work Station Active LED off. | At least one attached work station must have its power switched on. The 5394 is not receiving or recognizing any response from the work stations. | 1. Attached work station<br>2. Twinaxial cable<br>3. Planar |
| Power and Work Station Active LEDs on.<br>Ready LED off. | Disconnect all twinaxial cables and switch power on again. If the Ready LED comes on, a cable or work station is failing. | 1. Twinaxial cable<br>2. Attached work station<br>3. Planar<br>4. Power supply |

| Table 2-7 (Page 2 of 2). Failure Symptom Index | | |
|---|---|---|
| **Major Symptom** | **Minor Symptom** | **Probable Cause** |
| Single LED failure | 5394 works. All operations normal. | 1. Operator panel<br>2. Planar |
| | **Other Symptoms** | |
| Symptoms not described | | 1. Power supply<br>2. Planar |

– Look for the symptom in Table 2-8.

Use this section only after making sure that no problem was detected by the control unit or attached work station diagnostics.

These are symptoms that are observed at the work stations.

| Table 2-8 (Page 1 of 2). Attached Work Station Symptoms | | |
|---|---|---|
| **Major Symptom** | **Minor Symptom** | **Probable Cause** |
| System Available indicator off | No Free-Key mode | 1. Twinaxial cable<br>2. Planar<br>3. Attached work station |
| System Available indicator on | No character appears when a key is pressed | 1. Planar<br>2. Attached work station |
| System Available indicator on | Characters that appear do not match the key pressed<br><br>Free Key mode fails | 1. Wrong configuration<br>2. Planar |
| Light pen | Fails on all attached display stations<br><br>Fails on some attached display stations, works correctly on others | Possible microcode problem<br><br>Attached work station |
| System Available indicator off or flashing and work station contin-uously resets (goes through power-on cycle) | Fails on only one work station when more than one is attached to the same port and powered on<br><br>Fails on two or more work stations attached to the same port. Works when the power is switched on at only one of the failing work stations. | Attached work station<br><br>The failing work stations are responding to the same address. Either more than one work station is set for the same address or a failure of an attached work station is causing an address recognition failure. |
| System Available indicator off or flashing (the work station may also reset intermittently) | Fails on two or more work stations that have the same work station address and are attached to different ports. Data entered at or sent to one work station may be displayed at a work station with the same address on a dif-ferent port. | Planar |

Table 2-8 (Page 2 of 2). Attached Work Station Symptoms

| Major Symptom | Minor Symptom | Probable Cause |
|---|---|---|
| System Available indicator off or flashing and/or Com Line Sync off (including off intermittently)<br><br>**Note:** Use only if preceding entries do not match. | Fails on only one work station when more than one are attached to the same port<br><br>Fails on more than one work station or only one is attached to the port | 1. Twinaxial cable<br>2. Attached work station<br>3. Wrong configuration<br><br>1. Twinaxial cable<br>2. Attached work station<br>3. Wrong configuration<br>4. Planar |
| MSR | Fails on all attached display stations<br><br>Fails on some attached display stations, works correctly on others | Possible microcode problem<br><br>Attached work station |
| Overstrike or Hex key failure | Machine operates normally for all other functions | 1. Wrong configuration<br>2. Planar |
| Self-check | Fails when correct check digits are entered | 1. Possible microcode problem<br>2. Attached work station |
| Wrong characters displayed | Check for correct keyboard code in configuration record (see "Control Unit Configuration Procedure" on page 3-6). | 1. Wrong configuration<br>2. Planar |
| Offline copy-to-printer function fails | System diskette is Release 2<br><br>Printer diagnostics run correctly | 1. Twinaxial cable<br>2. Planar |
| Other | Other attached work station failures when no internal problem with the work station can be found and System Available indicator is on at the failing work station<br><br>Other work station failures when a possible cabling problem is indicated | 1. Attached work station (FRUs not tested by diagnostics)<br>2. Twinaxial cable<br>3. Planar<br><br>Twinaxial cable not terminated or terminating resistance connected at work stations other than the last work station (can occur with work stations that provide cable-thru as an option). |

## Error Log Analysis

- Find the last SRC from the error history table or the error log buffer (see "Concurrent Mode Screens" on page 3-61).
- Find the SRC in the SRC column of Table 2-9 on page 2-33.

The FRUs are listed in the following cause number key.

**Cause Number Key**

1. External communication cable
2. Planar
3. Communication line or network
4. Modem or DCE
5. Host system
6. Configuration error

(Step **001** continues)

**001** (continued)

7. Power supply.

See "Error History Table (ERAP) Description" on page 3-85 for more detailed information on the SRCs.

Refer to "Error Logs" on page 3-83 for a general description of the error log and "SRC Summary Table" on page 3-89 for SRCs.

Table 2-9 indicates the possible causes for the communication SRCs.

The possible causes are listed in order of probability for each model.

Each possible cause is shown as a number that corresponds to a failure cause or FRU in the cause number key.

You may use "MAP 3030: Online Intermittent Problems" on page 2-77 with all 004x, 005x, and 006x SRCs to aid in isolating the failure.

Table 2-9. Communication Error Codes

| SRC | Model 01 | Model 02 |
|---|---|---|
| 0040 | 4,1,2,6 | 4,3,1,2,6 |
| 0041 | 3,4,1,2,6 | 4,3,1,2 |
| 0042 | 4,2 | 4,1,2 |
| 0043 | 4,2,6,7 | |
| 0044 | 3,4,1,2,6 | 6 |
| 0045 | 4,3,2 | 4,3,2 |
| 0046 | 4,2 | 4.2 |
| 0047 | 4,2 | 4,2 |
| 0050 | 4,1,2 | |
| 0051 | 4,1,2 | 4,1,2 |
| 0052 | 2 | 2 |
| 0053 | 4,3 | 4,3 |
| 0054 | 5,2 | 5,2 |
| 0062<br>0063 | 2 | 2 |
| 0064 | 3,4,1,2 | 3,4,1,2 |
| 0065<br>0066 | 4,2 | 4,2 |
| 0067<br>0068<br>0069 | 3,4,1,2 | 3.4,1,2 |
| 006A | 5,3,4 | 5,3,4 |
| 006C | 3,4 | 3,4 |
| 006D | 3,4,5 | 3,4,5 |

If the SRC is a 01xx or 02xx, suspect a twinaxial cable problem. Suspect a 5394 problem if no problems are found in the attached work station or the twinaxial cable.

Probable cause: planar or power supply.

**Did you find the failing FRU or did you replace an FRU for an intermittent problem?**

**Yes No**

**002**

- Use the information you have with Chapter 3, "Maintenance Information" on page 3-1 and Chapter 5, "Theory" on page 5-1 for a free-lance approach.

**003**

- Record the FRU replaced, the symptoms, and the date.

Notes

# MAP 0400: Verify

001

- Switch power off.
- Reconnect all cables that you disconnected.
- Insert the 5394 diskette in the drive.
- Set the Test switch to Off.
- Wait 5 seconds, then switch power on.
- Have the host system operator vary on the 5394.
- Attempt to repeat the original error.
- Make sure that no new errors have occurred.

**Does the original error still occur?**
**Yes No**

002

The correct power-on sequence when the Test switch is set to Off follows:

1. The power is switched on.
2. All LEDs come on for about 1/2 second for a lamp test.
3. All LEDs, except for the Power LED, go off.
4. The Ready LED comes on when the power-on sequence completes.
5. The Work Station Active LED comes on if the power is switched on at any attached work station and it responds to polling from the control unit.
6. The control unit is ready to operate once it establishes the communication link to the host system.

**Do no errors occur and does the control unit operate correctly offline when you switch power on?**
**Yes No**

003

Note the error or symptom that is now occurring and go to "MAP 0100: Start Of Call" on page 2-3.

004

- Run the online test and select option 1 from the Prime Options Menu. See "Online Tests" on page 3-78.

**Does the online test run correctly?**
**Yes No**

005

Note the error or symptom that is now occurring and go to "MAP 0100: Start Of Call" on page 2-3.

006

- If necessary, run the customer application.
- If not necessary to run the customer application, end of call.

**Does the customer application run correctly now?**
**Yes No**

007

Note the error or symptom that is now occurring and go to "MAP 0100: Start Of Call" on page 2-3.

008

End of call.

009

Go to "MAP 0300: Problem Not Found" on page 2-27.

Notes

# MAP 0500: Power Problem

| Symptom Explanation | Conditions That Could Cause This Symptom |
|---|---|
| The control unit is inoperative.<br>or<br>One or more DC voltages are incorrect or missing. | • The power supply is failing.<br>• The planar is failing.<br>• The diskette drive is failing.<br>• The operator panel is failing. |

**Attention!**

**REMOVE THE DISKETTE FROM THE CONTROL UNIT BEFORE USING THIS MAP.**

If the J1 power connector is removed when the power is switched on, the diskette may be permanently damaged.

Re-insert the diskette after the voltage problem is corrected.

**CAUTION:**
**Switch power off before removing cables.**

**001**

– Switch 5394 power on.

The operator panel Power LED should come on.

**Is the operator panel Power LED off?**
**Yes No**

**002**

– Go to Step 011 on page 2-38.

**003**

**Is the green AC indicator at the rear of the control unit on?**
**Yes No**

**004**

AC power may be failing.

– Check for AC power at the 5394 end of the power cord.

If AC power is bad, check and replace the line cord, or notify the customer of a power problem.
(Step **004** continues)

**004** (continued)

– or –

If AC power is good up to the 5394, replace the power supply. See "Power Supply Removal and Replacement Procedure" on page 3-33.

– Go to "MAP 0400: Verify" on page 2-35.

**005**

– Switch the control unit power off and remove the covers. See "Cover Removal and Replacement Procedure" on page 3-26.

– Disconnect the following component cable plugs (See Figure 3-20 on page 3-18):

- Diskette drive power plug P2 and the diskette drive signal cable
- Fan plug P3.

– Switch the control unit power on.

**Is the Power LED still off?**
**Yes No**

**006**

– Connect the fan plug, and then the diskette drive cables. Switch power off, then on, after you connect each plug.

Replace the FRU that causes the Power LED to fail to come on. See "Fan Removal and Replacement Procedure" on page 3-29 or "Diskette Drive Removal and Replacement Procedure" on page 3-27.

– Go to "MAP 0400: Verify" on page 2-35.

**007**

(Step **007** continues)

**007** (continued)

- Switch the control unit power off.
- Remove DRAM modules from the planar. See "DRAM Removal and Replacement Procedure" on page 3-31.
- Switch the control unit power on.

**Is the Power LED still off?**
**Yes No**

**008**

Replace the DRAMs. See "DRAM Removal and Replacement Procedure" on page 3-31

- Go to "MAP 0400: Verify" on page 2-35.

**009**

- Measure the voltage at:

  P10-B5 to P10-A5(GND) +5V

  See Figure 3-21 on page 3-19 and Figure 3-20 on page 3-18.

**Is the voltage missing?**
**Yes No**

**010**

Replace the operator panel. See "Operator Panel Removal and Replacement Procedure" on page 3-37.

- Go to "MAP 0400: Verify" on page 2-35.

**011**

The power supply is designed to operate while disconnected from the planar board.

- Switch the control unit power off and remove the diskette.
- Disconnect power supply cable P1. See Figure 3-20 on page 3-18.
- Switch the control unit power on.
- Measure the voltages at the end of the power supply cable:

  P1-1 to P1-4(GND) +5V
  P1-3 to P1-4(GND) −5V
  P1-8 to P1-4(GND) −12V

(Step **011** continues)

**011** (continued)

  P1-9 to P1-4(GND) +12V

  See Figure 3-21 on page 3-19.

The voltages may be high, but all should be present.

**Are all voltages present?**
**Yes No**

**012**

Replace the power supply. See "Power Supply Removal and Replacement Procedure" on page 3-33.

- Go to "MAP 0400: Verify" on page 2-35.

**013**

Replace the planar. See "Planar Removal and Replacement Procedure" on page 3-32.

- Go to "MAP 0400: Verify" on page 2-35.

---

**014**

(From MAP 0100 step 020 on page 2-8)
(From MAP 0200 step 043 on page 2-14)
(From MAP 0200 step 046 on page 2-15)
(From MAP 0200 step 113 on page 2-21)

- Remove the 5394 diskette until you have completed this procedure.

The operator panel LEDs should all go on for about 1/2 second when the 5394 power is switched on.

Failure of the LEDs to go on may be caused by failure of the '-POR' signal from the power supply.

- Switch the control unit power off and remove the covers if you have not already done so. See "Cover Removal and Replacement Procedure" on page 3-26.
- Verify that connector P1 is securely installed in the planar.
- Carefully jumper P1-6 (brown wire) to P1-5 (black wire) on top of the P1 connector using meter leads or any suitable jumper wire. Do not remove the plug. See Figure 3-21 on page 3-19.
- Observe the 5394 operator panel LEDs and switch power on for 5 seconds; then switch the power off. Remove the jumper.

(Step **014** continues)

**014** (continued)

**Did all the LEDs come on?**

**Yes No**

**015**

**Did all the LEDs except one come on?**

**Yes No**

**016**

Replace the planar. See "Planar Removal and Replacement Procedure" on page 3-32.

- Go to "MAP 0400: Verify" on page 2-35.

**017**

- Use an ohmmeter to check the failing operator panel LED. See "Operator Panel (Including LEDs and Test Switch)" on page 3-21.

If a problem is found, replace the operator panel. See "Operator Panel Removal and Replacement Procedure" on page 3-37.

— or —

If a panel tests good, replace the planar. See "Planar Removal and Replacement Procedure" on page 3-32.

- Go to "MAP 0400: Verify" on page 2-35.

**018**

Replace the power supply. See "Power Supply Removal and Replacement Procedure" on page 3-33.

- Go to "MAP 0400: Verify" on page 2-35.

Notes

# MAP 0700: Diskette Drive Problem

| Symptom Explanation | Conditions That Could Cause This Symptom |
|---|---|
| The Check Disk LED is on or flashing or a diskette error code is displayed. | • The diskette is write protected or damaged. • The diskette drive or signal cable is failing. • The planar is failing. |

**001**

- Switch the 5394 power off.
- Remove the 5394 diskette and check the write-protect tab.

**Is the tab in the closed (unprotected) position?**
**Yes No**

**002**

- Move the write-protect tab to the closed position.
- Insert the diskette and switch the 5394 power on.

**Does the Ready LED come on and the Check Disk LED remain off?**
**Yes No**

**003**

- Go to Step 006.

**004**

End of call.

Inform the customer that the write-protect tab was in the wrong position.

**005**

- Make sure the write protect tab on the **backup** diskette is closed.
- Insert the **backup** diskette and switch the 5394 power on.
- Go to Step 006.

**006**

(From steps 003 and 005)

**Did the Check Disk LED come on?**
**Yes No**

**007**

**Did the Ready LED come on?**
**Yes No**

**008**

- Go to "MAP 0200: Main MAP" on page 2-11.

**009**

Inform the customer that the diskette is bad and recommend that a replacement diskette be ordered.

**010**

- Switch the 5394 power off and remove the covers. See "Cover Removal and Replacement Procedure" on page 3-26.

  **Note:** The pointed meter probe is too wide to enter the probe slots in plug P12. Use the narrower hooked probe to make measurements on P12.

- Measure the resistance between diskette drive power plug P2—2 and diskette drive signal cable P12—36. See Figure 3-21 on page 3-19.

**Is the resistance less than 1 ohm?**

**Yes No**

011

Replace the diskette drive signal cable (see "Diskette Drive Cable Removal and Replacement Procedure" on page 3-29).

- Go to "MAP 0400: Verify" on page 2-35.

012

- Switch the control unit power on.
- Measure the voltages at:

| | |
|---|---|
| P12-38 to P12-36(GND) | +5 |
| P12-40 to P12-36(GND) | +12 |

See Figure 3-21 on page 3-19 and Figure 3-20 on page 3-18.

**Are the voltages correct?**

**Yes No**

013

- Measure the voltages at:

| | |
|---|---|
| P2-4 to P2-2(GND) | +5 |
| P2-1 to P2-2(GND) | +12 |

**Are the voltages correct?**

**Yes No**

014

The power supply is failing.

Replace the power supply. See "Power Supply Removal and Replacement Procedure" on page 3-33.

- Go to "MAP 0400: Verify" on page 2-35.

015

- Go to Step 027 on page 2-43.

016

- Switch the 5394 power off.
- Set the Test switch to On.
- Check that the diskette write-protect tab is in the closed (unprotected) position and insert the diskette in the drive.
- Switch the 5394 power on and wait about 10 seconds.

**Did the disk activity LED on the front of the drive come on?**

**Yes No**

017

- Measure the voltage at:

| | |
|---|---|
| P12-16 to P12-36(GND) | 0.1 to 0.4 |

See Figure 3-21 on page 3-19 and Figure 3-20 on page 3-18.

**Is the voltage correct?**

**Yes No**

018

- Go to Step 027 on page 2-43.

019

Replace the diskette drive (see "Diskette Drive Removal and Replacement Procedure" on page 3-27).

- Go to "MAP 0400: Verify" on page 2-35.

020

- Set the Test switch to Off **immediately**.

This signals the microcode to start a continuous test loop. When you finish this MAP, you will have to switch the 5394 power off to end this test.

The Disk Activity LED should begin to flash on and off every 2-3 seconds. You may have to wait up to 4 minutes before this occurs.

**Did the Disk Activity LED come back on after you turned the Test switch Off?**

**Yes No**

021

Replace the planar (see "Planar Removal and Replacement Procedure" on page 3-32).

- Go to "MAP 0400: Verify" on page 2-35.

022

**Is the disk activity LED flashing on and off every 2 to 3 seconds?**

**Yes No**

023

Go to Step 032 on page 2-44.

024

- Measure the voltage at:

| | |
|---|---|
| P12-2 to P12-36(GND) | 0.0 to 0.4 |

See Figure 3-21 on page 3-19 and Figure 3-20 on page 3-18.

**Is the voltage correct?**

**Yes No**

025

- Go to Step 027.

026

- Connect a logic probe (see "General and Integrated Logic Probes" on page 4-1) and check to see if the following signals are active:

P12-18 - DIR
P12-20 - STEP
P12-32 - HDSEL

See Figure 3-21 on page 3-19 and Figure 3-20 on page 3-18.

**Do all signals cause both the Up and Down lights to come on?**

**Yes No**

027

(From steps 015, 018, and 025)

- Switch the 5394 power off.
- Remove the diskette drive signal cable and check for continuity between the failing signal pin and the correspondingly numbered pin on the opposite end of the cable.

If continuity is good, replace the planar (see "Planar Removal and Replacement Procedure" on page 3-32).

— or —

If no continuity is found, replace the diskette drive signal cable.

- Go to "MAP 0400: Verify" on page 2-35.

028

- Probe the signals at:

P12-8 - INDEX
P12-26 - TRK0
P12-30 - RDATA

**Do all signals cause both the Up and Down lights to come on?**

**Yes No**

029

Replace the diskette drive (see "Diskette Drive Removal and Replacement Procedure" on page 3-27).

- Go to "MAP 0400: Verify" on page 2-35.

030

- Probe the signal at P12-28 (-WTPRO).

**Is the signal at an "up" level?**

**Yes No**

**031**

Replace the diskette drive (see "Diskette Drive Removal and Replacement Procedure" on page 3-27).

– Go to "MAP 0400: Verify" on page 2-35.

**032**

(From step 023)

Either the diskette drive or the planar is failing. Do the following in the order given to correct the problem:

Replace the diskette drive (see "Diskette Drive Removal and Replacement Procedure" on page 3-27).

– or –

Replace the planar (see "Planar Removal and Replacement Procedure" on page 3-32).

– Go to "MAP 0400: Verify" on page 2-35.

# MAP 0910: Twinaxial Cabling System

This MAP directs you to use resistance measurements to locate cable and work station problems. This technique works, but it is slow and tedious. If you have access to an IBM Work Station Controller Port Tester, see "Port Tester" on page 4-4 for an improved method of finding cable or work station problems.

To use this MAP to diagnose a problem to the twinaxial cable or to a work station attached to the 5394, do the following:

- Obtain copies of the IBM 5394 Remote Work Station Setup Worksheets.
- Identify the failing work stations and the control unit port used for attachment.

If the System Available indicator is off at all attached work stations, all work stations are failing.

If the System Available indicator is on at any attached work station, use the following procedure to identify the failing work stations:

- Make sure the power at all work stations is switched on and the work stations are connected to the cabling system.
- Display the configuration screen at any attached work station that has a System Available indicator on (see "Control Unit Configuration Procedure" on page 3-6). This display station cannot be an IBM PC or Personal System/2 with AS/400 PC Support or an IBM Personal System/55 with 5250 PC/2 AD Support.
- Confirm that the letter E, indicating that too many work stations are attached, does not appear at any work station position on the screen.
- If the control unit is operating in 5294 Emulation mode, make sure that no more than eight work stations are attached.
- Compare the Remote Work Station Setup Worksheets with the configuration screen to identify all failing work stations on each control unit port(s) used. A work station is failing if:
  - Its power is switched on
  - It is connected to the cabling system
  - It is not shown on the configuration screen.

**Note:** If more than one control unit port is used, determine which port(s) has failing work stations attached. If more than one port has failing work stations attached, do the steps in this MAP, starting at Step 001 on page 2-46, **once for each port** with failing work stations attached.

**001**

**Are all work stations attached to this port failing?**
**Yes No**

**002**

- Refer to the maintenance or setup manual for the work station and check the following for all failing work stations:
  - Addresses are correctly set according to the setup form.
  - No addresses are duplicated on the same port.
  - The twinaxial cables are correctly terminated.
  - Cables are tightly and correctly connected.

**Are the addresses correctly set and the twinaxial cables correctly terminated?**
**Yes No**

**003**

- Correct the address, the twinaxial cable termination, or both.
- Check for normal operation.

**004**

Go to Step 005.

**005**

(From step 004)

- Disconnect the cable to the failing work station(s) at the control unit I/O panel.
- Connect an ohmmeter to the twinaxial cable and check for the resistance as shown in Table 2-10. (See Figure 3-71 on page 3-137.)

Table 2-10. Measuring Resistances at the Failing Work Stations

| Connect Meter Leads As Follows: | | Normal Resistance |
|---|---|---|
| **Positive** | **Negative** | |
| Phase A | Phase B | <250 Ω |
| Phase B | Phase A | <250 Ω |
| Shield | Phase A | <140 Ω |
| Shield | Phase B | <140 Ω |

**Were all resistance measurements in the normal range?**
**Yes No**

**006**

Go to Step 024 on page 2-49.

**007**

Do the following steps at the work stations. You will need the following:

- An ohmmeter
- Remote Work Station Setup Worksheets.

**Note:** The term "data path" includes all of the cables and accessories used to connect one or more work stations to a control unit port.

Do the following:

- Disconnect the cable from the twinaxial socket (socket 1) of the last work station on the data path.
- Set an ohmmeter to the 2k ohm or higher scale.
- Connect the ohmmeter to the twinaxial connector of the cable as shown in Table 2-11. (See Figure 3-71 on page 3-137.) If any measurement is less than 5000 ohms, record the ohmmeter connection that has the low resistance.

Table 2-11. Socket 1 of Last Work Station to Previous Work Station

| Connect Meter Leads As Follows: | | Normal Resistance |
|---|---|---|
| **Positive** | **Negative** | |
| Phase A | Phase B | >5000 Ω |
| Phase B | Phase A | >5000 Ω |
| Shield | Phase A | >5000 Ω |
| Shield | Phase B | >5000 Ω |

**Were all four resistance measurements more than 5000 ohms?**
**Yes No**

**008**

- Leave the twinaxial cable to the last work station disconnected.

Starting at the work station nearest the control unit, do the following at each work station:

- Disconnect the twinaxial cable at socket 2 of the work station.
- Connect the ohmmeter to the twinaxial cable you disconnected from socket 2 and check for the resistances as shown in Table 2-12. (See Figure 3-71 on page 3-137.)

Table 2-12. Socket 2 of Work Station to Next Work Station

| **Connect Meter Leads As Follows:** | | **Normal Resistance** |
|---|---|---|
| **Positive** | **Negative** | |
| Phase A | Phase B | >5000 Ω |
| Phase B | Phase A | >5000 Ω |
| Shield | Phase A | >5000 Ω |
| Shield | Phase B | >5000 Ω |

- If one or more resistance measurements are lower than the normal range, reconnect the cable to socket 2. Repeat the measurements at the next work station until all measurements are in the normal range or until you do the test at the next-to-last work station.
- Answer YES to the following question as soon as all measurements are in the normal range.

**Are all resistances in the normal range?**
**Yes No**

**009**

- Report to the customer that there is a short circuit in the cable between the last work station you checked and the next-to-last work station.

**010**

- Do the work station twinaxial interface check on the work station that you just disconnected (see "Work Station Twinaxial Interface Check" on page 3-136).

**Does the work station twinaxial interface check good?**
**Yes No**

**011**

(Step **011** continues)

**011** (continued)

- Repair the work station, or report the problem to the customer for work stations that do not have IBM on-site service.

**012**

- Report to the customer that there is a short circuit in the cable between the preceding work station and the one you just checked.

**013**

- Jumper phase A to the shield at the twinaxial connector of the cable you disconnected in Step 007 on page 2-46.
- At the control unit end of the data path, set an ohmmeter to the 20k ohm or higher scale. Connect the positive lead to the shield and the negative lead to phase B.
- Check for a resistance of more than 5000 ohms.

**Is the resistance measurement more than 5000 ohms?**
**Yes No**

**014**

The phase leads are reversed in the data path, probably because of a cabling system problem.

- Report the problem to the customer and decide if you will continue to isolate the failure.

**Do you want to isolate the failure?**
**Yes No**

**015**

- Reconnect all of the cables you disconnected.

End of call.

**016**

- Leave the twinaxial cable to the last work station disconnected.

(Step **016** continues)

**016** (continued)

Starting at the work station nearest the control unit, do the following at each work station:

- Set an ohmmeter to the 20k ohm or higher scale.
- Disconnect the twinaxial cable at socket 2 of the work station.
- Connect the ohmmeter to the twinaxial cable disconnected from socket 2 as follows: the positive lead of the ohmmeter to the shield and the negative lead to phase B.
- Check for a resistance of more than 5000 ohms.
- If the resistance measurement is less than 5000 ohms, reconnect the cable to socket 2 and repeat the measurement at the next work station until the measurement is more than 5000 ohms or until you have done the measurement at the next-to-last work station.
- When the measurement is more than 5000 ohms, the work station you just disconnected or the cable from it to the preceding work station is the failure cause. Use "Work Station Twinaxial Interface Check" on page 3-136 to check the work station.
- If the resistance is less than 5000 ohms at all work stations, the cable to the last work station is failing.

**017**

**Note:** The term "data path" includes all of the cables and accessories used to connect one or more work stations to a control unit port.

The data path must be terminated at the last work station under either of the following conditions:

- The last work station has cable-thru and the terminator switch is set to the terminate position (position 1) or has an auto-terminating connector installed.
- The last work station does not have cable-thru (the work station has only one socket and the terminating resistance is always present).

(Step **017** continues)

**017** (continued)

- Determine if the data path is terminated correctly.

**Is the data path terminated correctly?**

**Yes No**

**018**

- Report the problem to the customer.

**019**

- Check the work station twinaxial interface of the last work station on the data path (see "Work Station Twinaxial Interface Check" on page 3-136).

**Does the last work station twinaxial interface check good?**

**Yes No**

**020**

- Repair the work station, or report the problem to the customer for work stations that do not have IBM on-site service.

**021**

If the work stations are still failing, the possible cause is one of the following:

- Possible work station causes:
  - Two or more work stations on the same data path are set for the same address.
  - Shorted diodes in a work station twinaxial interface. (You can check these using "Work Station Twinaxial Interface Check" on page 3-136.)
- Possible cabling system causes:
  - A high-resistance connection in the data path
  - A failing station protector
  - A cable in the cabling system that is not terminated
  - A data path length that is longer than the maximum permitted.

The failure is probably caused by a problem in the cabling system.

(Step **021** continues)

**021** (continued)

**Do you want to check out the cabling system?**
**Yes No**

**022**

- Check to see if the work stations are still failing.
- If the work stations are still failing, report to the customer that no problem was found and that the failure is probably in the cabling system.

**023**

- Check to see if the work stations are still failing.
- If the work stations are still failing, report to the customer that the failure is caused by a cabling system problem.
- To further isolate the failure cause, you must use the procedures in "Cable Signal Quality Check" on page 3-128.

---

**024**

(From step 006)

**Note:** The term "data path" includes all of the cables and accessories used to connect one or more work stations to a control unit port.

Do the following steps at the work stations. You will need the following:

- An ohmmeter
- The Remote Work Station Setup Worksheet.

The data path must be terminated at the last work station under either of the following conditions:

- The last work station has cable-thru and the terminator switch is set to the terminate position (position 1) or has an auto-terminating connector installed.
- The last work station does not have cable-thru (the work station has only one socket and the terminating resistance is always present).

- Determine if the data path is terminated correctly.

(Step **024** continues)

**024** (continued)

**Is the data path terminated correctly?**
**Yes No**

**025**

- Report the problem to the customer.

**026**

- Do the work station twinaxial interface check on the last work station (see "Work Station Twinaxial Interface Check" on page 3-136).

**Does the work station twinaxial interface check good?**
**Yes No**

**027**

- Repair the work station, or report the problem to the customer for work stations that do not have IBM on-site service.

**028**

- Reconnect the twinaxial cable to the last work station.

Starting with the work station nearest the control unit, do the following at each work station:

- Disconnect the twinaxial cable at socket 2 of the work station.
- Connect the ohmmeter to the twinaxial cable you disconnected from socket 2 and check for the resistances as shown in Table 2-13. (See Figure 3-71 on page 3-137.)

Table 2-13. Socket 2 to Next Work Station Resistance Measurements

| Connect Meter Leads As Follows: Positive | Negative | Normal Resistance |
|---|---|---|
| Phase A | Phase B | <250 Ω |
| Phase B | Phase A | <250 Ω |
| Shield | Phase A | <140 Ω |
| Shield | Phase B | <140 Ω |

- If one or more resistance measurements are higher than the normal range, reconnect the cable to socket 2 and repeat the measurements at the next work station until all measurements are in the normal range or until you do the measurements at the next-to-last work station.

(Step **028** continues)

**028** (continued)

- Answer YES to the following question as soon as all measurements are in the normal range.

**Are all resistances in the normal range?**

**Yes No**

**029**

- Report to the customer that the cable between the last work station you checked and the next-to-last work station is open.

**030**

- Do the work station twinaxial interface check on the work station you just disconnected (see "Work Station Twinaxial Interface Check" on page 3-136).

**Does the work station twinaxial interface check good?**

**Yes No**

**031**

- Repair the work station, or report the problem to the customer for work stations that do not have IBM on-site service.

**032**

- Report to the customer that the cable between the preceding work station and the work station you just checked is open.

# MAP 0920: IBM Cabling System

This MAP directs you to use resistance measurements to locate cable and work station problems. This technique works, but it is slow and tedious. If you have access to an IBM Work Station Controller Port Tester, see "Port Tester" on page 4-4 for an improved method of finding cable or work station problems.

To use this MAP when the IBM Cabling System is used to connect the work stations to the control unit, do the following:

- Obtain copies of the Remote Work Station Setup Worksheets.
- Identify the failing work stations and the control unit port used for attachment.

If the System Available indicator is off at all attached work stations, all work stations are failing.

If the System Available indicator is on at any attached display station, use the following procedure to identify the failing work stations:

- Make sure power is switched on at all work stations and that all work stations are connected to the cabling system.
- Display the configuration screen at any attached display station that has the System Available indicator on (see "Control Unit Configuration Procedure" on page 3-6). This display station cannot be an IBM PC or Personal System/2 with AS/400 PC Support, or an IBM Personal System/55 using 5250 PC/2 AD Support.
- Confirm that the letter E, indicating that too many work stations are attached, does not appear at any work station position on the screen.
- If the control unit is operating in 5294 Emulation mode, make sure that no more than eight work stations are attached.
- Compare the Remote Work Station Setup Worksheets with the configuration screen to identify all failing work stations and the control unit port(s) used. A work station is failing if:
  - Its power is switched on
  - It is connected to the cabling system
  - It is not shown on the configuration screen.

**Note:** If more than one control unit port is used, determine which port(s) has failing work stations attached. If more than one port has failing work stations attached, do the steps in this MAP, starting with Step 001 on page 2-52, once for each port with failing work stations attached.

**001**

**Are all work stations attached to this port failing?**
**Yes No**

**002**

Go to Step 005.

**003**

- Test the impedance matching device (IMD) connected to the control unit (see "IBM Cabling System Tests" on page 3-138).

**Did the IMD test good?**
**Yes No**

**004**

- Report the problem to the customer.

**005**

(From step 002)

**Note:** The term "data path" includes all of the cables and accessories used to connect one or more work stations to a control unit port.

- Connect the IMD, at the control unit location, to the cabling system wall connector if it is not connected.
- Set an ohmmeter to the 200 ohm or higher scale and connect the ohmmeter to phase A and phase B at the twinaxial connector of the IMD.
- Record the resistance measurement.
- Exchange the meter leads and record the resistance measurement.

**Were both resistance measurements less than 600 ohms?**
**Yes No**

**006**

Go to Step 030 on page 2-55.

**007**

- Disconnect the IMD or direct connect cable from the twinaxial socket (socket 1) of the last work station on the data path.

(Step **007** continues)

**007** (continued)

- Set an ohmmeter to the 2k ohm or higher scale.
- Measure and note the resistance at the twinaxial connector using the following connections:
  - Connect the positive lead to phase A and the negative lead to phase B.
  - Connect the positive lead to phase B and the negative lead to phase A.
  - Connect the positive lead to the shield and the negative lead to phase A.
  - Connect the positive lead to the shield and the negative lead to phase B.

**Were all four measurements more than 5000 ohms?**
**Yes No**

**008**

Go to Step 043 on page 2-57.

**009**

- Jumper phase A to the shield at the twinaxial connector of the cable that you disconnected in Step 007.
- At the control unit end of the data path, set an ohmmeter to the 2k ohm or higher scale. Connect the positive lead of the ohmmeter to the shield and the negative lead to phase B.
- Check for a resistance of more than 5000 ohms.

**Is the resistance measurement more than 5000 ohms?**
**Yes No**

**010**

The phase leads are reversed in the data path, probably because of a cabling system problem.

- Report the problem to the customer and decide if you will continue to isolate the failure.

(Step **010** continues)

**010** (continued)

**Do you want to isolate the failure?**
**Yes No**

**011**

- Reconnect all cables in the original configuration.

End of Call.

**012**

- Leave the jumper installed at the last work station end of the data path.

Go to Step 045 on page 2-57.

**013**

The data path must be terminated at the last work station by either of the following methods:

- The last work station is connected to the wall connector by a direct-connect cable with a terminator assembly installed in socket 2 and the terminator switch (if present) set to the non-terminated position (position 2). You can only use this method with work stations that have cable-thru installed.
- The last work station is connected to the wall connector by an IMD and the work station terminator switch (if present) is set to the terminated position (position 1).

- Determine if the data path is terminated correctly.

**Is the data path terminated correctly?**
**Yes No**

**014**

- Report the problem to the customer.

**015**

- Check the work station twinaxial interface of the last work station on the data path (see "Work Station Twinaxial Interface Check" on page 3-136).

(Step **015** continues)

**015** (continued)

**Does the last work station twinaxial interface check good?**
**Yes No**

**016**

- Repair the work station problem, or report the problem to the customer for work stations that do not have IBM on-site service.

**017**

- Answer YES to the following question if the terminator assembly is not used.
- Test the terminator assembly (see "IBM Cabling System Tests" on page 3-138).

**Does the terminator assembly check good?**
**Yes No**

**018**

- Report the failing terminator assembly to the customer.

**019**

If the work stations are still failing, the remaining possible causes are:

- Work station problems:
  - Two or more work stations on the same data path are set for the same address.
  - Failing diodes in a work station twinaxial interface (can be tested using "Work Station Twinaxial Interface Check" on page 3-136).
- Cabling system problems:
  - A high-resistance connection in the data path
  - A failing surge suppressor
  - A cable that is not terminated
  - The data path length is longer than the maximum permitted.

The failure is probably in the cabling system.
(Step **019** continues)

**019** (continued)

**Do you want to continue checking out the cabling system?**

**Yes No**

**020**

- Check to see if the work stations are still failing.
- If the work stations are still failing, report to the customer that no problem was found and that the failure is probably in the cabling system.

**021**

- Disconnect the control unit from the cabling system wall connector.

Do the following at the cabling system distribution panel. You will need the following:

- An ohmmeter
- The Remote Work Station Setup Worksheet
- The cable schedule.

- See "IBM Cabling System Data Path Tests" on page 3-142 and do the following tests in the order listed. Do this until you find an error condition or until you have checked all the cable drops on the data path (including any cable between panels, if used).
  1. Test the cable drop from the distribution panel to the control unit.
  2. Test the cable drop from the distribution panel to each work station (including the last) starting with the one nearest the control unit.
  3. If one or more work stations connect to a different distribution panel, check the cable between panels. Then continue checking the work station cable drop at the second panel.

(Step **021** continues)

**021** (continued)

**Are any of the cable drops failing?**

**Yes No**

**022**

- Do the following checks for each work station that is attached to the data path. Make sure that you check all failing work stations and all other work stations that are connected to the same data path. For information on the address and terminator setting, see the work station setup book.
  - Work station twinaxial interface check (see "Work Station Twinaxial Interface Check" on page 3-136).
  - Addresses are correctly set according to the Remote Work Station Setup Worksheet.
  - No duplicate addresses on the same port.
  - Terminator switches (if present) are set correctly.
  - Cables are tightly and correctly connected.

**Are all of the work stations operating correctly?**

**Yes No**

**023**

- Repair the work station problem, or report the problem to the customer for work stations that do not have IBM on-site service.

**024**

- Check to see if the work stations are still failing.
- If the work stations are still failing, report to the customer that the failure is caused by a cabling system problem.

(Step **024** continues)

**024** (continued)

To further isolate the failure cause, use the procedures in "Cable Signal Quality Check" on page 3-128.

---

**025**

**Is the failing cable drop not the one to the control unit?**

**Yes No**

**026**

- Reconnect all of the cables in the original configuration.
- Report to the customer that the cable drop from the distribution panel to the control unit is failing.

**027**

- Reconnect all of the cables at the distribution panel.
- Check the twinaxial interface of the work station attached to the failing cable drop (see "Work Station Twinaxial Interface Check" on page 3-136).

**Does the work station twinaxial interface check good?**

**Yes No**

**028**

- Repair the work station problem, or report the problem to the customer for work stations that do not have IBM on-site service.

**029**

One of the following is failing:

- The twinaxial Y, IMD, or direct connect cable between the work station and the wall connector
- The terminator assembly
- The cable drop from the distribution panel to the wall connector.

(Step **029** continues)

**029** (continued)

Use the procedures in "IBM Cabling System Tests" on page 3-138 to test the accessories listed above.

- Reconnect all of the cables in the original configuration.
- Report the failure cause to the customer.

---

**030**

(From step 006)

The data path must be terminated at the last work station by one of the following methods:

- The last work station is connected to the wall connector by a direct connect cable with a terminator assembly installed in socket 2 and the terminator switch (if present) set to the non-terminated position (position 2). You can use this method only with work stations that have cable-thru installed.
- The last work station is connected to the wall connector by an IMD and the work station terminator switch (if present) is set to the terminated position (position 1).

- Determine if the data path is terminated correctly.

**Is the data path terminated correctly?**

**Yes No**

**031**

- Report the problem to the customer.

**032**

- Check the IMD or direct-connect cable and terminator assembly used at the last work station (see "IBM Cabling System Tests" on page 3-138).

**Do the IMD or direct-connect cable and terminator assembly check good?**

**Yes No**

**033**

- Report the problem to the customer.

**034**

(Step **034** continues)

**034** (continued)

– Check the work station twinaxial interface. See "Work Station Twinaxial Interface Check" on page 3-136.

**Does the work station twinaxial interface check good?**

**Yes No**

**035**

– Repair the work station problem, or report the problem to the customer for work stations that do not have IBM on-site service.

**036**

– Disconnect the control unit from the cabling system wall connector.

Do the following steps at the cabling system distribution panel. You will need the following:

- An ohmmeter
- The Remote Work Station Setup Worksheet
- The cable schedule.

– Do the continuity test for each of the following in the order listed until you find an error or until you have tested all cable drops (see "IBM Cabling System Data Path Tests" on page 3-142).

  - The cable drop from the distribution panel to the control unit.
  - The cable drops from the distribution panel to each work station (including the last) starting with the one nearest the control unit.
  - If one or more work stations connect to a different distribution panel, check the cable between the panels. Continue checking the work stations at the second panel.

**Are any cable drops failing?**

**Yes No**

**037**

– Reconnect all of the cables in the original configuration.

(Step **037** continues)

**037** (continued)

The failure is probably caused by one of the following:

- Multiple connections with high resistance
- Cable length is in excess of the maximum permitted.

Report the problem to the customer.

**038**

**Is the failing cable drop not the one to the control unit?**

**Yes No**

**039**

– Reconnect all of the cables in the original configuration.

– Report to the customer that the cable drop from the distribution panel to the control unit is failing.

**040**

– Reconnect all of the cables at the distribution panel.

– Go to the work station attached to the failing cable drop and check the work station twinaxial interface (see "Work Station Twinaxial Interface Check" on page 3-136).

**Does the work station twinaxial interface check good?**

**Yes No**

**041**

– Repair the work station problem, or report the problem to the customer for work stations that do not have IBM on-site service.

**042**

(Step **042** continues)

**042** (continued)

One of the following is failing:

- The twinaxial Y, IMD, or direct-connect cable between the work station and the wall connector
- The terminator assembly
- The cable drop from the distribution panel to the wall connector.

You can use the procedures in "IBM Cabling System Tests" on page 3-138 to test the accessories listed above.

- Reconnect all of the cables in the original configuration.
- Report the failure cause to the customer.

**043**

(From step 008)

- Test the direct-connect cable or IMD used to connect the last work station to the wall connector (see "IBM Cabling System Tests" on page 3-138).

**Does the direct-connect cable or IMD used to connect the last work station check good?**

**Yes No**

**044**

- Reconnect all of the cables in the original configuration.
- Report the failing cable to the customer.

**045**

(From step 012)

- At the last work station, connect the direct-connect cable or IMD to the wall connector but do not connect it to the work station.

Do the following steps at the cabling system distribution panel. You will need the following:

- An ohmmeter
- The Remote Work Station Setup Worksheet
- The cable schedule.

(Step **045** continues)

**045** (continued)

- Disconnect the red leg of the Y that connects the cable drop to the control unit.
- Install a test connector on the cable drop to the control unit.
- Set an ohmmeter to the 2k ohm or higher scale.
- Connect the ohmmeter, using Table 2-14, to check the resistance that was less than 5000 ohms in the end-to-end test you ran earlier. (See Figure 3-71 on page 3-137)
- Check for a resistance of less than 5000 ohms.

Table 2-14. Distribution Panel Resistance Measurements

| **If ohmmeter connection for earlier test was:** | | **Connect ohmmeter leads as follows for this test:** | |
|---|---|---|---|
| **Positive** | **Negative** | **Positive** | **Negative** |
| Phase A | Phase B | green | red |
| Phase B | Phase A | red | green |
| Shield | Phase A | shield | green |
| Shield | Phase B | shield | red |

**Is the resistance measurement less than 5000 ohms?**

**Yes No**

**046**

Report to the customer that the cable drop from the distribution panel to the control unit is failing.

**047**

- Leave the ohmmeter connected and disconnect the center connector of each Y, one at a time, starting with the Y nearest the control unit.
- Check for a resistance of more than 5000 ohms after you disconnect each Y until you find a resistance of more than 5000 ohms, or until you have disconnected the center connector of all of the Ys.

(Step **047** continues)

047 (continued)

**Is the resistance measurement more than 5000 ohms after disconnecting the center connector of any Y?**

**Yes No**

048

- Report to the customer that the cable drop from the distribution panel to the last work station is failing.

049

The failing cable drop is the one you disconnected just before you obtained an ohmmeter reading of more than 5000 ohms.

- Check the work station twinaxial interface of the work station that is attached to the failing cable drop (see "Work Station Twinaxial Interface Check" on page 3-136).

**Does the work station twinaxial interface check good?**

**Yes No**

050

- Repair the work station problem, or report the problem to the customer for work stations that do not have IBM on-site service.

051

Either the cable drop from the distribution panel or the twinaxial Y is failing.

To determine which is failing, check the twinaxial Y (see "IBM Cabling System Tests" on page 3-138).

If the twinaxial Y functions correctly, then the cable drop from the distribution panel to the wall connector is failing.

- Report the problem to the customer.

# MAP 3000: SDLC Online Communication

**Attention!**

All bits referred to in this MAP appear on the C2 Concurrent mode screen. See "Concurrent Mode Screens" on page 3-61.

**001**

**Note:** Answer YES to the following questions if a busy signal is received by the calling system when the communication line is not being used. Wrap level 3 must complete successfully before you use this MAP.

**Is the problem associated with the autoanswer function (failure to autoanswer)?**

**Yes No**

**002**

**Did a communication SRC of 004x or 005x appear when you attempted to run the online tests?**

**Yes No**

**003**

Go to Step 016 on page 2-61.

**004**

- Do the repair action indicated in Table 2-15 for the communication SRC you received.

Table 2-15. Communication SRCs

| SRC | Repair Action |
|---|---|
| 0040<br>0043 | Go to Step 043 on page 2-63. |
| 0042<br>0051 | Problem is not in control unit. Either 'transmit clock' or 'receive clock'. signal from DCE is failing. If DCE is not an IBM modem, ask customer to call DCE service representative and report failing clock signal. |
| 0044 | Go to Step 016 on page 2-61. |
| 0050 | Problem is not in control unit. The 'ready for sending' signal from DCE is failing. If DCE is not an IBM modem, ask customer to call DCE service representative and report that 'ready for sending' signal is failing. |
| 0052 | Replace planar (see "Planar Removal and Replacement Procedure" on page 3-32) and go to "MAP 0400: Verify" on page 2-35. |
| 0054 | Problem is not in control unit. Report to host site that SDLC commands are being received that are not valid for the control unit. |
| Any other 004x or 005x | You are in wrong MAP or planar is failing (see "Planar Removal and Replacement Procedure" on page 3-32). |

**005**

- Select the C2 screen and observe the communication parameters in row 1. See Table 3-9 on page 3-64.

**Is the control unit configured for DTR operation 'DTR' bit = 0?**

**Yes No**

**006**

- Dial the number for the control unit communication line from a nearby telephone.
- Press the Enter key at the display station each time the phone rings.

(Step **006** continues)

**006** (continued)

The 'CDSTL' bit should be on after two or three rings. See Table 3-17 on page 3-70.

**Did the 'CDSTL' bit (same bit as 'DTR') in the communication interface register go on after two or three rings?**
**Yes No**

**007**

Go to Step 046 on page 2-64.

**008**

- Install an EIA breakout box between the EIA communication cable and the EIA receptacle at the back of the control unit.
- Meter the 'data set ready' line at pin 6.

**Is the 'data set ready' ('DSR') line active in 3 to 15 seconds after the ring stops?**
**Yes No**

**009**

There is a DCE failure on the 'data set ready' line.

- If the DCE is not an IBM modem, ask the customer to call the DCE service representative and report that the DCE is not responding to the 'data terminal ready' signal from the control unit.

**010**

There is no problem in the autoanswer function.

Go to Step 016 on page 2-61.

**011**

- Select the C2 screen and observe the communication interface register. See "Concurrent Mode Screens" on page 3-61.

(Step **011** continues)

**011** (continued)

**Is the 'data terminal ready' ('DTR') bit on?**
**Yes No**

**012**

- Replace the planar (see "Planar Removal and Replacement Procedure" on page 3-32) and go to "MAP 0400: Verify" on page 2-35.

**013**

**Is the 'data set ready' ('DSR') bit on in 3 to 15 seconds after the ring stops?**
**Yes No**

**014**

There is a DCE failure on the 'data set ready' line.

- If the DCE is not an IBM modem, ask the customer to call the DCE service representative and report that the DCE is not responding to the 'data terminal ready' signal from the control unit.

**015**

There is no problem in the autoanswer function.

Go to Step 016 on page 2-61.

**016**

(From steps 003, 004, 010, and 015)

- Read all of this step before you attempt to start it.

Establish communication with the host system.

- Call the host system operator on a nearby telephone and have the operator put the 5394 online (vary-on command).
- Ask the operator to remain on the telephone to help you determine if the host system is attempting to communicate with the 5394.

  **Note:** When the operator puts the 5394 online, the host system should immediately attempt to transmit to the 5394 unless it is on a switched network.
- If you are using a switched network, dial the host system on the communication line when the system is ready for the call.

If the host system does not receive a response after a specified number of attempts, the following occurs:

- The 5394 is taken offline.
- The line is disconnected if it is a switched line.
- A message displays for the host system operator.

When this occurs, the host system operator must put the 5394 back online before you answer the following questions about the LEDs and received signals.

**Note:** If the host system is not attempting to communicate with the 5394 while you are answering the following questions, the results will not be valid.

**Does a logon screen appear?**
**Yes No**

**017**

- Select Concurrent mode diagnostics.
- Select the C2 test and observe the SDLC state byte. See "Concurrent Mode Screens" on page 3-61.

(Step **017** continues)

**017** (continued)

**Is the 'address compared' bit on?**
**Yes No**

**018**

Go to Step 025 on page 2-62.

**019**

Go to Step 030 on page 2-62.

**020**

- Enter the Test Request key sequence for the type of display station you are using. See "Key Sequences" on page 3-40.

**Does the Prime Option Menu appear?**
**Yes No**

**021**

- Press the Reset key.
- Have one of the display station operators attempt to log on and run a normal job.

**Can the operator sign on successfully?**
**Yes No**

**022**

- Report to the host site that all appears normal except the host system is not recognizing the input from the logon screen (neither Test Request key sequence nor normal job logon).

Probable cause: host system problem.

**023**

- Report to the host site that no cause of failure was found, but the system did not correctly respond to the test request.
- Ask the host site to report the test request failure and the intermittent communication problem to the host system CE.

**024**

(Step **024** continues)

**024** (continued)

If the control unit is attached to a switched network, the difference in the quality of the line each time a call is made may cause the intermittent problem.

- Check the entries in the error history table and refer to the communication error table in the back of "MAP 0300: Problem Not Found" for other possible causes.

---

**025**

(From step 018)

- Observe the Com Line Sync LED on the operator panel of the 5394.

**Does the Com Line Sync LED flash?**
**Yes No**

**026**

- See Table 3-9 on page 3-64.
- Make sure that the NRZI option is correct and the same at both the control unit and the host system. If the NRZI option is correct and the same at both locations, the problem is not in the control unit.
- Report to the host site that no data is being received from the communication line.

Probable cause: DCE or communication line failure.

**027**

- Set the Test switch on the control unit to On.
- Determine the NRZI option used for this control unit. See Table 3-9 on page 3-64.
- Ask the host system operator what NRZI option is used for the communication line to this control unit.

**Is the control unit NRZI option correct and the same as the one used by the host system for the communication line to this control unit?**
**Yes No**

**028**

- Have the customer correct the configuration at the control unit or at the host system as needed.

**029**

- Report to the host site that flags are present on the communication line but no frames are present that contain the correct address for this 5394.

Probable cause: wrong address used by this 5394 or the host system, or there is a host system problem.

---

**030**

(From step 019)

**Is the 'CRC good' bit on?**
**Yes No**

**031**

- Report to the host site that SDLC frames are being received by this 5394 but they contain CRC frame sequence errors.

Probable cause: line, modem or DCE, or host system problem.

**032**

**Is the 'SNRM received' bit on?**
**Yes No**

**033**

**Is the 'XID frame received' bit on?**
**Yes No**

**034**

- Report to the host site that SDLC frames are being received by this 5394 without CRC errors and with the correct address but neither an SNRM nor an XID command was received.

Probable cause: communication link failure or a host system problem.

**Note:** If you can run CE test 66 without an error, the communication link is not failing.

**035**

(Step **035** continues)

**035** (continued)

- Report to the host site that SDLC frames are being received by this 5394 without CRC errors and with the correct address but an SNRM command was not received.

Probable cause: communication link failure or a host system problem.

**Notes:**

1. On a multipoint network, this failure could be caused by two control units set to the same address. If another control unit on this line is also failing, make sure that both control units are set to the correct address.
2. If you can run CE test 66 without an error, the communication link is not failing.

**036**

- Observe the SNA state byte. See Table 3-21 on page 3-89.

**Is the 'ACTLU received' bit on?**
**Yes No**

**037**

- Report to the host site that link-level communication was established but an ACTLU was not received.

Probable cause: host system problem.

**038**

- Observe the SNA state byte.

**Is the 'SNA BIND complete' bit on?**
**Yes No**

**039**

- Report to the host site that link-level communication was established but a BIND was not received.

Probable cause: host system problem.

**040**

(Step **040** continues)

**040** (continued)

- Observe the SNA state byte.

**Is the 'EC load complete' bit on?**
**Yes No**

**041**

A failure occurred during microcode change.

- Report to the host site that a failure occurred during the microcode change.

Probable cause: host system problem.

**042**

- Make sure that the host system operator attempted to vary on the display station that you were observing and that other display stations also failed.
- Report to the host site that all appears normal except that a logon screen is not being received by the work stations at this location.

Probable cause: host system problem.

**043**

(From step 004)

- Set the Test switch on the control unit to On.

On an attached display station:

- Enter the Test Request key sequence (see "Key Sequences" on page 3-40) for the type of display station you are using, and press the C key.
- Press Enter to select the C1 screen. See "Concurrent Mode Screens" on page 3-61.

The communication configuration bits appear on the top line of the screen.

**Is the switched or nonswitched configuration bit correct for this configuration?**
**Yes No**

**044**

- Have the customer correct the configuration.

**045**

(Step **045** continues)

**045** (continued)

The problem is not in this control unit.

- Report to the customer that the 'data set ready' signal from the DCE is failing (SRC 0040 or 0043).

---

**046**

(From step 007)

- If necessary, dial the control unit number from a nearby telephone.
- Press the Enter key at the display station each time the phone rings.
- Observe the 'calling indicator' bit of the communication interface register on the C2 screen.

**Is the 'calling indicator' bit set to 1 with each ring?**
**Yes No**

**047**

- Install an EIA breakout box between the EIA communication cable and the EIA receptacle at the back of the control unit.
- Meter the 'calling indicator' line at pin 22.

**Does the 'calling indicator' line go plus (+ 3 V to +15 V) when a ring signal is received?**
**Yes No**

**048**

The problem is not in this control unit. No 'calling indicator' signal is being received from the DCE.

- If the DCE is not an IBM modem, ask the customer to call the DCE service representative and report that no 'calling indicator' signal is being received from the DCE.

**049**

- Replace the planar (see "Planar Removal and Replacement Procedure" on page 3-32) and go to "MAP 0400: Verify" on page 2-35.

---

**050**

(Step **050** continues)

**050** (continued)

- Replace the planar (see "Planar Removal and Replacement Procedure" on page 3-32) and go to "MAP 0400: Verify" on page 2-35.

---

# MAP 3010: X.25 Online Communication

**Attention!**

All bits referred to in this MAP appear on the C2 Concurrent mode screen. See "Concurrent Mode Screens" on page 3-61.

**001**

**Note:** Wrap level 3 must complete successfully before you use this MAP.

**Did an SRC appear when you attempted to do the online test?**
**Yes No**

**002**

(From step 009)

- Read all of this step before you start.

Establish communication with the host system as follows:

- Dial the host system operator on a nearby telephone and have the operator put the 5394 online (vary-on command).
- Ask the host system operator to remain on the telephone to help you determine if the host system is attempting to communicate with the 5394.
- Use the normal procedures for your site to attempt to start communication with the host site.

**Did a logon screen appear?**
**Yes No**

**003**

- Select Concurrent mode diagnostics. See "Concurrent Mode Screens" on page 3-61.
- Select the C2 test and observe the X.25 state byte.

**Is the 'address compared' bit on?**
**Yes No**

**004**

Go to Step 019 on page 2-67.

**005**

Go to Step 022 on page 2-68.

**006**

- Press the Test Request key sequence (see "Key Sequences" on page 3-40) for the type of display station you are using.

**Does the Prime Option Menu appear?**
**Yes No**

**007**

Go to Step 039 on page 2-69.

**008**

The failure is intermittent. Refer to the PLE log for possible causes.

If no errors are logged, the probable cause is a network or host system failure.

**009**

Do the repair action indicated in Table 2-16 for the SRC that displayed.

Table 2-16 (Page 1 of 2). Displayed SRCs

| SRC | Repair Action |
|---|---|
| 0040 | Problem is not in control unit. Ask customer to call DCE service representative and report that a 'ready' signal is not being received from DCE. |
| 0041 | Go to Step 002. |
| 0042<br>0051 | Go to Step 013 on page 2-67. |
| 0045 | Problem is not in control unit. Report to customer that a 'disconnect' signal was received during link setup.<br>Probable cause: DCE failure. |
| 0046 | Go to Step 010 on page 2-67. |

Table 2-16 (Page 2 of 2). Displayed SRCs

| SRC | Repair Action |
|---|---|
| 0047 | Attempt failing operation again. If failure continues, report to customer that network is sending a DISCONNECT command to control unit when it is in Disconnect mode.<br><br>Probable cause: a DCE or network failure. |
| 0050 | Go to Step 016 on page 2-67. |
| 0052 | Replace planar (see "Planar Removal and Replacement Procedure" on page 3-32) and go to "MAP 0400: Verify" on page 2-35. |
| 0053 | Report to customer that T1 timeout expired after attempting to transmit to network with no transmission received from network (CSU parameter).<br><br>Probable cause: DCE failure. |
| 0054 | Problem not in this control unit. Ask customer to report to network that LAPB commands are being received that are not valid for this control unit. Sense bytes 1 through 3 of the 0054 error in the PLE log contain the rejected command and the reject cause. |
| Any other 004x or 005x | Either you are in wrong MAP or planar is failing (see "Planar Removal and Replacement Procedure" on page 3-32). |
| 10xxxx | If a 10xxxx SRC appears, failure is probably caused by an operator error or a configuration problem.<br><br>If a 10xxxx SRC appears during correct operation, planar is probably failing (see "Planar Removal and Replacement Procedure" on page 3-32). |
| 1100xx<br>1200xx | See "X.25 Communication SRCs" on page 3-110 for meaning of SRC. If diagnostic field content indicates a possible configuration problem, check configuration. See "Control Unit Configuration Procedure" on page 3-6.<br><br>If no configuration problem is found, report problem defined by diagnostic field to the customer.<br><br>Probable cause: configuration does not match network subscription or there is a network failure. |
| 1800xx<br>1900xx<br>1A00xx | See "X.25 Communication SRCs" on page 3-110 for meaning of code and diagnostic field of SRC. If contents of fields indicate a possible configuration problem, check configuration.<br><br>If no configuration problem is found, suspect a possible microcode problem. Contact your support structure.<br><br>If failure still occurs, report problem defined by cause code and diagnostic fields to customer.<br><br>Probable cause: configuration does not match network subscription or there is a network failure. |
| 1Bxxxx | See "X.25 Communication SRCs" on page 3-110 for meaning of cause code field of SRC. Report cause code to customer.<br><br>Probable cause: a network failure. |
| xxxxxx | If any other SRC appears, either you are in wrong MAP or planar is failing (see "Planar Removal and Replacement Procedure" on page 3-32). |

**010**

(From step 009)

- Display the C2 screen and observe sense byte 1 of the 0046 SRC. See "Concurrent Mode Screens" on page 3-61.
- Compare the sense byte with the list of supported commands and responses in "LAPB Command" on page 5-39.

**Is the command contained in the I-field of the frame reject a valid LAPB command for the 5394?**

**Yes No**

**011**

- If the failure continues to occur, report to the customer that the network is not receiving commands or responses correctly.

Probable cause: DCE or network failure.

**012**

The problem is not in this control unit.

- Report to the customer that the network is rejecting commands or responses that are valid.

Probable cause: DCE or network failure.

---

**013**

(From step 009)

**Is this control unit a Model 01?**

**Yes No**

**014**

- Replace the planar. See "Planar Removal and Replacement Procedure" on page 3-32.

**015**

The problem is not in this control unit.

Either the 'transmit clock' signal or the 'receive clock' signal from the DCE is failing.

- Ask the customer to call the DCE service representative and report the failing clock signal.

---

**016**

(From step 009)

**Is this control unit a Model 01?**

**Yes No**

**017**

- Replace the planar. See "Planar Removal and Replacement Procedure" on page 3-32.

**018**

The problem is not in this control unit.

The 'ready for sending' signal from the DCE is failing.

- Ask the customer to call the DCE service representative and report that no 'ready for sending' signal is being received from the DCE.

---

**019**

(From step 004)

- Observe the Com Line Sync LED on the operator panel of the control unit.

**Is the Com Line Sync LED flashing?**

**Yes No**

**020**

The problem is not in this control unit.

- Report to the customer that no data is being received from the network.

Probable cause: DCE or network failure.

**021**

- Report to the host site that flags are present on the communication line but no LAPB frames are present that contain the correct address for this work station.

Probable cause: address used by network is not 01 or 03.

---

**022**

(From step 005)

**Is the 'CRC good' bit on?**

**Yes No**

**023**

- Report to the host site that LAPB frames are being received by this work station but they contain CRC errors.

Probable cause: DCE or network problem.

**024**

**Is the 'Link activated' bit on?**

**Yes No**

**025**

- Select the C2 screen.
- Check the X.25 configuration bits for the setting of the 'link initialization' bit.

**Is the 'link initialization' bit correct for the network used?**

**Yes No**

**026**

- Correct the setting of the 'link initialization' bit and attempt the failing operation again.

**027**

- Report to the customer that the link cannot be activated.

Probable cause: DCE or network problem.

**028**

(Step **028** continues)

**028** (continued)

**Is the 'packet level restarted' bit on?**

**Yes No**

**029**

- Report to the customer that the packet level restart request was not successful.

Probable cause: DCE or network problem.

**030**

5394 enters the Normal Receive mode (NRM).

**Note:** A delay may occur between the time that your display station is varied on and the time that the data-transfer state is entered. If the bit is not on, wait at least 2 minutes for it to turn on before you answer the following question.

**Is the 'data transfer entered' bit on?**

**Yes No**

**031**

- Report to the customer that the control unit could not enter the data-transfer state.

Probable cause: DCE or network problem.

**032**

- Observe the SNA state byte.

**Is the 'ACTLU received' bit on?**

**Yes No**

**033**

- Report to the host site that link-level communication was established but an ACTLU was not received.

Probable cause: host system problem.

**034**

- Observe the SNA state byte.

(Step **034** continues)

**034** (continued)

**Is the 'SNA BIND complete' bit on?**

**Yes No**

**035**

- Report to the host site that the link-level communication was established and an ACTLU command was received but a BIND was not received.

Probable cause: host system problem.

**036**

- Observe the SNA state byte.

**Is the 'EC load complete' bit on?**

**Yes No**

**037**

A failure occurred during the microcode change.

- Report to the customer that a failure occurred during microcode change time.

Probable cause: host system problem.

**038**

- Verify that the host system operator attempted to vary on the display station that you were observing and that other display stations also failed.
- Report to the host site that all appears normal except that a logon screen is not being received by the work stations at this location.

Probable cause: host system problem.

---

**039**

(From step 007)

- Press the Reset key.
- Have one of the display station operators log on and run a normal job.

**Can the operator log on successfully?**

**Yes No**

**040**

- Report to the host site that all appears normal except the host system is not recognizing the input from the logon screen (neither Test Request key sequence nor normal job logon).

Probable cause: host system problem.

**041**

- Report to the host site that no cause of failure was found, but the system did not correctly respond to the test request.
- Request the host site to report the test request failure and the intermittent communication problem to the host system CE.

---

Notes

# MAP 3020: X.21 Switched Online Problems

**Attention!**

All bits referred to in this MAP appear on the C2 Concurrent mode screen. See "Concurrent Mode Screens" on page 3-61.

**001**

**Note:** Wrap level 3 must complete successfully before you use this MAP.

- Switch the power off.
- Wait 5 seconds, then switch the power on.
- Make sure that no operation is attempted at any work station other than the one you are using.

Establish communication with the host system as follows:

- Dial the host system operator on a nearby telephone and have the operator put the display station online (vary-on command).
- Ask the operator to remain on the telephone to help you determine if the host system is attempting to communicate with the display station.
- Use the normal procedures for your site to attempt to start communication with the host system.
- If an SRC of 210x00 (format for call progress signals) appears, wait 1 minute or until an SRC other than 20xx00 appears before you answer the following question.

**Does a logon screen appear?**

**Yes No**

**002**

Go to Step 008.

**003**

- Press the Test Request key sequence (see "Key Sequences" on page 3-40) for the type of display station you are using.

(Step **003** continues)

**003** (continued)

**Does the Prime Option Menu appear?**

**Yes No**

**004**

- Press the Reset key.
- Have one of the display station operators attempt to log on and run a normal job.

**Can the operator log on successfully?**

**Yes No**

**005**

- Report to the host site that all appears normal except the host system is not recognizing the input from the logon screen (neither Test Request key sequence nor normal job logon).

Probable cause: host system problem.

**006**

- Report to the host site that no cause of failure was found, but the system did not correctly respond to the test.
- Ask the host site to report the test request failure and the intermittent communication problem to the host system CE.

**007**

The failure is intermittent.

- Check the PLE log for possible causes.

If no errors are logged, the probable cause is a network or host system failure.

**008**

(From step 002)
(Step **008** continues)

**008** (continued)

**Does SRC 210x00 display?**

**Yes No**

**009**

Go to Step 011 on page 2-73.

**010**

Refer to Table 2-17 and do the repair action listed for the SRC that was displayed.

Table 2-17 (Page 1 of 2). Communication SRCs

| SRC | Repair Action |
|---|---|
| 0040 | Problem not in control unit. Report to customer that DCE in not-ready state when it should be in ready state. Ask customer to call DCE repair representative and report the failure. |
| 0042<br>0051 | Problem not in control unit. The 'signal element timing' (SET) signal from DCE is failing. Ask customer to call DCE repair representative and report failing signal. |
| 0044 | Go to Step 025 on page 2-75. |
| 0052 | Replace planar (see "Planar Removal and Replacement Procedure" on page 3-32) and go to "MAP 0400: Verify" on page 2-35. |
| 0054 | Problem not in control unit. Report to host site that SDLC commands are being received that are not valid for this control unit. |
| 004x<br>005x | If any other 004x or 005x operator SRC appears, either you are in wrong MAP, or planar is failing (see "Planar Removal and Replacement Procedure" on page 3-32). |
| 212000<br>212300<br>216100 | Make sure number called is correct and attempt call again after 1 minute. If same problem occurs again, report cause indicated by SRC to customer.<br><br>Probable cause: network problem. |
| 212100 | Can be normal condition. Make sure that number called is correct and attempt call again. If number busy for longer than normal, have customer call the host system to see if host system port for number called is actually busy. If host system port and DCE for number called is ready and not busy, failure caused by a network problem. |
| 212200 | Procedure error in selection signals sent to network. Make sure operating procedures are correct and attempt operation again. If same failure occurs again, report to customer that failure caused by DCE or network problem. |
| 214100<br>214200<br>214300<br>215200 | Have customer make sure that number called is correct, and that operating procedures and configuration are compatible with network subscription for both 5394 and host system locations. If procedures and configuration are correct and compatible, report to customer that failure is caused by a network problem. |
| 214400<br>214500<br>214600<br>214700 | Have customer make sure that:<br>• Host system power is on.<br>• Host site DCE power is on.<br>• DCE and host system are ready.<br>• The 5394 is varied on.<br><br>If all of above conditions are met, failure is caused by a network problem. |
| 214800 | Make sure facility request code used is correct and that operating procedures and configuration are compatible with network subscription for 5394 and host system locations. If all of above conditions are met, then failure is caused by a network problem. |

| SRC | Repair Action |
|---|---|
| 214900<br>217100<br>220400<br>220500<br>220600<br>221001<br>221102<br>221103<br>221104<br>221105<br>221106<br>23xx00<br>240000 | Report cause indicated by SRC to customer.<br><br>Probable cause: network or DCE problem. |
| 215100 | Make sure number called is correct. Customer should call network information service for information on why called number is temporarily unobtainable. |
| 217200 | Make sure number called is correct. Customer should call network information for information on why called number is out of order. |
| 218100<br>218200<br>218300 | If facility registration, cancellation, activation, or deactivation is a part of operating procedures used to make a call, then this message is normal. Return to beginning of this MAP and continue problem isolation. If none of above was done, then there is a network problem. |
| 220000 | Make sure that number called is correct. If number called is correct, then report cause indicated by SRC to customer.<br><br>Probable cause: host system programming configuration problem. |
| 220700<br>220800<br>220900 | Replace the planar (see "Planar Removal and Replacement Procedure" on page 3-32). |
| 221300 | Make sure the 5394 is varied on at the host system, and attempt operation again. If this condition continues to occur, then replace planar. See "Planar Removal and Replacement Procedure" on page 3-32.<br><br>If the condition still continues to occur, report cause indicated by SRC to customer.<br><br>Probable cause: network problem. |
| 221400 | Make sure number called is correct. If number called is correct, then report cause indicated by SRC to customer.<br><br>Probable cause: network or host system problem. |
| Any other | If 20xxxx SRC appears, failure is probably caused by operator error or configuration problem. If 20xxxx SRC occurs during correct operation with correct configuration, then either diskette or planar is failing. If any other SRC appears, either you are in wrong MAP or planar is failing (see "Planar Removal and Replacement Procedure" on page 3-32). |

**011**

(From step 009)

- Select Concurrent mode diagnostics. See "Concurrent Mode Screens" on page 3-61
- Observe the X.21 state byte by selecting the C2 test.

**Is the 'call sequence started' bit on?**

**Yes No**

**012**

- If the call was started by the operator at your location, check that the call procedure was done correctly.

(Step **012** continues)

**012** (continued)

If the 'call sequence started' bit is not on after you attempt to establish a call using the correct procedure, suspect a planar failure.

- If the call was made by the host system, check that the host system is calling the correct number.

— or —

If the 'call sequence started' bit is not on after the host system attempts to establish a call, the problem is caused by a procedure error at the host system or by a DCE or network failure.

**013**

- Observe the X.21 state byte.

**Is the 'ready-for-data state entered' bit on?**
**Yes No**

**014**

The problem is not in this control unit.

- Report to the customer that the network is not entering the data-transfer state.

Probable cause: DCE or network failure.

**015**

- Observe the X.21 state byte.

**Is the 'address compared' bit on?**
**Yes No**

**016**

- Report to the host site that flags are present on the communication line but no SDLC frames are present that contain the the correct address for this station.

Probable cause: wrong address used by host system or host system is using NRZI encoding.

**017**

(Step **017** continues)

**017** (continued)

**Is the 'CRC good' bit on?**
**Yes No**

**018**

- Report to the host site that SDLC frames are being received by this station but they contain CRC errors.

Probable cause: DCE or network problem.

**019**

**Is the 'XID frame received' bit on?**
**Yes No**

**020**

**Is the 'SNRM received' bit on?**
**Yes No**

**021**

- Report to the host site that SDLC frames are being received by this station without CRC errors and with the correct address but neither an SNRM nor an XID command was received.

Probable cause: host system problem.

**022**

Go to Step 025 on page 2-75.

**023**

**Is the 'SNRM received' bit on?**
**Yes No**

**024**

- Report to the host site that SDLC frames are being received by this work station without CRC errors and with the correct address and the XID command was received but the SNRM command was not received.

(Step **024** continues)

**024** (continued)

Probable cause: host system problem.

**025**

(From step 022)

- Observe the SNA state byte.

**Is the 'ACTLU received' bit on?**
**Yes No**

**026**

- Report to the host site that link-level communication was established but an ACTLU command was not received.

Probable cause: host system problem.

**027**

- Observe the SNA state byte.

**Is the 'SNA BIND complete' bit on?**
**Yes No**

**028**

- Report to the host site that link-level communication was established and an ACTLU command was received but a BIND command was not received.

Probable cause: host system problem.

**029**

- Observe the SNA state byte.
- If the 'EC load in progress' bit is on, wait 40 seconds before you answer the following question.

(Step **029** continues)

**029** (continued)

**Is the 'EC load complete' bit on?**
**Yes No**

**030**

A failure occurred during microcode change.

- Report to the host site that a failure occurred during microcode change.

Probable cause: host system problem.

**031**

- Observe the SNA state byte.

**Is the 'SNA BIND complete' bit on?**
**Yes No**

**032**

A failure occurred after the microcode change.

- Report to the host site that a BIND failure occurred after microcode change completed.

Probable cause: host system problem.

**033**

- Make sure that the host system operator attempted to vary on the 5394 that you were observing and that other display stations also failed.
- Report to the host site that all appears normal except that a logon screen is not being received by the display stations at this location.

Probable cause: host system problem.

Notes

# MAP 3030: Online Intermittent Problems

**001**

- Run CE test 63 (see "Dedicated Mode Tests" on page 3-50) with the C option 1000 times. The approximate run time is 2 minutes for Model 01 and 3 to 13 minutes for Model 02.

**Did an error occur while the CE test was running?**

**Yes No**

**002**

- The cause of the failure is probably not in this control unit (more than 90 percent probable). If the failure continues to occur, check the hard error (HE) log and the permanent link error (PLE) log entries for this control unit. Note any communication errors and go to "MAP 0300: Problem Not Found" on page 2-27.
- If an IBM external modem (or a modem with the same wrap function) is attached, you can run CE test 64 (see "Dedicated Mode Tests" on page 3-50) to verify correct operation of the data terminal equipment (DTE) interface of the modem. When CE test 64 runs 1000 times without errors, it is more than 90 percent probable that there is no failure in the DTE interface of the modem. The approximate run time is shown in Table 2-18.

Table 2-18. Modem Speeds

| Modem Speed | Run Time |
|---|---|
| 2400 bps | 13 min |
| 4800 bps | 12 min |
| 7200 bps | 11 min |
| 9600 bps | 10 min |

**003**

(Step **003** continues)

**003** (continued)

- Use "Cable Wrap SRCs" on page 3-58 to identify the signal line indicated by the SRC.
- Check the DC voltage levels (see "DC Power Supply Voltage Level Check" on page 3-20) and the ripple levels (see "DC Power Supply Ripple Level Check" on page 3-20).

**Did the power check good?**

**Yes No**

**004**

- Go to "MAP 0500: Power Problem" on page 2-37.

**005**

**Is the error still occurring?**

**Yes No**

**006**

End of call.

**007**

Replace the planar.

- Run CE test 63 (see "Dedicated Mode Tests" on page 3-50) to verify the repair. Run the test three times as long as it took for the failure to occur or 1000 times, whichever is longest.

**Did the error occur again?**

**Yes No**

**008**

End of call.

**009**

The cause of the failure is probably not in this control unit. Check for environmental problems such as electrical interference on the AC power line or an electrical discharge.

# Chapter 3. Maintenance Information

## Introduction

This chapter contains the reference information you will need to do the procedures in Chapter 2, "Maintenance Analysis Procedures (MAPs)" on page 2-1. The MAPs will refer you to a specific heading in this chapter to do the following tasks:

- Locate field-replaceable units (FRUs) of the IBM 5394
- Test data communication system FRUs
- Remove and replace FRUs.

## General Locations

This section contains figures that you can use to locate indicators, switches, FRUs, and connectors.

Figure 3-1 shows the 5394 front and rear covers. This figure shows the locations of the indicators and switches used in diagnostics. This figure also shows the locations of the connectors and AC power LED.

Figure 3-2 on page 3-4 shows the 5394 with the top cover removed. This figure shows the locations of FRUs.

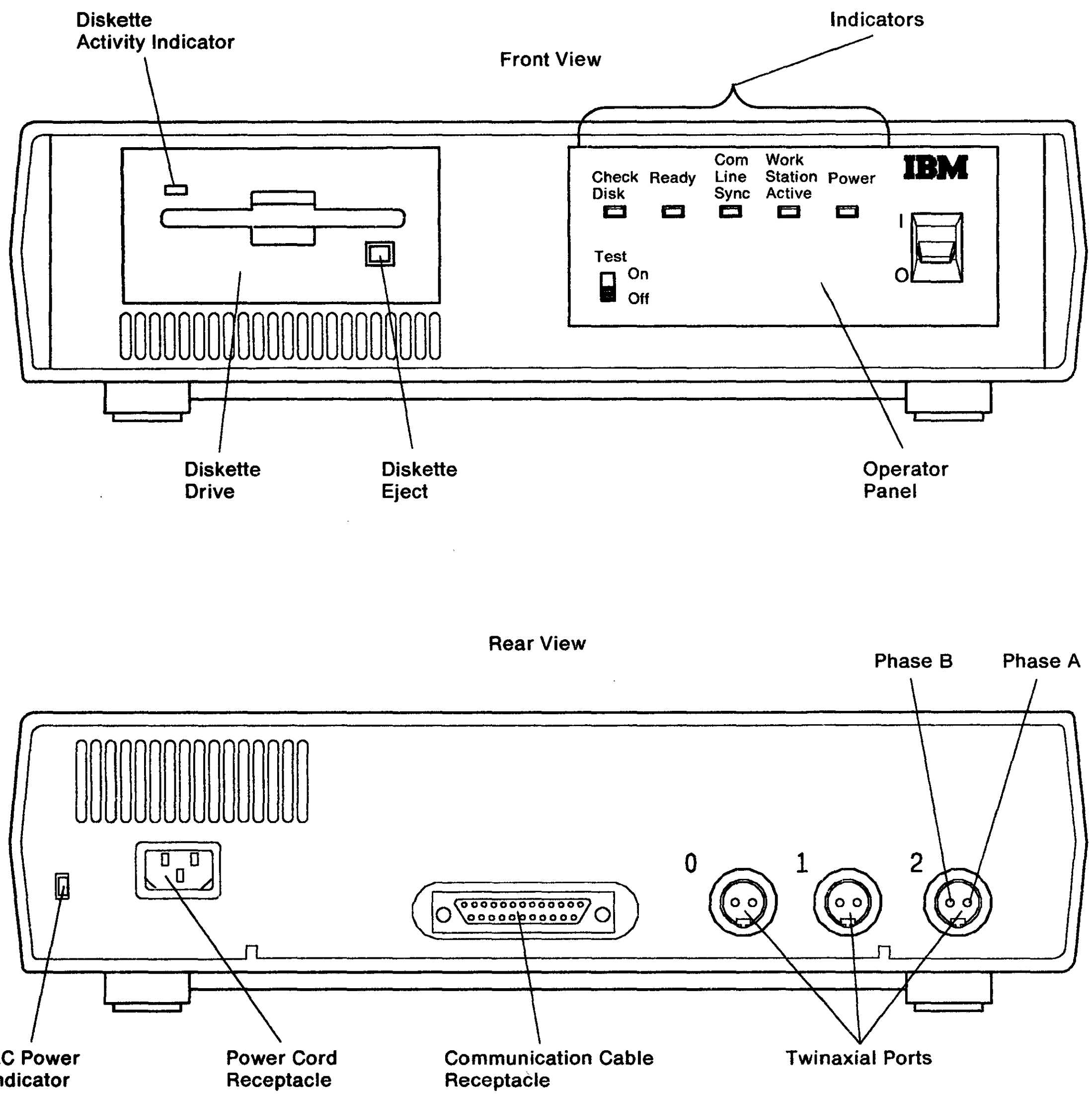



Figure 3-1. Front and Rear Covers

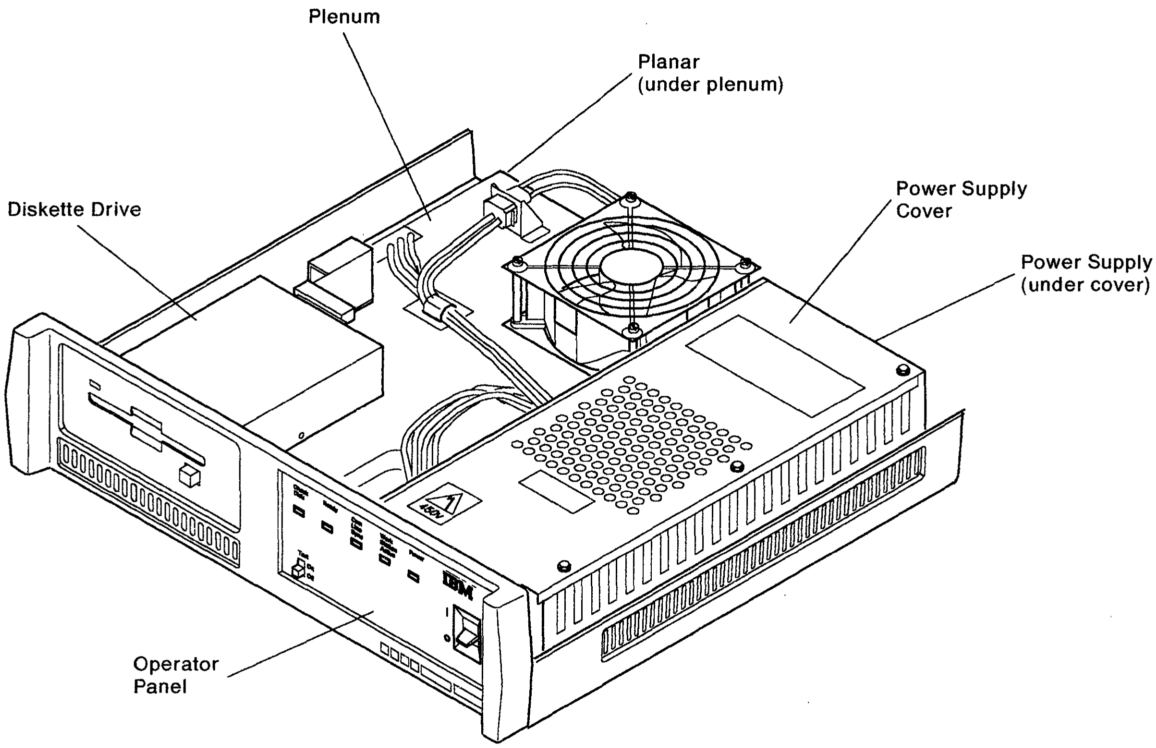



Figure 3-2. Top View

## Diskette Drive

The diskette drive allows the 5394 to load information stored on the system diskette into DRAM. It also allows the 5394 to store error log and configuration information on the system diskette.

The diskette drive has one front panel control and one indicator. See Figure 3-1 on page 3-3.

The Diskette Activity indicator comes on when the diskette drive is running. The Diskette Eject button is used to eject the diskette from the diskette drive for removal.

## Diskette

The 3 1/2-inch diskette that came with the 5394 contains the functional microcode for the control unit. This diskette is also used to store the configuration data and error logs. When the power is switched on, the functional microcode, configuration data, and error logs are loaded from the diskette into the control unit DRAM.

The customer is responsible for backing up and restoring configuration data. If the customer requests assistance, see "Diskette Replacement."

### Diskette Replacement

1. If a backup diskette is available, see "Configuration Restore."
2. If a backup diskette is not available, follow the instructions in "Control Unit Configuration Procedure" on page 3-6.

### Configuration Restore

1. Insert the backup diskette in the diskette drive.
2. Set the 5394 Test switch to On.

3. Switch the 5394 power on. The 5394 Ready LED and the System Available indicator at the display station should come on within 4 minutes.
4. Enter the Test Request key sequence for the type of display station you are using. See "Key Sequences" on page 3-40.
5. The configuration screen should appear. If the configuration screen does not appear, repeat this procedure beginning with step 1 on page 3-4. If the configuration screen still does not appear, go to "MAP 0100: Start Of Call" on page 2-3.
6. Make sure that the new system diskette is not write-protected. See Figure 3-3.
7. Remove the backup diskette from the diskette drive and insert the new system diskette.
8. Press the Enter key twice to store the configuration data on the new system diskette.
9. Make sure that the system operates correctly before you return it to the customer.

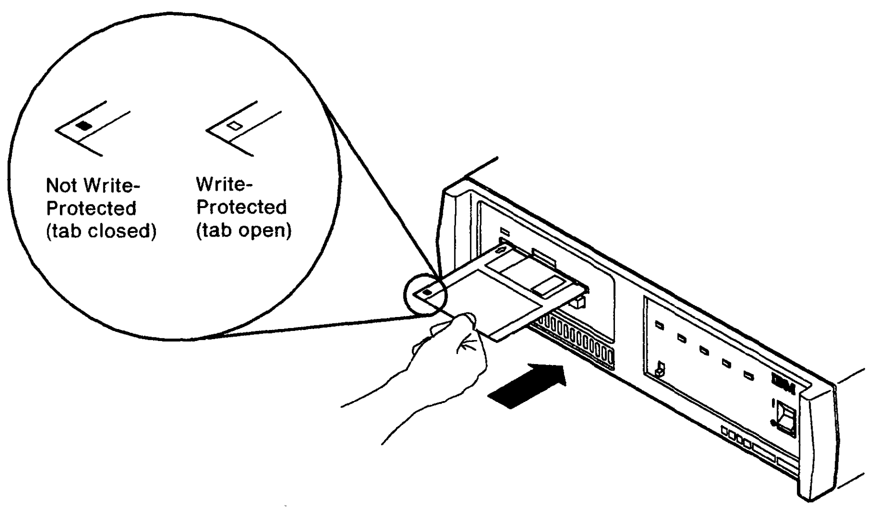



Figure 3-3. Write-Protect Switch

## Diskette Error Log Reset Procedure

1. Set the Test switch on the 5394 to Off.
2. Switch the power on.
3. After the power-on sequence completes successfully, set the 5394 Test switch to On.
4. Enter the Test Request key sequence for the type of display station you are using. See "Key Sequences" on page 3-40.
5. Press the C key. C1 should appear at the bottom of the screen. If C1 does not appear, repeat this procedure, beginning with step 1. If C1 still does not appear, go to "MAP 0100: Start Of Call" on page 2-3.
6. Press the Enter key to display the C1 Concurrent mode screen.
7. Press the Error Log Reset key sequence. See "Key Sequences" on page 3-40. The diskette error logs are reset.
8. Return the 5394 to Normal Operating mode by pressing the Reset key twice and then setting the Test switch to Off. Turn the display station power off, then on. A logon screen should appear if the control unit is online.

   **Note:** See "Concurrent Mode Screens" on page 3-61 for a complete description of the Concurrent mode tests.

## Control Unit Configuration Procedure

1. Make sure the 5394 power switch is set to off.
2. Set all work station power switches to on. If you are using IBM AS/400 PC Support on any IBM Personal System/2 or IBM PC, do not start the AS/400 PC Support program until step 5 of this procedure. If you are using an IBM PC or IBM Personal System/2 with a 5250 Emulation Program (such as Enhanced 5250 Emulation or System 36/38 Work Station Emulation), start the emulation program now.

   **Note:** Work stations that are not on will not be included in the configuration and will not appear on the configuration screen.
3. Set the 5394 Test switch to On.
4. Make sure the system diskette is not write-protected. See Figure 3-3 on page 3-5. Place the system diskette in the diskette drive.
5. Set the control unit power switch to on. After the 5394 Ready indicator appears, start the IBM AS/400 PC Support program at each IBM Personal System/2 or IBM PC that is running AS/400 PC Support. Wait for the AS/400 PC Support router to complete initialization and become active before proceeding to the next step.
6. When the System Available indicator comes on at the display station you plan to use for configuration, press the Test Request key sequence to display the configuration screen. See "Key Sequences" on page 3-40 for the correct key sequence for your keyboard.

   If an SRC appears in the upper left corner of the display after you complete the Test Request key sequence, press the Error Reset key and repeat step 6.

   **Note:** Do not use an IBM PC or Personal System/2 with AS/400 PC Support, or an IBM Personal System/55 using 5250 PC/2 AD Support to configure the 5394.
7. Does the configuration screen appear? (See Figure 3-4 on page 3-7.)

   If **Yes**, go to step 8.

   If **No**, do the following:

   - Switch the power off and repeat steps 1 through 6.
   - If the configuration screen still does not appear, go to "MAP 0100: Start Of Call" on page 2-3.
8. Figure 3-4 on page 3-7 shows the SDLC configuration screen.

   **Note:** The SDLC configuration screen is used as an example. X.25 and X.21 communication modes use the same procedures, but have different entry fields and values. If the 5394 is a Model 02, Field 3 will have slightly different values. Also, the configuration screen for the Release 2 system diskette includes additional fields.

**Work Station Addresses**

**Port Numbers**

```
          0     1     2     3     4     5     6
          ----------------------------------------------------------
     0/   D     .     .     .     .     P     .

     1/   D     .     .     .     .     .     .

     2/   D     .     .     .     .     .     .





AA-> 0     BB-> 0
1-> 00        2-> 01    3-> 0 0 0 0 0 0 0     8-> 3C 0

                                                          P-> _ _
```

Figure 3-4. SDLC Configuration Screen

The upper portion of the screen shows the configuration of the work stations on the three ports.

**Notes:**

a. This is an example only. The arrangement of Ds and Ps varies according to planning considerations.

b. The letter D next to each of the ports shows that display stations are located at address 0 on each port. The letter P under address 5 shows that a printer is on port 0 at address 5. Additional two-digit codes may appear beside some of the Ds on the display screen. You can change these codes later.

c. Up to eight work stations can be attached to a Model 01B or 02B connected to an IBM System/36 or System/38. If more than eight work stations are attached, a D or P appears, but the host system will not communicate with the extra work stations.

d. An E on the screen indicates an extra work station. Models 01A and 02A support up to four work stations; models 01B and 02B support up to 16 work stations.

The lower portion of the screen displays the operator input fields.

The operator input fields differ depending on the communication mode you are using. The SDLC fields appear as the defaults. If you enter a setting other than 0 in Field AA, the fields will change to display either X.25 or X.21 fields.

The default fields for the three possible communication modes are shown in Figure 3-5 through Figure 3-7.

**Note:** If the 5394 is a Model 02, Field 3 will have different default values than those shown in Figure 3-5.

```
AA-> 0    BB-> 0
1-> 00        2-> 01    3-> 0 0 0 0 0 0 0     8-> 3C 0

                                                              P-> _ _
```

**Note:** The 8 and P fields apply only to Release 2.

Figure 3-5. SDLC Communication Mode Operator Input Fields

```
AA-> 1    BB-> 0
1-> 00        2-> 01    4-> 0 2 7    5-> 1  0 0 0 0    6-> 0 0 1 0 0 0 0
7-> 0A 03

                                                              P-> _ _
```

**Note:** The P field applies only to Release 2.

Figure 3-6. X.25 Communication Mode Operator Input Fields

```
AA-> 2    BB-> 0
1-> 00        2-> 01    A-> _______________     B-> 05 6 0
C-> _ _ _ _ _ _ _ _

                                                              P-> _ _
```

**Note:** The P field applies only to Release 2.

Figure 3-7. X.21 Switched Communication Mode Operator Input Fields

The contents of the fields contained in these screens are defined in Table 3-1.

Table 3-1 (Page 1 of 3). CSU Screen Field Definitions

| Field Name | Bit Position | Definition |
|---|---|---|
| AA-> | | Communication mode<br>0 = SDLC<br>1 = X.25<br>2 = X.21 |
| BB-> | | 5394 operating mode<br>0 = 5394<br>1 = 5294 emulation |

| Table 3-1 (Page 2 of 3). CSU Screen Field Definitions | | |
|---|---|---|
| **Field Name** | **Bit Position** | **Definition** |
| 1-> | 1 | Port address |
| | 2 | Work station address |
| 2-> | | Control unit station address (HEX) |
| 3-> | | SDLC control parameters |
| | 1 | 0 = nonswitched<br>1 = switched, manual dial<br>2 = switched, V.25 bis auto-dial (Release 2 only) |
| | 2 | 0 = half-duplex<br>1 = full duplex |
| | 3 | 0 = multipoint<br>1 = point-to-point |
| | 4 | 0 = NRZI<br>1 = NRZ |
| | 5 | 0 = DTR<br>1 = CDSTL |
| | 6 | 0 = no leading pad<br>1 = leading pad transmitted |
| | 7 | 0 = no local loopback support<br>1 = local loopback support |
| 4-> | | X.25 subscription parameters |
| | 1 | 0 = modulo 8<br>1 = modulo 128 |
| | 2 | Packet window size:<br>X'2' to X'F' for modulo 8;<br>X'2' to X'F' for modulo 128 |
| | 3 | Link window size: X'1' to X'7' |
| 5-> | 1 | Packet size<br>0 = 64-byte<br>1 = 128-byte<br>2 = 256-byte<br>3 = 512-byte |
| | 2 | Circuit type<br>0 = multiple PVCs, multiple SVCs, or SVC call allowed<br>1 = single PVC<br>2 = single SVC answer only (Release 2 only) |
| | 3 | Flow control<br>0 = negotiation not permitted<br>1 = negotiation permitted |
| | 4 | Manual options allowed<br>0 = all options entered manually<br>1 = only network address, channel ID, and password entered manually |
| | 5 | 0 = no local loopback support<br>1 = local loopback support |

| Table 3-1 (Page 3 of 3). CSU Screen Field Definitions | | |
|---|---|---|
| **Field Name** | **Bit Position** | **Definition** |
| 6-> | 1 | 0 = reverse charging not accepted |
| | | 1 = reverse charging accepted |
| | 2-3 | 00 = PSH |
| | | 01 = QLLC |
| | | 10 = ELLC |
| | | 11 = not valid |
| | 4 | 0 = special network attachment support |
| | | 1 = no special network attachment |
| | 5 | 0 = link initiation by either network or 5394 |
| | | 1 = link initiation by network only |
| | 6 | 0 = CCITT X.25 Recommendation (1980) |
| | | 1 = CCITT X.25 Recommendation (1984) |
| | 7 | Diagnostic codes |
| | | 0 = 1984 SNA format diagnostic codes |
| | | 1 = 1984 ISO format diagnostic codes |
| | | 2 = 1980 SNA format diagnostic codes |
| 7-> | | X.25 link retry parameters |
| | 1-2 | Number of retry attempts ( X'00' to X'FF') |
| | 3-4 | Time between attempts ( X'01' to X'3C') |
| 8-> | | V.25 call establishment parameters (Release 2 only) |
| | 1-2 | Time for call connection ( X'01' to X'FF') |
| | 3 | 0 = call information not saved on diskette |
| | | 1 = call information saved on diskette |
| A-> | | X.21 network ID (up to 15 digits) |
| B-> | | X.21 SHM retry parameters |
| | 1-2 | Number of retries ( X'00' to X'FF') |
| | 3 | Time between retries ( X'1' to X'F') |
| | 4-5 | 0 = 5394 dials host XID for SHM reconnection |
| | | 1 = 5394 does not dial host XID |
| C-> | | Call progress signals (optional) |
| | | Enter the specific codes selected by the customer. |
| P-> | | Copy-to-printer address (Release 2 only) |
| | 1 | Port address (0 to 2) |
| | 2 | Printer address (0 to 6) |

9. Ask the customer for a printed copy of the configuration screen.

   If the customer printed out a copy of the configuration screen, go to step 11 to transfer those field parameters to the screen.

   If the customer did not make a printed copy of the configuration screen, go to step 10.

10. Use the worksheets in the *IBM 5394 Remote Control Unit User's Guide* to identify the values in each field required for the customer's configuration.

    Go to step 11 to transfer those parameters to the screen.

11. Locate the cursor on your display screen. It is under the number 0 in Field AA. See Figure 3-8 on page 3-11.

    **Note:** The operator input fields differ depending on the communication mode and the release level of the system diskette.

```
AA-> 0     BB-> 0
1-> 00          2-> 01     3-> 0 0 0 0 0 0 0      8-> 3C 0

                                                          P-> _ _
```

Figure 3-8. Cursor in Field AA of Operator Input Fields

12. Refer to the printed copy of the configuration screen or the Communication Worksheet. Find the setting to enter in Field AA.
13. Press the Cursor Up key to increase the value or the Cursor Down key to decrease the value of the setting in Field AA on the display screen until it matches the correct setting.

    **Note:** When you enter a setting other than 0 in Field AA, the other fields change. The number of values that can appear in Field AA varies, depending on the 5394 model number. Model 01 does not support X.21 communication mode.
14. Press the Cursor Right key to move to Field BB. See Figure 3-9.

```
AA-> 0     BB-> 0
1-> 00          2-> 01     3-> 0 0 0 0 0 0 0      8-> 3C 0

                                                          P-> _ _
```

Figure 3-9. Cursor in Field BB of Operator Input Fields

15. Find the setting to enter in Field BB.
16. Press the Cursor Up key to increase the value or the Cursor Down key to decrease the value of the setting in Field BB on the display screen until it matches the correct setting.
17. Press the Cursor Right key to move to the next field. Continue entering the correct settings in each operator input field until the bottom portion of your display screen matches the bottom portion of the printed copy or the values on the worksheets.
18. When all fields on the lower portion of the screen match, press the Enter key twice to store the information on the system diskette.
19. Do the Ds and Ps on your display screen match the printed copy or the values on the worksheets?

    If **Yes**, go to Step 20.

    If **No**, suspect that a work station has been added, disconnected, or relocated. Compare the Remote Work Station Setup Worksheet for each port with the actual work stations attached.
20. Refer to the printed copy of the configuration screen. (If a copy is not available, refer to the Remote Work Station Setup Worksheet. If any keyboard codes do not match the master code entered in Field 1, you must enter these codes individually.) Is there a two-digit code beside some or all of the letter Ds on the top portion of the worksheet?

If **Yes**, go to Step 21 on page 3-12.

If **No**, do the following:

a. Make sure the diskette activity indicator on the front of the control unit is off.

b. Remove the system diskette.

c. Place the backup system diskette in the diskette drive.

d. Press the Enter key *twice* to store the information on the backup system diskette.

e. Store one system diskette and all worksheets in the *IBM 5394 Remote Control Unit User's Guide.*

f. If a printer is attached and you are configuring a 5394 using a Release 2 system diskette, press the Print key to produce a printed copy of the CSU screen. Store this copy with the backup diskette.

g. **End of procedure.**

21.

**Note:** The procedure in this section does not change the information that you entered and stored in the previous section.

A two-digit code beside a letter D on the printed copy is a keyboard code. The code assigns a country character set to a display station keyboard. See the following example of a worksheet (Figure 3-10).

```
        0        1        2        3        4        5        6
        -----------------------------------------------------------
    0/  D 17     D        .        .        P        .        .

    1/  D        P        D 09     .        .        .        ..

    2/  D 1D     D        P        .        .        .        .






AA-> 0    BB-> 0
1-> 05        2-> 01    3-> 0 0 0 0 0 0 0     8-> 3C 0

                                                            P-> _ _
```

Figure 3-10. Example of a Worksheet

To enter the keyboard codes, do the following:

a. Press the Cursor Right or Cursor Left key to move the cursor under the second position of Field 1 (see Figure 3-11 on page 3-13).

```
AA-> 0    BB-> 0
1-> 05        2-> 01     3-> 0 0 0 0 0 0 0      8-> 3C 0

                                                           P-> _ _
```

Figure 3-11. Cursor in Field 1 of Operator Input Fields

b. Refer to the printed copy. Locate the first D on the worksheet that has a two-digit code beside it.

c. Press the Cursor Up or Cursor Down key to set the value in Field 1 on the display screen until it is the same as the code beside the first D on the worksheet.

   When a valid keyboard code is in Field 1, two dashes appear beside that code (see Figure 3-12).

```
AA-> 0    BB-> 0
1-> 17 - -    2-> 01     3-> 0 0 0 0 0 0 0      8-> 3C 0

                                                           P-> _ _
```

Figure 3-12. Operator Input Field 1

d. Press the Cursor Right key to move the cursor under the first dash next to Field 1 on the display screen (see Figure 3-13).

```
AA-> 0    BB-> 0
1-> 17 - -    2-> 01     3-> 0 0 0 0 0 0 0      8-> 3C 0

                                                           P-> _ _
```

Figure 3-13. Cursor Under First Dash

e. Refer to the printed copy. Find the port number (row number) of the first D with a two-digit code on the worksheet.

f. Press the Cursor Up key until this port number appears in the position of the first dash beside Field 1 on the display screen (see Figure 3-14).

```
AA-> 0    BB-> 0
1-> 17 0 -    2-> 01     3-> 0 0 0 0 0 0 0      8-> 3C 0

                                                           P-> _ _
```

Figure 3-14. Port Number in First Dash Position

g. Press the Cursor Right key to move the cursor under the second dash (see Figure 3-15 on page 3-14).

```
AA-> 0    BB-> 0
1-> 17 0 _    2-> 01    3-> 0 0 0 0 0 0 0     8-> 3C 0

                                                      P-> _ _
```

Figure 3-15. Cursor Under Second Dash

h. Refer to the printed copy. Locate the address (column number) of the first D with a two-digit code on the worksheet.

i. Press the Cursor Up key until this address appears in the position of the second dash beside Field 1 on the display screen (see Figure 3-16).

```
AA-> 0    BB-> 0
1-> 17 0 0    2-> 01    3-> 0 0 0 0 0 0 0     8-> 3C 0

                                                      P-> _ _
```

Figure 3-16. Address in Second Dash Position

j. Press the Enter key.

22. Does the two-digit code (keyboard code) you entered in Step 21 of this procedure appear beside the correct D on your display screen?

If **Yes**, do the following:

a. Press the Enter key again to store the information on the system diskette.

b. Repeat Step 21 of this procedure until the keyboard codes on the upper portion of the configuration screen match those on the printed copy or Remote Work Station Setup Worksheet.

c. Remove the system diskette. Place the backup system diskette in the diskette drive. Press the Enter key *twice* to store the information on the backup system diskette.

d. Store one system diskette and all worksheets in the *IBM 5394 Remote Control Unit User's Guide*.

e. If a printer is attached and you are configuring a 5394 using a Release 2 system diskette, press the Print key to produce a printed copy of the CSU screen. Store this copy with the backup diskette.

If **No**, do the following:

a. Press the Error Reset key and repeat Step 21 of this procedure.

b. If the keyboard code is still not correct, contact your support structure.

**Note:** If an SRC appears in the lower left corner of your display screen, see "Customer Setup SRCs" on page 3-102.

# Power Supply

The locations of the power supply, power supply cover, and power cables are shown in Figure 3-17.

AC power is supplied to the control unit by a power cord that plugs into the receptacle at the back of the power supply. Information about AC power is shown in Figure 3-18 on page 3-16 and Table 3-2 on page 3-16.

The power supply provides DC power for the planar, fan, and diskette drive. Information about DC power is shown in Figure 3-19 on page 3-18, Figure 3-20 on page 3-18, and Figure 3-21 on page 3-19.

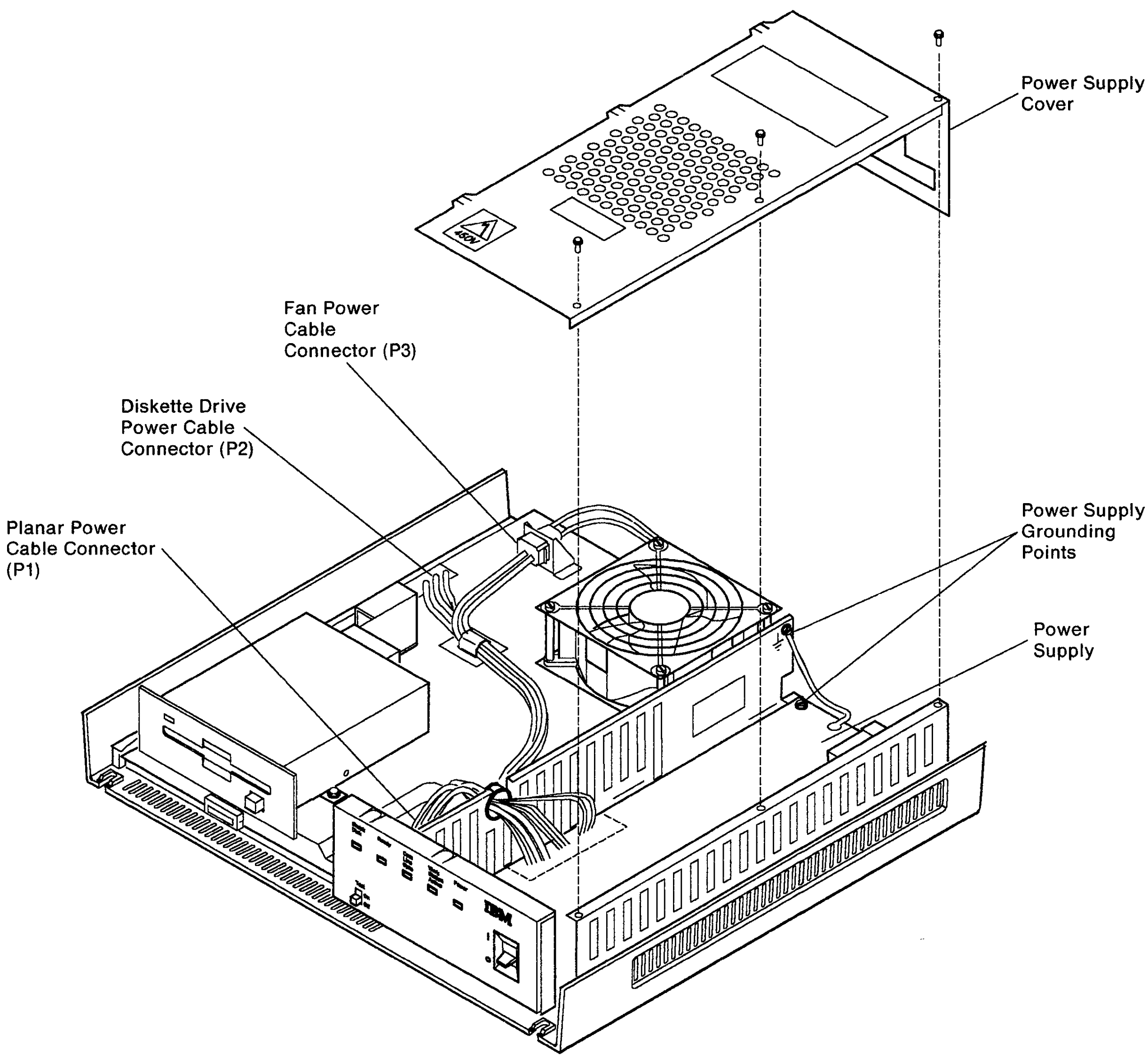
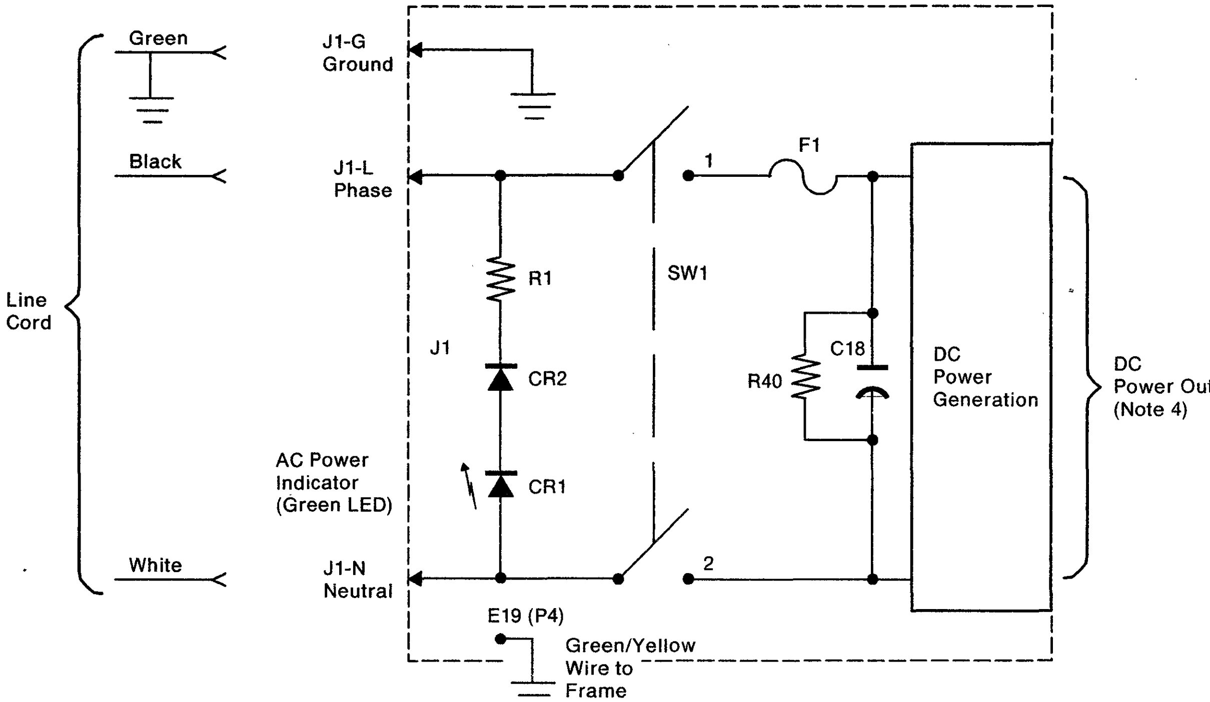



Figure 3-17. Power Supply Locations

# AC Power Distribution




Notes:

1. All parts within the dashed lines are an FRU, the power supply.
2. SW1 is connected by the AC actuator link to the AC actuator switch on the operator panel.
3. Fuse F1 is not replaceable as an FRU.
4. See 5394 DC power distribution figure.
5. This illustration shows the 110 VAC power supply. The internal construction of the 220 VAC power supply is different, but the DC output voltages are the same.

Figure 3-18. AC Power Distribution

Table 3-2. AC Voltage and Frequency Specifications

| **Voltage (RMS)** | **Voltage Range (RMS)** | **Frequency Range (Hertz)** |
|---|---|---|
| 100 | 90 to 137 | 49 to 61 |
| 200 | 180 to 259 | 49 to 61 |

# DC Power Distribution

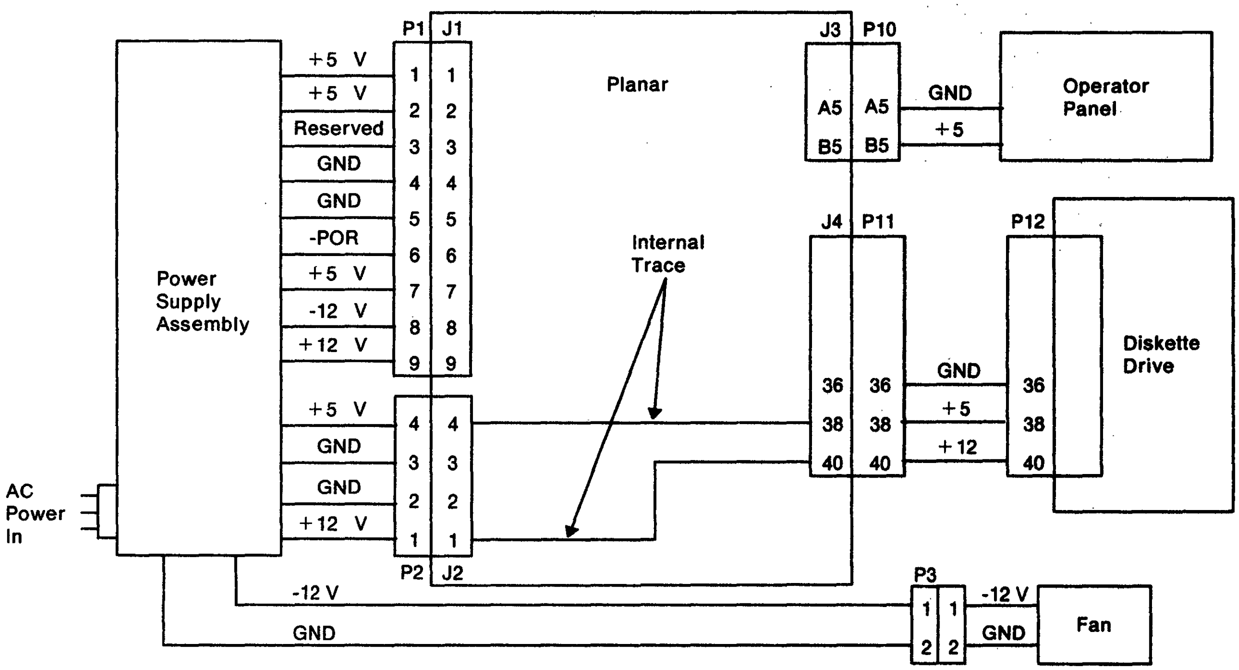



Figure 3-19. DC Power Distribution

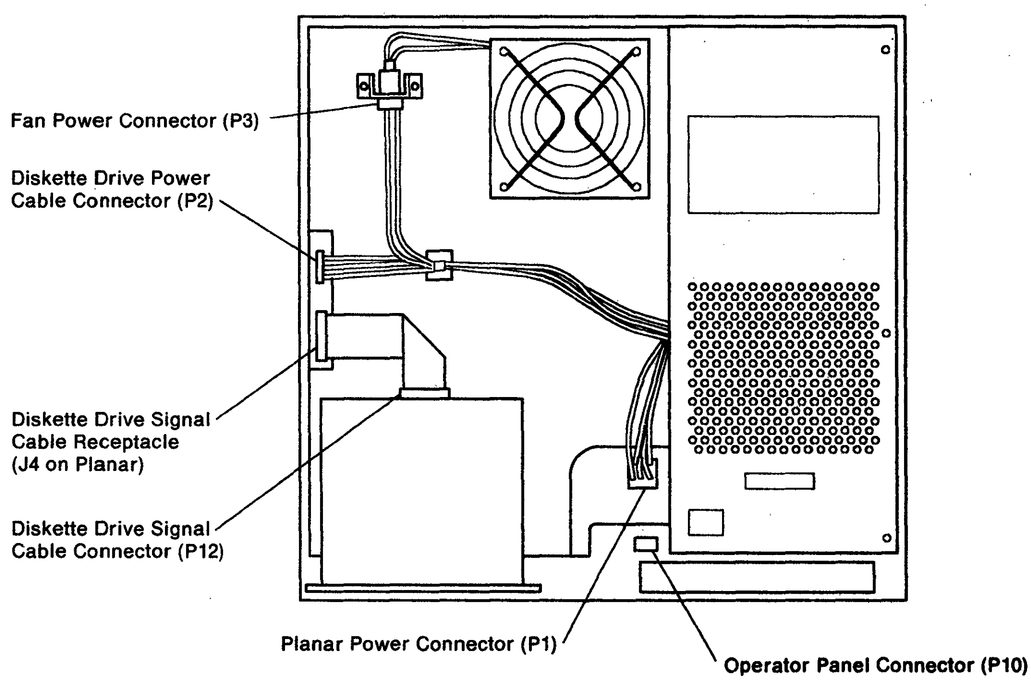
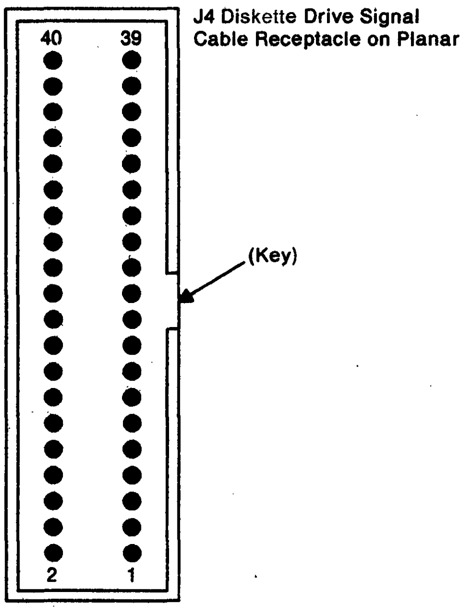
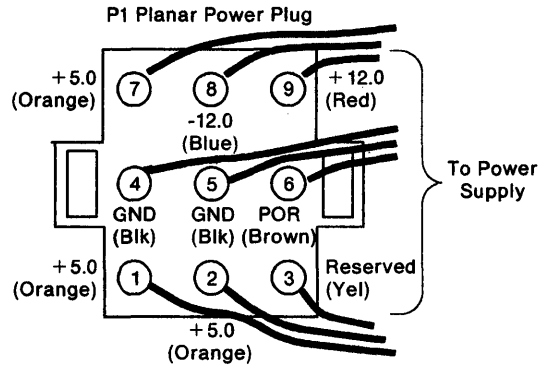
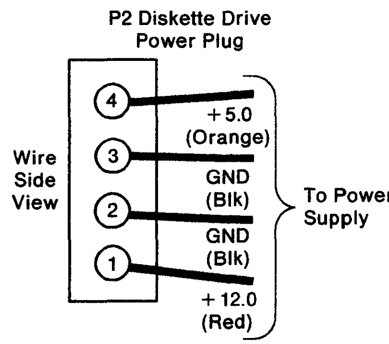
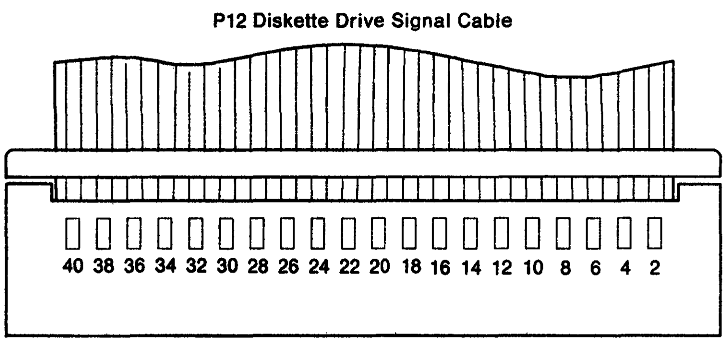



Figure 3-20. Connector Locations



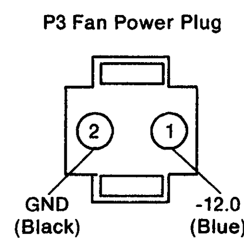



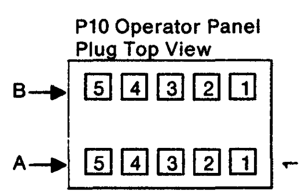




Note: The pointed meter probe is too wide to enter the probe slots in plug P12. Use the narrow hooked probe to make measurements on P12.

| | |
|---|---|
| 2 -RSEL | 22 -WDATA |
| 4 NC | 24 -WEN |
| 6 NC | 26 -TRK0 |
| 8 -INDEX | 28 -WTPRO |
| 10 -DSEL 0 | 30 -RDATA |
| 12 -DSEL 1 | 32 -HDSEL |
| 14 -DSEL 2 | 34 -DSK CHG |
| 16 -MOTOR EN | 36 GND |
| 18 -DIR | 38 +5V |
| 20 -STEP | 40 +12V |

Note: Odd-numbered test points are signal grounds. Pin numbering for J4 and P12 is the same.




Note: All connectors are shown as viewed from the front of the control unit.

Figure 3-21. Cable Test Point Locations

## DC Power Supply Voltage Level Check

See Figure 3-20 on page 3-18 to locate the connectors used in this procedure. See Figure 3-21 on page 3-19 for test point locations.

Use the following procedure to check voltage levels on the power supply:

**DANGER**

> **Line voltage is always present at the power supply when the AC line voltage LED is on. Disconnect the power cord from the customer AC supply before disassembling the 5394 power supply.**

**DANGER**

> **Do not connect AC voltage to the power supply when it is removed from the control unit. Severe electrical shock could result. Safe grounding of the power supply is ensured only when the power supply is securely fastened in the control unit.**

> **Attention!**
>
> **REMOVE THE DISKETTE FROM THE CONTROL UNIT BEFORE DOING THIS PROCEDURE.**
>
> If the J1 power connector is removed when the power is switched on, the diskette may be permanently damaged.
>
> Re-insert the diskette after the voltage problem is corrected.

1. Switch the power off and remove the front and top cover. See "Cover Removal and Replacement Procedure" on page 3-26.
2. Remove power connector P1 from the planar.
3. Set the multimeter for resistance measurements and measure from J1-4 on the planar to the chassis ground. If this resistance is 0.1 ohm or more, make sure the planar grounding screws are secure.
4. Reconnect plug P1 to J1.
5. Reconnect the power cord.
6. Switch the power on and wait about 5 minutes before you do the next step.
7. Set the multimeter for DC voltage measurements and probe the points indicated in Table 3-3.

Table 3-3. DC Power Supply Voltage Level Check

| Probe Points | Voltage Level |
|---|---|
| P1-1 to P1-4<br>P1-2 to P1-4<br>P1-7 to P1-4<br>P2-4 to P1-4<br>P10-B5 to P1-4<br>P12-38 to P1-4 | +5 (4.8 to 5.25) VDC |
| P1-9 to P1-4<br>P2-1 to P1-4<br>P12-40 to P1-4 | +12 (11.49 to 12.72) VDC |
| P1-8 to P1-4 | -12 (-10.75 to -13.2) VDC |
| P3-1 to P1-4 | -12 (-10.75 to -13.5) VDC |

**Notes:**

1. Make all of the voltage measurements with the power cables (P1, P2, and P3) connected. Make the voltage measurements through the top of each connector plug.
2. P1-3 is reserved and should not be measured.

## DC Power Supply Ripple Level Check

See Figure 3-20 on page 3-18 to locate the connectors used in this procedure. See Figure 3-21 on page 3-19 for test point locations.

The peak-to-peak output ripple should be less than 4% of the respective DC voltages when measured with an oscilloscope. Use the values in the "Volts Peak-to-Peak" column of Table 3-4 on page 3-21.

When an oscilloscope is not available, you can observe the ripple voltage by using the 8060 A/AA digital multimeter as follows:

1. Set the AC/DC switch to AC.
2. Set the range switch to 200mv.
3. Set the proper switch combination for V/db measurements.
4. Connect one of the meter leads to frame ground and the other lead to the DC voltage in question.
5. Read the measured value on the multimeter. If the OL symbol appears on the multimeter display, the input is higher than the range selected. Select a higher range for measurement.
6. Use the values in the "Volts RMS" column of Table 3-4 to determine if you have an acceptable value.

Table 3-4. Ripple Level Check

| Power Supply Voltage | Acceptable Ripple Level (Volts Peak-to-Peak) | Acceptable Ripple Level (Volts RMS) |
|---|---|---|
| +12 VDC | Less than 480 mv; measured at P1-9 to P1-4 | Less than 340 mv; measured at P1-9 to P1-4 |
| +12 VDC | Less than 100 mv; measured at P2-1 to P2-2 | Less than 70.7 mv; measured at P2-1 to P2-2 |
| +5 VDC | Less than 100 mv; measured at P2-4 to P2-3 | Less than 70.7 mv; measured at P2-4 to P2-3 |
| -12 VDC | Less than 480 mv | Less than 340 mv; measured at P1-8 to P1-4 |
| -12 VDC (fan) | Less than 600 mv | Less than 424 mv; measured at P3-1 to P1-4 |

# Operator Panel (Including LEDs and Test Switch)

The operator panel is located on the front of the control unit. The operator panel contains the power switch, the Test switch, and the LEDs that are used for diagnostics. Figure 3-22 is a schematic diagram of the operator panel.

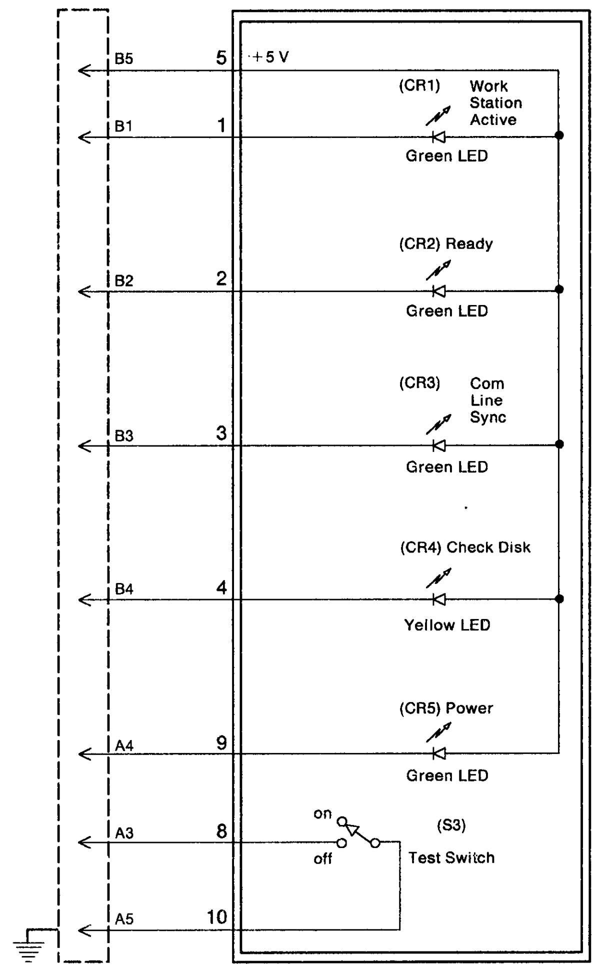



Figure 3-22. Operator Panel Wiring

## LED Descriptions

The functions of the five LEDs on the operator panel follow:

***Power:*** When on, this LED indicates that +5 VDC is present.

***Ready:*** When on, this LED indicates that the power-on sequence has successfully completed and that the control unit is ready for operation.

This LED flashes to indicate a DRAM module failure. The number of flashes indicates the position of the failing DRAM module.

When off, this LED indicates that either the power-on sequence failed or that a failure occurred during normal operation (see Table 3-5 on page 3-22).

| Table 3-5. Failure Indication Table | | | | |
|---|---|---|---|---|
| **Power LED** | **Ready LED** | **Work Station Active LED** | **Check Disk LED** | **Failing FRU** |
| On | Off | Off | Off | Planar |
| On | Flashing | Off | Off | DRAM |
| On | Off | On | Off | Twinaxial Inter-face |
| On | Off | Off | On | Diskette Drive or Diskette |
| Off | Off | Off | Off | Power Supply |
| On | Off | Off | Flashing | Diskette |

***Com Line Sync:*** This LED flashes to indicate that flags are being received from the communication line. This LED flashes twice after the power is switched on.

***Work Station Active:*** The meaning of this LED is dependent on the state of the Ready LED. If the Ready LED is on, the Work Station Active LED on indicates that one or more attached work stations are responding to polls. If the Ready LED is off, use Table 3-5.

***Check Disk:*** When on, this LED indicates a diskette drive or system diskette failure.

### Test Switch Description

The Test switch on the operator panel is:

- Used to select CE tests
- Used to select CSU mode
- A problem determination aid for the control unit operator.

This switch has two settings: On and Off.

When the Test switch is set to On before the control unit power is switched on, the 5394 completes the power-on sequence and goes to Customer Setup mode. If the Test switch is set to Off while the Diskette Activity LED is on, the control unit enters a continuous diskette drive test. To exit this test, you must switch the 5394 power off, then on.

If the Test switch is set to On after the power-on sequence completes, the following modes of operation are permitted:

- Selection of Concurrent mode (see "Concurrent Mode Screens" on page 3-61)
- Selection of Dedicated mode (see "Dedicated Mode Tests" on page 3-50).

  **Note:** The Dedicated mode disables normal data communication.

## Planar

A 16-bit microprocessor unit (MPU) located on the planar controls and directs the flow of all data moving between the host system and the attached work stations. The MPU also controls the diskette drive and the operator panel.

Read-only storage (ROS) modules supply microprogram instructions to the MPU when power is initially switched on.

The DRAM modules provide storage for the operational microcode, error buffers, and configuration. All information exchanged between the host system, the 5394, and the attached workstations is temporarily stored in this DRAM.

Work station control logic manages communication between the control unit and work stations through the three twinaxial ports.

The communication interface provides SDLC or X.25 protocol and the communication functions.

For more information about the planar, see "Planar" on page 5-3.

## Communication Information

This section contains information about the signal lines and voltage levels associated with the 5394 communication interface. See "Communication Wrap Tests" on page 3-57 for test procedures.

## EIA 232D Interface Reference Information

The planar uses five signal drivers and seven signal receivers to convert signal levels between the control unit and the external modem. Figure 3-23 shows the voltage levels used by the EIA 232D interface.

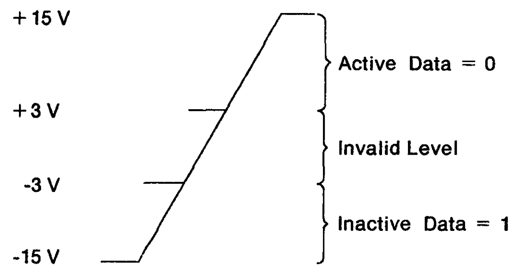



Figure 3-23. EIA 232D Signal Levels

A common carrier or customer-supplied DCE must meet the specifications for signal lines, as specified by EIA standard ANSI EIA 232D or V.25 bis for US and Canada or by CCITT Recommendation V.24/V.28 or X.21 bis for World Trade countries.

### Signal Line Descriptions

**Signal Ground (SG):** The common ground for all signal lines.

**Transmitted Data (TD):** Digital data signals generated and sent from the control unit to the modem or data circuit-terminating equipment (DCE) for transmission to the host system.

**Received Data (RD):** Digital data signals generated by the modem or DCE from the signals received on the communication line and sent from the modem or DCE to the control unit.

**Request to Send (RTS):** A signal generated by the control unit to put the modem or DCE in Transmit mode.

**Ready for Sending (RFS):** A signal generated by the modem or DCE that indicates to the control unit that the modem or DCE is ready to transmit data. RFS is usually active in response to RTS active.

**Data Set Ready (DSR):** A signal generated by the modem or DCE that, when active, indicates one of the following:

- For a nonswitched line and a switched line with manual answer, DSR indicates the modem or DCE is ready to operate.
- For a modem or DCE with a switched line autoanswer setup, DSR indicates the modem or DCE is connected to the communication line and is ready to operate.

**Data Terminal Ready (DTR):** One of two uses (the other is CDSTL) that can be selected by configuration bit 5. Both use the same signal line (20). In DTR, this signal indicates to the modem or DCE that the control unit is ready to operate.

When the modem or DCE has the autoanswer function, DTR also prepares the modem or DCE to answer a call, connects the modem or DCE to the communication line, and maintains that connection until DTR is inactive.

During automatic answering, the connection to the communication line is in response to the DTR being active. An acceptable connection (off hook) activates DSR. An inactive DTR causes the autoanswer function to deactivate the communication line connection (go on hook). DTR usually goes inactive when the transmission of data completes.

**Connect Data Set to Line (CDSTL):** A usage similar to DTR that is used with some World Trade modems or DCEs. This signal uses the same line as DTR (20) and is selected by configuration bit 5. In CDSTL, this signal indicates to the modem or DCE that the control unit is ready to operate.

On a nonswitched communication line, the CDSTL signal is active in response to the DSR being active.

On a switched communication line, CDSTL is active in response to DSR being active (this occurs when the line connection is made through a call placed to the host system), or in response to RI being active (this indicates to the modem or DCE that the control unit is ready to answer the incoming call).

**Data Carrier Detect (DCD):** A signal generated by the modem or DCE to indicate to the control unit that a carrier signal is present on the communication line. This signal is also known as received line signal detector (RLSD).

**Data Signal Rate Select (DSRS):** (Also known as Speed Select.) A signal generated by the control unit and used by modems or DCEs that can use either of two transmission speeds over the same communication line. When this signal is active, the lower speed is selected.

**Note:** The polarity for the 'rate select' signal is opposite that for all other control lines.

**Received Signal Element Timing (RSET):** Generated by the modem or DCE to supply timing pulses to the control unit. These pulses control the shift of data bits from the modem or DCE to the receive buffer.

**Transmitted Signal Element Timing (TSET):** Generated by the modem to supply timing pulses to the control unit. These pulses control the shift of data bits from the transmit buffer to the modem or DCE.

**Calling Indicator (CI):** A signal generated by the modem or DCE to indicate to the control unit that a calling signal is being received on the communication line.

**Local Loopback:** A signal generated by the control unit that conditions the modem or DCE to do a local modem or DCE wrap test. The wrap test is done if the modem or DCE supports the wrap function and the use of the signal line. The transmit data from the control unit is looped back on the receive line to the control unit.

## V.35 Interface Reference Information

The 5394 V.35 communication cable consists of:

- 15 shielded signal lines
- A 25-pin connector at the 5394 end
- A switch assembly
- An adapter cable with a 34-pin connector at the modem or DCE end.

This cable assembly converts the physical configuration of signal lines at the back of the 5394 into the configuration required by Recommendation V.35.

### V.35 Signal Line Descriptions

**Receive Line Signal Detect (RLSD)**: A signal generated by the modem or DCE that indicates to the control unit that a carrier signal is present on the communication line. This signal is also known as Data Carrier Detect (DCD).

**Request to Send (RTS)**: A signal generated by the control unit that puts the modem or DCE into Transmit mode.

**Clear to Send (CTS)**: A signal generated by the modem or DCE that indicates to the control unit that the modem or DCE is ready to transmit data. CTS usually becomes active in response to RTS. This signal is also known as Ready for Sending (RFS).

**Data Terminal Ready (DTR)**: DTR is not included in Recommendation V.35, but it is included in the communication cable and used for wrap testing. This signal cannot be used by individual V.35 modems or DCEs.

**Data Set Ready (DSR)**: A signal generated by the modem or DCE that indicates to the control unit that it is ready to begin active operation.

**Transmit Data (TDA and TDB)**: A differential pair of digital data signals that the control unit sends to the modem or DCE. These signals contain the information that is transmitted by the control unit through the external communication network.

**Receive Data (RDA and RDB)**: A differential pair of digital data signals that the modem or DCE sends to the control unit. These signals contain the information that is transmitted to the control unit through the external communication network.

**Transmit Signal Element Timing (TSETA and TSETB)**: A differential pair of timing pulses generated by the modem or DCE. These pulses control the rate of data transfer from the control unit to the modem or DCE.

**Receive Signal Element Timing (RSETA and RSETB)**: A differential pair of timing pulses generated by the modem or DCE. These pulses control the rate of data transfer from the modem or DCE to the control unit.

**Signal Ground:** This signal line supplies a common reference level for the single-ended interchange lines (RLSD, RTS, CTS, DTR, and DSR).

**Cable ID (ID0 and ID1):** A hard-wired, 2-bit code that enables the 5394 to determine when a V.35 cable is attached to the communication receptacle.

### V.35 Signal Levels

The V.35 interface includes both single-ended and differential signal lines. The single-ended signals operate within the same voltage range as EIA 232D signal lines. The differential lines consist of balanced, current-mode signals that develop line voltage across 120-ohm resistors. Table 3-6 identifies the voltage ranges associated with both types of signal line.

Table 3-6. Signal Line Voltage Levels for the V.35 Interface

| Line Type | Voltage Reference | DC Voltage Range | Network Definition |
|---|---|---|---|
| Single-Ended Interchange Lines | Signal line to GND | +3 to +15 V<br>-3 to -15 V<br>-3 to +3 V (exclusive) | Off or Logic 0<br>On or Logic 1<br>Invalid |
| Differential Lines | VA to GND<br>VB to GND<br>VA-VB<br>VA-VB<br>VA-VB | -4 to +4 V<br>-4 to +4 V<br>+0.44 to +0.66 V<br>-0.44 to -0.66 V<br>-0.44 to +0.44 V (exclusive) | <br><br>Off or Logic 0<br>On or Logic 1<br>Invalid |

**Note:** The state of data circuits is denoted by logic 0 (also called space) and logic 1 (also called mark). Corresponding states of interchange circuits are identified as Off and On.

## X.21 Interface Reference Information

The X.21 physical interface attaches to the user's DCE through the communication connector on the control unit and enables the user to connect to a DCE that has attributes matching CCITT Recommendation X.24/X.27 (V.11) and that operates as described in CCITT Recommendation X.21.

Model 02 operates in the data rate range of 2400 bps to 64,000 bps. Clocking is supplied by the DCE.

### X.21 Physical Interface

The X.21 physical interface includes five balanced differential interchange circuits. Because the signal characteristics of these circuits are not compatible with logic levels used by the MPU, drivers and receivers on the planar supply the necessary signal conversion. Each driver and receiver controls a separate pair of interchange lines (designated A and B). Table 3-7 indicates valid voltage ranges for VA, VB, and VA-VB.

Table 3-7. Signal Line Voltage Levels for the X.21 Interface

| Line Voltage | Voltage Range | Network Definition |
|---|---|---|
| VA | -10V to +10V | |
| VB | -10V to +10V | |
| VA-VB | +0.3V to +6.0V | Mark |
| VA-VB | -0.3V to -6.0V | Space |
| VA-VB | -0.3V to +0.3V | Not Valid |

### Interface Signal Lines

**Transmit A and B:** These signals send data to the DCE.

**Received A and B:** These signals send data to the control unit.

**Signal Element Timing (SET) A and B:** These signals supply timing for the control unit.

**Control A and B:** These signals transmit the control status to the DCE.

**Indicate A and B:** These signals indicate the DCE status to the control unit.

# Removal and Replacement Procedures

This section contains information on how to remove and replace FRUs in the 5394. You may have to remove more than one FRU in order to replace a particular one. If you have to remove more than one FRU, the procedure will refer you to the removal and replacement procedure for each FRU involved.

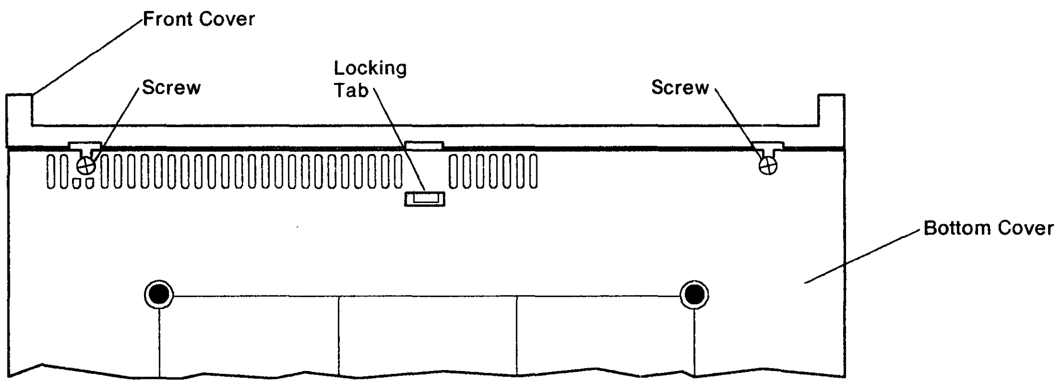
**Note:** Some versions of the 5394 have special maintenance requirements. Read "Special Maintenance Topics" on page 4-6 before replacing any components.

## Cover Removal and Replacement Procedure

1. See Figure 3-24 on page 3-27 and do the following steps.
2. Make sure the power switch is off.
3. Disconnect the power cord from the power outlet and from the rear of the control unit.
4. Disconnect the communication cable and the twinaxial work station cables.
5. Place the control unit on a table with the back connector panel down and the bottom facing you. Loosen, but do not remove, the two screws located on the bottom front of the control unit.
6. Push the locking tab down and pull the bottom of the front cover away from the front of the control unit. The locking tab is centered between the two screws that were loosened in step 5.
7. Place the control unit back on its bottom.
8. Remove the top cover by pressing down on the two locking tabs at the rear of the control unit and sliding the cover away from the back of the control unit.
9. Reverse these steps to replace the front and top covers.

**Notes:**

1. Make sure that the AC power indicator aligns with the cutout at the rear of the top cover.
2. Do not overtighten the screws.



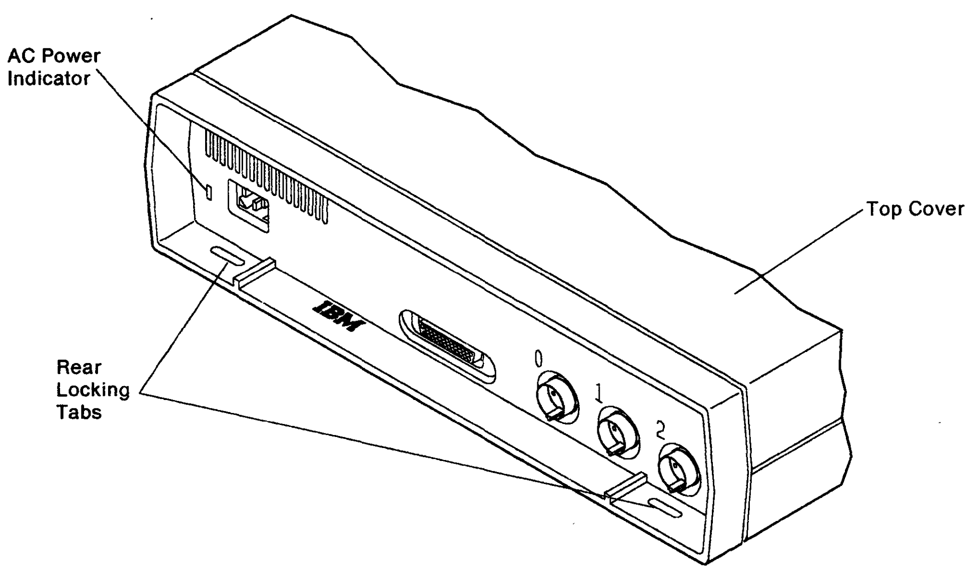




Figure 3-24. Front and Top Cover Removal

## Diskette Drive Removal and Replacement Procedure

1. Remove the front and top covers. See "Cover Removal and Replacement Procedure" on page 3-26.
2. See Figure 3-25 on page 3-28.
3. Disconnect the diskette drive signal cable from the rear of the diskette drive.
4. Remove the two screws that secure the diskette drive to the plenum.
5. Remove the four hex head screws that secure the diskette drive cover to the diskette drive.
6. Remove the diskette drive cover and remove the bezel.
7. Reverse these steps and actions to replace the diskette drive.

**Notes:**

1. Place the diskette drive on a flat surface before you tighten the cover screws, to make sure the cover aligns correctly with the diskette drive.
2. When replacing the diskette drive and cover assembly, hold it to the front of the plenum while tightening the screws.

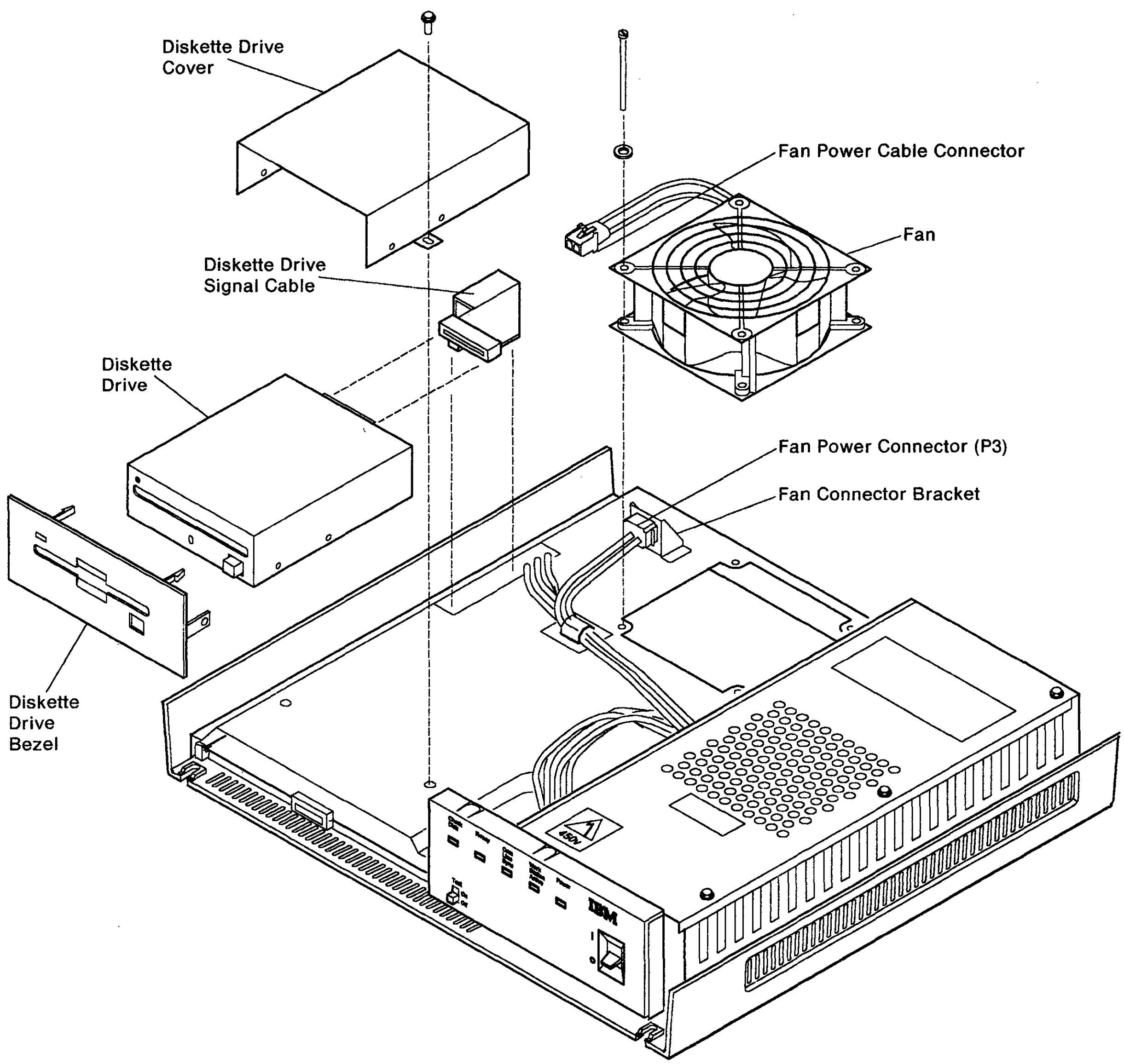



Figure 3-25. Diskette Drive and Fan Removal and Replacement

## Diskette Drive Cable Removal and Replacement Procedure

1. Remove the front and top covers. See "Cover Removal and Replacement Procedure" on page 3-26.
2. See Figure 3-25 on page 3-28.
3. Remove the diskette drive cable from the diskette drive and the planar board.
4. Notice the fold in the diskette drive cable. Fold the new one to match the cable you removed.
5. Reverse these steps and actions to replace the diskette drive cable.

## Fan Removal and Replacement Procedure

1. Remove the front and top covers. See "Cover Removal and Replacement Procedure" on page 3-26.
2. See Figure 3-25 on page 3-28.
3. Disconnect the fan power cable (P3).
4. Remove the fan power connector from the connector bracket.
5. Remove the four fan mounting screws and washers.
6. Remove the fan guard.
7. Lift the fan from the plenum.
8. Position the replacement fan on the plenum. Make sure that the fan is positioned so that it blows air on the planar.
9. Make sure that the fan power cable passes through the slot on the fan and is not pinched against the cutout in the plenum.
10. Route the fan wires between the fan and the fan mounting screw.
11. Reverse these steps beginning at step 6.

## Plenum Removal and Replacement Procedure

1. Remove the front and top covers. See "Cover Removal and Replacement Procedure" on page 3-26.
2. See Figure 3-26 on page 3-30.
3. Disconnect the following cables:
   - Planar power cable (P1)
   - Fan power cable (P3)
   - Diskette drive power cable (P2)
   - Diskette drive signal cable (at P11 from J4).
4. Remove the cables from the cable clip on the plenum.
5. Remove the screws that secure the plenum to the chassis.
6. Remove the plenum from the control unit.
7. If you are replacing a defective plenum, do the following:
   a. Remove the fan and mount it on the replacement plenum. See "Fan Removal and Replacement Procedure."
   b. Remove the diskette drive and mount it on the replacement plenum. See "Diskette Drive Removal and Replacement Procedure" on page 3-27.
   c. Remove the connector bracket and mount it on the replacement plenum.
8. Reverse these steps, starting at step 6, to replace the plenum.

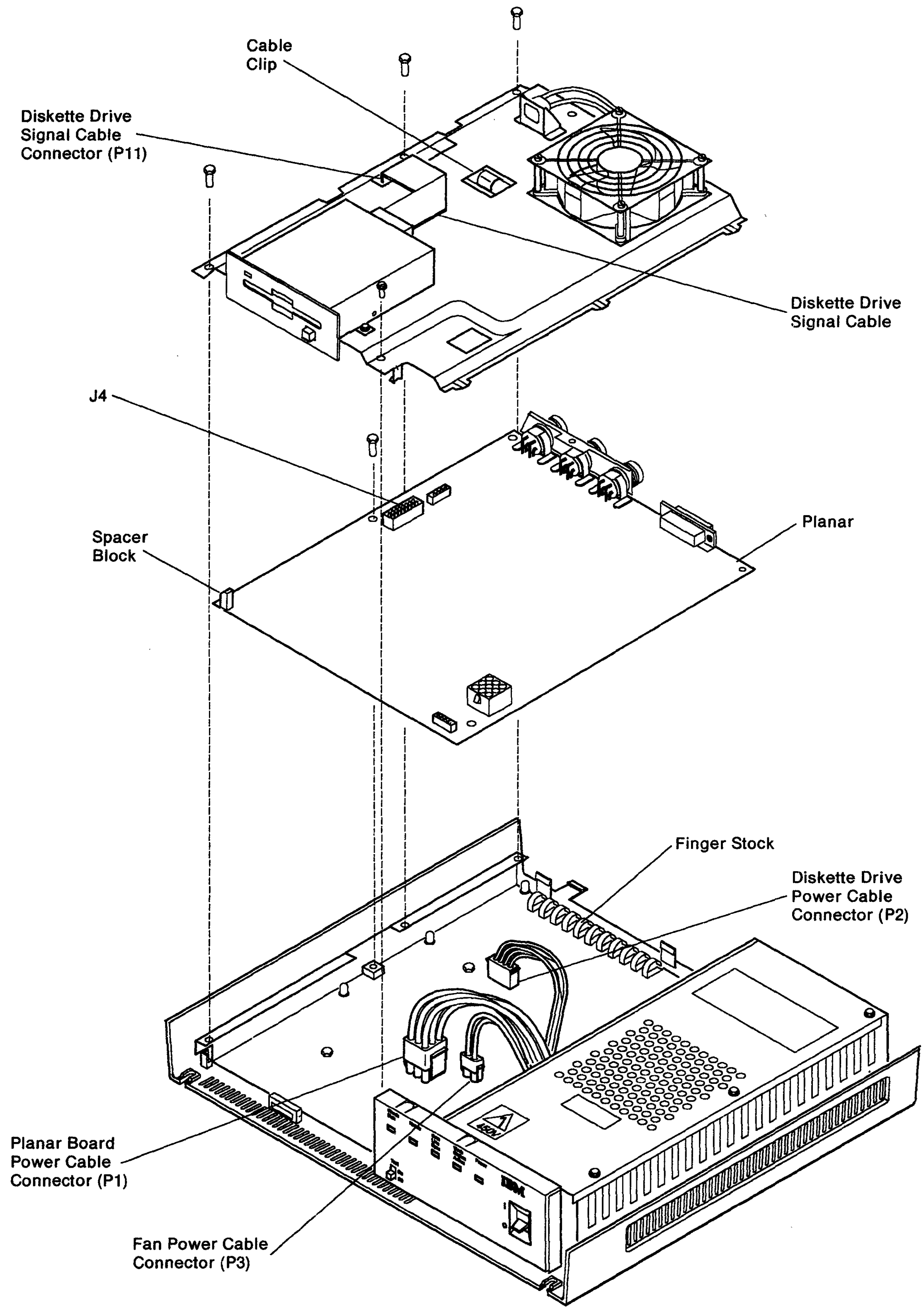



Figure 3-26. Plenum and Planar Removal and Replacement

## DRAM Removal and Replacement Procedure

**Warning:** To avoid damage to the DRAM modules, follow normal electrostatic discharge procedures when removing and replacing them.

1. Remove the front and top covers. See "Cover Removal and Replacement Procedure" on page 3-26.
2. Remove the plenum. See "Plenum Removal and Replacement Procedure" on page 3-29.
3. Use Figure 3-27 to remove one or more DRAM modules.
4. Spread the clips outward to unlatch the DRAM module from the bracket.
5. Rotate the DRAM module in the direction of the large arrow and pull up to remove it.
6. Reverse these steps to replace the DRAM module.

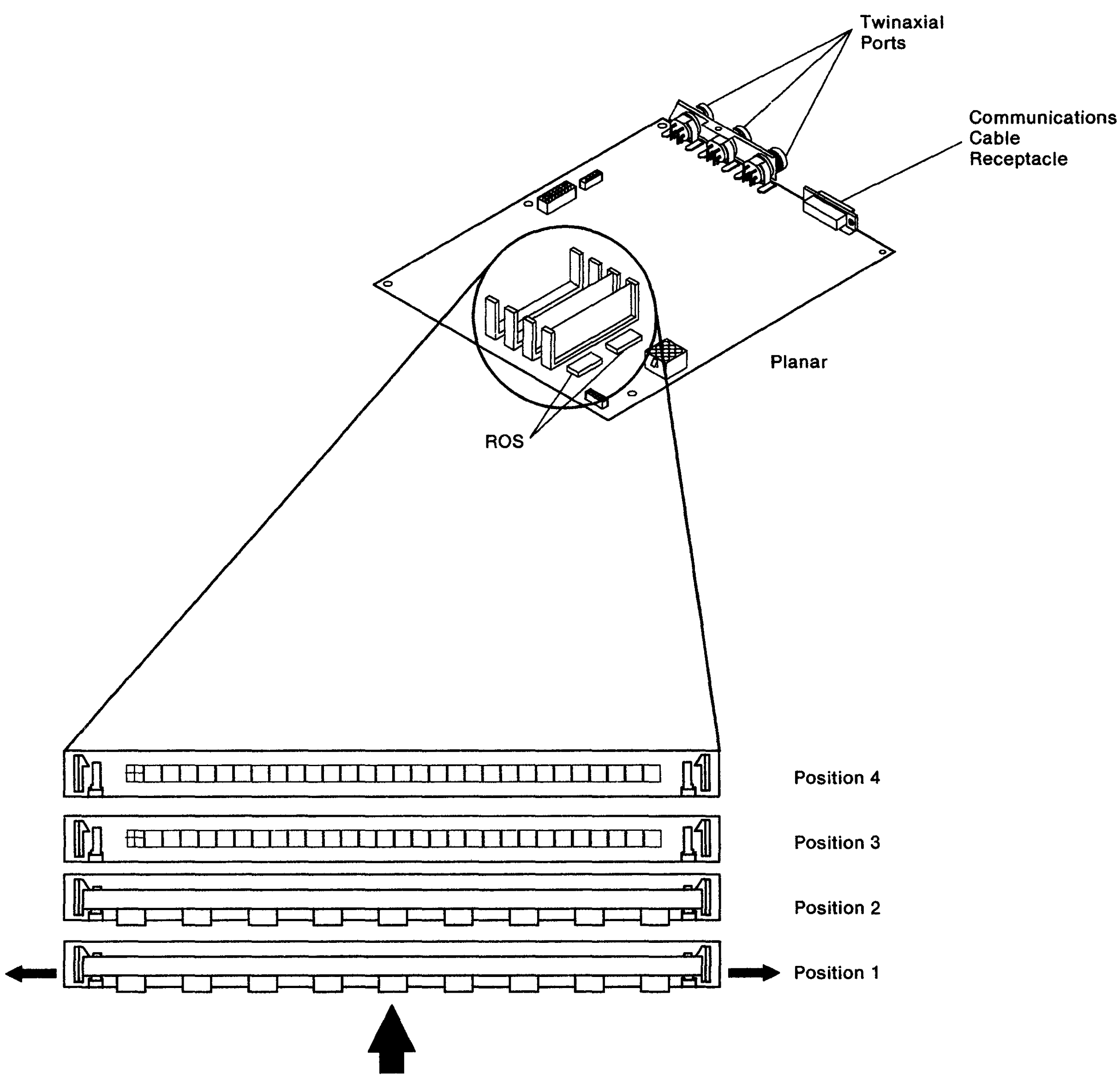



Figure 3-27. DRAM Module Locations

## Planar Removal and Replacement Procedure

Use the following procedure to remove and replace the planar:

**Warning:** To avoid damage to the planar, follow normal electrostatic discharge procedures when you remove and replace it.

1. Remove the front and top covers. See "Cover Removal and Replacement Procedure" on page 3-26.
2. Remove the plenum. See "Plenum Removal and Replacement Procedure" on page 3-29.
3. Disconnect the operator panel connector (P10) from the planar.
4. Remove the two planar mounting screws (7mm).
5. Carefully remove the spacer block from between the chassis and the planar. See Figure 3-28.

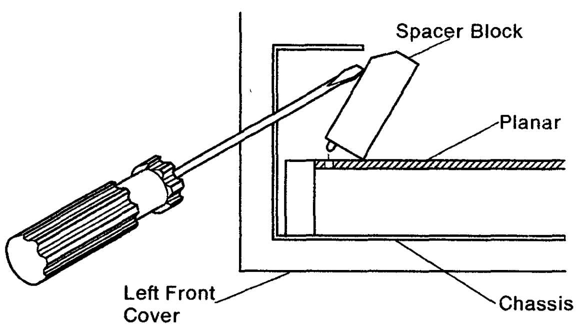



Figure 3-28. Removing Spacer Block

6. Disengage the three locking tabs located near the rear of the control unit.
7. Lift the rear of the planar upward and toward the rear of the chassis to remove it.
8. Examine the two pieces of finger stock located along the back edge of the chassis. See Figure 3-26 on page 3-30. If either piece is bent or damaged, replace the finger stock as follows:
   a. Remove the two hex head screws (7mm) that secure the chassis to the bottom cover.
   b. Disengage the chassis from the two locking clips on the side of the bottom cover.
   c. Lift the back end of the chassis out of the bottom cover until the finger stock can be removed.
   d. Remove the damaged finger stock and install the appropriate replacement. Make sure that the short piece is near the power supply.
   e. Press the chassis into place in the bottom cover and secure with the two hex head screws.
9. Before you install the replacement planar, make sure that the two pieces of finger stock are as far apart as possible and that they are fully pushed into the chassis.
10. Slide the replacement planar into the chassis from the rear until it engages the locking tabs at the front of the chassis.
11. Press the back of the replacement planar down until it engages the locking tab and the support posts. Make sure that all four corners of the planar are aligned with the support posts.
12. Check the finger stock at the back of the chassis and make sure that it makes no contact with the communication interface traces on the bottom of the planar.
13. Install the two hex head screws (7mm) that secure the planar to the chassis.
14. Carefully install the spacer block. Make sure that the tab on the spacer block fits into the hole on the planar.
15. If no DRAM modules are mounted on the new planar, remove the DRAM modules from the old planar and install them in the corresponding positions on the replacement planar. See "DRAM Removal and Replacement Procedure" on page 3-31.
16. Start at step 3 and reverse the steps to complete reassembly of the control unit.

## Power Supply Removal and Replacement Procedure

**DANGER**

> **Do not connect AC voltage to the power supply when it is removed from the control unit. Severe electrical shock could result. Safe grounding of the power supply is ensured only when the power supply is securely fastened in the control unit.**

1. Remove the front and top covers. See "Cover Removal and Replacement Procedure" on page 3-26.
2. Use Figure 3-29 on page 3-34 to do the following steps.
3. Remove three hex screws (7mm) from the top of the power supply cover and remove the power supply cover.
4. Disconnect the following power cables:
   - Planar board power cable (P1)
   - Fan power cable (P3)
   - Diskette drive power cable (P2).
5. Remove the fan and diskette drive power cables from the cable clamp on the plenum.
6. Press the locking tabs on the sides of the plastic grommet and remove it from the side of the power supply housing.

   **Note:** Be careful when removing the plastic grommet. Applying excessive force can damage it.
7. Remove the cables from the plastic grommet.
8. If an electromagnetic shielding core is present on the power supply cables, remove it and install it on the new power cables.

   **DANGER**

   > **Make sure that you have disconnected the power cord from the control unit.**
9. Place the power switch in the on position.
10. Remove the plastic actuator link. See "Actuator Link Removal and Replacement Procedure" on page 3-35.
11. Remove the hex screw (7mm) and lock washer from the end of the green/yellow grounding wire. Do not lose the washer.
12. Remove the two power supply mounting screws.
13. Lift up on the power supply and disengage the four plastic locking tabs one at a time to complete the removal procedure of the power supply.
14. Reverse these steps to replace the power supply. When installing the green/yellow ground wire, place the lockwasher between the wire terminal and the control unit chassis, and tighten the screw securely.

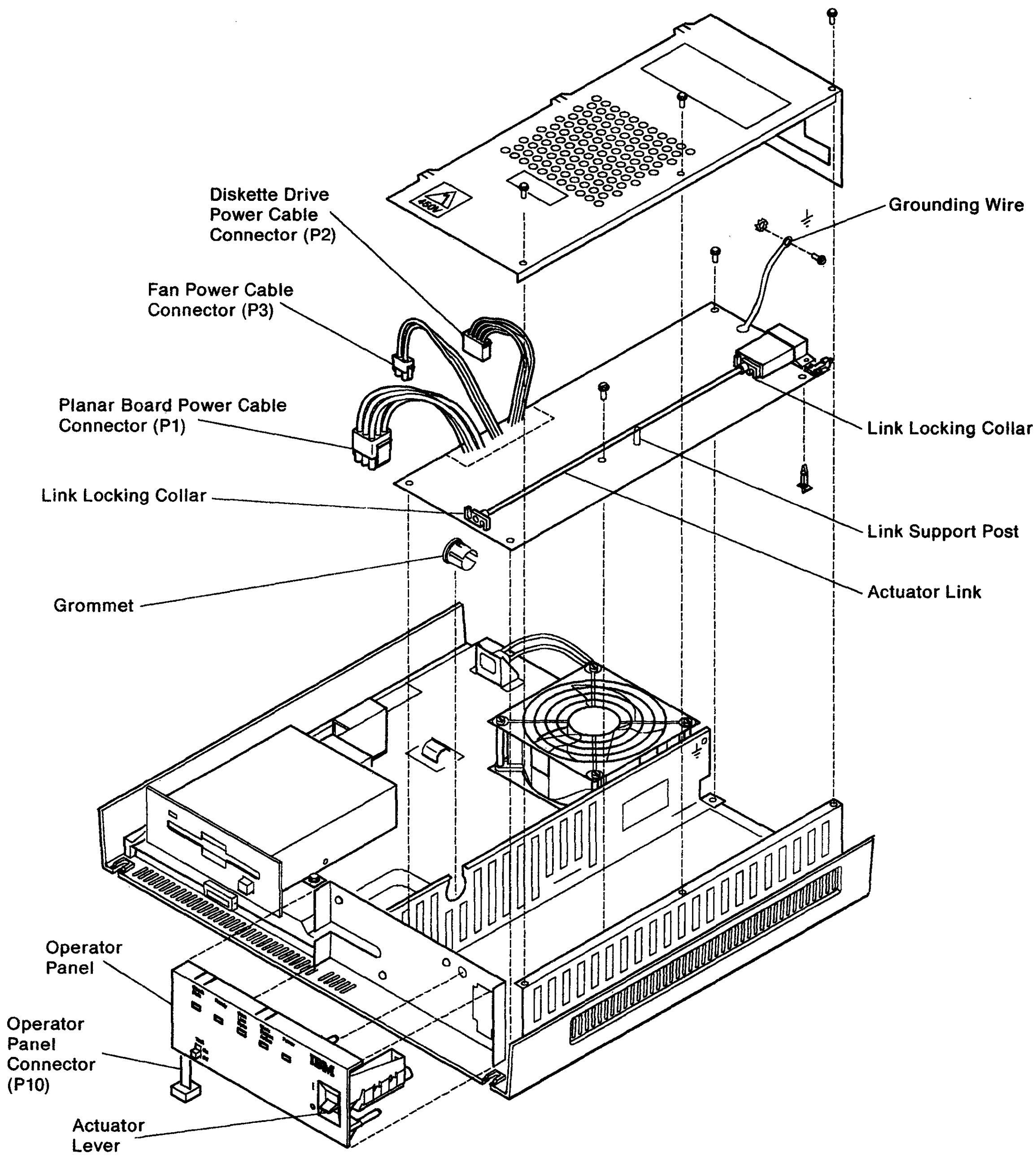



Figure 3-29. Power Supply and Operator Panel Removal and Replacement

## Actuator Lever Removal and Replacement Procedure

1. Remove the front and top covers. See "Cover Removal and Replacement Procedure" on page 3-26.
2. Use Figure 3-30 on page 3-36.
3. Remove three hex screws (7mm) from the top of the power supply cover and remove the cover.

   **DANGER**

   > **Make sure that you have disconnected the power cord from the control unit.**

4. Place the power switch in the on position.
5. Disconnect the plastic actuator link as follows:
   a. Rotate counterclockwise the link-locking collar attached to the actuator lever and pull the collar back.
   b. Lift the end of the actuator link up and pull the link out of the actuator lever.
6. Disconnect the operator panel cable (P10).
7. Pull the operator panel assembly away from the front of the control unit. Slide the operator panel signal cable to the left to clear the machine frame.
8. On the back of the control panel, remove the two hex head screws (5.5mm - approximately 7/32 inch) that hold the actuator lever to the control panel, and remove the actuator lever.
9. Reverse these steps to replace the actuator lever.

   **Note:** When reconnecting the actuator link, make sure the link correctly engages the actuator lever. Pull the tip of actuator link forward, if necessary.

## Actuator Link Removal and Replacement Procedure

**DANGER**

> **Do not connect AC voltage to the power supply when it is removed from the control unit. Severe electrical shock could result. Safe grounding of the power supply is ensured only when the power supply is securely fastened in the control unit.**

1. Remove the front and top covers. See "Cover Removal and Replacement Procedure" on page 3-26.
2. Use Figure 3-30 on page 3-36 to do the following steps.
3. Remove three hex screws (7mm) from the top of the power supply cover and remove the power supply cover.

   **DANGER**

   > **Make sure that you have disconnected the power cord from the control unit.**

4. Place the power switch in the on position.
5. Disconnect the plastic actuator link as follows:
   a. Rotate the link-locking collar at each end counterclockwise and pull the collar back.
   b. Lift the actuator link up and pull the end of the actuator link out of the actuator lever and the power switch on the power supply.
   c. Free the actuator link from its support post.
6. Reverse these steps to replace the actuator link.

   **Note:** When reconnecting the actuator link, make sure the actuator link correctly engages the actuator lever and the power switch on the power supply. Pull the tip of the actuator link forward, if necessary.

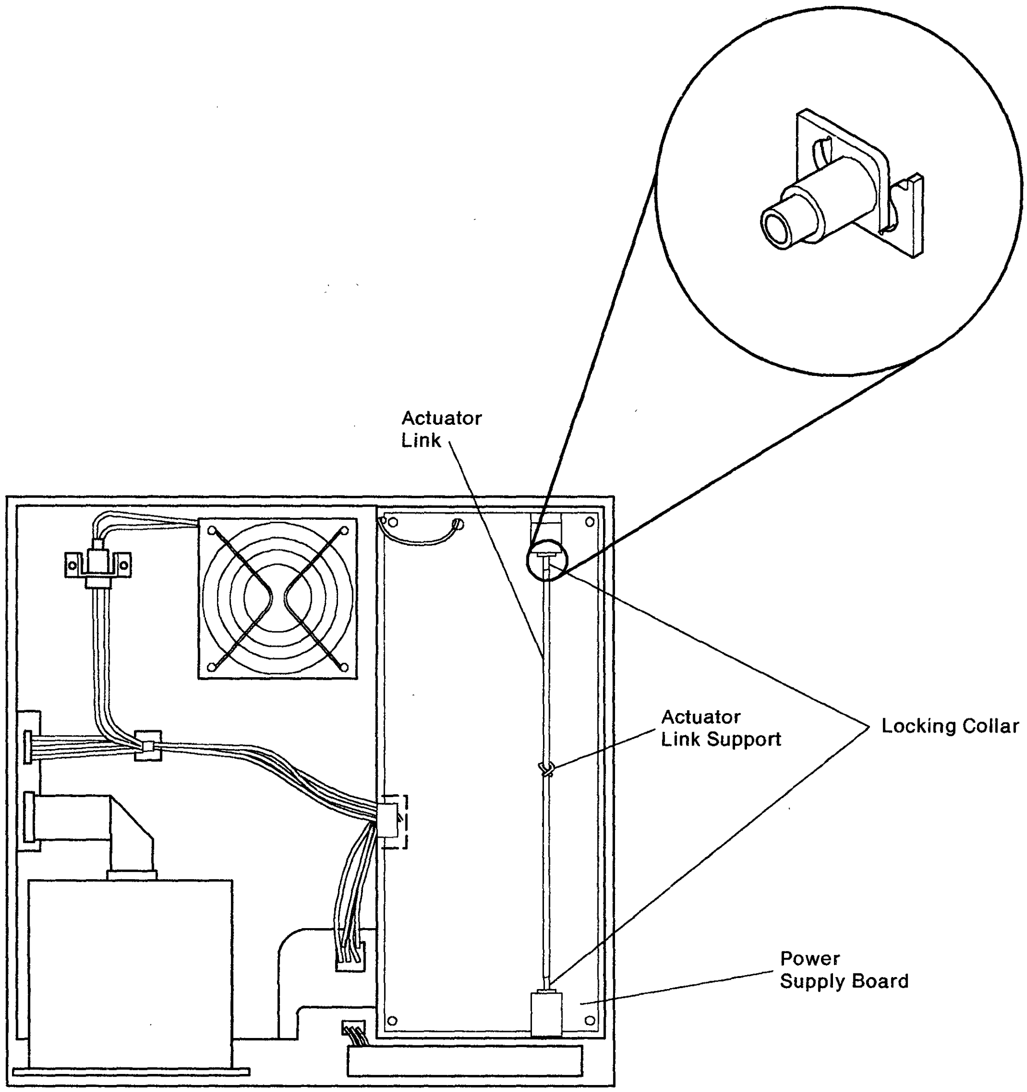



Figure 3-30. Actuator Link

## Operator Panel Removal and Replacement Procedure

1. Remove the front and top covers. See "Cover Removal and Replacement Procedure" on page 3-26.
2. See Figure 3-29 on page 3-34.
3. Remove three hex screws (7mm) from the top of the power supply cover and remove the cover.

   **DANGER**

   > **Make sure that you have disconnected the power cord from the control unit.**

4. Place the power switch in the on position.
5. Disconnect the plastic actuator link as follows:
   a. Rotate counterclockwise the link-locking collar attached to the actuator lever and pull the collar back.
   b. Lift the end of the actuator link and pull the link out of the actuator lever.
6. Disconnect the operator panel cable (P10).
7. Pull the operator panel assembly away from the front of the control unit. Slide the operator panel signal cable to the left to clear the chassis.
8. Disengage the four plastic locking tabs to remove the operator panel logic card from the control panel assembly.
9. Reverse these steps to replace the operator panel.

   **Note:** When reconnecting the actuator link, make sure the link correctly engages the actuator lever. Pull the tip of actuator link forward, if necessary.

# Diagnostics and Test Information

The 5394 supplies power-up diagnostics, offline tests, online diagnostic aids, and access to online tests controlled by the host system. Figure 3-31 on page 3-38 illustrates the overall sequence of operation and indicates when you can enter the various test modes.

When you first switch the power on, a series of internal tests check most major functions of the control unit and load the functional microcode from the system diskette. When an error occurs during the power-on sequence, the 5394 uses the LEDs on the operator panel to identify the failure condition. Depending on the nature of the failure, a 6-digit SRC (DXXXXX) also appears on attached display stations. Failures at this stage of operation usually prevent additional diagnostics from running. You should use the test procedure outlined in "MAP 0100: Start Of Call" on page 2-3 or "MAP 0300: Problem Not Found" on page 2-27 to identify the failing component.

If the power-on sequence completes without detecting an error, you can either start normal operation or run additional tests. Offline test modes include the Free Key mode and the Dedicated mode. The 5394 automatically starts Free Key mode operation for each attached display station before any sessions are established with the host system. The Dedicated mode supplies a series of special tests that check operation of the interface with the host system.

Once you start a session with the host system, you can enter either the online test mode or the Concurrent mode. The online test mode, which is controlled by the host system, checks various aspects of 5394 operation. The Concurrent mode controls no tests but permits you to examine the contents of internal memory registers of the 5394 without stopping all customer sessions.

# Operation Flowchart

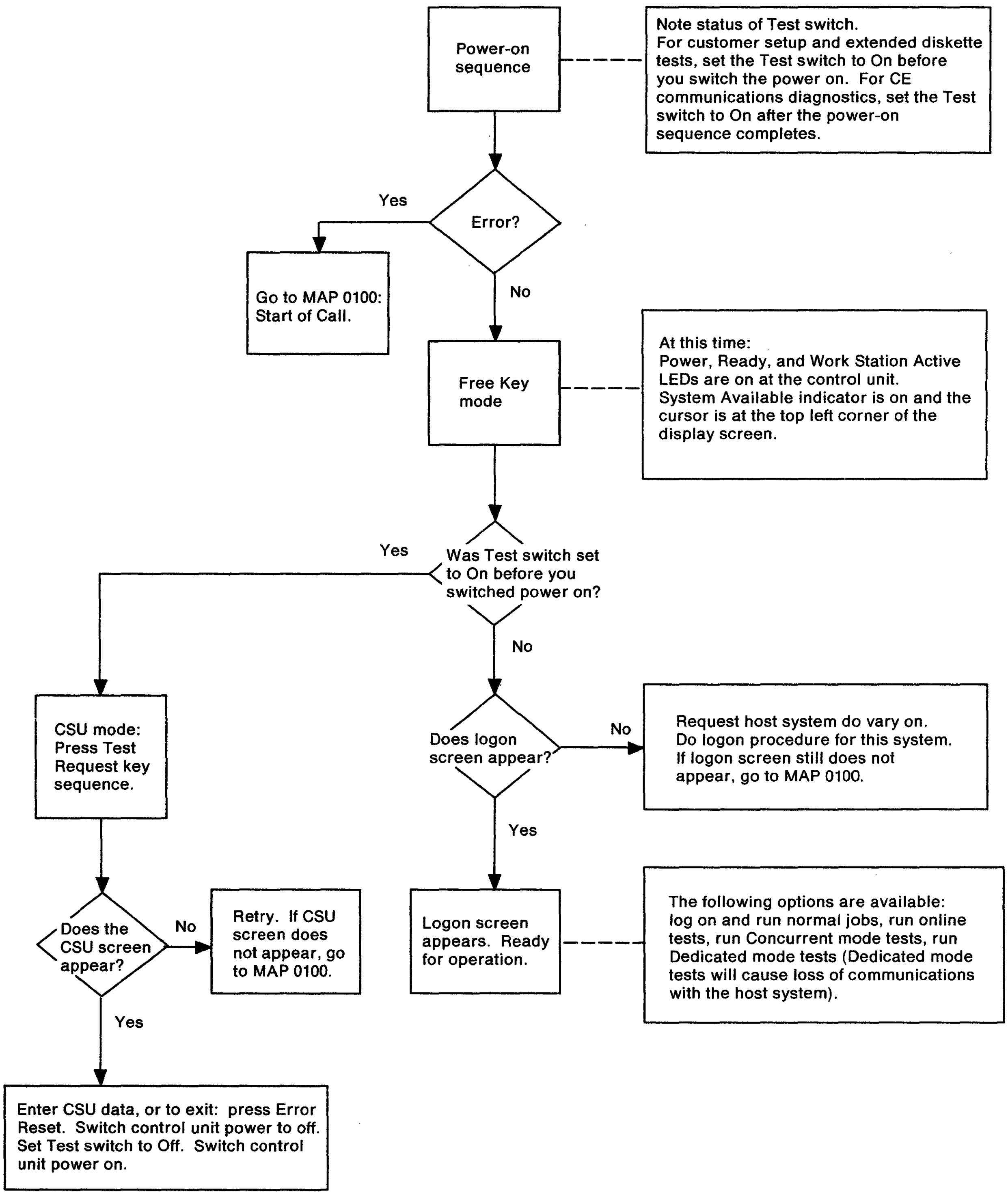
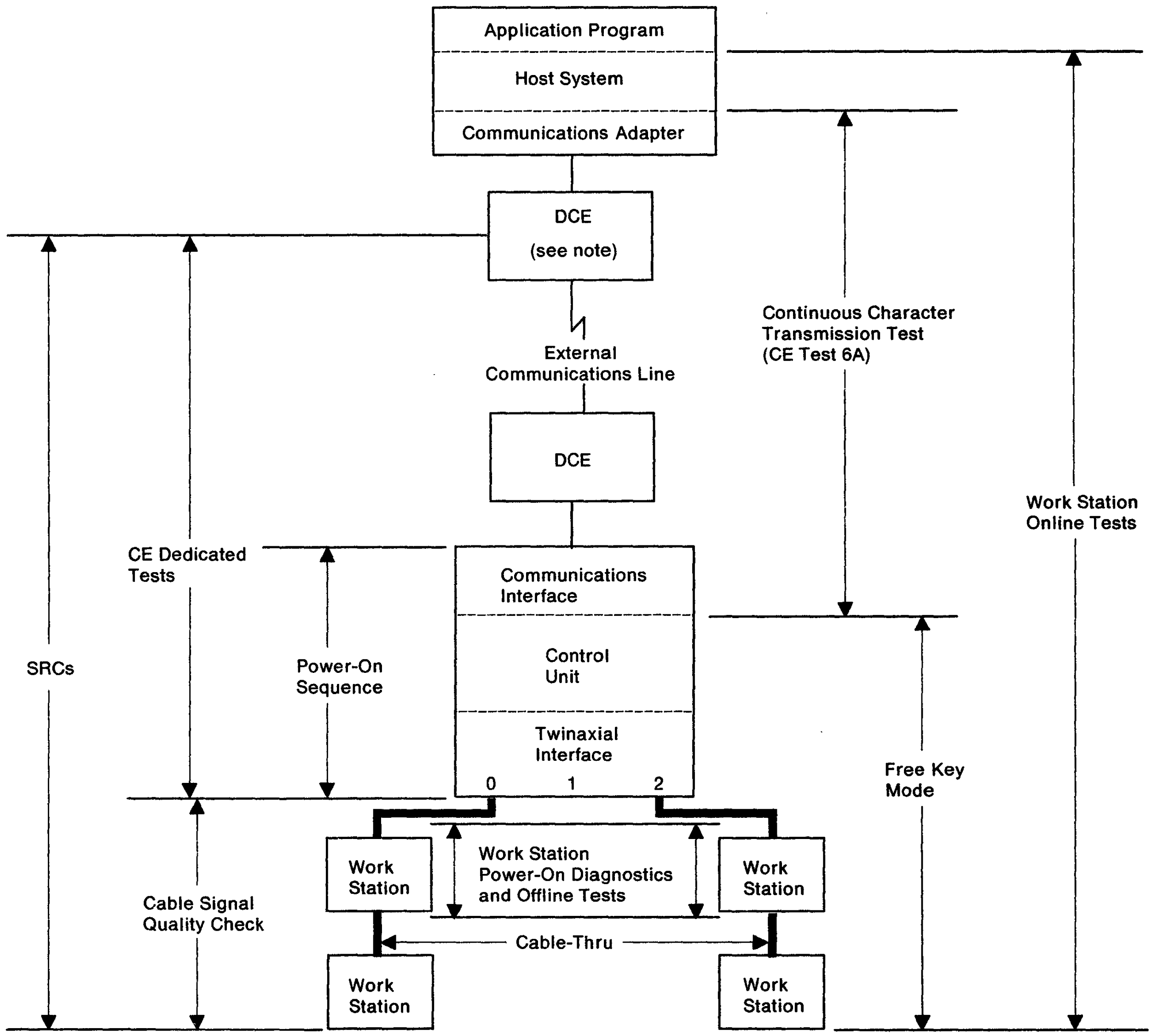



Figure 3-31. Operation Flowchart

## Diagnostic Summary

Figure 3-32 shows the diagnostic routines that you can run on a control unit to check both the internal functions and online functions.




Note: The host system DCE may be an integrated modem or DCE, an external modem or DCE, or an external digital DCE.

Figure 3-32. Diagnostic Summary

## Key Sequences

The key sequences are operations that permit you to do the following tests and procedures:

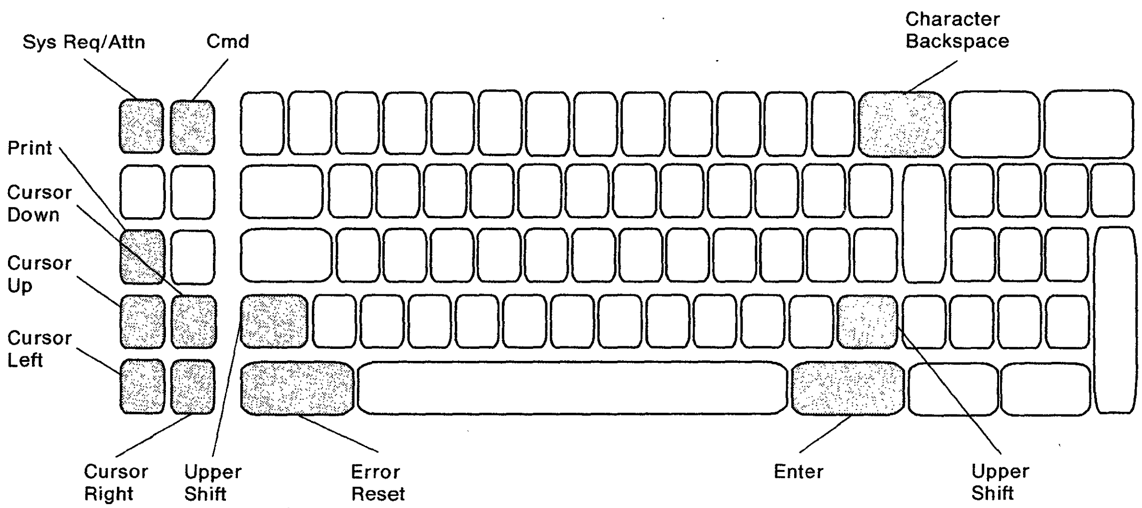
- "Dedicated Mode Tests" on page 3-50
- "Concurrent Mode Screens" on page 3-61
- "Online Tests" on page 3-78
- "Communication Wrap Tests" on page 3-57
- "Control Unit Configuration Procedure" on page 3-6.

The keys involved in the operations vary, depending on the type of display station attached to the control unit and the operation.

The figures on the following pages show keyboards supported by the 5394. Go to the figure for the type of keyboard your display station uses.

The key sequence function keys are shaded in the figures. The actual keytop characters on your keyboard may not be the same as the ones shown in the figure due to language differences.

### IBM Typewriter Keyboard




#### Test Request Key Sequence

1. Press the Error Reset key.
2. Press the Command (Cmd) key.
3. Press the Character Backspace (←) key.

#### System Request Key Sequence

1. Press the Error Reset key.
2. Press and hold the Shift key.
3. Press the Sys Req/Attn key.

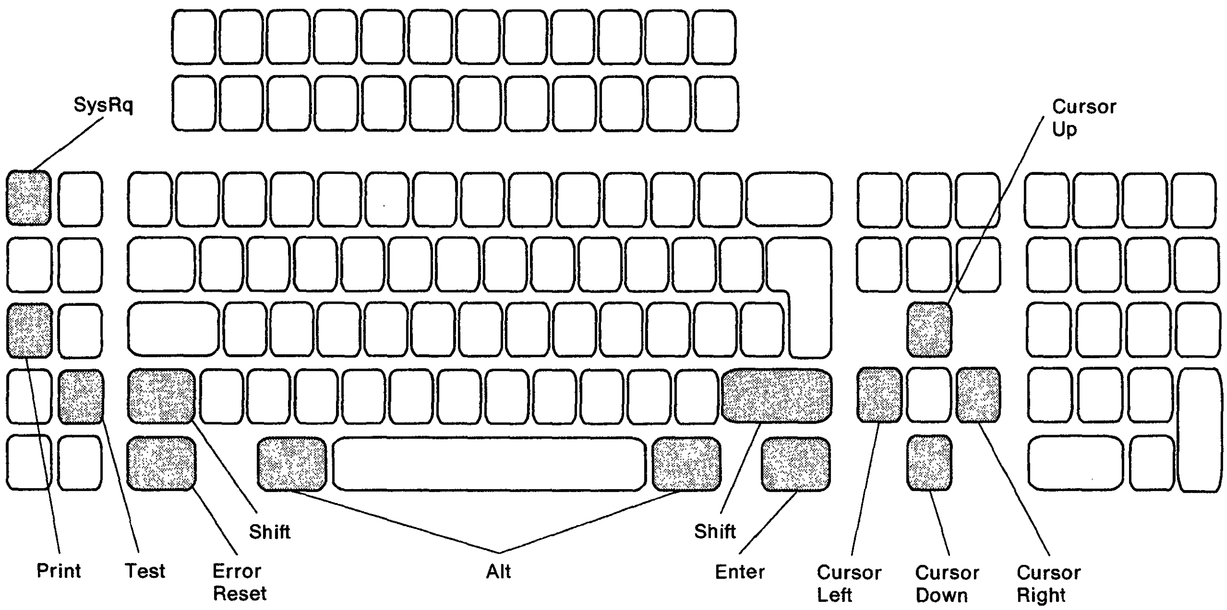
#### Local Copy Key Sequence

Press the Print key.

#### Diskette Error Log Reset Key Sequence

1. Press the Command (Cmd) key.
2. Press the Cursor Right key.

## IBM 122-Key Keyboard




**Test Request Key Sequence**

1. Press the Error Reset key.
2. Press and hold the Alt key.
3. Press the Test key.

**System Request Key Sequence**

1. Press the Error Reset key.
2. Press and hold the Shift key.
3. Press the SysRq key.

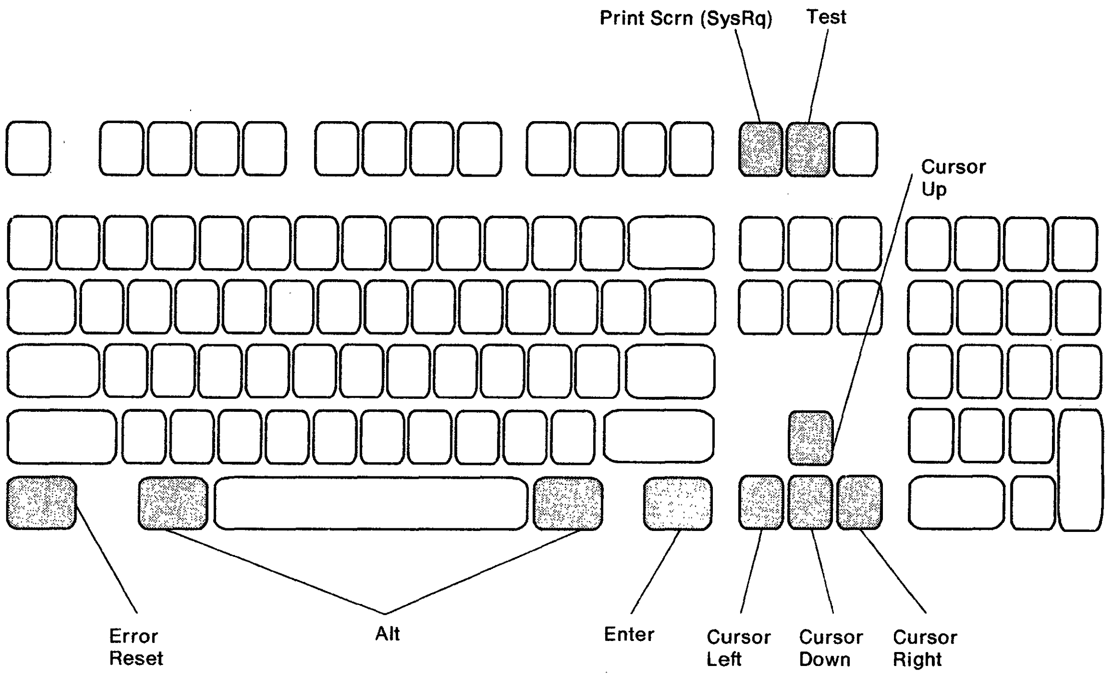
**Local Copy Key Sequence**

Press the Print key.

**Diskette Error Log Reset Key Sequence**

1. Press and hold the Alt key.
2. Press the Cursor Right key.

## IBM Enhanced (102-Key) Keyboard




**Test Request Key Sequence**

1. Press the Error Reset key.
2. Press and hold the Alt key.
3. Press the Test key.

**System Request Key Sequence**

1. Press the Error Reset key.
2. Press and hold the Alt key.
3. Press the SysRq (Print Scrn) key.

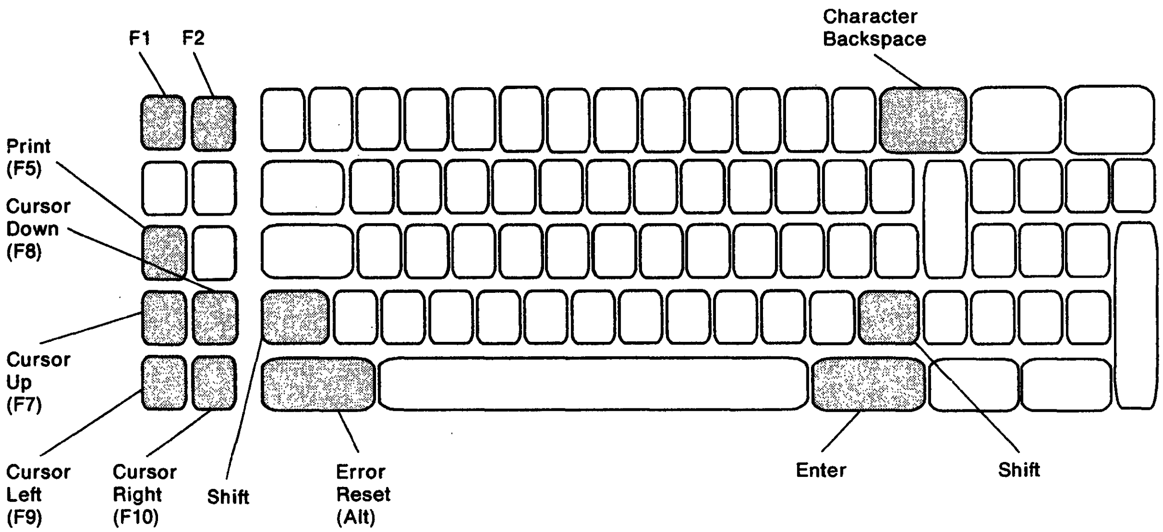
**Local Copy Key Sequence**

Press the Print Scrn key.

**Diskette Error Log Reset Key Sequence**

1. Press and hold the Alt key.
2. Press the Cursor Right key.

## IBM PC, PC XT, and Portable PC Keyboard




### Test Request Key Sequence

1. Press the Error Reset (Alt) key.
2. Press the F2 key.
3. Press the Character Backspace (←) key.

### System Request Key Sequence

1. Press the Error Reset (Alt) key.
2. Press and hold the Shift key.
3. Press the F1 key.

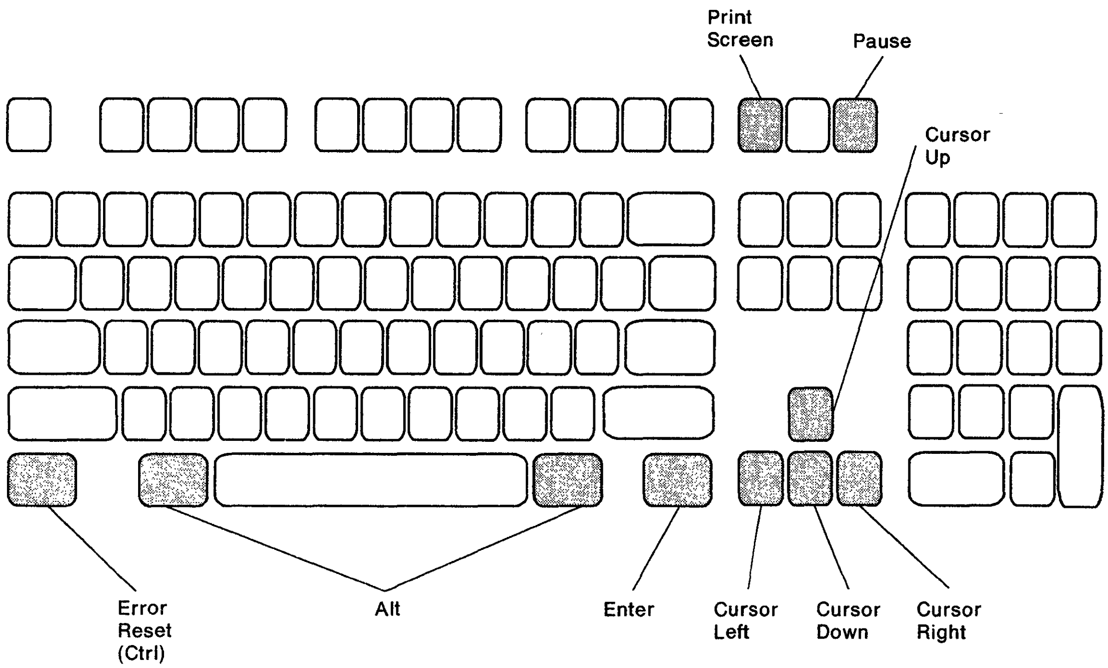
### Local Copy Key Sequence

Press the F5 (Print) key.

### Diskette Error Log Reset Key Sequence

1. Press the F2 key.
2. Press the Cursor Right key.

## IBM Personal System/2 Keyboard (Using IBM System 36/38 Work Station Emulation Program)




### Test Request Key Sequence

1. Press the Error Request (Ctrl) key.
2. Press and hold the Alt key.
3. Press the Pause key.

### System Request Key Sequence

1. Press the Error Reset (Ctrl) key.
2. Press and hold the Alt key.
3. Press the Print Screen key.

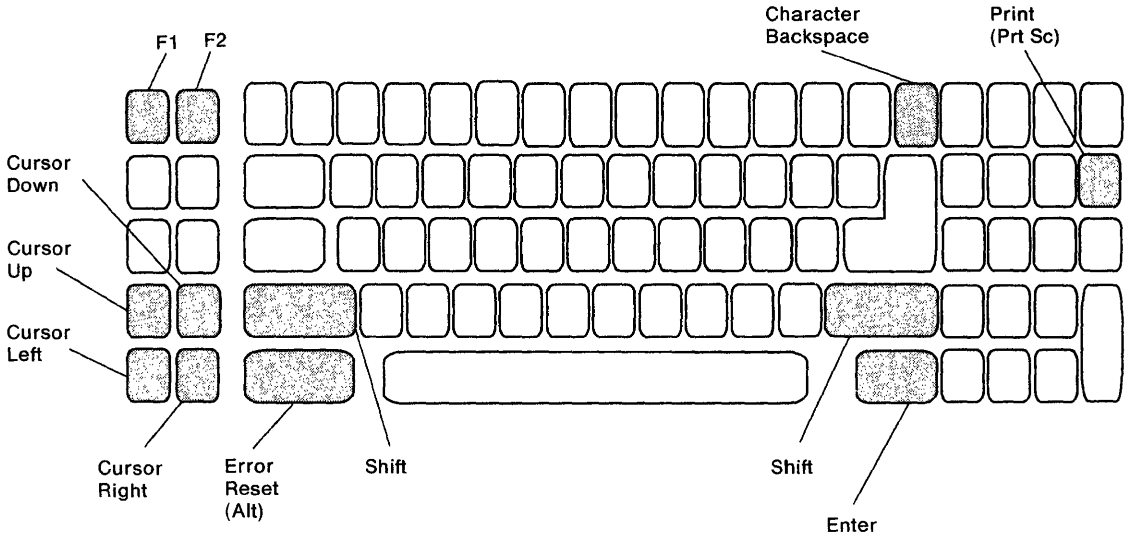
### Local Copy Key Sequence

Press the Print Screen key.

### Diskette Error Log Reset Key Sequence

1. Press and hold the Alt key.
2. Press the Cursor Right key.

## IBM Personal Computer AT Keyboard




**Test Request Key Sequence**

1. Press the Error Reset (Alt) key.
2. Press the F2 key.
3. Press the Character Backspace (←) key.

**System Request Key Sequence**

1. Press the Error Reset (Alt) key.
2. Press and hold the Shift key.
3. Press the F1 key.

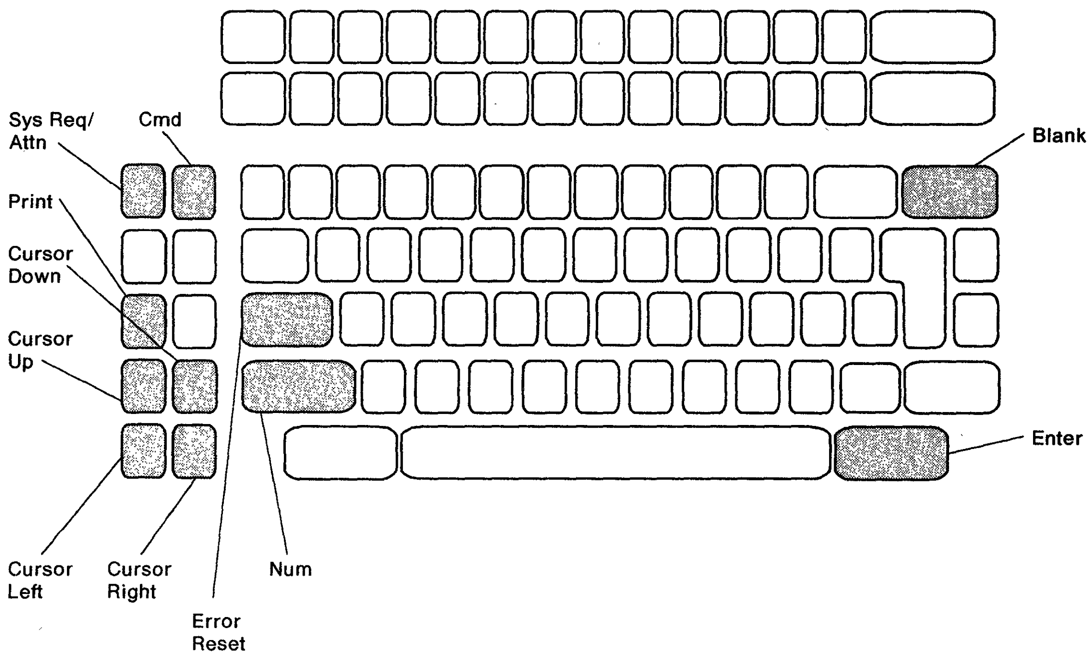
**Local Copy Key Sequence**

1. Press and hold the Shift key.
2. Continue to hold the Shift key and press the Prt Sc key.

**Diskette Error Log Reset Key Sequence**

1. Press the F2 key.
2. Press the Cursor Right key.

## IBM Typewriter Data Entry Keyboard




### Test Request Key Sequence

1. Press the Error Reset key.
2. Press the Command (Cmd) key.
3. Press the Blank key.

### System Request Key Sequence

1. Press the Error Reset key.
2. Press and hold the Num key.
3. Press the Sys Req/Attn key.

### Local Copy Key Sequence

Press the Print key.

### Diskette Error Log Reset Key Sequence

1. Press the Command (Cmd) key.
2. Press the Cursor Right key.

## Power-on Sequence

During the power-on sequence, internal microcode tests all major parts of the control unit and loads the functional microcode from the diskette. A flow-chart of the power-on sequence is shown in Figure 3-33 on page 3-48.

The following information describes how the control unit should function at power-on. This description assumes that the control unit configuration was checked and is correct. For a description of the configuration screen and how to determine if the 5394 configuration is correct, see "Control Unit Configuration Procedure" on page 3-6.

1. Set the Test switch to Off.
2. Switch the power on.

   All LEDs on the control unit should come on for approximately 1/2 second during the lamp test. After 1/2 second, all the LEDs except the Power LED go off. The Power LED should remain on. The Com Line Sync LED should flash twice.

   At this time, the power-on diagnostics start. The diagnostics proceed as follows:

   - Microprocessor (MPU)
   - DRAM
   - ROS
   - Diskette drive
   - Twinaxial adapter
   - Communication interface.

If all of the diskette drive tests complete without errors, the microcode, configuration data, and error logs are loaded from the diskette into the DRAM.

If no diagnostic test errors occur and the diskette contents load normally, the Ready LED comes on.

The Work Station Active LED comes on now if an attached work station is on and responds to poll commands.

At all active work stations, a System Available indicator should appear and the cursor should be located in the top left corner of the screen. The display station should now be in the Free Key mode (see "Free Key Mode" on page 3-50).

The control unit is now ready to communicate with the host system. Do the following steps to start communication:

1. Make sure that the communication cable is connected to a modem or DCE.
2. Set the power on at the modem or DCE.
3. Request the host system to vary on the control unit. If using a switched line, take the steps required to place a call.
4. The host system now begins polling the control unit. When the control unit detects flags, the Com Line Sync LED flashes.

The control unit is now operating normally and you may start normal operation with the system.

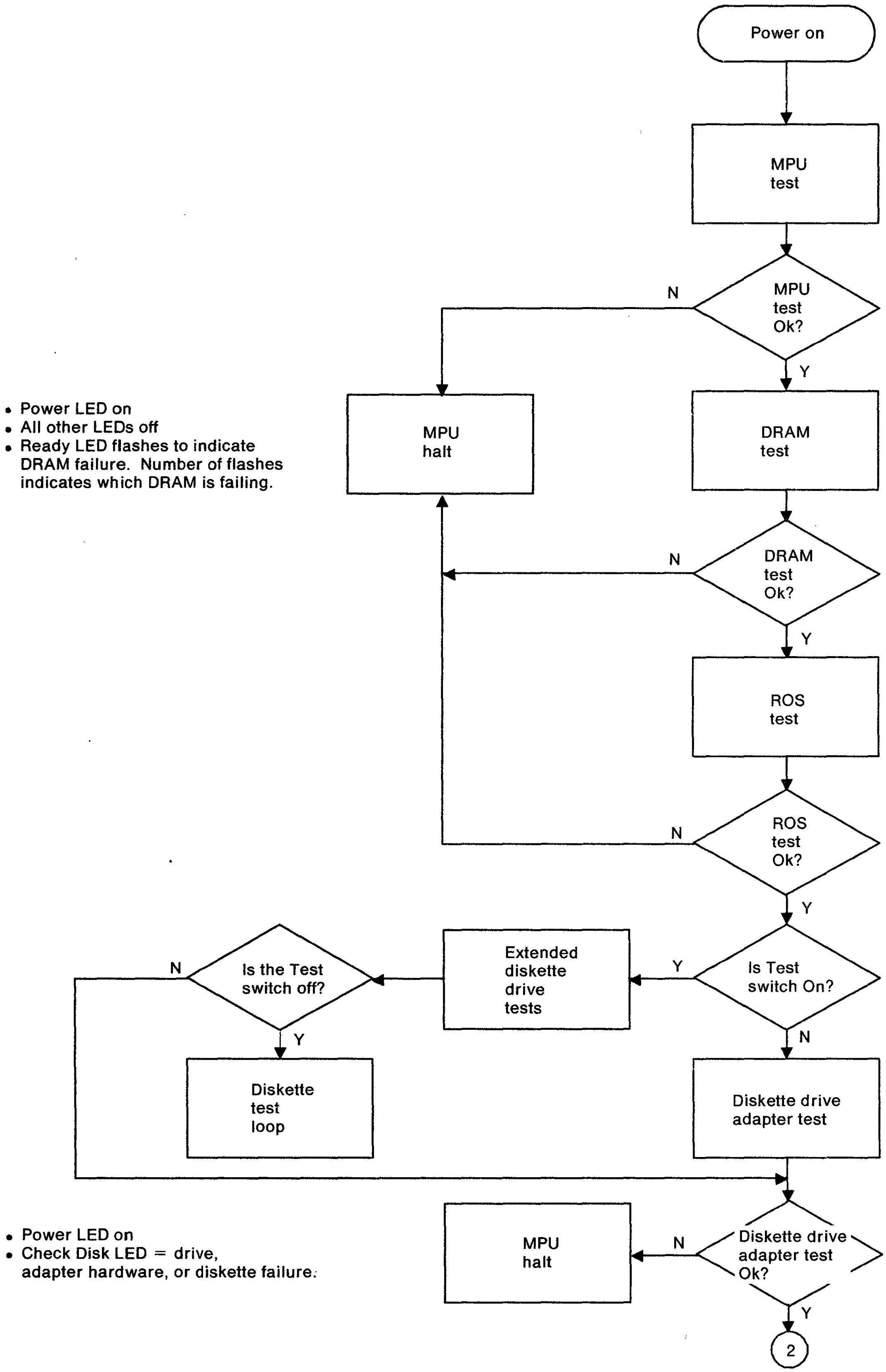



Figure 3-33 (Part 1 of 2). Power-On Sequence Flowchart

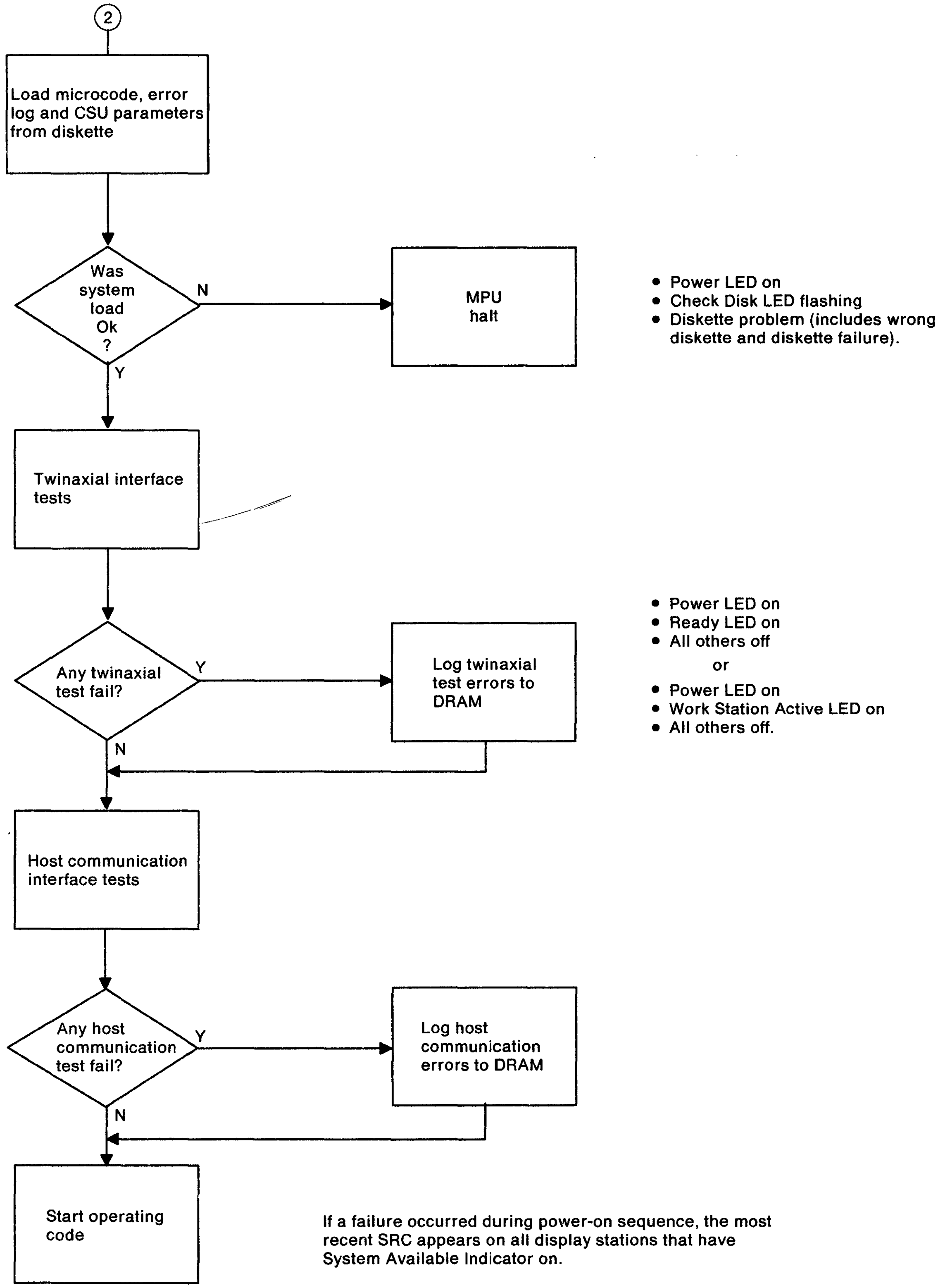



Figure 3-33 (Part 2 of 2). Power-On Sequence Flowchart

## Free Key Mode

Free Key mode permits you to enter information using the keyboard and display it on the display screen when the control unit is not in session with the host system. This mode starts after the power-on sequence completes correctly and permits you to test the keyboard and other functions of the attached display stations. The attached display stations remain in Free Key mode until the host system transmits a logon screen.

Free Key mode does not test the following function keys and, if you press one of these keys during Free Key operation, a 0099 SRC appears:

- Print
- Help
- Roll Up (Page Down)
- Roll Down (Page Up)
- Enter/Rec Adv
- Test Request (backspace or yen key)
- Attn
- Command function keys (Cmd, 1 through 24, see note).

You can reset errors with the Error Reset key.

When the control unit is attached to a host system that causes a sign-on screen to appear immediately after the power-on sequence completes, a type of Free Key mode is available in a field of the PRIME OPTION MENU of the online tests. (See the display station maintenance information library.)

**Note:** See the display station keyboard template or operator's manual for identification of the command function keys.

## Dedicated Mode Tests

The Dedicated mode allows you to test the communication interface. These tests include the following:

- Communication wrap tests
- Tests that control specific functions of the communication interface
- The ability to view Concurrent mode screens from Dedicated mode.

You can run these tests on any attached display station except an IBM PC or Personal System/2 with AS/400 PC Support, or an IBM Personal System/55 using 5250 PC/2 AD Support. The 5394 cannot communicate with the host system while in the Dedicated mode.

### Entering the Dedicated Mode

**Warning:** To prevent destruction of data, stop all work station sessions before you start any Dedicated mode test.

1. Switch the power off. Set the Test switch to Off.
2. Switch the power on at the 5394 and at a display station other than an IBM Personal System/2.
3. Wait about 2 minutes for the power-on sequence to complete. Reset any error condition that occurs.
4. At the control unit, set the Test switch to On.
5. At the display station, enter the Test Request key sequence. See "Key Sequences" on page 3-40.
6. Press the D key. A diagnostic display appears in the lower left corner of the screen. See Figure 3-34 on page 3-51 and the following text for definitions of control fields.
7. Use the Cursor Up key to select the desired Dedicated mode test.
8. Press the Enter key to start the test, and press the Error Reset key to stop the test. See "Running Dedicated Mode Tests" on page 3-52.

## Dedicated Mode Screen Fields

```
A        B
600000   Y


C D    E
6X C   000000
```

Figure 3-34. Dedicated Mode Screen Data Fields

**A** SRC Field: This field displays SRCs that indicate the overall status of the selected Dedicated mode test. The first two digits of the code identify the test selection, and the remaining four digits define the test results. The test result code remains all zeros as long as the test is running. When a selected test stops, this field displays either a test result code or prompt. For detailed information about the SRCs, see Table 3-47 on page 3-124.

**B** Test Counter: The significance of data in this field depends on the current test selection and the type of interface:

- During cable wrap tests on a 5394 attached to a V.35 communication cable, this field contains a 1 or a 2 to differentiate between phase A and phase B test prompts. These prompts allow you to determine which signal lines the microcode is testing.
- If you select test 61, field **B** indicates the wrap level (3, 4, or 6) associated with the SRC in field **A**.
- If you select test 69 (line speed), field **B** indicates the frequency of the clock signal being received from the modem or DCE.

**C** Test Selection Field: This field allows you to select the desired Dedicated mode test. When the test screen first appears at the display station, the cursor is positioned below the second digit of the test number. You can use the Cursor Up or the Cursor Down key to select any Dedicated mode test supported by the control unit.

**D** Test Option Field: This field enables you to select either the continuous or the loop on error mode of test operation. To select the mode of operation, move the cursor to the test option field and press the Cursor Up or the Cursor Down key. The difference between these modes of operation is as follows:

- Continuous loop: When this field contains a C, the selected test runs continuously until you press the Error Reset key or the 5394 detects an error. Under either condition, the 5394 stops the test in progress and displays the appropriate information in fields **A** and **B**.
- Loop on error: When this field contains an E, the selected test runs until you press the Error Reset key. If the 5394 detects an error, the test stops and an SRC appears in field **A**. After a brief pause, the 5394 resets the SRC to all zeros and begins running the test again.

**Note:** This field does not appear if you select test 61.

E Test Data Field: Three bytes of test data appear in this field when either the continuous transmit (6A) or the continuous receive (6B) test is selected. When you select test 6A, you can use the Cursor Up or Cursor Down key to create any hexadecimal test pattern. If you select test 6B, this field displays the first three bytes of each new transmission received from the network.

## Running Dedicated Mode Tests

Figure 3-35 shows a general sequence for running Dedicated mode tests, and Figure 3-36 on page 3-53 shows the overall sequence for running a specific test. Table 3-8 on page 3-54 identifies SRCs and describes operating procedures for each Dedicated mode test supplied by the 5394. Detailed information about tests 63, 64, and 66 is supplied in "Communication Wrap Tests" on page 3-57. Use the following procedure as a general outline for running all Dedicated mode tests:

1. Enter the Dedicated mode. See "Entering the Dedicated Mode" on page 3-50.
2. Use the Cursor Up key to select the desired test number and option.
3. Press the Enter key. If an SRC appears on the screen before the test begins to run, see Table 3-8 on page 3-54 to determine the appropriate response.
4. While the test is running, the last four digits in field A remain all zeros and the test counter continues incrementing.
5. If you want to stop the test manually, press the Error Reset key. See "Cable Wrap SRCs" on page 3-58 for definitions of SRCs associated with cable wrap tests. See "Dedicated Diagnostic SRCs" on page 3-124 for the meaning of any SRC that appears in field A.
6. Press the Error Reset key twice to clear the Dedicated mode test screen.

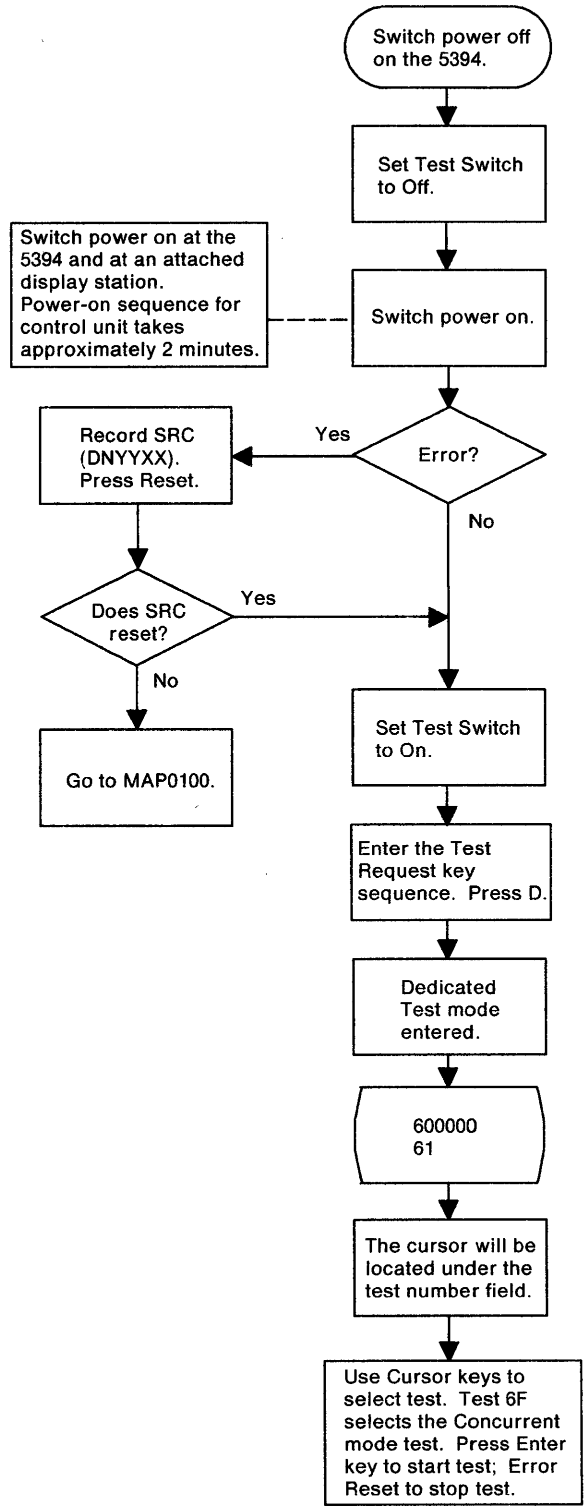
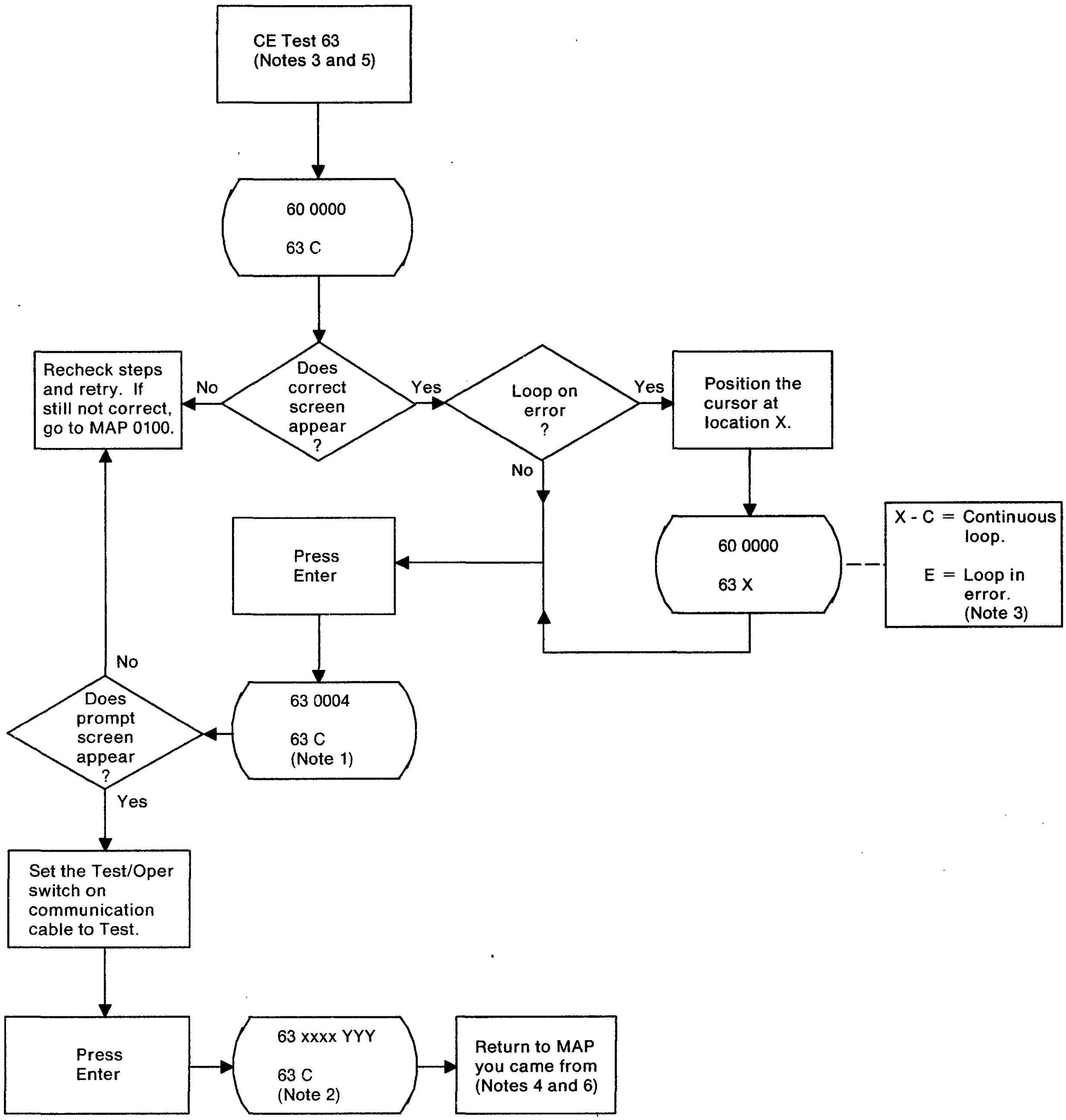



Figure 3-35. Dedicated Mode Flowchart




Notes

1. 630004 is a prompt to set the Test/Oper switch on the communication cable to Test.
2. xxxx = 0000 if test is running, 0007 if test completed successfully. Any other number indicates a failure condition.
3. Use the Cursor Up or Cursor Down movement keys to change options.
4. SRCs will be used in MAPs.
5. This example assumes that test 63 was selected and the 5394 is attached to an EIA 232D interface.
6. You must set the Test switch to Off and switch the 5394 power off, then on, to exit the Dedicated mode.

Figure 3-36. Example of a Dedicated Mode Test

| Table 3-8 (Page 1 of 3). CE Test Description | | | |
|---|---|---|---|
| **Test Number (Field C)** | **SRC (Field A)** | **Test Level (Field B)** | **Description** |
| | 600000 | | Default SRC that appears in field A at entry into the Dedicated mode. Press the Enter key to start the test selected in field C. |
| 61 | 610000 | | Dedicated test 61 (the extended communication test) is in progress. |
| 61 | 610004 | | Prompt. For a 5394 Model 02, make sure that the DCE is powered on and that the communication cable is connected. To start the cable wrap test, set the switch on the communication cable to Test and press the Enter key.<br>**Note:** If an EIA 232D cable has two switches, both must be in the Test position before you press the Enter key. |
| 61 | 610004 | 1 | Prompt for V.35 interface only. To start the phase A wrap test, disconnect the communication cable from the modem or DCE. Set switches 1 and 3 to the Test position and switch 2 to the Oper position. Press the Enter key. |
| 61 | 610004 | 2 | Prompt for V.35 interface only. To start the phase B wrap test, set switches 1 and 2 to the Test position and switch 3 to the Oper position. Press the Enter key. |
| 61 | 610005 | | Prompt. Make sure that the communication cable is connected to the back of the modem or DCE and that all switches on the communication cable are in the Oper position. Set up for local loopback testing and press the Enter key. If you cannot set up for this test, press the Error Reset key. |
| 61 | 610006 | | Prompt. Set up for a remote modem or DCE loopback test and press the Enter key. If you cannot set up for this test, press the Error Reset key. |
| 61 | 610007 | 3 | The test sequence has ended. The 5394 passed the cable wrap test; local loopback is not possible for this configuration. |
| 61 | 610007 | 4 | The test sequence has ended. Local loopback passed; remote loopback is not possible for this configuration. |
| 61 | 610007 | 6 | The test sequence has ended. Local and remote loopback tests passed. |
| 61 | 6189XX | 3 | Cable wrap test failed on an X.21 communication cable. |
| 61 | 618CXX | 3 | Cable wrap test failed on an EIA 232D communication cable. |
| 61 | 618DXX | 3 | The cable wrap test failed on interchange lines of a V.35 communication cable. |
| 61 | 618EXX | 3 | The cable wrap test failed on phase A lines of a V.35 communication cable. |
| 61 | 618FXX | 3 | The cable wrap test failed on phase B lines of a V.35 communication cable. |

| Table 3-8 (Page 2 of 3). CE Test Description | | | |
|---|---|---|---|
| **Test Number (Field C)** | **SRC (Field A)** | **Test Level (Field B)** | **Description** |
| 61 | 6180XX | 4 | Cable wrap test passed, but local loopback test failed. |
| 61 | 6180XX | 6 | Remote loopback test failed. |
| 63 | 630000 | | Dedicated test 63 (cable wrap) is in progress. |
| 63 | 630004 | | Prompt. For 5394 Model 02, make sure that the DCE is powered on and that the communication cable is connected. To start the cable wrap test, set the switch on the communication cable to Test and press the Enter key.<br>**Note:** If an EIA 232D cable has two switches, both must be in the Test position before you press the Enter key. |
| 63 | 630004 | 1 | Prompt for V.35 interface only. To start the phase A wrap test, disconnect the communication cable from the modem or DCE. Set switches 1 and 3 to the Test position and switch 2 to the Oper position. Press the Enter key to continue the test; press the Error Reset key to stop the test. |
| 63 | 630004 | 2 | Prompt for V.35 interface only. To start the phase B wrap test, set switches 1 and 2 to the Test position and switch 3 to the Oper position. Press the Enter key to continue the test; press the Error Reset key to stop the test. |
| 63 | 630007 | | Cable wrap test completed successfully. |
| 63 | 6389XX | | Cable wrap test failed on an X.21 communication cable. |
| 63 | 638CXX | | Cable wrap test failed on an EIA 232D communication cable. |
| 63 | 638DXX | | The cable wrap test failed on interchange lines of a V.35 communication cable. |
| 63 | 638EXX | | The cable wrap test failed on phase A lines of a V.35 communication cable. |
| 63 | 638FXX | | The cable wrap test failed on phase B lines of a V.35 communication cable. |
| 64 | 640000 | | Dedicated test 64 (local loopback) is in progress. |
| 64 | 640004 | | Prompt. Make sure that the communication cable is connected to the modem or DCE and that all switches on the communication cable are in the Oper position. Set up for local loopback testing and press the Enter key. |
| 64 | 640007 | | Local loopback test completed successfully. |
| 64 | 6480XX | | Local loopback test failed. |
| 66 | 660000 | | Dedicated test 66 (remote loopback) is in progress. |
| 66 | 660004 | | Prompt. Set up for remote loopback and press the Enter key. |
| 66 | 660007 | | Remote loopback test completed successfully. |
| 66 | 6680XX | | Remote loopback test failed. |

| Table 3-8 (Page 3 of 3). CE Test Description | | | |
|---|---|---|---|
| **Test Number (Field C)** | **SRC (Field A)** | **Test Level (Field B)** | **Description** |
| 67 | 670000 | | Dedicated test 67 (continuous control line activate) is in progress. |
| 67 | 670007 | | Continuous control line activate test complete. |
| 68 | 680000 | | Dedicated test 68 (continuous control line deactivate) is in progress. |
| 68 | 680007 | | Continuous control line deactivate test complete. |
| 69 | 690000 | | Dedicated test 69 (line speed) is in progress. This test measures the line speed and displays that value in field B. |
| 69 | 690007 | | Line speed test complete. |
| 69 | 690036 | | No clock signal is being received from the local DCE. |
| 6A | 6A000A | | Dedicated test 6A (continuous transmit) is in progress (Model 01 only). During this test, the 5394 transmits test data contained in field E. You can enter any character from 0000 to FFFF in this field. A test field of 7E7E7E causes the 5394 to transmit SDLC flags continuously. |
| 6A | 6A0007 | | Continuous transmit test complete. |
| 6B | 6B0000 | | Dedicated test 6B (continuous receive data) is in progress (Model 01 only). During this test, the first three bytes of each data block received from the host system are displayed in field E. |
| 6B | 6B0007 | | Continuous receive data test complete. |
| 6F | | | Press the Enter key to access Concurrent mode screens. |

**Notes:**

1. The XX in the SRCs identify specific failure conditions. See "Cable Wrap SRCs" on page 3-58 for definitions of SRCs associated with cable wrap tests. See "Dedicated Diagnostic SRCs" on page 3-124 for a complete listing of Dedicated mode SRCs.
2. After completing a cable wrap test, make sure that you connect the communication cable back to the modem or DCE and return all switches to the Oper position.

## Communication Wrap Tests

The 5394 supports four different wrap tests: wrap levels 1, 3, 4, and 6. During a wrap test, the communication interface hardware outputs a test signal to the transmit circuitry, and that signal is looped back to the receive circuitry. When a communication failure occurs, you can use these tests to isolate failures to either the 5394 or to external equipment. Figure 3-37 shows the general extent of wrap levels 3, 4, and 6. Wrap level 1 is an internal test of the control unit.

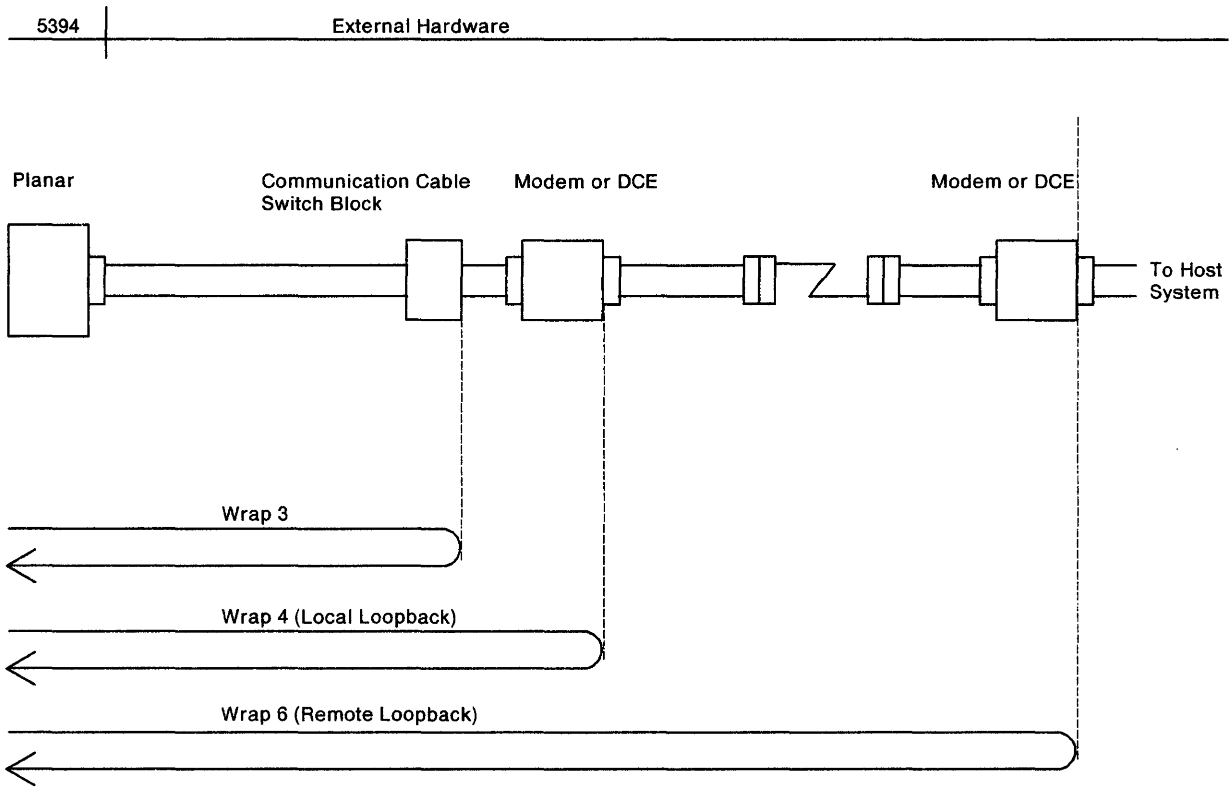



Figure 3-37. Communication Wrap Tests

**Wrap Level 1:** This test checks the internal logic of the communication adapter on the planar up to (but not including) the interface drivers and receivers. This test runs automatically as part of the power-on sequence.

**Wrap Level 3:** Dedicated mode test 63 selects wrap level 3. Wrap level 3 tests the 5394 communication interface and most of the external communication cable. The signal loopback is controlled by the Test/Oper switch at the DCE end of the communication cable.

**Notes:**

1. If you are testing a 5394 with an X.21 interface, the 5394 must receive clock signals from a DCE to run this test.
2. If you are testing a 5394 with an EIA 232D interface, you can use a wrap plug to aid in isolating a failure.
3. If an EIA 232D cable has two Test/Oper switches, both must be in the Test position before you start this test.
4. If you are testing a 5394 with a V.35 interface, the communication cable must be disconnected from the modem or DCE. In addition, you must run the wrap test in two phases as indicated in Table 3-8 on page 3-54.

**Wrap Level 4:** Dedicated mode test 64 selects wrap level 4. Wrap level 4 tests all of the external communication cable and part of the attached modem or DCE. You can run wrap level 4 with the IBM 3863, 3864, 3874, or 3875 modem. You can also run wrap level 4 with modems or DCEs that comply with CCITT Recommendations V.54 and V.24/V.28 (1980 version), or modems or DCEs with the same wrap functions.

Some non-IBM modems or DCEs may go into wrap mode under control of the 'test control' line. Other modems may have operator switches that select Wrap Test mode, and some may not support any of the wrap tests.

**Wrap Level 6:** Dedicated mode test 66 selects wrap level 6. During wrap level 6, the 5394 outputs a test signal to the attached modem or DCE, which encodes the signal for transmission through the communication network. The modem or DCE attached to the host system receives the test signal from the network and loops it back to its transmit lines. As a result, wrap level 6 provides a complete functional test of the communication link with the host system.

**Notes:**

1. During wrap level 6, the test signal must be decoded, encoded again, and transmitted at the normal transmit level by the modem or DCE attached to the host system. If this is not done, the signal returned may be distorted by transmission in both directions.
2. You can only run this test when the 5394 is attached to a point-to-point duplex communication line.
3. You cannot run this test on 5394 Model 02. In addition, neither X.21 nor X.25 networks support this test. To run one of the wrap tests, select test 61, 63, 64 or 66 and respond to the prompts as described in Table 3-9 on page 3-64. When you run a cable wrap test, see "Cable Wrap SRCs" for detailed information about signal lines and SRCs. See "Dedicated Diagnostic SRCs" on page 3-124 for a complete listing of Dedicated mode SRCs.

## Cable Wrap SRCs

The 5394 generates different SRCs for the EIA 232D, V.35, and X.21 interfaces. If a failure occurs while you are running a cable wrap test, use the table of SRCs and signal lines for the interface you are testing to identify the failing signal lines:

- EIA 232D - Figure 3-38 on page 3-59
- V.35 - Figure 3-39 on page 3-60
- X.21 - Figure 3-40 on page 3-61.

| SRC 638Cxx | | | Connector | | Wrap 3 Path | Line Type[1] |
|---|---|---|---|---|---|---|
| Open | Short | Signal Line | 5394 | DCE | | |
| 49 | 49 | TD | 2 | 2 | | X |
| 03 | 49 | RD | 3 | 3 | | R |
| | | CI[3] | 22 | 22 | | R |
| | | Local Loopback[3] | 18 | 18 | | X |
| 43 | 43 | DCD | 8 | 8 | | R |
| 43 | 43 | RTS | 4 | 4 | | X |
| 45 | 43 | RFS | 5 | 5 | | R |
| 47 | 47 | DTR/CDSTL | 20 | 20 | | X |
| 47 | 47 | DSR | 6 | 6 | | R |
| | | DSRS | 23 | 23 | | X |
| 49 | 49 | TSET | 15 | 15 | | R |
| 4B | 49 | RSET | 17 | 17 | | R |
| | | ID 0[2] (+5 VDC) | 14 | | | Logic |
| | | ID 1[2] (0 VDC) | 16 | | | Logic |

[1] X= transmit and R = receive.

[2] Pins 14 and 16 and ground are connected together in the wrap plug.

[3] Pins 18 and 22 are connected only in the wrap plug.

Figure 3-38. Table of SRCs and Signal Lines for the EIA 232D Interface

| SRC | Failing Signal Line | Connector Pin 5394 | Connector Pin DCE | Wrap Path | Cable Switch | Line Type |
|---|---|---|---|---|---|---|
| 6X8D40 | RLSD (DCD) | 8 | F | ← | SW 1 | Single-Ended Interchange |
| 6X8D47[1] | RTS | 4 | C | → | | |
| 6X8D41 | CTS (RFS) | 5 | D | ← | | |
| 6X8D42 | DTR | 20 | H | → | | |
| 6X8D42 | DSR | 6 | E | ← | | |
| 6X8E4F[1] | TDA | 10 | P | → | SW 3 | Differential |
| 6X8E48 | RDA | 12 | R | ← | | |
| 6X8E49 | RSETA | 25 | V | ← | | |
| 6X8E4A | TSETA | 21 | Y | ← | | |
| 6X8F4F[1] | TDB | 9 | S | → | SW 2 | Differential |
| 6X8F48 | RDB | 13 | T | ← | | |
| 6X8F49 | RSETB | 24 | X | ← | | |
| 6X8F4A | TSETB | 19 | a or AA | ← | | |
| – | Signal GND | 7 | B | | No Wrap Path | Common |
| – | Shield | Shell | A | | | |
| – | ID0 (0 VDC) | 14 | – | | | Logic |
| – | ID1 (+5 VDC) | 16 | – | | | |

**Notes:**

1. All receivers wrapped to this driver failed. A failing driver or one or more signals shorted to ground may cause this failure.
2. Pin a on the DCE connector is labeled AA on the DCE connector for France and Switzerland.
3. The 'X' in the SRCs may be either a 1 or a 3, depending on which test was run.

Figure 3-39. Table of SRCs and Signal Lines for the V.35 Interface

| SRC | | | | | | |
|---|---|---|---|---|---|---|
| 6389xx | | | Cable Wrap Path | Connector Pin | | |
| Open | Short | Signal | | DTE | DCE | Line Type[1] |
| 16 | 17 | Control A | | 11 | 3 | X |
| 16 | 16 | Control B | | 23 | 10 | X |
| 78 | 78 | Receive A | | 13 | 4 | R |
| 78 | xx[2] | Receive B | | 12 | 11 | R |
| 78 | 78 | Xmit A | | 9 | 2 | X |
| xx[2] | xx[2] | Xmit B | | 10 | 9 | X |
| 78 | 78 | SET A | | 15 | 6 | R |
| 16 | 78 | SET B | | 22 | 13 | R |
| 16 | 17 | Indicate A | | 17 | 5 | R |
| 16 | 17 | Indicate B | | 3 | 12 | R |
| | | ID 0 (0 VDC) | | 14 | NC | Logic |
| | | ID 1 (0 VDC) | | 16 | NC | Logic |
| | | Ground | | 7 | | Common |

[1] X = transmit and R = receive.

[2] No indication or intermittent indication.

Figure 3-40. Table of SRCs and Signal Lines for the X.21 Interface

## Concurrent Mode Screens

The Concurrent mode formats the contents of 5394 data registers for presentation at an attached display station. You can use any display station for this purpose except an IBM PC or Personal System/2 with AS/400 PC Support or an IBM Personal System/55 using 5250 PC/2 AD Support. When you start the Concurrent mode correctly, customer applications will continue to operate normally at every work station except the one you are using.

**Note:** You can also observe Concurrent mode screens while running Dedicated mode tests by selecting test 6F. Although the same information appears on the display station screen, no customer applications can run concurrently.

Lines 1 through 5 and line 24 of each Concurrent mode screen contain the same information. The contents of these fields are defined in "Common Data Fields" on page 3-63. The contents and format of data in lines 7 through 23 vary, depending on which screen you select.

Screen C1 displays the contents of the twinaxial interface error counters, error log buffer, and hard error (HE) log.

Screen C2 displays the contents of the communication and statistical counters, permanent link error (PLE) log, communication state byte, and SNA state byte.

Screen C3 displays 128 consecutive bytes of data from the 5394 memory. You can select any starting address from 00000 to FFFFF.

Screen C4 displays the contents of the 5394 trace buffer.

Screen C5 displays the customer setup data for all possible work station addresses. In addition, the screen presents the vital products data for each work station that is powered on and responding to polls from the 5394.

Screen C6 displays a formatted task control block (TCB).

Screen C7 identifies all microcode changes that currently reside in the 5394 DRAM (Release 2 only).

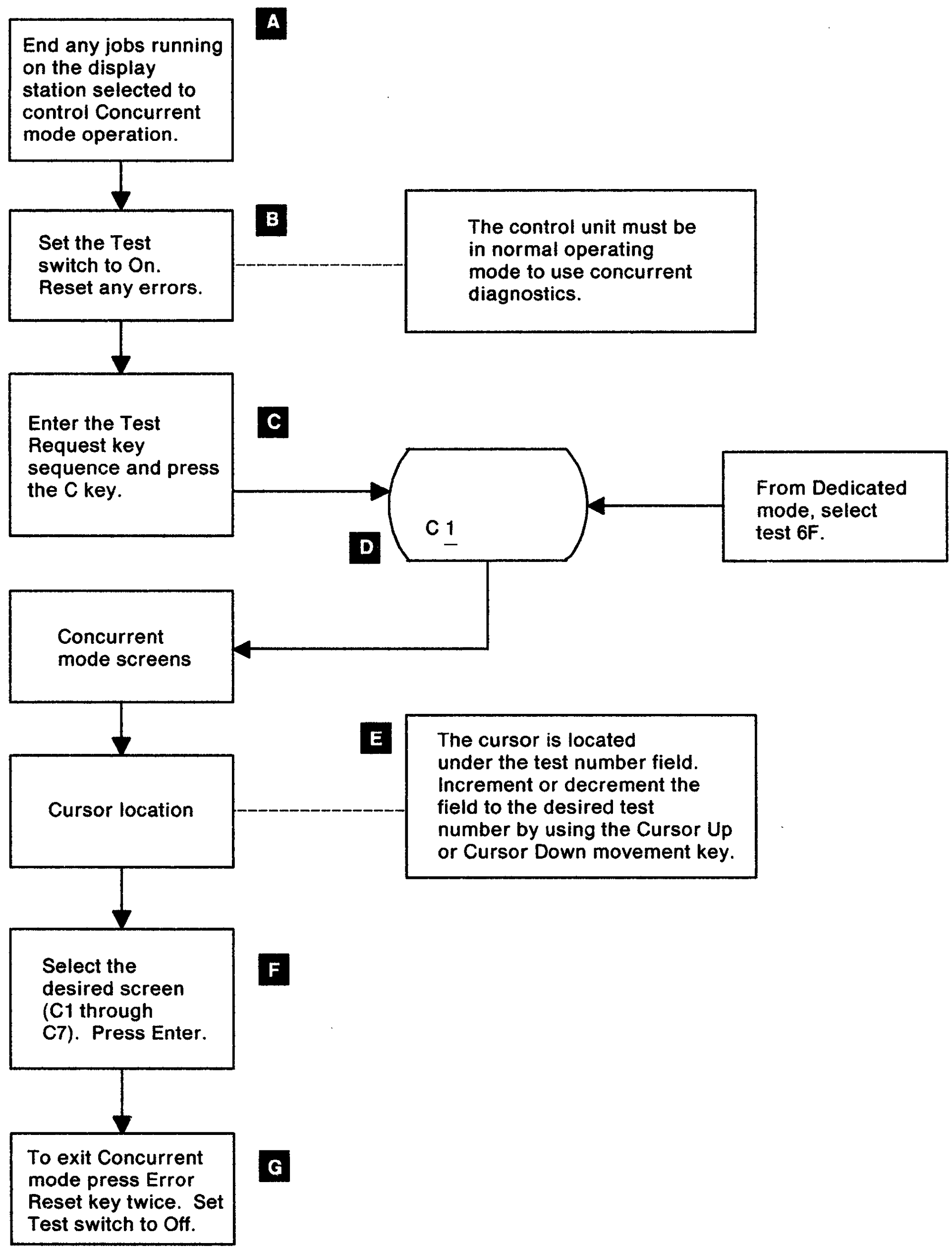



Figure 3-41. Concurrent Mode Flowchart

Do the following to start Concurrent mode operation:

**Warning:** It is important to enter the Concurrent mode correctly, as described in the following procedure. If not, *all sessions can be destroyed.*

**A** Select an attached display station (not an IBM PC or Personal System/2 with AS/400 PC Support or an IBM Personal System/55 using 5250 PC/2 AD Support), end any job in progress, and log off the display station.

**B** At the control unit, set the Test switch to On.

**C** At the display station, enter the Test Request key sequence (see "Key Sequences" on page 3-40). Press the C key.

**D** A diagnostic display screen appears containing a test number in the lower left-hand corner of the display.

**E** The cursor is located under the test number field. Change the number to the desired test number by using the Cursor Up or Cursor Down key.

**F** Press the Enter key to display the C1 screen.

The status information on the screen is updated each time you press the Enter key.

Repeat steps **E** and **F** to select another display screen.

**G** Restart the session by pressing the Error Reset key twice. Set the display station power switch to off. Wait 30 seconds, then set display station power switch to on. If the control unit is online, a sign-on screen should appear within a few seconds.

## Common Data Fields

Display lines 1 through 5 and line 24 of each Concurrent mode screen contain the same data fields. However, there are some differences in the contents of the common data fields depending on the release level of the system diskette. Figure 3-42 on page 3-64 shows the format of these fields for both release levels.

Release 1 Format:

```
A  AAAA  B  CC  DD  EE  0000 0000  0000 0000

   F.F  G.G  HH  J  KK
B  LL  MM MM MM MM MM MM MM MM MM MM MM MM MM MM MM
       -------------------------------------------------------


C  CX
```

Release 2 Format:

```
A  AAAA  B  CC  DD  EE  0000 0000  0000 0000

   F.F  G.G  HHHH  II  J  KK
B  LL  MM MM MM MM MM MM MM MM MM MM MM MM MM MM MM
       -------------------------------------------------------


C  CX                                                D  P P
```

Figure 3-42. Data Fields Supplied on all Concurrent Mode Screens

### A Communication Parameters

The contents of this line depends on the communication mode used.

The contents of each field in all communication modes are defined as follows:

- Field AAAA is the storage size.
- Field B is the number of ports and is always set to 3.
- Field CC is the communication mode and is one of the following:

  00 = SDLC
  01 = X.25
  02 = X.21 switched.

- Field DD is the operating mode

  00 = 5394
  01 = 5294 emulation

- Field EE is the station address.

The fields shown as all zeros in Figure 3-42 are the configuration fields. These fields are different for each communication mode.

The definition of each bit or subfield is shown in the table for the communication mode you are using.

- SDLC - see Table 3-9
- X.25 - see Table 3-10 on page 3-65
- X.21 switched - see Table 3-11 on page 3-66.

**Note:** Both X.21 nonswitched and V.35 networks use SDLC communication protocols. X.21 switched uses SDLC protocols after the communication link is established.

Table 3-9 (Page 1 of 2). Communication Configuration (SDLC)

| Position(s) | Function |
|---|---|
| **Release 1 Field Definitions** | |
| 1 | 0 = Nonswitched<br>1 = Switched |
| 2 | 0 = Half-duplex<br>1 = Duplex |
| 3 | 0 = Multipoint<br>1 = Point-to-point |
| 4 | 0 = NRZI<br>1 = NRZ |

Table 3-9 (Page 2 of 2). Communication Configuration (SDLC)

| Position(s) | Function |
|---|---|
| 5 | 0 = DTR<br>1 = CDSTL |
| 6-7 | Reserved |
| 8 | 1 = Send pad |
| 9-13 | Reserved |
| 14 | 1 = Local loopback supported |
| 15-16 | Reserved |
| **Release 2 Field Definitions** | |
| 1 | 0 = Nonswitched<br>1 = Switched, manual-dial<br>2 = Switched, V.25 bis auto-dial |
| 2 | 0 = Half-duplex<br>1 = Duplex |
| 3 | 0 = Multipoint<br>1 = Point-to-point |
| 4 | 0 = NRZI<br>1 = NRZ |
| 5 | 0 = DTR<br>1 = CDSTL |
| 6 | 1 = Send pad |
| 7 | 1 = Local loopback supported |
| 8-9 | V.25 bis call connected time-out (01-FF) |
| 10 | 1 = Save V.25 bis call information |

Table 3-10 (Page 1 of 2). Communication Configuration (X.25)

| Position(s) | Function |
|---|---|
| **Release 1 Field Definitions** | |
| 1 | 0 = Modulo 8<br>1 = Modulo 128 |
| 2-5 | Packet window size<br>0010 through 0111 for modulo 8.<br>0010 through 1111 for modulo 128. |
| 6-8 | Link window size (001-111) |
| 9-10 | Packet size in bytes<br>00 = 64<br>01 = 128<br>10 = 256<br>11 = Reserved |
| 11 | Virtual circuit type<br>0 = SVC or SVC and PVC<br>1 = PVC only |
| 12 | 1 = Flow control permitted |
| 13 | 1 = Manual options permitted |
| 14 | 1 = Local loopback supported |
| 15-16 | Reserved |
| 17 | 1 = Accept reverse charge |

Table 3-10 (Page 1 of 2). Communication Configuration (X.25)

| Position(s) | Function |
|---|---|
| 18-19 | LLC selection<br>00 = PSH<br>01 = QLLC<br>10 = ELLC<br>11 = Reserved |
| 20 | 1 = Attached to Telenet type, such as UK Switch Stream I |
| 21 | Link initiation<br>0 = Link initiated by 5394 or network<br>1 = Link initiated by network only |
| 22 | 0 = 1984 subscription<br>1 = 1980 subscription |
| 23-30 | Reserved |
| 31-32 | Diagnostic codes<br>00 = 1984 SNA<br>01 = 1984 ISO<br>10 = 1980 SNA |
| 33-34 | Retry counter (00-FF) |
| 35-36 | Retry interval (01-3C) |
| **Release 2 Field Definitions** | |
| 1 | 0 = Modulo 8<br>1 = Modulo 128 |
| 2 | Packet window size<br>2-7 for modulo 8.<br>2-F for modulo 128. |
| 3 | Link window size (1-7) |
| 4 | Packet size in bytes<br>0 = 64<br>1 = 128<br>2 = 256<br>3 = 512 |
| 5 | Virtual circuit type<br>0 = Multiple PVCs, multiple SVCs, or SVC call allowed<br>1 = Single PVC<br>2 = Single SVC answer only |
| 6 | 1 = Flow control permitted |
| 7 | 1 = Manual options permitted |
| 8 | 1 = Local loopback supported |
| 9 | 1 = Accept reverse charge |
| 10-11 | LLC selection<br>00 = PSH<br>01 = QLLC<br>10 = ELLC<br>11 = Reserved |
| 12 | 1 = Attached to UK Switch Stream or Telenet network |
| 13 | Link initiation<br>0 = Link initiated by 5394 or network<br>1 = Link initiated by network only |
| 14 | 0 = 1984 subscription<br>1 = 1980 subscription |

| Table 3-10 (Page 2 of 2). Communication Configuration (X.25) | |
|---|---|
| **Position(s)** | **Function** |
| 15 | Diagnostic codes<br>0 = 1984 SNA<br>1 = 1984 ISO<br>2 = 1980 SNA |
| 16-17 | Retry counter (00-FF) |
| 18-19 | Retry interval (00-1C) |

| Table 3-11. Communication Configuration (X.21) | |
|---|---|
| **Position(s)** | **Function** |
| **Release 1 Field Definitions** | |
| 1-4 | Reserved |
| 5-8 | Recall delay time (0001-1111) |
| 9-11 | Reserved |
| 12 | Short hold mode direct call support |
| 13-16 | Reserved |
| 17-18 | Short hold mode recall counter (00-FF) |
| 19-34 | Call progress signals |
| **Release 2 Field Definitions** | |
| 1-2 | Recall counter (00-FF) |
| 3 | Recall delay time (1-F) |
| 4 | 1 = Short hold mode direct call support |
| 5-20 | Call progress signals |

For further configuration information, see *IBM 5394 Remote Control Unit User's Guide.*

**B** **Control Unit Specifications** (Release 1)

These two lines contain specifications for the hardware and software included with the control unit. The contents of each field on these lines are defined as follows:

- Field F.F is the ROS ID.
  1.0 = Release 1
  1.1 = V.35 support
- Field G.G is the system diskette ID.
  1.0 = Release 1
  1.1 = V.35 support
- Field H H is the microcode change ID.
- Field J is the model number of this control unit.
  1 = model 01
  2 = model 02
- Field KK is the cable ID.
  00 = X.21
  10 = EIA 232D
  01 = V.35
  11 = No cable attached
- Field LL is the microcode feature.
  00 = Support for four work stations
  01 = Support for 16 work stations

**B** **Control Unit Specifications** (Release 2)

These two lines contain specifications for the hardware and software included with the control unit. The contents of each field on these lines are defined as follows:

- Field F.F is the ROS ID.
  1.0 = Release 1.0
  1.1 = V.35 support
- Field G.G is the system diskette ID.
  1.0 = Release 1.0
  1.1 = Release 1.1
  2.0 = Release 2.0
- Field HHHH is the microcode change ID.
  0100 = Release 1.0
  0110 = Release 1.1
  0200 = Release 2.0
- Field II is the EC data level.
- Field J is the model number of this control unit.
  1 = model 01
  2 = model 02
- Field KK is the cable ID.
  00 = X.21
  01 = V.35
  10 = EIA 232D
  11 = No cable attached
- Field LL is the microcode feature.
  00 = Support for four work stations
  01 = Support for 16 work stations

The fields identified by MM are the microcode feature bytes. These bytes are defined in Table 3-12.

| Table 3-12. Microcode Feature Bytes | |
|---|---|
| **Byte(s)** | **Meaning** |
| 1 | Maximum number of work stations in Hex (04 or 10) |
| 2-15 | Reserved |

**C** **Screen Selection Field**

This field allows you to select which Concurrent mode screen the 5394 displays. When you first enter the Concurrent mode, screen C1 appears on the display station with the cursor positioned below the second character of this field. To select a different screen, use the Cursor Up or Cursor Down key to change the screen number and then press the Enter key. If you do not change the value of the screen selection field, the 5394 updates all fields in the current screen each time you press the Enter key.

**D** **Printer Selection Field (Release 2 only)**

This field contains the port (0 - 2) and station (0 - 6) address of the printer selected for the copy to printer function. The default value of this field is determined by the value selected for the P field during CSU. If no printer was selected at that time, '_ _' appears on the screen. In either case, you can use the Cursor Up or Cursor Down key to change the printer address contained in this field. However, if you press the Print key with no printer selected, the 5394 uses the first printer it finds to print out the contents of the Concurrent mode screen currently being displayed.

## C1 Screen

The C1 screen displays the contents of the error log buffer, the hard error (HE) log, and the twinaxial interface error counters. See Figure 3-43.

```
    AAAA  B  CC  DD  EE  0000 0000  0000 0000

    F.F  G.G  HHHH  II  J  KK
    LL  MM MM MM MM MM MM MM MM MM MM MM MM MM MM MM
    ----------------------------------------------------------------

A   LL EEEE SSSSSSSSSS  LL EEEE SSSSSSSSSS  LL EEEE SSSSSSSSSS
    LL EEEE SSSSSSSSSS
    ----------------------------------------------------------------
    LL EEEE SSSSSSSSSS  LL EEEE SSSSSSSSSS  LL EEEE SSSSSSSSSS
    LL EEEE SSSSSSSSSS  LL EEEE SSSSSSSSSS  LL EEEE SSSSSSSSSS
    LL EEEE SSSSSSSSSS  LL EEEE SSSSSSSSSS  LL EEEE SSSSSSSSSS
    LL EEEE SSSSSSSSSS  LL EEEE SSSSSSSSSS  LL EEEE SSSSSSSSSS
B   LL EEEE SSSSSSSSSS  LL EEEE SSSSSSSSSS  LL EEEE SSSSSSSSSS
    LL EEEE SSSSSSSSSS  LL EEEE SSSSSSSSSS  LL EEEE SSSSSSSSSS
    LL EEEE SSSSSSSSSS  LL EEEE SSSSSSSSSS  LL EEEE SSSSSSSSSS
    LL EEEE SSSSSSSSSS  LL EEEE SSSSSSSSSS  LL EEEE SSSSSSSSSS
    LL EEEE SSSSSSSSSS  LL EEEE SSSSSSSSSS  LL EEEE SSSSSSSSSS

C   AAAAAA  AAAAAA  AAAAAA  AAAAAA AAAAAA

D   BBBB  BBBB  BBBB   CCCC  CCCC  CCCC


   C1                                                          1 5
```

Figure 3-43. C1 Screen

**A** **B** **Error Log Buffer**

The error log buffer section of the C1 screen lists all errors currently stored in the control unit error log buffer. The oldest entry is the first entry in the first column. The error log buffer section is divided into two blocks by a dashed line. All entries above the dashed line ( **A** ) have been sent to the host system. The entries below the dashed line ( **B** ) have not been sent to the host system.

Each entry consists of three fields, described as follows:

- Field LL is a 1-byte logical session ID that indicates the session in which the error was detected.
- Field EEEE is a 2-byte SRC.
- Field SSSSSSSSSS is the sense byte field. The number of sense bytes displayed in this field depends on the SRC.

**C** **Hard Error Log**

This section of the C1 screen displays the contents of the control unit hard error (HE) log. The first entry on the left is the oldest entry.

**D** **Twinaxial Interface Error Counters**

This section of the C1 screen displays the contents of two different sets of error counters. The fields indicated by BBBB contain the transmit activity check (TAC) counters. The fields indicated by CCCC contain the parity-timeout counters. Separate counters are displayed for each port as follows:

```
 Port 0    Port 1    Port 2

0 0 0 0   0 0 0 0   0 0 0 0
```

The first byte (hex) of these 2-byte fields is the low-order byte and the second byte is the high-order byte.

**Note:** Some versions of the 5394 do not detect TAC errors caused by external cable faults. All versions of the 5394 detect failure of internal drivers and receivers.

## C2 Screen

The C2 screen displays the communication and statistical counters, the permanent link error log, and the communication interface status. The C2 screen is shown in Figure 3-44.

**Note:** The character "X" is used in fields **C**, **D**, and **E** to indicate arbitrary values that may change each time you display this screen. All other values in these fields indicate the current logic state of the displayed signals.

```
     AAAA  B  CC  DD  EE  0000 0000  0000 0000

     F.F  G.G  HHHH  II  J  KK
     LL  MM MM MM MM MM MM MM MM MM MM MM MM MM MM MM
     -----------------------------------------------------------

 A   AA AA AA AA AA AA AA AA AA AA AA AA AA AA  BBBBBBBB BBBBBBBB

     LL EEEE SSSSSSSSSS   LL EEEE SSSSSSSSSS   LL EEEE SSSSSSSSSS
 B   LL EEEE SSSSSSSSSS   LL EEEE SSSSSSSSSS   LL EEEE SSSSSSSSSS
     LL EEEE SSSSSSSSSS   LL EEEE SSSSSSSSSS   LL EEEE SSSSSSSSSS

     1111 0XX0    1X11 11XX    X1XX 1111  X111 10XX

        C             D                  E



C2                                                          1 5
```

Figure 3-44. C2 Screen

## A Communication and Statistical Counters

This section of the C2 screen displays the contents of communication and statistical counters. The counters identified by AA are 1-byte communication counters (60 through 6D). The counters identified by BBBBBBBB are 4-byte statistical counters (6E and 6F). See "Communication Error Counters (60 through 6D)" on page 3-84 and "Statistical Counters (6E and 6F)" on page 3-84 for more information on these counters. See Table 3-24 on page 3-98 for definitions of these codes.

## B Permanent Link Error (PLE) Log

This section of the C2 screen displays the permanent link error (PLE) log. The entries in this error log have the same format as the error log buffer entries on the C1 screen.

## C Communication State Bytes

The function of each bit in this field is shown in Table 3-13 for SDLC, Table 3-14 for X.25, and Table 3-15 for X.21 Switched.

Table 3-13. State Byte for SDLC

| Bit | Function |
|---|---|
| 0 | 1 = Address compared |
| 1 | 1 = CRC good |
| 2 | 1 = XID frame received |
| 3 | 1 = SNRM received |
| 4 | 0 = NDM entered<br>1 = NRM entered |
| 5-6 | Reserved |
| 7 | 0 = NDM is actual state<br>1 = NRM is actual state |

**Note:** This byte is reset when a correct address is received while in Disconnect mode.

Table 3-14. State Byte for X.25

| Bit | Function |
|---|---|
| 0 | 1 = Address compared |
| 1 | 1 = CRC good |
| 2 | 1 = Link activated (UA received for SABM sent) |
| 3 | 1 = Packet level restarted (restart confirmation was received for restart request sent) |
| 4 | 1 = Data transfer entered |
| 5-6 | Reserved |
| 7 | Reserved (Release 1)<br>1 = LLC information transfer entered (Release 2) |

**Note:** This byte is reset when a correct address is received while in Disconnect mode.

Table 3-15. State Byte for X.21 Switched

| Bit | Function |
|---|---|
| 0 | 1 = Call sequence started |
| 1 | 1 = Ready for data state entered (State 12; SDLC mode) |
| 2 | 1 = Address compared |
| 3 | 1 = CRC good |
| 4 | 1 = XID frame received |
| 5 | 1 = SNRM received |
| 6 | 1 = NRM entered |
| 7 | 0 = NDM is actual state<br>1 = NRM is actual state |

**Note:** Bits 1 through 6 are reset when a call is initiated (whether incoming or outgoing).

## D SNA State Byte

The function of each bit in this field is shown in Table 3-16.

Table 3-16. SNA State Byte

| Bit | Function |
|---|---|
| 0 | 1 = ACTLU received |
| 1 | Reserved |
| 2 | 1 = SNA BIND complete |
| 3 | 1 = EC load complete |
| 4 | 1 = EC load in progress |
| 5 | 1 = EC load LU state flag |
| 6-7 | Reserved |

## E Communication Interface Register

The data contained in the communication interface register depends on the physical interface used. The bit definitions for an EIA 232D interface are shown in Table 3-17. The bit definitions for an X.21 interface are shown in Table 3-18.

Table 3-17. Communication Interface Register for Model 01

| Bit | Function |
|---|---|
| 0 | RD |
| 1 | Reserved |
| 2 | RSET |
| 3 | TSET |
| 4 | DSR |
| 5 | RFS |
| 6 | CD |
| 7 | CI |
| 8 | TD |
| 9 | DTR/CDSTL |
| 10 | RTS |
| 11 | Local loopback |
| 12-15 | Reserved |

Table 3-18. Communication Interface Register for Model 02

| Bit | Function |
|---|---|
| 0 | Receive data |
| 1 | Reserved |
| 2 | Network clock |
| 3 | Network clock |
| 4 | Reserved |
| 5 | Reserved |
| 6 | Indicate |
| 7 | Transmit wait for network ready |
| 8 | Transmitted data |
| 9 | Reserved |
| 10 | Control |
| 11 | Reserved |
| 12 | DCE not ready |
| 13 | Reserved |
| 14 | Wait for proceed to select |
| 15 | Diagnostic indicate |

## C3 Screen

The C3 screen displays 128 bytes of data from DRAM. The C3 screen is shown in Figure 3-45. The display of data begins with the memory address entered in field **D**. The screen consists of an address field (**A**) followed by data displayed in hexadecimal code (**B**) and EBCDIC (**C**). You can scroll the display to the next 128 bytes by moving the cursor to the underscore (_) at field **E** and pressing the Cursor Up or the Cursor Down key.

```
AAAA  B  CC  DD  EE  0000 0000  0000 0000

F.F  G.G  HHHH  II  J  KK
LL  MM MM MM MM MM MM MM MM MM MM MM MM MM MM MM
---------------------------------------------------------------------

     A                                    B                           C
     EEEEE      00000000  00000000  00000000  00000000  ...  .........
     DDDDD      00000000  00000000  00000000  00000000  ...  .........
     DDDDD      00000000  00000000  00000000  00000000  ...  .........
     DDDDD      00000000  00000000  00000000  00000000  ...  .........
     DDDDD      00000000  00000000  00000000  00000000  ...  .........
     DDDDD      00000000  00000000  00000000  00000000  ...  .........
     DDDDD      00000000  00000000  00000000  00000000  ...  .........
     DDDDD      00000000  00000000  00000000  00000000  ...  .........




        D
C3   E EEEE _E                                                      1 5
```

Figure 3-45. C3 Screen

## C4 Screen

The C4 screen permits you to examine data flows inside the control unit. These flows are tagged by trace entries and pointers stored in a trace buffer. You can trace the following types of data:

- Task Control Blocks (TCB). TCB entries control data flows through internal buses of the control unit.
- Communication Control Blocks. These blocks govern data flows to or from the host system.
- Input/Output Blocks (IOB). IOBs contain data associated either with a TCB or a communication control block.
- Special Conditions Block. Special conditions blocks are constructed by the system microcode to trace various aspects of internal operation.

The specific format of a C4 screen depends upon the particular type of trace data being displayed. Detailed instructions for selecting a particular type of trace test will be supplied by your support structure as needed during problem isolation. The C4 screen shown in Figure 3-46 on page 3-72 is an unformatted TCB trace display.

```
AAAA  B  CC  DD  EE  0000 0000  0000 0000

F.F  G.G  HHHH  II  J  KK
LL  MM MM MM MM MM MM MM MM MM MM MM MM MM MM MM
------------------------------------------------------------
A --NNNN--TT  LLLL
B  0000       00000000  00000000  00000000  00000000  ...  .........
   0010       00000000  00000000  00000000  00000000  ...  .........
   0020       00000000  00000000                      ...

C  0000       00000000  00000000  00000000  00000000  ...  .........
   0010       00000000  00000000  00000000  00000000  ...  .........

C4  0 - 2  1 1 1  0 0000 0 0000000000  0 1 1 0 0 0 0 0 0 0 0 0 0 00 00 1 5
                           D
```

Figure 3-46. C4 Screen

### A Trace Type ID

The first line of a trace entry indicates the type of trace being done as follows:

- Field NNNN is a 2-byte code for an entry number associated with the current trace entry. The oldest entry is X'0001'.
- Field TT is a 1-byte code for a trace entry type:

  00 = TCB trace entry
  01 = special conditions trace entry
  02 = transmit communication trace entry
  03 = receive communication trace entry.

- Field LLLL is a 2-byte code for the length of the trace entry in bytes.

### B Trace Entry

The specific trace entry displays as the second field in an unformatted trace screen. The location and size of this field depends on the type of trace being displayed:

- A TCB entry supplies the following information:
  - A 32-byte block of data
  - A 2-byte return code sent to the task dispatcher
  - A 2-byte time code that indicates when the TCB assumed control over the bus
  - A 2-byte time code that indicates when the TCB returned control to the task dispatcher
  - A 2-byte absolute address assigned to the TCB.
- A special conditions trace entry consists of a 2-byte field that is presented immediately following the trace entry size.
- A communication trace entry consists of a 16-byte block of data presented on the line below the trace entry header.

### C IOB

If test C4 is used to display either a TCB or a communication trace, the trace buffer may contain one or more IOBs. When present, this data displays in a block below the trace entry.

### D Trace Control Switches

Flags that control operation of test C4 are listed on line 24 of the display. These flags are defined in Table 3-19 on page 3-73.

| Table 3-19. Trace Control Switches | |
|---|---|
| **Position** | **Function** |
| 1 | Master switch<br>0 = Disable tracing<br>1 = Enable tracing |
| 2 | Dummy field for scrolling entries |
| 3 | TCB trace switch<br>0 = Do not trace TCBs or their IOBs<br>1 = Trace TCBs<br>2 = Trace TCBs and their IOBs |
| 4 | 1 = Trace communication and special entries |
| 5 | 1 = Enable breakpoint on data match |
| 6 | Trace Wrap Switch<br>0 = Wrap trace data when area full<br>1 = Do not wrap trace data |
| 7 | Trace entry type for breakpoint (0-3) |
| 8-11 | Breakpoint data offset within entry |
| 12 | Breakpoint data length (0-5) |
| 13-22 | Breakpoint data string (hex) |
| 23 | 1 = Trace SDLCID |
| 24 | 1 = Trace SNAID |
| 25 | 1 = Trace DSMID |
| 26 | 1 = Trace WSMID |
| 27 | 1 = Trace CSUID |
| 28 | 1 = Trace RASLID |
| 29 | 1 = Trace AUTOID |
| 30 | 1 = Trace X25ID |
| 31 | 1 = Trace DISKID |
| 32 | 1 = Trace LINKWID |
| 33 | 1 = Trace COPYID |
| 34 | 1 = Trace ECLDID |
| 35 | 1 = Trace LCOPID |
| 36-39 | Reserved |
| **Notes:**<br>1. The dash (-) in field position 2 is not always displayed.<br>2. Positions 23 through 39 apply to Release 2 only. | |

**Note:** If the TCB trace switch and the communication/special trace switch (fields 3 and 4 on row 24) are both zero when the Enter key is pressed, then the master switch (field 1) is also set to zero.

## C5 Screen

The C5 screen displays the following data for every work station address on a selected twinaxial port:

- Current operating status
- Vital Product Data (VPD)
- Translate table information.

If the power at a work station is switched off, or if a communication failure prevents a work station from responding to commands from the 5394 while the C5 test is running, only the port address and the translate table data for that unit appears on the screen. The C5 screen is shown in Figure 3-47 on page 3-74 and Figure 3-48 on page 3-75.

```
AAAA  B  CC  DD  EE  0000 0000  0000 0000

F.F  G.G  HH  J  KK
LL  MM MM MM MM MM MM MM MM MM MM MM MM MM MM MM
-------------------------------------------------------------------
B
00    1000 0000    0000 0000  AAAA     BBBB          CC
      DD  EE  FF   0000 0000  GGGGGGGG HHHHHHHH      IIII JJJJ
01                                                   CC
                                                     IIII JJJJ
02                                                   CC
                                                     IIII JJJJ
03                                                   CC
      ___________ C ____________                     IIII JJJJ
04    1000 0000    0000 0000  AAAA     BBBB          CC
      DD  EE  FF   0000 0000  GGGGGGGG HHHHHHHH      IIII JJJJ
05                                                   CC
                                                     IIII JJJJ
06    1000 0000    0000 0000  AAAA     BBBB          CC
      DD  EE  FF   0000 0000  GGGGGGGG HHHHHHHH      IIII JJJJ
                        D


    A
C5  0
```

Figure 3-47. C5 Screen, Release 1 Format

```
AAAA  B  CC  DD  EE  0000 0000  0000 0000

F.F  G.G  HHHH  II  J  KK
LL  MM MM MM MM MM MM MM MM MM MM MM MM MM MM MM
-------------------------------------------------------------------
B
00     1000 0000     0000 0000   AAAA BBB KKKK KKKK     CC
       DD EE FF      0000 0000   GGGGGGGG HHHHHHHH      IIII JJJJ
01                                                      CC
                                                        IIII JJJJ
02                                                      CC
                                                        IIII JJJJ
03                                                      CC
       ____________C____________                        IIII JJJJ
04     1000 0000     0000 0000   AAAA BBB KKKK KKKK     CC
       DD EE FF      0000 0000   GGGGGGGG HHHHHHHH      IIII JJJJ
05                                                      CC
                                                        IIII JJJJ
06     1000 0000     0000 0000   AAAA BBB KKKK KKKK     CC
       DD EE FF      0000 0000   GGGGGGGG HHHHHHHH      IIII JJJJ
                           D


    A
C5  0                                                           1 5
```

Figure 3-48. C5 Screen, Release 2 Format

**A Port Select Field**

This field permits you to select a particular twinaxial port for display on screen. Valid entries for this field are 0, 1, and 2. Each time you change this value, the 5394 revises the screen to show the configuration of the selected port after you press the Enter key.

**B Address Field**

The first two columns of the C5 screen show each possible address for a selected port. The first digit of this address contains the port number contained in field A, and the second digit is the work station address. The screen presents a separate entry for each work station address from 0 to 6, whether or not any device is actually present.

**Translate Table Data**

Fields on the right side of the screen contain a keyboard code (CC), translate table offset (IIII), and translate table segment (JJJJ) for each port address. These codes are initially set to default values corresponding to US/Canada standard keyboards. As a result, this default translate table will be used for all attached display stations unless specifically changed during the CSU procedure. The current values for these three fields appear on screen for each possible port address without regard to the status of attached work stations.

**Device Identification Data**

When a work station is powered on and responding to polls, fields in the center of the screen present device identification data. There are either four or five distinct fields, depending on release level:

- Field C consists of a 1 followed by fifteen zeros. This field indicates that a work station is present and currently responding to polls.
- Field AAAA contains the type code for the device at the indicated port address.
- Field BBB(B) contains the model code for the device at the indicated port address.
- Field KKKK KKKK defines the characteristics of IBM 3476, IBM 3477, and newer display stations (Release 2 only).

- Field D contains vital product data for that device. Table 3-20 on page 3-76 provides specific definitions for each code contained in this field.

| Table 3-20. Vital Product Data | |
|---|---|
| **Position(s)** | **Function** |
| 1-2 | Device ID |
| 3-4 | Keyboard ID |
| 5-6 | Extend Keyboard ID |
| 7 | 1 = Device is an IWS |
| 8 | 1 = Supports pass-thru data stream |
| 9 | Reserved |
| 10 | 1 = Device has MSR feature |
| 11 | 1 = Device has SLP feature |
| 12-13 | Reserved |
| 14 | Device Type<br>0 = Display station<br>1 = Printer |
| 15-22 | Serial Number |
| 23-30 | Manufacturing ID |

## C6 Screen

The C6 screen shown in Figure 3-49 is a formatted display of TCB data. Field I is the address of the TCB selected for display. Areas A through E are offsets to the head and tail pointers for the following TCB queues:

- Active task queue pointers (A)
- Pending task queue pointers (B)
- Wait I/O task queue pointers (C)
- Timer task queue pointers (D)
- Free TCB queue pointers (E).

Area F is a display of the TCB formatted into fields. The same TCB is shown in hexadecimal at G and EBCDIC at H.

```
AAAA  B  CC  DD  EE  0000 0000  0000 0000

F.F  G.G  HHHH  II  J  KK
LL  MM MM MM MM MM MM MM MM MM MM MM MM MM MM MM
------------------------------------------------------------------
   AC80  AC80        0000  0000       AC60  AC40       ACA0...ACC0
      A                 B                C            D      E
------------------------------------------------------------------
        00          FC00          70

    FC00  7000          0000 1100 1111 1100          00

        70        00        FC        7000

F   FC00        7000  FC00        FC00:7000       0070

        00     FC         0000 0000 0111 0000


    00000     00FC0070  00FC0070  0CFC0070  00FC0070  ..............
G   00010     00FC0070  00FC0070  00FC0070  00FC0070  ..............  H


        I
C6   0 0000                                                      1 5
```

Figure 3-49. C6 Screen

## C7 Screen (5394 Release 2 only)

The C7 screen permits you to examine the microcode corrections contained in the 5394 RAM. These corrections are written into RAM from the system diskette during the power-on sequence or from the host system during session establishment. In general, each system update or revision includes changes to more than one portion of the microcode. As a result, corrections from a single update are grouped into a section and stored with common header data. When you use screen C7 to examine these data, the 5394 automatically displays the first correction in the first section as shown in Figure 3-50.

```
AAAA  B  CC  DD  EE  0000 0000  0000 0000

F.F  G.G  HHHH  II  J  KK
LL  MM MM MM MM MM MM MM MM MM MM MM MM MM MM MM
-----------------------------------------------------------------
06   A        B        C          D                  ___E___
07  0100      01      0056       0002               11/30/88
08    F        G        H
09  -0001-    0015      01
10     I    ________J_______                          ___K___
11    -01-    1001 0000  1000 0000                  11/20/88
12    L    M
13  7000:6E52
14  0042
15
16  00000000000000000000000000000000000000000...000000000000000000
17  00000000000000000000000000000000000000000...000000000000000000
18  00000000000000000000000000000000000000000...0000000000000000..
19
20  00000000000000000000000000000000000000000...000000000000000000
21  00000000000000000000000000000000000000000...000000000000000000
22  00000000000000000000000000000000000000000...0000000000000000..

 C7   S P                                                    1 5
```

Figure 3-50. C7 Screen

### Row Number

To facilitate identifying the information on the screen, the first two columns in each row of the data field contain the row number.

### Row 07

This row contains header data for the entire file of microcode corrections:

- Field **A** contains the EC level of the microcode loaded into RAM.
- Field **B** indicates the data level in RAM.
- Field **C** contains a hexadecimal count of the total number of bytes in the correction file.
- Field **D** contains a hexadecimal count of the sections in the correction file.
- Field **E** contains the date of the last entry in the correction file.

### Row 09

This row presents header data for a single section:

- Field **F** contains the number assigned to this section.
- Field **G** contains a hexadecimal count of the total number of bytes in this section.
- Field **H** contains a hexadecimal count of the individual microcode corrections in this section.

**Row 11**

This row presents header data for an individual correction:

- Field **I** contains the number assigned to this correction.
- Field **J** contains a 2-byte binary control word for this correction whose bits are defined as shown in the following table.

| Bit | Definition |
|---|---|
| 0 | 1 = Verify data first |
| 1 | 1 = Do not remove |
| 2 | 1 = Do not apply |
| 3 | 1 = Single patch in section |
| 4 | 1 = Perform an OR operation |
| 5 | 1 = Perform an AND operation |
| 6 | 1 = No verify data present |
| 7 | Reserved |
| 8 | 1 = Correction applied successfully |
| 9 | 1 = Verify failed |
| 10 | 1 = Another verify in section failed |
| 11 - 15 | Reserved |

- Field **K** contains the date that this correction was added to the correction file.

**Line 13**

This line contains the starting address for the microcode that this correction replaces. This address is defined by a hexadecimal value for the address segment ( **L** ) and address offset ( **M** ).

**Line 14**

This line contains the total number of bytes included in this correction.

**Lines 16-22**

When bit 0 of the control word is 1, lines 16 through 18 contain the verify data for the correction. A maximum of 114 bytes can be displayed in these lines. If the correction includes more than 114 bytes of verify data, the first 113 bytes are displayed, and two dots at the end of row 18 indicate that the data is truncated.

When verify data is present, display of replacement data begins on line 20. As before, the maximum display field is 114 bytes. If the correction includes more than 114 bytes of replacement data, the first 113 bytes are displayed, and two dots at the end of row 22 indicate that the data is truncated.

However, if the correction currently being displayed does not include verify data, display of replacement data begins on line 16. In such cases, screen C7 can accommodate up to 266 bytes of replacement data. If the correction data field exceeds this limit, the display is truncated to the first 265 bytes, and that truncation is indicated by two dots at the end of line 22.

**Field S**

When the correction file includes more than one section, move the cursor to this field and use the Cursor Up and Cursor Down keys to scroll through the file. To display the first or last section, do the following:

- Depending on the keyboard you are using, press and hold the Cmd, Alt, or F2 key.
- Press the Cursor Up key to display the last section in the file.
- Press the Cursor Down key to display the first section in the file.

**Field P**

When a section includes more than one correction, move the cursor to this field and use the Cursor Up and Cursor Down keys to scroll through the file. To display the first or last correction in the current section, do the following:

- Depending on the keyboard you are using, press and hold the Cmd, Alt, or F2 key.
- Press the Cursor Up key to display the last correction in the section.
- Press the Cursor Down key to display the first correction in the section.

## Online Tests

Online tests include work station test routines that the host system supplies. When the PRIME OPTION MENU appears, you can select the following: display verification, printer verification, configuration data, ERAP (error recording analysis procedure) data, and a link test.

You can run online tests on the work station while other jobs are running on the host system. However, you must log off the work station that will run the online tests before you can run online tests on that work station. There may be various methods that you can use to end or sign off a job. These methods are not described in this book because they are system operating procedures.

## Test Procedure

To start the online tests, the display station must be communicating with the control unit (the System Available indicator is on). The following procedure is correct for most systems.

1. If the System Available indicator is on, go to step 3.
2. If the System Available indicator is not on, make sure that control unit power is switched on, the Test switch is set to Off, and the Power, Ready, and Work Station Active LEDs are all on.
3. If a logon screen appears, go to step 4.
   a. If this station is on a switched line, determine if the connection to the host system has been made. Go to step 3c.
   b. If the 5394 is on a nonswitched line, call the system operator and have the control unit brought online. Go to step 3c.
   c. If you cannot get a logon screen, go to "MAP 0100: Start Of Call" on page 2-3.
4. Enter the Test Request key sequence. See "Key Sequences" on page 3-40.

The online test PRIME OPTION MENU should now appear. If it does not appear, check the following list of possible reasons:

- The display station is not logged off. Check with the operator before you log off the display station.
- The display station is offline. Call the system operator.
- An error message about this display station is waiting on the system console. Call the system operator.

Use the displayed menus to select the test desired.

To exit this procedure, follow the exit procedure supplied on the display screens.

The following online test information is a example only. The content of these tests depend on the host system used and may be different from this example. Follow the instructions on your display screen to do these tests. See Figure 3-51 on page 3-80 and "Online Test Aids" on page 3-81.

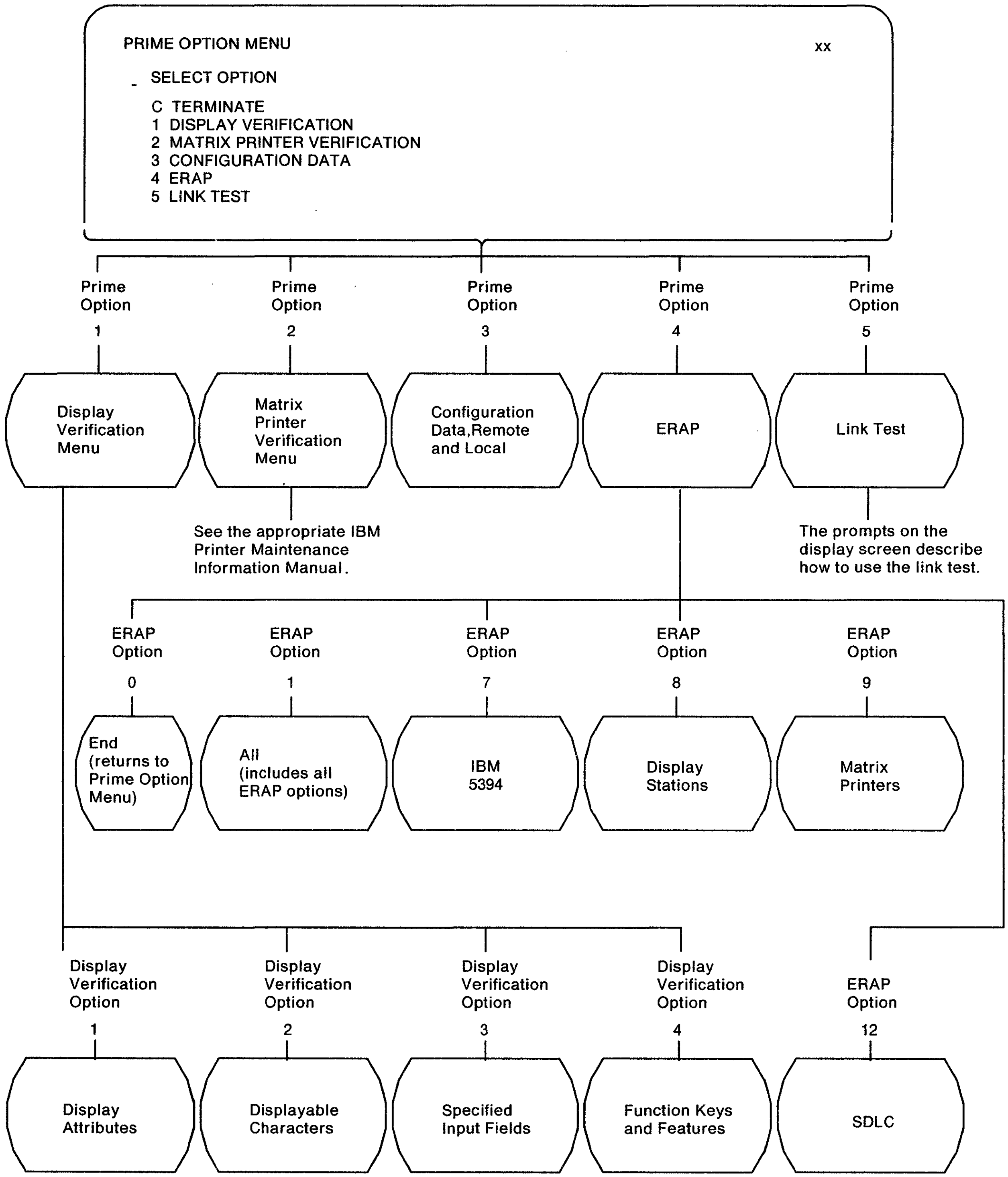



Figure 3-51. Prime Option Menu

## Online Test Aids

The following descriptions will aid you in using the online test screens. Most of the screens are self-explanatory. Read the screen carefully. When you select an option from the screen, you must also press the Enter key to activate it. How-to-use information is supplied here for the following screens:

## Display Verification

The Display Verification Menu allows you to select the following tests: the display attributes test, the displayable characters test, the specified input fields test, the function keys test. The display attributes test and the displayable characters test check the display station planar. The specified input fields test checks the control unit. The function keys test checks the interface with the host system.

**Display Attributes:** This screen tests the display screen attributes. To use this screen to check the attribute operation:

1. Press the spacebar once to position the cursor to the right of SPECIFY ATTRIBUTES statement on the display screen.
2. Type in one of the hexadecimal numbers shown on the screen and press the Enter key.
3. Observe the results that take place on the right side of the display screen.

To cancel this screen, follow the exit procedure on the display screen.

**Displayable Characters:** This screen (shown in Figure 3-52) shows the characters that are generated when you press the comparable keyboard keys. The screen on your display station may not look the same.

See *IBM 5394 Remote Control Unit Functions Reference* to determine the hexadecimal codes for the characters that will change because of the language selected.

```
DISPLAYABLE CHARACTERS                                                XX---XX
   ENTER C TO RETURN TO DISPLAY VERIFICATION MENU:

FIRST HEX CHAR ->0 1 4 5 6 7 8 9 A B C D E F   FIRST HEX CHAR ->0 1 4 5 6 7 8 9 A B C D E F
                 0 _ _ _ & - ø Ø _ _ 0̄ { } \ 0                  8 _ _ c ì Ç Ì h q y 8̄ H Q Y 8
                 1 _ _ _ é / É a j ~ 1̄ A J _ 1                  9 _ _ ñ ß Ñ ` i r z 9̄ I R Z 9
                 2 _ _ â ê Â Ê b k s 2̄ B K S 2                  A _ _ ¢ ! ¦ : _ _ _ _ _ _ _ _
SECOND HEX    -> 3 _ _ ä ë Ä Ë c l t 3̄ C L T 3   SECOND HEX -> B _ _ _ $ , # _ _ _ _ ô û Ô Û
CHAR             4 _ _ à è À È d m u 4̄ D M U 4   CHAR          C _ * < * % @ _ æ _ _ ö ü Ö Ü
                 5 _ _ á í Á Í e n v 5̄ E N V 5                  D _ _ ( ) _ ' _ _ _ _ ò ù Ò Ù
                 6 _ _ ã î Ã Î f o w 6̄ F O W 6                  E _ - + ; > = _ Æ ´ _ ó ú Ó Ú
                 7 _ _ å ï Å Ï g p x 7̄ G P X 7                  F _ █ | ¬ ? " _ █ _ _ õ ÿ Õ _
```

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

Figure 3-52. Displayable Characters

**Specified Input Fields:** This screen tests the control unit operations that the display station uses. Fields of information are entered, read by the control unit, and written back to the display screen next to the input field. To use this screen:

1. Press the spacebar once to position the cursor at the start of the first input field. The cursor moves from the field on the left to the field on the right when you enter the input field information.
2. Enter information in the fields described on the display screen. If you make an error, press the Error Reset key and correct the error.

The field descriptions are as follows:

- Alpha or numeric: Type five alphabetic or numeric characters.
- Alpha only: Type five alphabetic characters.
- Field exit req: Type five alphabetic or numeric characters and then press the Field Exit key.
- Numeric only: Type five numeric characters.
- Dup key: Press the Dup key once. The key code of the Dup key is shown until the screen is written by the control unit. This field duplicates the numeric-only field.
- Signed numeric: Type four numeric characters. The cursor remains under the last character typed. Press the Field Exit key (positive) or the Field- key (negative).
- Bypass: The field is automatically bypassed and no entry is needed.
- Upper case: Type five alphabetic characters.
- Rt adj z fill: Type one alphabetic or numeric character. Press the Field Exit key. The character you typed moves to the right of the field and the left four positions are filled with zeros.
- Self-check for Modulus 10: Type A F 1 2 7 6 5 6.
- Rt adj b fill: Type one alphabetic or numeric character. Press the Field Exit key. The character you typed will move to the right (Rt) of the field and the left four positions are filled with blanks.
- Self-check for Modulus 11: Type A F 1 2 7 6 5 5.
- Auto enter: Type five alphabetic or numeric characters.

As soon as you type the last character, the control unit reads all the input fields, sends the information to the system, and writes the information back to the display screen next to the input fields.

**Function Keys and Features:** This screen tests the roll keys and command function keys. To use this screen:

1. Press and hold the Upper Shift key while you press either the Roll Up or Roll Down key. (On some keyboards, press Page Down instead of Roll Up; instead of Roll Down, press Page Up. No shift key is needed.)
2. Observe roll lines 1, 2, 3, and 4. To return lines that have rolled off the display screen, press the Enter key.
3. Observe the intensity of the numbers on the display screen while you do step 4.
4. Press the Cmd key; then press Command Function key 1. If the Command Function key operates correctly, the number 1 on the screen should change from normal to high intensity. Repeat until you have pressed Command Function keys 1 through 12. Press the Cmd key again; then press and hold the Upper Shift key while pressing Command Function key 13. Release both keys. Repeat until you have pressed Command Function keys 13 through 24. If all of the Command Function keys operate correctly, the numbers 1 through 24 on the screen should be high intensity.
5. Repeat step 4 to obtain a normal display of the numbers.

## Configuration Data

*Remote Stations:* The following are descriptions of the configuration data for remote stations:

- **Line** is the communication line number that this display station is on.
- **Station Addr** is the address for the control unit. The station address permits the data communication system to address a specific remote control unit.
- **LSID** (logical station identification) permits the data communication system to communicate to the control unit which specific work station the system wants to communicate with. The work station address is the last 6 bits of the LSID.

- **Logical ID** is the name the data communication system uses to address a specific work station.
- **Description** is the type of device being addressed.

*Local Stations:* The following are descriptions of the configuration data for local stations:

- **Device Addr** is the address of the control unit.
- **Unit Addr** is the address of the work station(s) assigned to the control unit. The first digit is the physical port or cable number, and the second digit is the station address.
- **Logical ID** is the name the data communication system uses to address the station(s) assigned to the control unit.
- **Description** is the type of device being addressed.

### Error Recording Analysis Procedure (ERAP)

The following describes the ERAP options:

- If you select the `END` option, the ERAP function ends. If you select the `END` option and press the Field Exit key, the screen returns to the sign-on menu.
- If you select the `ALL` option, the ERAP tables appear one at a time for all devices on the line. When the error history table for the first device appears and you press the Enter key, the I/O counter table for the second device appears. This sequence repeats until the error history table for the last device on the line appears.
- If you select the `WORK STATION CONTROLLER` option, the `DISPLAY STATIONS` option, or the `MATRIX PRINTERS` option, you must also select a specific device. The I/O counter table, the error counter table, and the error history table appear for the selected device only.

**Note:** For a description of the error history table, see "Error History Table (ERAP) Description" on page 3-85.

### Link Tests

Link tests, like wrap tests, send test signals through the transmit lines that are returned through the receive lines. The test signals in link tests, however, are sent from and returned to the host system.

To determine if you can select a link test from a remote work station or only from a host system, do the following:

1. Press the 5 key
2. Press the Enter key.

**Note:** The prompts on the display screen describe how to use the link test or where to get the information needed to use it.

## Error Logs

Three error logs are kept to record errors that occur on the control unit and all attached work stations. They are the error log buffer, the permanent link error (PLE) log, and the hard error (HE) log. The contents of the error log buffer is transmitted to the host system and stored there when the error log buffer is full and at the end of each session.

### Displaying Error Log Information

You can display the contents of the 5394 error log buffer and the 5394 HE log on any attached display station by using Concurrent mode test C1 (see "Concurrent Mode Screens" on page 3-61).

You can display the contents of the 5394 PLE log on any attached display station by using Concurrent mode test C2 (see "Concurrent Mode Screens" on page 3-61).

The host error log stored at the host system can be displayed or printed at an operating display station by running the online tests (see "Online Tests" on page 3-78) and selecting the ERAP option from the Prime Option menu. The ERAP option shows the error log as an error history table.

## Error Log Information

Error log entries in the error log buffer and the PLE log have the following format:

LSID,XXYY,S0,S1,S2,S3,S4.

where:

LSID = logical session ID

XXYY = SRC (see "System Reference Codes" on page 3-88)

XX = device type
00 = control unit
01 = display station
02 = printer

YY = error detail

S0 through S4 Sense Bytes

SRCs 0040 through 0045, 0047, 0048, and 0050 through 0053 have no sense bytes.

SRCs 0046 through 0054 have four sense bytes.

SRCs 0070 through 0098 have five sense bytes.

SRCs 01xx and 02xx have five sense bytes.

X.21 and X.25 SRCs are 6-bit codes and appear in fields XXYY and S0.

## Error Log Buffer

The error log buffer is a 128-byte buffer in DRAM where SRCs from attached work stations and some selected control unit SRCs are accumulated and then sent to the host system for storage. The error log buffer retains entries that have been sent to the host until they are overwritten.

## Permanent Link Error (PLE) Log

The permanent link error (PLE) log is a 37-byte buffer in DRAM where all communication hard errors are stored. These errors are also written to the system diskette. The PLE log is reloaded from the diskette during the power-on sequence.

## Hard Error (HE) Log

Nonrecoverable errors caused by an internal failure of the control unit and detected either during power-on sequence or during operation are entered into this log when possible. The HE log is a 15-byte buffer in DRAM and all entries are 6 characters (3 bytes) long. This log contains only the five latest errors. These errors are also written to the system diskette, if not prevented by the nature of the failure. The HE log is reloaded from the diskette during the power-on sequence.

## Host Error Logging

The control unit error log entries are sent to the host system when the error log is full or when requested by the host system. The host system always requests the error log entries at the end of a session.

## Communication Error Counters (60 through 6D)

SDLC errors that can be corrected and recovered are counted and the cumulative total is stored in the control unit. When any counter reaches 255, or when the host system requests maintenance statistics, each counter that has a value more than zero has its contents converted to an error code. The code is sent to the host system as a control unit error log entry. These SRCs are not logged internally in the control unit. The counters are reset when the contents are formatted into an SRC. These counters give an indication of communication interface line quality and recovery activity within the 5394.

## Statistical Counters (6E and 6F)

The control unit has two statistical counters that contain 4 bytes each. These counters are used to count the number of valid Information frames received and transmitted. The contents of these counters are formatted into SRCs and sent to the host system when the communication counters are sent. The counters are reset when the contents are formatted into an SRC.

# Error History Table (ERAP) Description

Use the ERAP option on the PRIME OPTION MENU of the online tests to display or print the errors that are logged in the host system for the control unit and attached work stations. See "Online Tests" on page 3-78. A description of the data fields is given on the following pages.

## ERAP Table for the Control Unit

"ERAP Table for the Control Unit" shows the error log for the control unit. "ERAP Table for Attached Display Stations" on page 3-86 shows the error log for attached display stations. "ERAP Table for Printers" on page 3-87 shows the error log for attached printers. The printout shown is from a System/36. Printouts from other host systems will contain the same information, but the format may be different.

```
                    ERROR HISTORY TABLE FOR CONTROLLER C03/01                       W1
             PRESS ENTER TO VIEW NEXT DISPLAY     CM07-RESTART     CMD7-BACKUP
             FROM:  83/01/01   00:00:01           TO:  83/10/12   06:00:01
                                ............... SENSE BYTES .................
   DATE     TIME     SRC   0       1           2           3           4           BYTES 1-4
 YY/MM/DD HH:MM:SS ...HEX.. ................ BINARY ..................              DECIMAL
 83/10/08 09:14:53 006F   00    0000 0000 0000 0000  0000 1000  1000 1110            2190
 83/10/08 09:14:53 006E   00    0000 0000 0000 0000  0000 1000  1001 0000            2192
```

System Reference Code (including error codes). Not used for 004x and 005x.

Error counter for error codes 006x, except 006E and 006F.

LISD for error codes 007x and 008x.

For 6-character error codes the first 4 characters appear in the SRC column and the last 2 characters appear in the Sense 0 column.

004x and 005x (except 0046 and 0054) have no sense bytes.

0046 and 0054 use sense bytes 1 through 3. These sense bytes contain the content of the FRMR I-field.

006E and 006F use sense bytes 1 through 4. These sense bytes contain the count of I-frames.

The bytes 1-4 Decimal column is used for 006E and 006F only and contains the count in decimal format.

Notes:

1. Sense bytes 1, 2, 3, and 4 will contain zeros when the error code is not 007x, 008x, or 009x.
2. The Date and Time columns may be located on the left or right side of screen, depending on the host system.

## ERAP Table for Attached Display Stations

```
                    ERROR HISTORY TABLE FOR DISPLAY STATION R1/0001    W1

       FROM:  83/01/01 00:00:01          TO:  83/10/27 13:00:01
                       CONT/HOST       CABLE STATUS         DEVICE STATUS
 DATE    TIME    SRC    STATUS       CONT.     DEVICE        0         1
YY/MM/DD HH:MM:SS      ...................... BINARY .......................
 831021   093531  0220  0000 0000   0010 0100  0000 1001  0000 0000 0000 0000
 830928   095358  0200  0000 0000   0010 0010  0000 0000  1000 0000 0111 0000
 830928   093540  0220  0000 0000   0010 0100  0000 1001  0000 0000 0000 0000
```

System Reference Code (including error codes)

Always Zeros for 01 Device Code

CABLE STATUS, CONT.:

(reserved)
No Response
Transmit Activity Check
(reserved)

Receive Parity Check
Receive Length Check
(reserved)
Even/Odd Timeout

CABLE STATUS, DEVICE:

Busy
Line Parity
(reserved)
Outstanding Status

*456*

000 No Exception Status
001 Null or Attribute Not Found
010 Activate Not Valid
011 (reserved)
100 Command Not Valid
101 Input Queue/Storage Overrun
110 Register Value Not Valid
111 Power-on Transition

Even/Odd Response Level
0 Even
1 Odd

DEVICE STATUS:

Scan Code, Command, or MSR Status

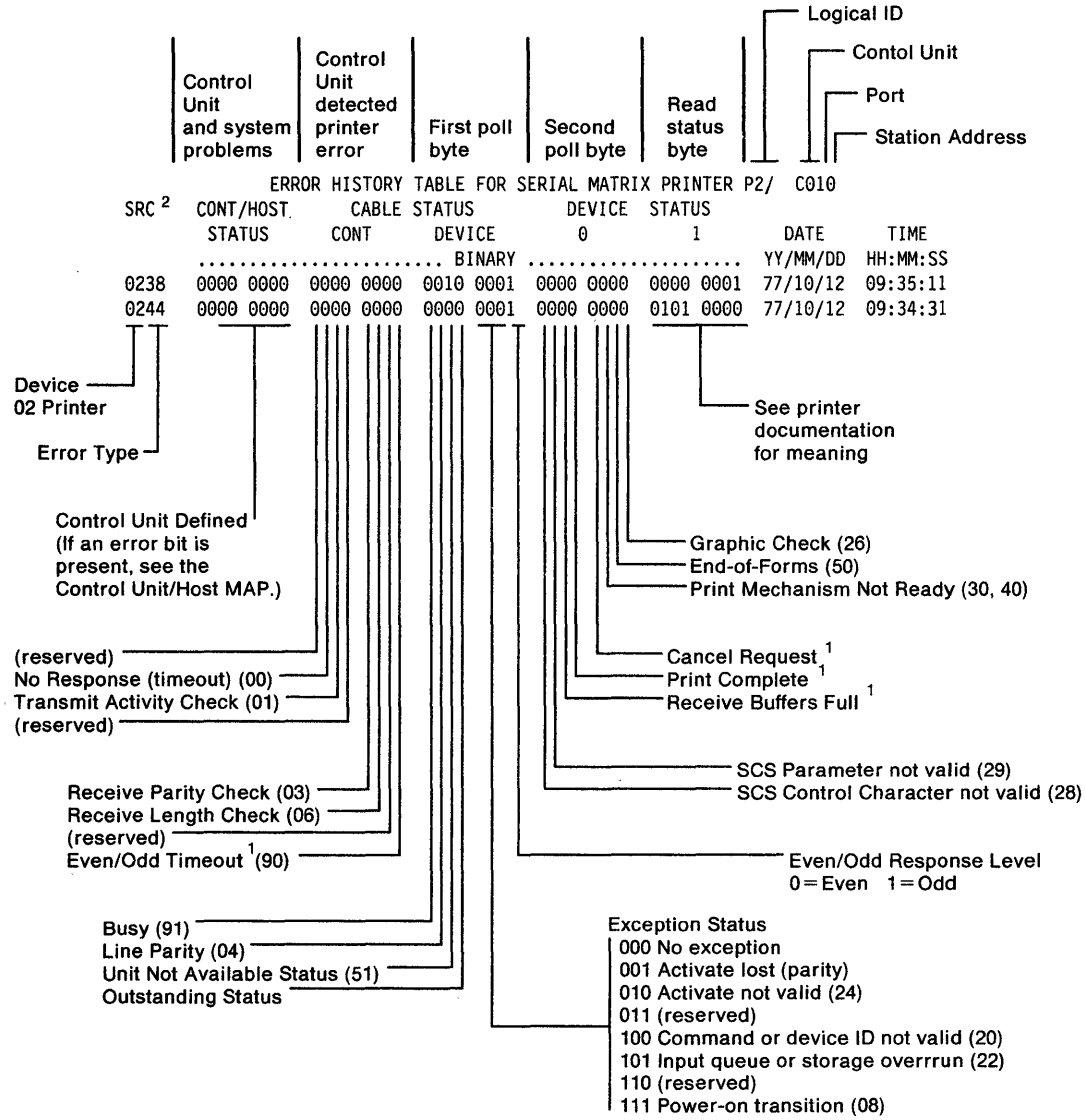
Defines Status Byte 0
0010 Keyboard Scan Code
1000 MSR Status Byte

MSR Status Byte
*01234567*

Data Present
Rdr Error
Last Data Byte
P8421 — Data Byte

Note: The Date and Time columns may be located on the left or right side of your screen, depending on the host system.

# ERAP Table for Printers




Note: The Date and Time columns may be located on the left or right side of the screen, depending on the host system.

[1] Presence of these bits depends on the system that the printer is attached to.
[2] The 2 digits on the left are used by the system to further identify the SRC. Refer to the system manuals for further explanation.

## System Reference Codes

See Table 3-21 on page 3-89 for a summary of all the valid system reference codes (SRCs) for the 5394 and attached work stations.

Also included are descriptions of the error history table for the control unit and display station. SRCs for specific work stations are defined in the work station maintenance documentation. Table 3-21 on page 3-89 identifies which SRCs appear and where they are logged. Figure 3-53 shows where the SRCs appear.

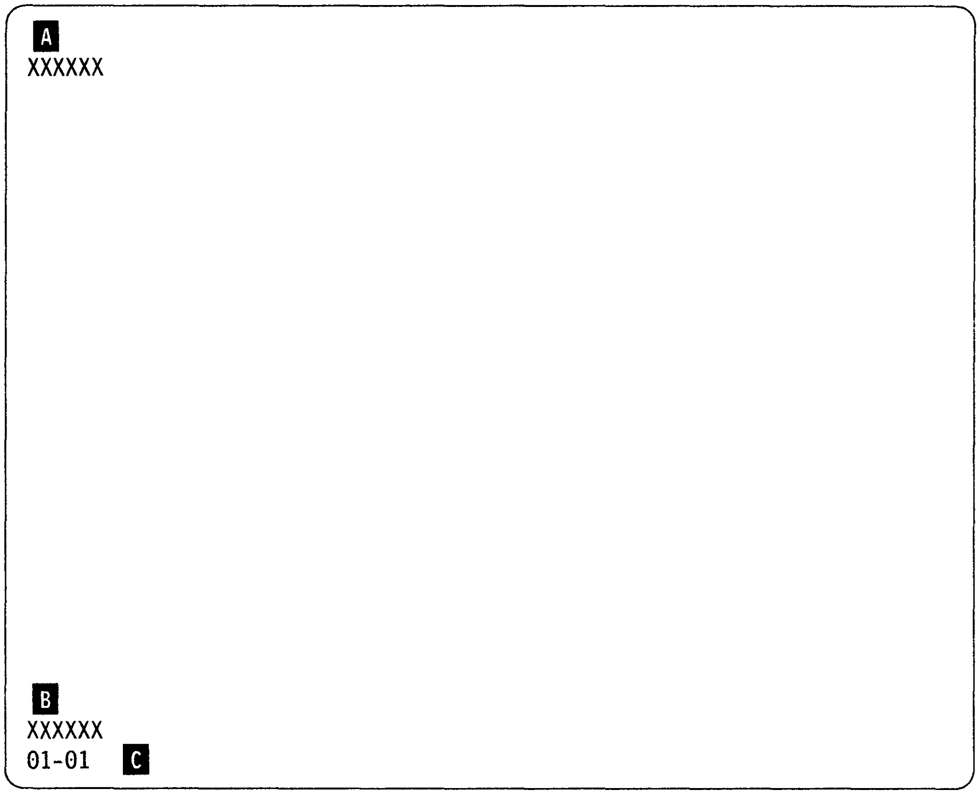



Figure 3-53. SRC locations

**A** SRCs prior to log on

**B** SRCs after log on

**C** Cursor location code (may be in a different location)

**Note:** SRCs may be either 4 or 6 characters.

## SRC Summary Table

A detailed description of the system reference codes follows Table 3-21.

Table 3-21 (Page 1 of 3). SRC Summary Table

| SRC | Definition | Displayed | Logged Host Sys | Error Log Buf | Logged PLE Log | Logged HE Log |
|---|---|---|---|---|---|---|
| 0000 thru 003F | Go to "Operator Entry SRCs" on page 3-92 | Yes | No | No | No | No |
| 0040 thru 005F | Go to "Communication Network SRCs" on page 3-96 | Yes | Yes | Yes | Yes | No |
| 0060 thru 006F | Go to "Communication and Statistical Counters" on page 3-98 | No | Yes | No | No | No |
| 0060 thru 006F, 0071 | Go to "Ideographic Support SRCs" on page 3-100 | Yes | No | No | No | No |
| 0070 thru 007F | Go to "Text Entry Assist SRCs" on page 3-101 | Yes | No | No | No | No |
| 0080 thru 008F | Go to "Customer Setup SRCs" on page 3-102 | Yes | No | No | No | No |
| 0090 thru 009F | Go to "Host Support SRCs" on page 3-103 | Yes | No | No | No | No |
| 0100 thru 01FF | Go to "Display Station SRCs" on page 3-103 | No | Yes | Yes | No | No |
| 0200 thru 02FF | Go to "Printer SRCs" on page 3-106 | No | Yes | Yes | No | No |
| 0300 thru 0FFF | Reserved | | | | | |
| 100000 thru 10FFFF | Go to "X.25 Operator SRCs" on page 3-108 | Yes | No | No | No | No |
| 110000 thru 1FFFFF | Go to "X.25 Communication SRCs" on page 3-110 | Yes | Yes | Yes | Yes | No |
| 200000 thru 20FFFF | Go to "X.21 Switched Operator SRCs" on page 3-117 | Yes | No | No | No | No |
| 210000 thru 21FFFF | Go to "X.21 Network SRCs" on page 3-118 | Yes | Yes/No (See Note 1) | Yes/No (See Note 1) | Yes/No (See Note 1) | No |

| Table 3-21 (Page 2 of 3). SRC Summary Table | | | | | | |
|---|---|---|---|---|---|---|
| **SRC** | **Definition** | **Displayed** | **Logged Host Sys** | **Error Log Buf** | **Logged PLE Log** | **Logged HE Log** |
| 220000 thru 24FFFF | Go to "X.21 Network SRCs" on page 3-118 | Yes | Yes | Yes | Yes | No |
| 250000 thru 29FFFF | Reserved | | | | | |
| 300000 thru 30FFFF | Go to "V.25 bis Operator System Reference Codes" on page 3-120 | Yes | No | No | No | No |
| 310000 thru 31FFFF | Go to "V.25 bis Call Indication System Reference Codes" on page 3-120 | Yes | No | No | No | No |
| 320000 thru 32FFFF | Go to "V.25 bis Circuit-Terminating System Reference Codes" on page 3-121 | Yes | Yes | Yes | Yes | No |
| 330000 thru 49FFFF | Reserved | | | | | |
| 500000 thru 50FFFF | Go to "Diskette Drive and Diskette SRCs" on page 3-121 | Yes | No | No | No | No |
| 510000 thru 51FFFF | Go to "Microcode Change SRCs" on page 3-122 | Yes | Yes | Yes | No | No |
| 520000 thru 52FFFF | Go to "Copy-to-Printer SRCs" on page 3-123. | Yes | No | No | No | No |
| 530000 thru 5FFFFF | Reserved | | | | | |
| 600000 thru 6FFFFF | Go to "Dedicated Diagnostic SRCs" on page 3-124 | Yes | No | No | No | No |
| 700000 thru D0FFFF | Reserved | | | | | |
| D10000 thru DFFFFF | Go to "Power-On Test SRCs" on page 3-126 | Yes (See Note 2) | No | No | No | Yes |
| E00000 thru EFFFFF | Go to "5394 Hardware Errors Detected During Operation" on page 3-128 | Yes (See Note 2) | No | No | No | Yes |

| Table 3-21 (Page 3 of 3). SRC Summary Table | | | | | | |
|---|---|---|---|---|---|---|
| **SRC** | **Definition** | **Displayed** | **Logged Host Sys** | **Error Log Buf** | **Logged PLE Log** | **Logged HE Log** |
| F00000 thru FFFFFF | Go to "5394 Microcode Errors Detected During Operation" on page 3-128 | Yes (See Note 2) | No | No | No | Yes |

**Notes:**

1. Logging of 21xxxx codes depends on the mode of operation at the time when the error occurs.
2. The nature of the failure may prevent the display of SRCs D10000 through FFFFFF.

## Operator Entry SRCs

If a typing error occurs while the operator is entering information, the keyboard locks. A blinking cursor indicates the location of the error, and a four-digit SRC (0000 through 003F) appears. The host system program determines the location of the displayed SRC, but it usually appears on the last line of the screen.

After logon is complete, you can press the Help key to display the message that describes the error. Then press the Error Reset key to recover from the error. The cursor remains at its current position unless otherwise noted.

These SRCs are listed in Table 3-22.

Table 3-22 (Page 1 of 4). 0000 through 003F

| SRC | Description |
|---|---|
| **0000** | Help Key Not Allowed<br><br>The display station operator pressed the Help key; however, either no SRC appeared or the application program did not support the Help key. |
| **0001** | Keyboard Overrun<br><br>The IBM 5394 did not keep up with the rate of information entered. The last character entered was not recognized. |
| **0002** | Invalid Scan Code<br><br>The IBM 5394 received an invalid key code from the display station. Either the keyboard code is incorrect for the keyboard at the display station or an error occurred in translating the keystroke. |
| **0003** | Invalid Command/PF Key<br><br>The display station operator pressed either a Command key sequence, a PF key that was not supported or not valid for the current field, or an invalid Alt key sequence. |
| **0004** | Data Not Allowed In This Field<br><br>The display station operator tried to enter data from the keyboard into a field where only MSR or SLP entries are allowed. |
| **0005** | Cursor In Protected Area Of Display<br><br>The display station operator tried to enter data, but the cursor was not in an input field on the display. Data cannot be entered in a protected area of the display. |
| **0006** | Key Following Sys Req Key Not Valid<br><br>The display station operator pressed the Sys Req/Attn key while establishing an X.25 circuit, or pressed an invalid key after pressing the Sys Req/Attn key and before pressing the Enter/Rec Adv key or the Error Reset key. |
| **0007** | Mandatory Enter Field – Must Enter Data<br><br>There is at least one mandatory enter field on the screen that the display station operator must enter data into before the screen can be changed or processed. (The cursor goes to the first character position of the first unentered mandatory entry field.) |
| **0008** | This Field Must Have Alphabetic Characters<br><br>The display station operator tried to enter nonalphabetic characters into a mandatory alphabetic field. Valid characters are A through Z, blank, comma, period, hyphen, apostrophe, and Dup. The Dup key may be used to duplicate these characters in the field. |

| Table 3-22 (Page 2 of 4). 0000 through 003F | |
|---|---|
| **SRC** | **Description** |
| **0009** | This Field Must Have Numeric Characters<br><br>The display station operator has attempted to enter nonnumeric characters into a mandatory numeric field. Valid characters are 0 through 9, blank, comma, period, plus, minus, and Dup. The Dup key may be used to duplicate these characters in the field. |
| **0010** | Only Characters 0 Through 9 Permitted<br><br>The key pressed is not valid for a signed numeric field. Valid entries are 0 through 9 and Dup key. |
| **0011** | Key For Sign Position Of Field Not Valid<br><br>The display station operator tried to enter data into the last position of a signed numeric field. |
| **0012** | Insert Mode – No Room To Insert Data<br><br>There is no room to insert data into this field. Either there is no room in the field, or the cursor is in the last position of the field.<br><br>Do not use Insert mode to change data or to enter the last character into this field. |
| **0013** | Insert Mode – Only Data Keys Permitted<br><br>The display station operator tried to exit a field while the display station was still in Insert mode. |
| **0014** | Mandatory Fill Field – Must Fill to Exit<br><br>The display station operator pressed a function key that would move the cursor out of this field; however, the requirements of this mandatory-fill field was not met. A mandatory-fill field must be completely filled or left blank. |
| **0015** | Modulo 10 Or 11 Check Digit Error<br><br>The display station operator entered data into a self-check field, and the number entered and the check digit did not compare. |
| **0016** | F- Key Not Valid In This Field<br><br>The display station operator pressed the Field-key when the cursor was not in a numeric only, digits only, or signed numeric field. |
| **0017** | Mandatory Fill Field – Key Pressed Is Not Valid<br><br>The display station operator pressed the Field-, Field+, or Field Exit key; however, the requirements for this mandatory-fill field were not met. A mandatory-fill field must be completely filled unless the operator exits it from the first position of the field. |
| **0018** | Key Used To Exit This Field Not Valid<br><br>The cursor is in a right adjust or field exit required field, and the display station operator pressed a data key. |
| **0019** | Dup Key Not Permitted In This Field<br><br>The display station operator pressed the Dup key; however, the Dup key is not permitted in this field. |

| Table 3-22 (Page 3 of 4). 0000 through 003F | |
|---|---|
| **SRC** | **Description** |
| **0020** | Function Key Not Valid For Right Adjust Field<br><br>The display station operator pressed a function key that is not permitted in this field. Press the Field Exit, F+, or F- key to exit this field before pressing one of the following function keys:<br><br>• Test Req<br>• Clear<br>• Enter/Rec Adv<br>• Print<br>• Help<br>• Roll<br>• Home (when the cursor is in the home position)<br>• PF/CMD1-24<br>• Sys Req<br>• Rec Backspace. |
| **0021** | Mandatory Enter Field – Must Enter Data<br><br>The cursor is positioned in a mandatory enter field. The display station operator must enter data into a mandatory entry field before exiting the field by pressing the Field-, Field+, or Field Exit key. |
| **0022** | Status Of Field Not Known<br><br>A system error occurred. The status of the current field is not known. This error can occur during an insert or delete operation. |
| **0023** | Hex Mode – Entry Not Valid<br><br>The display station is in Hexadecimal mode but the first key pressed was not a character 4 through 9 or A through F, or the second key pressed was not a character 0 through 9 or A through F.<br><br>This error also occurs when hexadecimal code is used in a numeric, signed numeric, alpha only, digits only, or I/O field. |
| **0024** | Decimal Field – Entry Not Valid<br><br>The display station operator pressed a key that is not valid. Only characters 0 through 9 and the Dup key (if specified in the field format word) are allowed in this field. |
| **0026** | F- Key Entry Not Valid<br><br>The display station operator pressed the Field- key to exit a numeric-only field but the last position of the field was not a character 0 through 9. |
| **0027** | Key Not Defined – Key Cannot Be Used<br><br>The display station operator pressed a key that is either blank or not defined for this display station. |
| **0029** | Diacritic Character Not Valid<br><br>The second key pressed during a diacritic key function in a two-key sequence did not produce a valid diacritic character. |
| **0031** | Data Buffer Overflow<br><br>The data received from the MSR card was longer than the maximum allowed. |

| Table 3-22 (Page 4 of 4). 0000 through 003F | |
|---|---|
| **SRC** | **Description** |
| **0032** | MSR Data Error<br><br>Data received from the MSR was not valid. |
| **0033** | MSR Secure Data Read Not Authorized<br><br>The MSR data received was secured data (the operator id card), and this field was not specified for secured data. |
| **0034** | MSR Data Exceeds Length Of Field<br><br>The magnetic stripe reader data received will not fit into the active input field. |
| **0035** | MSR Error<br><br>The card to be read was incorrectly inserted into the magnetic stripe reader, was incorrectly made, or is damaged. |
| **0036** | Light Pen Use Not Allowed<br><br>The display station operator tried to use the selector light pen while a field was active. |
| **0037** | Light Pen Tip Error<br><br>The light pen tip switch was actuated in a field that does not contain a light pen control word. |
| **0038** | Light Pen And MSR Use Not Allowed<br><br>The light pen or the MSR cannot be used during text processing. |

## Communication Network SRCs

SRCs 0040 through 005F indicate problems with the communication network at the link level. These SRCs are displayed, entered in the PLE log, and entered in the log buffer for transmission to the host system.

Communication network SRCs are listed in Table 3-23.

Table 3-23 (Page 1 of 2). 0040 through 005F SRCs

| SRC | Description |
|---|---|
| **0040** | Modem or DCE Not Ready<br><br>Data Set Ready Line Inactive (Model 01); DCE Not Ready (Model 02)<br><br>This SRC indicates that the modem or DCE was not ready during required intervals of normal operation. The operating state of the modem or DCE is checked at different times, depending upon the specific link-level protocol in use:<br><br>• When using the SDLC protocol, the state of the communication line is checked at the start of each transmit/receive operation or at the expiration of a receive inactivity timeout. This timeout occurs after 30 seconds on nonswitched lines or after 350 msec on switched lines. If the line is inactive at these times, the control unit starts another timer that lasts either 10 seconds (nonswitched) or 200 msec (switched). If the line still remains inactive, the 0040 SRC is posted and the link is disabled.<br><br>• For packet-switched networks, the status of the line is checked during each link retry (governed by CSU field 7) or at the expiration of a 30-second transmit/receive activity timer. The SRC error is posted immediately upon detection of either condition.<br><br>• For networks using the X.21 switched protocol, the SRC is posted when the control unit is ready to place a call but the DCE fails to present DCE Ready within 30 seconds. |
| **0041** | Idle Condition Detected (X.25 only)<br><br>This SRC indicates that the receive line was idle for 15 or more contiguous bit times. |
| **0042** | Receive Clock Failure<br><br>This SRC indicates that the receive clock signal became inactive during data transfer (For Model 01, this error is only meaningful if the attached modem or DCE holds the Data Carrier Detect (DCD) signal continuously active or supports local loopback under control of the local loopback signal.) |
| **0043** | DSR Remains Active (Model 01 on switched networks only - SDLC)<br><br>This SRC indicates that the control unit attempted to disconnect from the line, but the DSR, RFS, or CI line failed to become inactive. (This SRC is also posted when the modem or DCE is not operating in CDSTL mode and the DSR line becomes active before DTR.) |
| **0044** | 30-Second Timeout (Switched line only - SDLC and X.21 only)<br><br>This SRC indicates that no valid data has been received for 30 seconds. The DTR signal becomes inactive to disconnect the line. |

| Table 3-23 (Page 2 of 2). 0040 through 005F SRCs | |
|---|---|
| **SRC** | **Description** |
| **0045** | DCE Will Not Activate (X.25 only)<br><br>This SRC indicates that either a DM or DISC command was received during the link setup sequence. |
| **0046** | Frame Reject Received (X.25 only)<br><br>The control unit received an FRMR from the network, indicating that an error was detected in the last frame transmitted. The error log entry of this code includes three sense bytes, which preserve the contents of the FRMR I-field. |
| **0047** | Unexpected Disconnect mode (DM) or Disconnect (Disc) Command Received (X.25 only)<br><br>This SRC is posted if the control unit receives a DM or a DISC command while in the information transfer state. |
| **0048** | Unexpected Unnumbered Acknowledgment (UA) Frame Received (X.25 only)<br><br>This SRC is posted if the control unit receives a UA frame while in the information transfer state. |
| **0050** | Ready for Sending (RFS) Error (Model 01 interface only)<br><br>This SRC is posted when the RFS line is inactive for up to 30 seconds while the RTS line is active, or when the RFS line is active when the RTS line is inactive. The RFS line level is checked only when the control unit is attached to a multipoint or half-duplex communication line. |
| **0051** | Transmit Clock Failure<br><br>The transmit clock signal failed during a transmit operation. |
| **0052** | Transmit Hardware Error<br><br>The link adapter hardware failed to complete a transmit operation within 30 seconds, but no transmit clock or DCE hardware failure was detected. |
| **0053** | Expiration of Retry Count (X.25 only)<br><br>No acknowledgment of a transmission was received within allowed timeout. The timeout retry count (N2) and retry interval (T1) are specified in CSU field 7. |
| **0054** | Frame Reject Sent<br><br>The control unit has sent a link level FRMR response to the host system after receiving an invalid SDLC or LAPB command. Sense bytes S1, S2, and S3 preserve the contents of the FRMR I-field. |

## Communication and Statistical Counters

Codes between 0060 and 006F are used to transmit counter contents to the host system. These SRCs are listed in Table 3-24.

| Table 3-24 (Page 1 of 2). 0060 through 006F Counters | |
|---|---|
| **SRC** | **Description** |
| **0060** | Test Frames In Error (SDLC/X.21 Switched)<br><br>When the control unit is configured to use either SDLC or X.21 switched protocols, this counter maintains a cumulative record of test frames received with CRC errors.<br><br>RNR Sent (X.25)<br><br>When the control unit is configured to communicate over an X.25 network, this counter maintains a cumulative record of RNR commands sent. |
| **0061** | Test Frames Without Error (SDLC/X.21 Switched)<br><br>When the control unit is configured to use either SDLC or X.21 link-level protocols, this counter maintains a cumulative record of valid test frames received.<br><br>RNR Received (X.25)<br><br>When the control unit is configured to operate in conjunction with an X.25 network, this counter maintains a cumulative record of RNR commands received. |
| **0062** | Communication Underrun<br><br>This counter increments during transmit operations when the communication adapter fails to supply the next character to the transmit buffer in time for that character to be sent out on the line. |
| **0063** | Communication Adapter Overrun<br><br>This counter increments during receive operations when the link adapter fails to transfer 1 byte of data to memory before the next character is received from the line. |
| **0064** | Data Carrier Detect Lost (Model 01) or I Signal Lost (Model 02)<br><br>This counter increments if the signal is lost for two bit times during a receive operation and an error is detected in the newly received data frame. |
| **0065** | RFS Signal Lost (Model 01)<br><br>This counter increments if the RFS signal becomes inactive for two bit times during a transmit operation, and the host system response indicates that an error was detected. |
| **0066** | DSR Signal Lost (Model 01) or DCE Is Not Ready (Model 02)<br><br>This counter increments if the line becomes inactive for more than two bit times during nonswitched operation. |

Table 3-24 (Page 2 of 2). 0060 through 006F Counters

| SRC | Description |
|---|---|
| **0067** | Frame Sequence Error Counter (SDLC/X.21 Switched)<br>This counter increments when a frame sequence error (Ns and Nr do not match) is detected.<br>REJ Command Sent (X.25 only)<br>The counter increments each time the control unit transmits a REJECT command. |
| **0068** | Transmit Retry (SDLC/X.21 switched)<br>This counter increments each time one or more frames must be retransmitted due to a frame sequence error.<br>REJ Command Received (X.25 only)<br>The counter increments each time the control unit receives a REJECT command from the host system. |
| **0069** | CRC Error Counter<br>This counter increments when the CRC character sent with a newly received frame does not match the character calculated by the control unit. |
| **006A** | Frame Aborts Counter<br>This counter increments each time the 5394 receives an abort frame. |
| **006C** | T1 Timeout (X.25 only)<br>This counter increments if an acknowledgment frame is not received within a selected retry interval (T1 timeout). The control unit then retries the operation. After a selected number of retries, a 0053 SRC is posted in the PLE log. Both the retry interval and the number of retries are selected in CSU field 7.<br>SHM Call Collision (X.21 switched)<br>This counter increments each time a call collision occurs during SHM operation. |
| **006D** | IPDU Retransmission (X.25 only)<br>This counter increments each time an ELLC IPDU is retransmitted.<br>IA5 Parity Error (X.21 switched)<br>This counter increments each time a parity error is detected in an IA5 code received from the X.21 network. |
| **006E** | Transmitted I Frames<br>This counter increments for each I frame transmitted to the host system. |
| **006F** | Received I Frames<br>This counter increments for each valid I frame received from the host system. |

## Ideographic Support SRCs

A 0060 through 006F or 0071 SRC indicates an error related to the 5394 ideographic function. These error codes are listed in Table 3-25.

To recover from these errors, press the Error Reset key.

Table 3-25. 0060 through 006F, 0071 SRCs

| SRC | Description |
|---|---|
| **0060** | Alphanumeric Data Not Allowed<br><br>The display station operator attempted to enter alphanumeric data into a field that accepts only double-byte characters. |
| **0061** | Ideographic Data Not Translated<br><br>The display station operator attempted to enter a double-byte character into a field that only accepts alphanumeric data. |
| **0062** | Data Type Change Not Valid<br><br>The display station operator tried to change the data type, but the cursor is not in an open field or in the first position of an ideographic either field. |
| **0063** | Ideographic Number Not Valid<br><br>The display station operator entered an ideographic character that is not valid while operating in Alternate Entry mode. |
| **0064** | Key Not Defined<br><br>The display station operator pressed a key that is not valid for the current keyboard mode. |
| **0065** | Reserved for Shift Characters.<br><br>The cursor is positioned in a column reserved for shift-out or shift-in characters. |
| **0066** | Repeat Key Not Valid<br><br>The cursor is positioned under a shift character or attribute character, or at the first valid entry character position of an input field. Only data characters can be repeated at these positions. |
| **0067** | Extension Character RAM Full<br><br>The display station extension character RAM is full. All additional characters will appear as a special default character. |
| **0068** | Output Data Stream for Extension Character Not Valid<br><br>The outbound data stream to the control unit is not valid for extension characters. All additional characters will appear as a special default character. |
| **0069** | Outbound Extension Characters Not Valid<br><br>The output data stream to the control unit contains invalid or undefined extension characters. All additional characters will appear as a special default character. |
| **0071** | Shift Character List Full<br><br>The list of shift-in or shift-out characters in the 5394 is full. No more shift characters are allowed on the display screen. |

## Text Entry Assist SRCs

SRCs between 0070 and 007F indicate an error relating to DisplayWrite software. These SRCs are listed in Table 3-26.

**Note:** These errors usually result in text messages similar to the ones provided here. The SRC appears only when the Help key is pressed.

Table 3-26. 0070 through 007F SRCs

| SRC | Description |
|---|---|
| **0070** | Word Wrap/Carrier Return Error<br>An error occurred during the word spill function or the carrier return function. |
| **0071** | Command Conflict<br>The display station operator attempted to start copy, move, or delete text operation while one of the previous operations was already in progress. |
| **0072** | Key Not Valid For Cursor Position<br>The display station operator pressed a key that is not valid for current position of the cursor. |
| **0073** | Invalid Attempt To Delete<br>The display station operator attempted to delete or replace an instruction or format change when the general prompt function was not active. |
| **0074** | Invalid Entry During General Prompt<br>The display station operator pressed a key that is not valid when using the general prompt function. |
| **0075** | Character Not Found<br>The locate function did not locate the designated character string. |
| **0076** | Continuous Insert Mode Failed<br>The insert function failed because the host system has not processed the text on the screen. |
| **0077** | Function Key Selection Not Valid<br>The display station operator pressed a function key that is not valid at this time. |
| **0078** | Required Scale Line Not Defined To Control Unit<br>The required scale line is not defined for this display station. |

## Customer Setup SRCs

SRCs 0080 through 008F indicate errors in general setup parameters and appear on the screen only during CSU. These SRCs are listed in Table 3-27.

Diskette drive and diskette SRCs (50000x) can also appear during CSU. See "Diskette Drive and Diskette SRCs" on page 3-121 for a list of these SRCs.

Table 3-27. 0080 through 008F SRCs

| SRC | Description |
|---|---|
| **0081** | Too Many Work Stations<br>More than the maximum number of work stations are attached to the control unit. (An E should appear on the display for every extra work station attached.)<br>Notify the customer that too many work stations are attached. |
| **0083** | Keyboard Code Not Valid<br>The display station operator tried to enter a keyboard code for a printer or at a location where no display station exists. (Operators can enter keyboard codes only beside Ds on the display.)<br>To recover, make sure that the address and port number of the display station are set correctly and enter the keyboard code again. |
| **0087** | Flow Control Entry Error (X.25 only)<br>The values for bit 3 and bit 4 of field 5 are not compatible. If bit 4 is 0, bit 3 must be 1.<br>To recover, make sure that the values in Field 5 match those on the X.25 Communication Worksheet.<br>The 5394 cannot be configured to allow flow control negotiations unless manual options are also allowed. |
| **008B** | Too Many Keyboard Codes<br>More than the maximum number of different keyboard codes have been used. A maximum of four different keyboard codes can be selected (the master country and three others). |
| **008D** | Printer Port and Station Address Invalid<br>Check the configuration. Make sure that the printer port and the station address are either both numbers or both underscores. If a printer was selected, both subfields should be numbers. If not, both should be underscores. |

## Host Support SRCs

An SRC between 0090 and 009F indicates that required host support is not currently available. These SRCs are listed in Table 3-28.

| Table 3-28. 0090 through 009F SRCs | |
|---|---|
| **SRC** | **Description** |
| **0097** | Test Request Function Not Supported<br><br>A test request function is not supported by the host system. The customer should contact the host system operator and determine why the function is not supported. |
| **0098** | Undefined Hardware Error<br><br>The control unit entered an error handling routine, but did not detect an error. |
| **0099** | Host Support Not Currently Available<br><br>A key requiring host system action was pressed, but the requested function is either not supported or the work station is not in session with the host system. |

## Display Station SRCs

An SRC between 0100 and 01FF indicates a hardware problem with an attached display station. The control unit detects these errors when it receives either no response or a wrong response from a display station. These codes are stored in the error log buffer for transmission to the host system. To examine the contents of the error log buffer, select Concurrent mode screen C1. Use the ERAP function of the online tests to examine error log buffer data that have been transferred to the host system.

The SRCs are listed in Table 3-29.

| Table 3-29 (Page 1 of 3). 0100 through 01FF SRCs | |
|---|---|
| **SRC** | **Description** |
| **0100** | No Response<br><br>This SRC is reported if the display station does not respond to a poll within 200 $\mu$sec. This SRC is not logged. |
| **0101** | Transmit Activity Check<br><br>This SRC occurs when the control unit detects one or more bit errors in data transmitted to an attached display station. |
| **0103** | Receive Parity Error<br><br>The control unit reports this SRC if the wrong parity was received in response to a POLL or ACTIVATE RECEIVE command. |
| **0104** | Line Parity Check<br><br>This SRC occurs when a display station detects a parity error in data transmitted by the control unit. |
| **0105** | Display Station Not Accessible<br><br>The addressed display station cannot respond because another work station on the same twinaxial line is in a continuous transmission mode. |

| Table 3-29 (Page 2 of 3). 0100 through 01FF SRCs | |
|---|---|
| **SRC** | **Description** |
| **0106** | Receive Length Check<br><br>The control unit received the wrong number of bytes as a result of a POLL or an ACTIVATE RECEIVE command. |
| **0107** | Wrong Station Responded<br><br>A wrong station address was returned in response to a POLL or other command from the control unit. |
| **0108** | Power-On Transition<br><br>The power-on transition status bits are set when the display station is powered on. This SRC is reported only if the bits are set while the display station is in session. |
| **0109** | ACTIVATE WRITE Command Failure<br><br>The control unit checked the device status and found that the busy bit was not on after an ACTIVATE WRITE command. |
| **0111** | Scan Code Not Valid<br><br>The 8-bit code sent in the keyboard response frame could not be translated to a character or a function by the control unit. |
| **0120** | Command Not Valid<br><br>This condition indicates that a POLL or other command sent to the display station was not a valid command or that the device ID was not correct. |
| **0121** | Register Value Not Valid<br><br>This condition indicates that the address counter value was not inside the user accessible limits. |
| **0122** | Storage or Input Queue Overrun<br><br>This condition occurs if more than 16 commands and associated data frames are sent to the display station by the control unit, or if an attempt is made to store data in storage that is not accessible to the user. |
| **0123** | Null or Attribute Exception<br><br>This condition indicates that no attribute was found or that the address counter pointed to an attribute. |
| **0124** | ACTIVATE Not Valid<br><br>This condition indicates that the ACTIVATE command sent to the display station was not valid. |
| **0125** | Exception Status Not Defined<br><br>This condition indicates that the display station returned an undefined exception status in response to a POLL. |
| **0126** | Pass-Thru Interface Error<br><br>An invalid or unexpected pass-thru command was detected. |
| **0149** | Invalid POLL or READ Response<br><br>This condition indicates that the control unit received an invalid POLL response. |

| Table 3-29 (Page 3 of 3). 0100 through 01FF SRCs | |
|---|---|
| **SRC** | **Description** |
| **0181** | Magnetic Stripe Reader Error<br><br>Indicates an MSR-detected error, LRC check error, or control unit-detected parity error. |
| **0182** | Device Type Error<br><br>This SRC indicates that the work station responded to a READ DEVICE ID command without setting a valid device-type code. |
| **0183** | Wrong Size Display Assembly<br><br>The CRT image size does not match the CRT image size set in the ID word sent by the display station. |
| **0184** | Incorrect Keyboard ID<br><br>The keyboard ID received by the control unit was not valid. |
| **0189** | Outstanding Status Not Valid<br><br>An outstanding status bit was set in the POLL response, and no outstanding status information was available. |
| **0190** | Even/Odd Change In Status<br><br>This condition indicates that the work station status did not change within 7 seconds after a not-busy response was returned to a positive acknowledge poll. |
| **0191** | Busy Timeout<br><br>This condition indicates that the control unit found that the busy bit has been on for a period of more than 1.6 minutes. |

## Printer SRCs

An SRC between 0200 and 02FF indicates a hardware problem with an attached printer. The control unit detects these errors when it receives either no response or a wrong response from a printer. These codes are stored in the error log buffer for transmission to the host system. To examine the contents of the error log buffer, select Concurrent mode screen C1. Use the ERAP function of the online tests to examine error log buffer data that have been transferred to the host system.

The SRCs are listed in Table 3-30. Printer codes not listed in this table are device specific. For definitions of these codes, refer to the printer maintenance library.

Table 3-30 (Page 1 of 3). 0200 through 02FF SRCs

| SRC | Description |
|---|---|
| **0200** | No Response Timeout<br><br>The control unit posts this error when an attached printer fails to respond to a poll within 200 $\mu$sec. |
| **0201** | Transmit Activity Check<br><br>The control unit has detected one or more bit errors in a transmission to an attached printer. |
| **0203** | Receive Parity Error<br><br>The control unit has detected a parity error in response to a POLL or ACTIVATE RECEIVE command. |
| **0204** | Line Parity Check<br><br>This error occurs when a printer detects a parity error in data transmitted by the control unit. |
| **0205** | Printer Not Accessible<br><br>The addressed printer cannot respond because another work station on the same twinaxial line is in a continuous transmission mode. |
| **0206** | Receive Length Check<br><br>The control unit has received the wrong number of bytes as a result of a POLL or an ACTIVATE RECEIVE command. |
| **0207** | Wrong Station Responded<br><br>The control unit received a response to a POLL or other command with an incorrect station address. |
| **0208** | Power-On Transition<br><br>The power-on transition status bits are set when printer power is switched on. This SRC is reported only if the bits are set while the printer is in session. |
| **0209** | ACTIVATE WRITE Command Failure<br><br>The control unit checked the device status and found that the busy bit was not on after an ACTIVATE WRITE command. |
| **021X** | Printer Processing Errors<br><br>The printer detected a failure to process the incoming data stream correctly. These errors are device dependent. |

| Table 3-30 (Page 2 of 3). 0200 through 02FF SRCs | |
|---|---|
| **SRC** | **Description** |
| **0220** | Invalid Command or Device ID<br><br>An attached printer received a command having an invalid command code or device ID. |
| **0221** | Invalid Exception Status (110)<br><br>An attached printer returned an exception status of 110, which is not defined for this system. |
| **0222** | Storage or Input Queue Overrun<br><br>The printer received more than 16 frames of commands and associated data (more than 256 frames total) from the control unit. |
| **0223** | ACTIVATE Lost<br><br>The addressed printer failed to respond to a valid ACTIVATE command and the associated data stream. |
| **0224** | Invalid ACTIVATE<br><br>The addressed printer indicates that the control unit transmitted the wrong ACTIVATE command. |
| **0225** | Invalid Exception Status (011)<br><br>An attached printer returned an exception status of 011, which is not defined for this system. |
| **0226** | Unprintable Character<br><br>The addressed printer detected a character code in the data stream that it does not support. |
| **0228** | SCS Command Not Valid<br><br>The addressed printer detected an invalid SCS command in the data stream configured by the host system. |
| **0229** | SCS Parameter Not Valid<br><br>The addressed printer detected an invalid SCS parameter in the data stream configured by the host system. |
| **023X-024X** | Printer Errors<br><br>The addressed printer detected an internal hard failure. These errors are device dependent. |
| **0249** | Undefined Status Error<br><br>The control unit received an invalid POLL or READ response from the addressed printer. |
| **025X** | Normal Periodic Conditions<br><br>Printers report the following normal periodic conditions to the control unit:<br><br>— 0250 - End of form<br><br>— 0251 - Unit not available or not ready<br><br>— 0258 - End of ribbon (IBM 5219 Model D only). |

| Table 3-30 (Page 3 of 3). 0200 through 02FF SRCs | |
|---|---|
| **SRC** | **Description** |
| **0260** | Multiple Status<br><br>An IPDS printer has multiple status. The host system must return a READ MULTIPLE STATUS command to initiate readout. |
| **026X** | Data Stream Errors<br><br>The addressed printer detected errors in the data stream from the host system. Specific error codes are device dependent. |
| **028X** | Hardware Check<br><br>The addressed printer detected a hardware condition that halted printout. Specific error codes are device dependent. |
| **0290** | Status Change Timeout<br><br>The printer failed to change status within 7 seconds after a NOT BUSY response was returned to a positive acknowledge poll. |
| **0291** | Busy Timeout<br><br>The addressed printer returns a busy status flat to 64K consecutive POLL commands (from 1.6 to 9.6 minutes). |

## X.25 Operator SRCs

If the 5394 is in X.25 Communication mode and an error occurs during keyboard entry of commands, options, or parameters, an SRC between 100000 and 10FFFF is displayed. These SRCs are listed in Table 3-31.

| Table 3-31 (Page 1 of 3). 100000 through 10FFFF SRCs (X.25 Only) | |
|---|---|
| **SRC** | **Description** |
| **100000** | A previous CALL command is in progress. |
| **100100** | A virtual circuit has already been established.<br><br>The 5394 can only communicate over one virtual circuit at a time. |
| **100200** | An ANSWER command was entered for a permanent virtual circuit (PVC).<br><br>A mismatch might exist between the entry fields on the X.25 Communication Worksheet and configuration screen. |
| **100300** | A CALL command was entered for a permanent virtual circuit (PVC).<br><br>A mismatch might exist between the entry fields on the X.25 Communication Worksheet and configuration screen. |
| **100400** | The logical channel ID is invalid because it is not three characters long. |
| **100500** | The logical channel ID option is invalid because it is not a hexadecimal value between X'001' and X'FFF'. |
| **100600** | The password option is invalid because it is longer than eight characters. |

| Table 3-31 (Page 2 of 3). 100000 through 10FFFF SRCs (X.25 Only) | |
|---|---|
| **SRC** | **Description** |
| **100700** | The host network address (TO network address) is invalid because it is greater than 15 decimal digits. |
| **100800** | Your network address (FROM network address) is invalid because it is greater than 15 decimal digits. |
| **100900** | The network address is invalid because it does not contain all numeric digits (0 through 9). |
| **100A00** | The display station operator attempted to enter manual options or flow control negotiations from the keyboard, and the 5394 is not configured to allow the option.<br>A mismatch may exist between the entry fields on the X.25 Communication Worksheet and the entry fields on the configuration screen. |
| **100B00** | The facility option was entered but the characters are not hexadecimal (0 through 9 or A through F). |
| **100C00** | The packet window size option is invalid because it is less than 02. |
| **100D00** | The packet window size option is invalid because it is greater than 07 and Modulo 8 is specified. |
| **100E00** | The packet window size option is invalid because it is greater than 15 and Modulo 128 is specified. |
| **100F00** | The packet size is not equal to 064, 128, 256, or 512. |
| **101000** | The closed user group option does not contain two decimal digits. |
| **101100** | An invalid control character was entered. |
| **101200** | The host network address is missing for a CALL command. |
| **101300** | An A, O, C, or D was not entered as the first control character or an A, O, C, or D was previously entered. |
| **101400** | A network address was entered for a permanent virtual circuit (PVC).<br>A mismatch may exist between the entry fields on the X.25 Communication Worksheet and configuration screen. |
| **101500** | The password option was entered for a permanent virtual circuit (PVC).<br>A mismatch may exist between the entry fields on the X.25 Communication Worksheet and configuration screen. |
| **101600** | The password option is invalid because it is not all alphanumeric characters. |
| **101800** | The closed user group option was entered either for an ANSWER command or an OPEN command. |
| **101900** | The Q or the E option was selected with the ANSWER command. |
| **101A00** | An F (facility) control character or an R (reversed charging) was entered for an ANSWER command or a PVC.<br>A mismatch may exist between the entry fields on the X.25 Communication Worksheet and configuration screen. |
| **101B00** | The value entered with the E option is invalid because it is not three characters long, or is not a decimal value in the range of 100-999. |

| Table 3-31 (Page 3 of 3). 100000 through 10FFFF SRCs (X.25 Only) | |
|---|---|
| **SRC** | **Description** |
| **101C00** | A CALL command was entered for an answer-only SVC.<br>A mismatch may exist between the entry fields on the X.25 Communication Worksheet and the configuration screen. |
| **101D00** | An OPEN command was entered for an answer-only SVC.<br>A mismatch may exist between the entry fields on the X.25 Communication Worksheet and the configuration screen. |

## X.25 Communication SRCs

If the 5394 accepts the keyboard-entered options, but the network operation with the host system fails, an SRC between 110000 and 1FFFFF is displayed on all attached display stations. These SRCs indicate a communication network problem at the packet level.

When an error occurs, the 5394 or the DCE issues a packet defining the cause of the error. Individual SRCs are determined by the type of packet issued.

Determine from the customer which diagnostic codes (SNA or ISO) are used by the system. If the customer does not have this information, check the communication configuration field in row 1 of the concurrent diagnostics screens. See "Concurrent Mode Screens" on page 3-61.

### 1100ff or 1180ff SRCs

The 5394 issued a Clear Request packet after detecting an error. The cause of the error is contained in the diagnostic field (ff). The diagnostic codes for 1100ff and 1180ff error codes are listed in Table 3-32.

| Table 3-32 (Page 1 of 2). Diagnostic Codes for 1100ff and 1180ff Errors | | |
|---|---|---|
| **SNA Diagnostic Codes (ff)** | **ISO Diagnostic Codes (ff)** | **Description** |
| **14** | **14** | Invalid packet type for state p1 |
| **15** | **15** | Invalid packet type for state p2 |
| **17** | **17** | Invalid packet type for state p4 |
| **18** | **18** | Invalid packet type for state p5 |
| **31** | **31** | Call connected not received within 200 seconds |
| **32** | **32** | Clear confirmation not received within 200 seconds |
| **50** | | General ELLC/QLLC error |
| **51** | | Undefined ELLC C-field |
| **54** | | Undefined ELLC I-field |
| **55** | | I-field too long |
| **56** | | ELLC frame reject received |
| **57** | | ELLC header invalid |
| **59** | | ELLC timeout (LT1 x LN2) condition |
| **5A** | | ELLC receive sequence count (LNr) invalid |
| **5B** | | ELLC recovery rejected or terminated |

| Table 3-32 (Page 2 of 2). Diagnostic Codes for 1100ff and 1180ff Errors | | |
|---|---|---|
| **SNA Diagnostic Codes (ff)** | **ISO Diagnostic Codes (ff)** | **Description** |
| **60** | | General PSH error |
| **61** | | PSH sequence error |
| **A1** | | Invalid M-bit packet sequence |
| **A6** | **26** | Packet too short<br>Make sure that the packet size entered (in the configuration or manually) matches the network subscription. |
| **A7** | **27** | Packet too long<br>Check that the packet size entered (in the configuration or manually) matches the network subscription. |
| **AA** | | Interrupt packet not supported |
| **AB** | **01** | Invalid packet send sequence number (Ps) |
| **AC** | **02** | Invalid packet receive sequence number (Pr) |
| **AD** | | Invalid D-bit received |
| **D0** | **F4** | General resources error |
| **D2** | **F5** | PIU too long |
| **E0** | **69** | Invalid facility length |
| **E2** | **29** | LCID is not equal to 0 on restart indication or confirmation |
| **E6** | **42** | Facility parameters not supported |
| **E7** | **41** | Facility not supported |
| **E8** | **46** | Call from unexpected DTE |
| **E9** | | Invalid D-bit requested<br>There is a host system problem or you are connected to the wrong DTE. |
| **EA** | | Reset indication on virtual call |
| **EB** | | Invalid protocol identifier |
| **EC** | | Password mismatch |
| | **00** | No additional information |
| | **20** | Packet not allowed |

## 1200ff or 1280ff SRCs

The 5394 issued a Reset Request packet after detecting an error. The cause code (cc) is contained in the diagnostic field (ff). The cause codes that apply to the 1200ff or 1280ff SRCs are listed in Table 3-33.

Table 3-33. Diagnostic Codes for 1200ff and 1280ff Errors

| SNA Diagnostic Codes (ff) | ISO Diagnostic Codes (ff) | Description |
|---|---|---|
| 1B | 1B | Invalid packet type for state d1 |
| 33 | 33 | Reset confirmation not received within 200 seconds |
| 50 | | General ELLC/QLLC error |
| 51 | | Undefined ELLC C-field |
| 54 | | Undefined ELLC I-field |
| 55 | | ELLC I-field too long |
| 56 | | ELLC frame reject received |
| 57 | | ELLC header invalid |
| 59 | | ELLC timeout (LT1 x LN2) condition |
| 5A | | ELLC receive sequence count (LNr) invalid |
| 5B | | ELLC recovery rejected or terminated |
| 60 | | General PSH error<br>Host system or network problem |
| 61 | | PSH sequence error<br>Host system or network problem |
| A1 | | Invalid M-bit packet sequence |
| A6 | 26 | Packet too short |
| A7 | 27 | Packet too long |
| AA | | Interrupt packet not supported |
| AB | 01 | Invalid packet send sequence number (Ps) |
| AC | 02 | Invalid packet receive sequence number (Pr) |
| AD | | Invalid D-bit received |
| D0 | F4 | General resources |
| D2 | F5 | PIU too long |
| | 00 | No additional information |
| | 20 | Packet not allowed |

## 18ccdd, 19ccdd, and 1Accdd SRCs

SRCs between 180000 and 1AFFFF have the following format:

**TTccdd**

TT = General error category (18, 19, or 1A)

cc = Cause code

dd = Diagnostic code.

A description of each error category and its cause codes follows. The diagnostic codes for all errors in this range are listed in Table 3-37 on page 3-115.

**Notes:**

1. Most cause codes (cc) and diagnostic codes (dd) are issued by the network and may vary from network to network.
2. The cause codes and diagnostic codes listed here are defined by CCITT Recommendation X.25. IBM does not guarantee that they will apply to the network.

**18ccdd Errors:** The DCE issued a Clear Indication packet after detecting an error.

Table 3-34 lists the cause codes for 18ccdd errors.

**19ccdd Errors:** The DCE issued a Reset Indication packet after detecting an error.

Table 3-35 on page 3-114 lists the cause codes (cc) for 19ccdd errors.

**1Accdd Errors:** The DCE issued a Restart.

Table 3-36 on page 3-114 lists the cause codes for 1Accdd errors.

Table 3-34. Cause Codes for 18ccdd Errors

| Cause Code (cc) | Description |
|---|---|
| **00** | Call clearing originated at host system |
| **01** | Host system busy |
| **03** | Invalid facility request |
| **05** | Network congestion |
| **09** | Out of order - host not ready |
| **0B** | Access to the host system not allowed |
| **0D** | Unrecognized host network address |
| **11** | Error at the host system |
| **13** | Error at the 5394 |
| **15** | Recognized Private Operating Agency (RPOA) out of order |
| **19** | Reverse charging not subscribed |
| **21** | Incompatible destination |
| **29** | Fast select not supported |
| **80-FF** | Call clearing originated at host system |

| Table 3-35. Cause Codes for 19ccdd Errors | |
|---|---|
| **Cause Code** | **Description** |
| **00** | Reset originated at host system |
| **01** | Out of order - disconnected host system |
| **03** | Error at the host system |
| **05** | Error at the 5394 |
| **07** | Network congestion |
| **09** | Remote DTE operational<br>This is not an error. It is a normal condition at startup. |
| **0F** | Network operational<br>This is not an error. It is a normal condition at startup. |
| **11** | Incompatible destination. |
| **1D** | Network out of order |
| **80-FF** | Reset originated at host system |

| Table 3-36. Cause Codes for 1Accdd Errors | |
|---|---|
| **Cause Code** | **Description** |
| **00** | No additional information |
| **01** | Local procedure error |
| **03** | Network congestion |
| **07** | Network is operational<br>This is not an error. This is a normal condition at startup. |
| **7F** | Registration or cancelation confirmed.<br>This is not an error. |

| Table 3-37 (Page 1 of 2). Diagnostic Codes for 18ccdd, 19ccdd, and 1Accdd Errors | |
|---|---|
| **Diagnostic Code (dd)** | **Description** |
| **00** | No additional information |
| **01** | Invalid send sequence - P (S) |
| **02** | Invalid receive sequence - P (R) |
| **10** | Invalid packet type |
| **11** | State r1 |
| **12** | State r2 |
| **13** | State r3 |
| **14** | State p1 |
| **15** | State p2 |
| **16** | State p3 |
| **17** | State p4 |
| **18** | State p5 |
| **19** | State p6 |
| **1A** | State p7 |
| **1B** | State d1 |
| **1C** | State d2 |
| **1D** | State d3 |
| **20** | Packet not allowed |
| **21** | Unidentifiable packet |
| **22** | Call on one-way logical channel |
| **23** | Invalid packet type on a permanent virtual circuit |
| **24** | Packet on unassigned logical circuit |
| **25** | Reject not subscribed to |
| **26** | Packet too short |
| **27** | Packet too long |
| **28** | Invalid general format identifier |
| **29** | Restart with LCI not equal to X'000' |
| **2A** | Packet type not compatible with facility |
| **2B** | Unauthorized interrupt confirmation |

| Table 3-37 (Page 1 of 2). Diagnostic Codes for 18ccdd, 19ccdd, and 1Accdd Errors | |
|---|---|
| **Diagnostic Code (dd)** | **Description** |
| **2C** | Unauthorized interrupt |
| **2D** | Unauthorized reject |
| **30** | Timer expired, general |
| **31** | Timer expired for incoming call |
| **32** | Timer expired for Clear Indication packet |
| **33** | Timer expired for Reset Indication packet |
| **34** | Timer expired for Restart Indication packet |
| **40** | Call setup or call clearing problem |
| **41** | Facility code not allowed |
| **42** | Facility parameter not allowed |
| **43** | Invalid called address |
| **44** | Invalid calling address |
| **45** | Invalid facility/registration length |
| **46** | Incoming call barred |
| **47** | No logical channel available |
| **48** | Call collision |
| **49** | Duplicate facility requested |
| **4A** | Non-zero facility length |
| **4B** | Non-zero facility length |
| **4C** | Facility not provided when expected |
| **4D** | Invalid CCITT-specified DTE facility |
| **50** | Miscellaneous problems |
| **51** | Improper cause code from DTE |
| **52** | Octet not aligned |
| **53** | Inconsistent Q bit setting |
| **60-6F** | Not assigned |
| **70** | International problem |
| **71** | Remote network problem |

| Table 3-37 (Page 2 of 2). Diagnostic Codes for 18ccdd, 19ccdd, and 1Accdd Errors | |
|---|---|
| **Diagnostic Code (dd)** | **Description** |
| **72** | International protocol problem |
| **73** | International link out of order |
| **74** | International link busy |
| **75** | Transit network facility problem |
| **76** | Remote network facility problem |
| **77** | International routing problem |
| **78** | Temporary routing problem |
| **79** | Unknown called DNIC |
| **7A** | Maintenance action |
| **80-FF** | Network specific diagnostic information |

## 1Bcc00 SRCs

The 5394 issued a Restart Request packet after detecting an error.

The cause code is contained in the cause field (cc). The cause codes that apply to the 1Bcc00 SRC are listed in Table 3-38.

Table 3-38. Cause Codes for 1Bcc00 Errors

| SNA Cause Codes (cc) | ISO Cause Codes (cc) | Description |
|---|---|---|
| 11 | 11 | Unsolicited Restart Confirmation packet received |
| 34 | 34 | Restart Confirmation packet not received within 200 seconds |
| A5 | A5 | Diagnostic packet received[1] |
| A6 | A6 | Packet too short |
| A7 | A7 | Packet too long |
| A8 | 28 | Invalid GFI (restart indication or confirmation only) |
| E2 | 29 | LCID is not equal to 0 on restart indication or confirmation |
| E5 | 24 | LCID=0 on non-restart or diagnostic packet. |

[1] The error code for Diagnostic Packet Received has two additional descriptive characters appended, 1BA5yy, for example. The definitions of yy are described in *The X.25 Interface for Attaching IBM SNA Nodes to Packet-Switched Data Networks General Information Manual*. This packet does not generate a restart request.

# X.21 Switched Operator SRCs

If the 5394 is in X.21 switched communication mode and an error occurs during keyboard entry of commands, options, or parameters, an SRC between 200000 and 20FFFF is displayed. These SRCs are listed in Table 3-39.

Table 3-39. 200000 through 20FFFF SRCs

| SRC | Description |
|---|---|
| 200000 | A CALL command is already in progress (not in session). |
| 200100 | DETACH command accepted. Call clearing in progress. |
| 200200 | The display station operator attempted a DETACH command while a CALL command was in progress or when no-circuit connection existed. |

## X.21 Network SRCs

The X.21 network SRCs are divided into two groups: call progress signal codes and communication error codes.

Call progress signal codes indicate the status of the call during call placement. These SRCs are displayed at the calling display station.

Communication error codes indicate problems that occur during any phase of communication. These SRCs cause the loss of the communication link. These SRCs are displayed at the attached display station and are written to the PLE log.

If certain communication errors occur during a call attempt in Short Hold mode (SHM), the 5394 automatically retries the call after a set time interval. The time interval and number of retries are CSU parameters. An SRC is generated only if the retry attempts are unsuccessful and the communication link cannot be established.

These SRCs are listed in Table 3-40.

Table 3-40 (Page 1 of 2). X.21 Network SRCs

| SRC | Description |
|---|---|
| **210100** | The incoming call was received by the host system. Communication should be established shortly. |
| **210200** | The call is being redirected to a number other than the one entered. |
| **210300** | The call was queued and the communication will be established when the host system is not busy. |
| **210400** | A private network was reached. |
| **210500** | A public network was reached. |
| **212000** | There is no connection. |
| **212100** | The number is busy. |
| **212200** | There is a procedure error in the selection signals sent to the network (for example, incorrect format). |
| **212300** | The network detected a transmission error in the selection signals. |
| **214100** | Access is barred. The 5394 is not allowed to connect to the host system. |
| **214200** | The number called has changed. |
| **214300** | The called DTE address is not valid or not assigned to any DTE, or the user class of service is not compatible. |
| **214400** | The number called is out of order. |
| **214500** | The called DTE is signaling controlled-not-ready. |
| **214600** | The called DTE is signaling uncontrolled-not-ready. |
| **214700** | The called DTE power is off. |
| **214800** | The facility request code is not valid. |
| **214900** | There is a network problem in the local loop at the DCE called. |
| **215100** | The number called cannot be obtained. |
| **215200** | The user class of service is not compatible. |
| **216100** | The network is congested. |
| **217100** | There is long-term network congestion. |
| **217200** | The Recognized Private Operating Agency (RPOA) is out of order. |

Table 3-40 (Page 2 of 2). X.21 Network SRCs

| SRC | Description |
|---|---|
| **218100** | The registration or cancelation is confirmed.<br>This is a confirmation of the facility registration of cancellation, not an error. |
| **218200** | Redirection of the call facility is activated.<br>This is a response to a status inquiry, not an error. |
| **218300** | Redirection of the call facility is deactivated.<br>This is a response to a status inquiry, not an error. |
| **219x00** | Code reserved for national purposes. If this code appears, call the network supplier to determine the meaning of the call progress signal 9x. |
| **220000** | An invalid XID was received (invalid Short Hold indicators). |
| **220100** | An invalid XID was received (more than 27 digits were received or the number of digits received does not equal the number of digits specified for Short Hold mode). |
| **220200** | The wrong XID was received. |
| **220300** | An XID was required and was not received first. |
| **220400** | A DCE clear was received during call selection. |
| **220500** | There was a transition to SDLC during a message. |
| **220600** | An X.21 message was too long for the buffer. |
| **220700** | An attempt was made to send an X.21 message to the network in SDLC state. |
| **220800** | An attempt was made to send an SDLC frame to the network in X.21 state. |
| **220900** | An X.21 message was received in the not ready queue. |
| **221101** | A timeout (T1) for CALL REQUEST response occurred |
| **221102** | A timeout (T2) for SELECTION SIGNAL response occurred |
| **221103** | A timeout (T3A or T3B) for CALL PROGRESS SIGNAL termination or DCE-PROVIDED INFORMATION occurred |
| **221104** | A timeout (T4B) for CALL ACCEPTED response occurred |
| **221105** | A timeout (T5) for DTE CLEAR REQUEST occurred |
| **221106** | A timeout (T6) for DTE CLEAR CONFIRMATION occurred |
| **221300** | A call collision error occurred. |
| **221400** | A DCE clear was received during X.21 data-transfer state. Connection to the host system was lost. |
| **221500** | The received XID indicated that the host system was busy at the network address typed in. |
| **23xx00** | A call progress signal was received from the network, but a call was not placed. (Values of xx are identical to those for 21xx00 SRCs.) |
| **240000** | The DTE received an invalid call progress signal. |

## V.25 bis Operator System Reference Codes

**Note:** These SRCs apply only to the Release 2 system diskette.

If the IBM 5394 is in SDLC communication mode and an error occurs during the V.25 bis call establishment or call clearing procedure, a 6-digit SRC between 300000 and 30FFFF is displayed on the screen. Table 3-41 lists these SRCs.

Table 3-41. V.25 bis Operator System Reference Codes

| SRC | Meaning and Recovery Procedure |
|---|---|
| **300000** | Call request not allowed. Link is not established or another call is in progress. |
| **300100** | DETACH command accepted. Call clearing in progress. |
| **300200** | Call clearing not allowed. |
| **300300** | Call request entered with no call information. |

## V.25 bis Call Indication System Reference Codes

**Note:** These SRCs apply only to the Release 2 system diskette.

If a request for an outgoing call fails, an SRC between 310000 and 31FFFF is displayed on the screen. Table 3-42 lists these SRCs.

Table 3-42. V.25 bis Call Indication System Reference Codes

| SRC | Meaning and Recovery Procedure |
|---|---|
| **3101pp** | Call Failure Indication received. "pp" = one of the following parameters:<br>ET Engaged Tone<br>CB Local DCE Busy<br>RT Ring Tone (timeout)<br>AB Abort Call (timeout)<br>NT Answer Tone Not Detected<br>FC Forbidden Call (for nationally dependent parameters)<br>**Note:** The 5394 may receive other parameters that indicate a problem in the modem or DCE. |
| **3102nn** | Delayed Call Indication received. "nn" = time in minutes. Call delays of 99 minutes or more are indicated by 310299. |
| **310300** | Invalid Call Indication received. |

## V.25 bis Circuit-Terminating System Reference Codes

If a call is ended during call establishment because of an error, an SRC between 320000 and 3FFFFF is displayed on the screen. Table 3-43 lists these SRCs.

**Note:** These SRCs apply only to the Release 2 system diskette.

Table 3-43. V.25 bis Circuit-Terminating System Reference Codes

| SRC | Meaning and Recovery Procedure |
|---|---|
| 320100 | A V.25 bis message transmission error occurred. |
| 320600 | A V.25 bis message was too long for the buffer. |
| 320900 | A V.25 bis message was received in the not ready queue. |
| 321000 | An RFS timeout occurred during call establishment. |
| 321100 | A call-connected timeout occurred for an outgoing call. |
| 321200 | A call-connected timeout occurred for an incoming call. |
| 322000 | A call collision error occurred. |
| 322100 | An incoming call was rejected in invalid state. |
| 323100 | A message containing fewer than three characters was received. |
| 323300 | A corrupt or invalid call failure indication parameter was received. |
| 323400 | A delayed call failure indication was received with no time indicated. |

## Diskette Drive and Diskette SRCs

If a diskette or diskette drive error occurs during the power-on sequence, the Check Disk LED comes on. If this type of error occurs after the power-on sequence, an SRC appears. These SRCs are listed in Table 3-44.

Table 3-44. Diskette and Diskette Drive SRCs

| SRC | Description |
|---|---|
| 500001 | Configuration, error log, microcode change, or translate table data cannot be read from the system diskette. |
| 500002 | System diskette contains configuration parameters not supported by this model. |
| 500003 | System diskette not compatible with the hardware. |
| 500004 | You are using the wrong diskette. |
| 500005 | The system diskette you are using is write-protected. |
| 500006 | An error occurred when you tried to write information to the system diskette. |
| 500007 | The microcode on this diskette is not current. The customer should contact an IBM Sales Representative to order the current level. |

## Microcode Change SRCs

SRCs between 510000 and 51FFFF indicate errors detected either during installation of the microcode change file contained on the system diskette, or during installation of the microcode change file received from the host system. Table 3-45 lists these SRCs.

Table 3-45. 510000 through 51FFFF SRCs

| SRC | Description |
|---|---|
| | **Errors involving microcode change file from diskette** |
| **510100** | Diskette microcode change file contains invalid header format. No microcode changes have been applied. |
| **510101** | The diskette microcode change file is not compatible with the microcode that has been loaded. No microcode changes have been applied. |
| **510102** | The level length of the diskette microcode change file is not compatible with the microcode that has been loaded. No microcode changes have been applied. |
| **510105** | Length field in diskette microcode change file does not agree with location of EOF marker in file. No microcode changes have been applied. |
| **510110** | Diskette microcode change file contains a section with an invalid length. Some microcode changes may have been applied. |
| **510120** | The host microcode change file is a later level than the diskette microcode change file, and an error occurred while removing the microcode changes contained in the diskette microcode change file. No Host microcode changes have been applied. |
| | **Errors involving microcode change file from host system** |
| **510200** | Host microcode change file contains an invalid header format. No microcode changes have been applied. |
| **510201** | The level of the host microcode change file is not compatible with the microcode that has been loaded. No microcode changes have been applied. |
| **510202** | The level length of the host microcode change file is not compatible with the microcode that has been loaded. No microcode changes have been applied. |
| **510205** | Length field in host microcode change file does not agree with location of EOF marker in file. No microcode changes have been applied. |
| **510210** | Host microcode change file contains a section with an invalid length. Some microcode changes may have been applied. |

## Copy-to-Printer SRCs

SRCs between 520000 and 5FFFFF indicate that an error occurred during a copy-to-printer operation. These SRCs are listed in Table 3-46.

Table 3-46. 520000 through 5FFFFF SRCs

| SRC | Description |
|---|---|
| **520000** | The 5394 did not find a printer that was available for local copy-to-printer operation. |
| **520001** | The device at the address selected for the copy-to-printer operation is not a printer. |
| **520002** | The designated printer is in session, powered off, or in error state; no device responds to polls at this address. |
| **520003** | The 5394 lost communication with the printer while the print operation was in progress. |

## Dedicated Diagnostic SRCs

These SRCs appear when an error is detected during communication diagnostics run in the Dedicated mode.

The SRC is a six-digit hexadecimal code that includes four fields designated by 6 N FF XX. The meanings of these fields are defined as follows:

- 6 - indicates CE-selected Dedicated diagnostics
- N - test number
- FF - failure cause

  00 = no failure

  10 = planar

  89 = planar or external failure on 5394 connected to X.21 communication cable

  8C = planar or external failure on 5394 connected to EIA 232D communication cable

  8D = planar or external failure in interchange lines of V.35 interface

  8E = planar or external failure in phase A lines of V.35 interface

  8F = planar or external failure in phase B lines of V.35 interface
- xx - error detail (see Table 3-47).

  **Note:** For all communication diagnostics SRCs:

  – FF XX = 00 00 indicates test is in progress
  – FF XX = 00 07 indicates test is completed.

See "Dedicated Mode Tests" on page 3-50 for more information about the SRCs.

Table 3-47 (Page 1 of 2). xx Values for Dedicated Diagnostics SRCs

| xx | Description |
|---|---|
| 03 | Test timed out - Did not complete in the allowed time |
| 12 | Interface DSR line is active. |
| 13 | Interface DSR line is inactive. |
| 14 | Interface RFS line is active. |
| 15 | Interface RFS line is inactive. |
| 16 | For Model 01, interface DCD line is active. For Model 02, indicate line is active. |
| 17 | For Model 01, interface DCD line is inactive. For Model 02, indicate line is inactive. |
| 25 | Interface RSET and TSET lines at constant level when transitions expected. |
| 35 | Interface RSET line at constant level when transitions expected. |
| 36 | For Model 01, interface TSET line at constant level when transitions expected. For Model 02, SET line at a constant level when transitions expected. |
| 37 | Interface RSET line at constant level when transitions expected and DCD was inactive |
| 38 | Interface RFS and DCD both inactive |
| 39 | Interface RFS and DCD both active |
| 40 | Cable wrap between local loopback and CI active (EIA 232D, X.21) |
| 40 | Cable wrap between RTS and RLSD fails (V.35) |
| 41 | Cable wrap between local loopback and CI open (EIA 232D) |
| 41 | Cable wrap between RTS and CTS fails (V.35) |
| 42 | Cable wrap between RTS and DCD active (EIA 232D) |
| 42 | Cable wrap between DSR and DTR fails (V.35) |

| xx | Description |
|---|---|
| 43 | Cable wrap between RTS and DCD open |
| 44 | Cable wrap between RTS and RFS active |
| 45 | Cable wrap between RTS and RFS open |
| 46 | Cable wrap between DTR and DSR active |
| 47 | Cable wrap between DTR and DSR open (EIA 232D, V.35) |
| 48 | Cable wrap between TD data and TSET active |
| 48 | Cable wrap from TD driver to RD receiver fails (V.35) |
| 49 | Cable wrap between TD data and TSET open (EIA 232D) |
| 4A | Cable wrap between TD data and TSET active |
| 4B | Cable wrap between TD data and RSET open |
| 4F | Cable wrap from TD driver to all receivers fails (V.35) |
| 57 | Data wrap miscompare (Data pattern = 'FF' thru '00') |
| 58 | Data wrap miscompare (Data pattern = 'FF') |
| 59 | Data wrap miscompare (Data pattern = '00') |
| 61-85 | Planar failure |

Table 3-47 (Page 2 of 2). xx Values for Dedicated Diagnostics SRCs

## Power-On Test SRCs

D10000 through DFFFFF SRCs indicate errors found by diagnostic testing during the 5394 power-on sequence. SRCs between D10000 and D1FFFF result from the customer's problem determination procedures and are reported by the customer. These SRCs do not appear on the attached display stations. SRCs between D40000 and D9FFFF are displayed on the attached display station unless it is prevented by the nature of the failure.

The power-on test SRCs are listed in tables 3-48 through 3-50.

Table 3-48. D10000 through D1FFFF SRCs

| SRC | Description |
|---|---|
| D10001 | All LEDs are off. AC power indicator located on back panel is off. Voltage is present at power outlet. |
| D10002 | All LEDs are off. AC power indicator located on back panel is on. |
| D11001 | Power LED is on. All other LEDs are off. |
| D13002 | Power and Ready LEDs are on. Work Station Active LED is off. Work station(s) are properly attached and switched on. |
| D13003 | Power and Work Station Active LEDs are on. Ready LED is off. |
| D13004 | Power LED is on. Ready LED is flashing. Number of flashes indicates the position of a failing DRAM module. |
| D13005 | Check Disk LED is on or flashing. |
| D13007 | Power, Ready, and Work Station Active LEDs are on. All work stations on a single port fail. |

## D40000 through D7FFFF SRCs

These SRCs indicate errors detected by power-on tests of the twinaxial interface. The 6-digit hexadecimal codes for D4 through D7 SRCs are defined as shown in Table 3-49.

Table 3-49. D40000 Through D7FFFF SRCs

| SRC | Description |
|---|---|
| D4 10 43 | Twinaxial interface or bus arbiter interrupt failure |
| D4 10 44 thru D4 10 46 | Twinaxial interface interrupt failure |
| D4 10 82 | General purpose timer 2 interrupt failure |
| D4 10 83 | Serdes memory wrap failure |
| D4 10 84 | Parity Generation Diagnostic mode wrap failure |
| D4 10 85 | Twinaxial interface did not detect bad parity |
| D4 10 86 | Twinaxial interface did not detect station address fail to compare |
| D4 10 8F | Bus error detected by twinaxial interface |
| D4 10 F0 | Unexpected interrupt received |
| D4 10 FF | Address line failure |
| D5 10 51 | Auto poll chain process or twinaxial interface interrupt failure |
| D5 10 53 | Halt auto poll or twinaxial interface interrupt failure |
| D5 10 54 | Auto poll pause bit not reset |
| D5 10 55 | Auto poll delay count and halt auto poll failure |
| D5 10 95 | Auto poll delay count failure |
| D5 10 8F | Bus error detected by twinaxial interface |
| D5 10 F0 | Unexpected interrupt received |
| D6 10 56 | NORMAL INTERRUPT or START I/O command failure |
| D6 10 57 | NORMAL INTERRUPT or START I/O command failure |
| D6 10 58 | NORMAL INTERRUPT or START I/O command failure |
| D6 10 77 | Twinaxial interface did not set port active |
| D6 10 8F | Bus error detected by twinaxial interface |
| D6 10 96 | Twinaxial interface did not disable port |
| D6 10 97 | I/O timer decrement failure |
| D6 10 98 | Long delay for start I/O |
| D6 10 F0 | Unexpected interrupt received |
| D7 10 61 | Normal interrupt or start I/O command failure |
| D7 10 8F | Bus error detected by twinaxial interface |
| D7 10 A1 | Normal interrupt queue failure |
| D7 10 A3 | PCI bit not set in link control block status |
| D7 10 A4 | Incorrect control block address in interrupt queue |
| D7 10 F0 | Unexpected interrupt received |
| D7 31 A2 thru D7 37 A2 | TAC error |
| D7 31 A5 thru D7 37 A5 | Parity error (no TAC error) |

## D80000 and Above SRCs

These SRCs indicate errors detected by the level 1 power-on tests of the communication interface. See "Communication Wrap Tests" on page 3-57 for more information. The 6-digit code for D8 and above SRCs are defined as shown in Table 3-50.

Table 3-50 (Page 1 of 2). SRCs D80000 and Above

| SRC | Description |
|---|---|
| D8 10 03 | Host communication interface level 1 test did not complete (timeout) |
| D8 10 21 | Cannot put host communication interface in X.21 mode on Model 02 |
| D8 10 22 | Host communication interface X.21/SDLC hardware failure |
| D8 10 57 | Host communication interface level 1 data wrap failed compare test |
| D8 10 61 | Memory error, host communication interface bus master |
| D8 10 62 | Bus error, host communication interface bus master |
| D8 10 63 | Bus error, host communication interface bus slave |
| D8 10 64 | Host communication interface timer 1 failure |
| D8 10 65 | Host communication interface timer 1 interrupt error |
| D8 10 66 | Host communication interface timer 2 failure |
| D8 10 67 | Host communication interface timer 2 interrupt error |
| D8 10 71 | Unexpected interrupt received - xmit end operation on |
| D8 10 72 | Unexpected interrupt received - rcv end operation on |
| D8 10 73 | Unexpected interrupt received - no interrupt bits on |
| D8 10 74 | Unexpected interrupt received - xmit exception on |

| Table 3-50 (Page 2 of 2). SRCs D80000 and Above | |
|---|---|
| **SRC** | **Description** |
| D8 10 78 | Unexpected interrupt received - rcv exception on |
| D8 10 83 | Interrupt error - address compare expected but not received |
| D8 10 84 | Interrupt error - transmitter status incorrect |
| D8 10 85 | Interrupt error - receiver status incorrect |
| D9 10 10 | Planar not compatible with V.35 interface |

## 5394 Hardware Errors Detected During Operation

SRCs between E00000 and EFFFFF indicate that a hardware error was detected while the operational microcode was in control. These SRCs include four fields designated by the symbols E N XX YY, which are defined as follows:

- E - indicates the error classification
- N - identifies the specific component detecting the error
- XX YY - supplies a 2-byte readout from particular status registers.

When one of these SRCs appears, suspect one of the following:

- Planar failure
- Random bit error occurred following the operational microcode load from the diskette.

## 5394 Microcode Errors Detected During Operation

SRCs between F00000 and FFFFFF indicate that a programming error was detected while the operational microcode was in control. These SRCs include four fields designated by the symbols F C XX YY, which are defined as follows:

- F - indicates the error classification
- C - supplies the specific code segment that failed
- XX - supplies the low byte code pointer
- YY - supplies the high byte code pointer.

When one of these SRCs appear, suspect one of the following:

- A failure to download microcode patches from the host system correctly
- A programming error that was not previously detected
- Random bit error occurred following the operational microcode load from the diskette
- A planar failure.

# Service Aids

This section describes service aids that you use to test for failures in the cabling that connects the devices on the twinaxial interface.

## Cable Signal Quality Check

The purpose of the cable signal quality check is to determine if and where there is a failure in the cable, cable connectors, or an attached work station. The types of failures can be opens, shorts, poor connections, or impedance mismatches. You must use an oscilloscope to do this check.

**Note:** The customer installs and maintains the cables. Use the following precautions:

1. Do not use this test to check the quality of work done on the cables by a contractor or a customer.
2. If the cable installation is still under contractor warranty, or if a third party is responsible for the quality of the installation, use extra care so that quality of the product or workmanship of the cable is not disparaged.
3. Use this test as a problem determination aid only when instructed to do so by maintenance procedures, after you have followed all maintenance procedures, or if the customer could not determine the problem.
4. Do not use this test for common carrier owned or supplied communication facilities, such as telephone lines.

You can also use the test to check cables installed on other products for use on IBM systems.

## Test Description Using the Oscilloscope

This test transmits a signal down the line using the square wave from the B-gate output on the oscilloscope. You can check cables of any length, in sections of a maximum of 1525 meters (5000 feet). This test shown in Figure 3-54 uses the Tektronix 453 oscilloscope; however, you can use other oscilloscopes with the same oscilloscope setup.

For more information, refer to *Basic Oscilloscope Operation*.

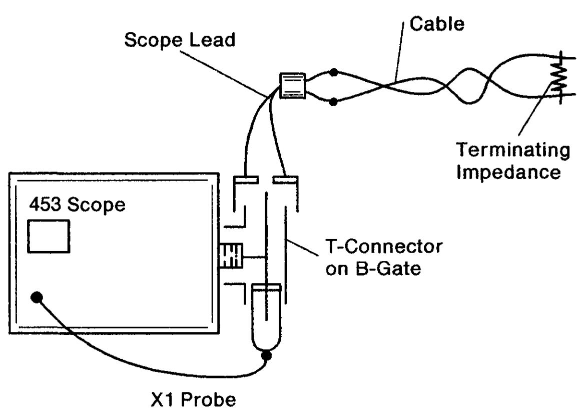



Figure 3-54. Oscilloscope Setup for Testing Cables

Figure 3-55 shows an oscilloscope display of a transmitted signal for a normal cable condition and the change to that signal a shorted or open cable causes.

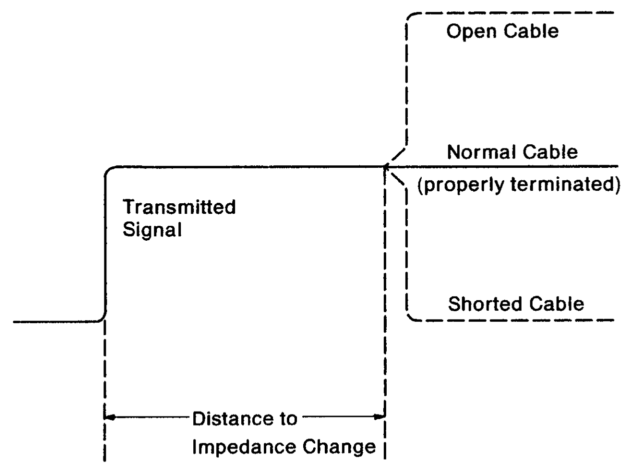



Figure 3-55. Oscilloscope Trace for Open or Shorted Cable

## Normal Cable

If the cable is terminated by the correct load impedance (110 Ω), all the energy of the transmitted signal is absorbed by the terminating impedance.

## Shorted Cable

If there is a cable failure that changes the impedance of the cable, a part of the signal is reflected back to the signal source. If the cable failure causes the impedance to be lower than normal, the reflected signal is out of phase and causes a reduction of the signal.

## Open Cable

If the failure causes the impedance of the cable to be more than normal, the reflected signal is in phase and causes an increase in the amplitude of the signal.

## Measuring Distance

The reflected energy is delayed by the time (t) it takes for the transmitted signal to travel to and from the termination or the fault.

By measuring the time from the start of the B-gate pulse to the start of the change caused by the reflected signal, you can determine the distance to the cable fault or cable end.

After you determine the fault, you can determine the distance from the cable end to the fault by using the following formulas:

For twinaxial (solid poly) cable:

Df = t ($\mu$s) × 324.7 feet

Dm = t ($\mu$s) × 99 meters

For twinaxial (Teflon[1]) cable:

Df = t ($\mu$s) × 344.5 feet

Dm = t ($\mu$s) × 105.0 meters

For IBM Cabling System cable:

Df = t ($\mu$s) × 366.7 feet

Dm = t ($\mu$s) × 111.8 meters

Where:

Df is the distance to the fault in feet.
Dm is the distance to the fault in meters.

t is the time in microseconds from the start of the B-gate pulse to the start of the reflected signal. To find t, multiply the number of scope divisions by the B-sweep time/div.

[1] Teflon is a trademark of E.I du Pont de Nemours & Co., Inc.

**Note:** Pulse rise time increases on long cables. Measure from the point where the reflected pulse just starts to change, as indicated by the arrows in Figure 3-56.

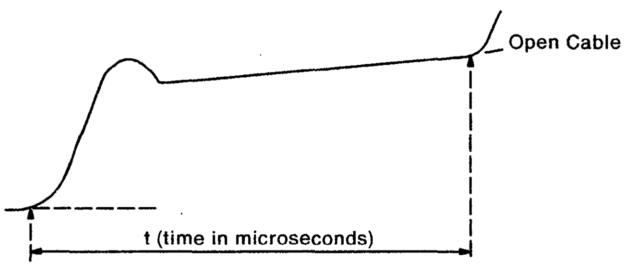



Figure 3-56. Pulse Rise Time

**An Example of Measuring Distance:** The example in Figure 3-57 is for a solid poly cable, using the preceding formula for measuring distance, with the B time/div set to 0.2 microseconds and the number of oscilloscope divisions at 6.

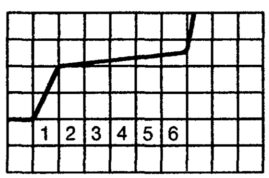



Figure 3-57. Measuring Distance Using an Oscilloscope

t = 6 divisions × 0.2 microseconds

t = 1.2 microseconds

Df = 1.2 microseconds × 324.7 feet

Df = 390 feet

Dm = 1.2 microseconds × 99 meters

Dm = 119 meters

The fault is indicated by the direction of the signal change (up for an open, down for a short).

**Note:** If the station protectors are installed, the B-gate pulse may cause the diodes to fire and generate a glitch on the displayed waveform.

## Oscilloscope Setup and Extra Parts Needed

Use an X1 probe (you can use X10 probes by changing the vertical input setting) and the following extra parts:

- One coaxial cable with a BNC end and alligator clips (part 1650790); or a BNC to banana plug adapter and multimeter leads
- One resistor equal to the impedance of the cable (110-Ω resistor); or resistor assembly (part 7362344)
- One BNC T-connector (part 1650789)
- One probe tip to BNC adapter (part 453199).

Use Figure 3-58 on page 3-132 and do the following steps in order:

1. Connect the T-connector to the B-gate on the side panel of the oscilloscope.
2. Use the probe tip adapter to connect the channel 1 probe to one side of the T-connector.
3. Connect the cable to be tested on the other side of the T-connector. If needed, use the coaxial cable with alligator clips or the BNC to banana plug adapter with CE meter leads. Connect the two alligator clips to the two leads of the cable to check the phase B and A lines of the cable, or to one phase line and the cable shield to check the shield continuity.
4. You can connect the other end of the cable to be tested to the work station if the cable is terminated.
5. When checking shield continuity, you should connect the remote end of the cable to a work station, or you should terminate it as shown in Figure 3-59 on page 3-132.

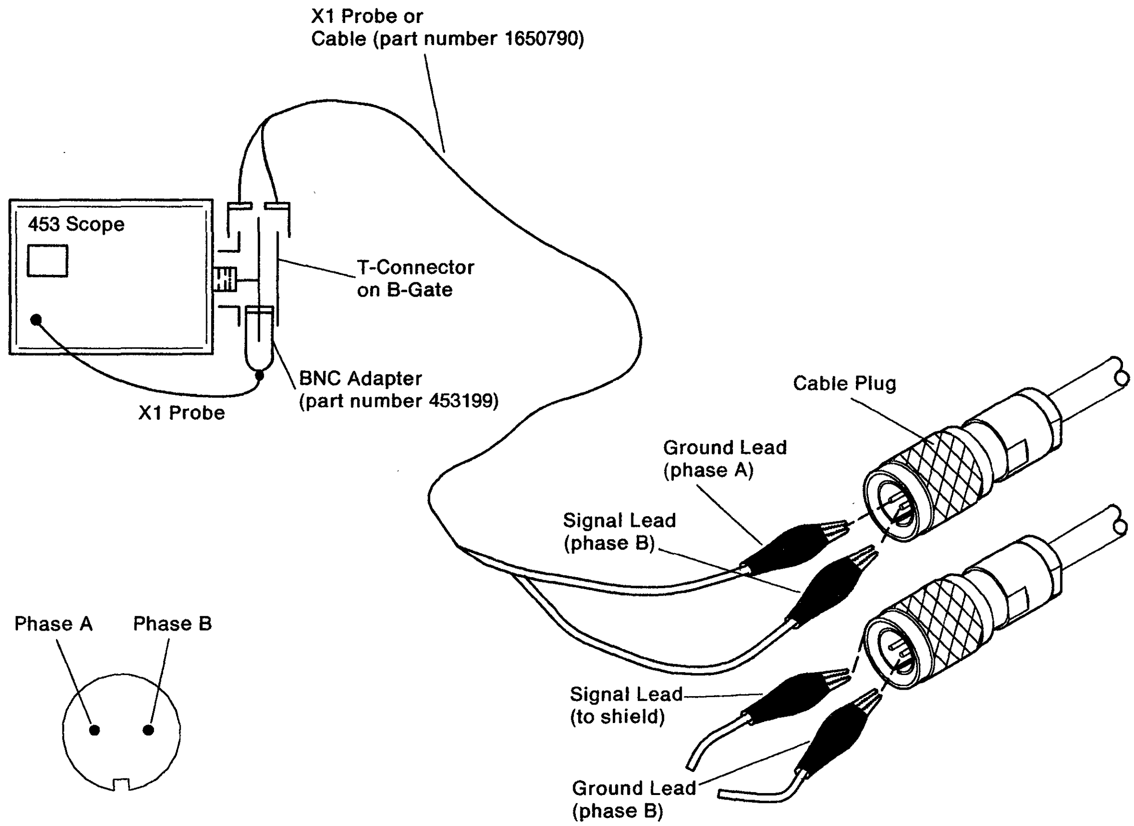



Figure 3-58. Oscilloscope Setup

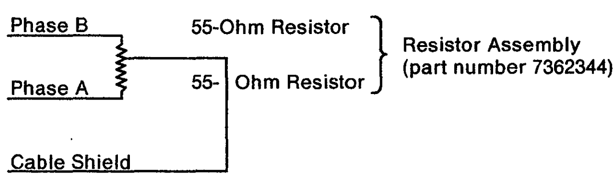



Figure 3-59. Terminating a Cable

## Oscilloscope Settings

Set the oscilloscope as follows:

- Mode to Channel 1
- Trigger to Channel 1 Only
- Volt/Div to 0.2 V (initial setting)
- Input to AC.

Set A triggering as follows:

- Level to full counterclockwise
- A-Sweep Length to Full
- Horiz Display to Delayed Sweep (B)
- B-Sweep Mode to B Starts after Delay Time
- A-Sweep Mode to Auto Trig
- Delay-Time Multiplier dial fully clockwise (9.5).

Set A- and B-time/division as follows:

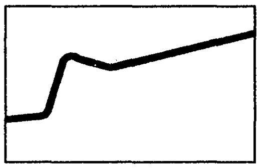
- A to 10 microseconds
- Pull to unlock
- B to 0.1 microseconds.

Then adjust as follows:

- Adjust the A triggering level for a stable display.
- Adjust the Delay Time to set the rise time of the B-gate pulse (left edge) at the left side of the oscilloscope.

## Adjusting the Oscilloscope for the Correct Display

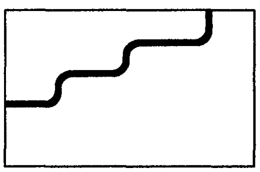
If no reflection displays (as shown in Figure 3-60), you may be looking at the first good part of a long cable with the fault; that is, a cable longer than 100 meters (328 feet).



B-sweep time / div = 0.1 µs / div

Figure 3-60. No Reflection

If multiple reflections display (as shown in Figure 3-61), the fault is less than 50 meters (164 feet) from your end of the cable, or the B-time base is not set correctly.



B-sweep time/div = 0.1 µs/div

Figure 3-61. Multiple Reflections

Increase the B-time/div from 0.1 to 0.2 or higher until a reflection displays; or, decrease the B-time/div to 0.05 so only a single reflection displays (as shown in Figure 3-62).

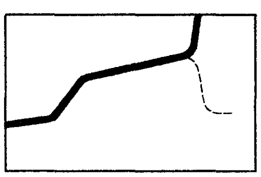


Figure 3-62. Single Reflection

Once the reflection displays, you must short the opposite end of the cable. If the displayed reflection changes by 180 degrees, you are seeing the other end of the cable. If the displayed signal does not change when the opposite end is shorted, the signal reflection is caused by a fault in the cable.

**Consider the following when you do the tests:**

- To determine the length of the cable, it is recommended that you start with the remote end of the cable open (unplugged).
- You can use 110 Ω resistor or a resistor assembly (IBM part number 7362344) to terminate the line, or you can terminate the line by plugging the cable into a work station and setting the work station terminator switch to 1.
- You can connect short cable segments up to a maximum length of 1524 meters (5000 feet).
- Look for a bad reflection. 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 0.1-microsecond setting equals 9.9 meters (32.47 feet)/div for a solid poly cable.
  - The 2-microsecond setting equals 198 meters (649.4 feet)/div for a solid poly cable.
- To magnify small changes, adjust the Channel 1 position knob and Channel 1 volts/div to a lower setting.
- Major faults at long distances can cause reflections no larger than smaller faults close to the test end of the cable.
- After finding mismatches, you can measure close to the fault to describe it more accurately.
- Faults too close to the tested end of the cable, within 6 meters (20 feet), cause reflections to occur within the rise time of the oscilloscope. Test from both ends of the cable if no clear reflection of the fault is displayed.

**Note:** The 6-meter (20-foot) measurement is approximate and depends on the oscilloscope that you use.

**Oscilloscope Display Examples:** See Figure 3-63 on page 3-134 through Figure 3-69 on page 3-135.

Figure 3-63 on page 3-134 shows a good cable that is 155.5 meters (510 feet) long. A gradual upward slope of the displayed signal is normal after the first division and appears as a higher upward slope as the B-sweep time increases.

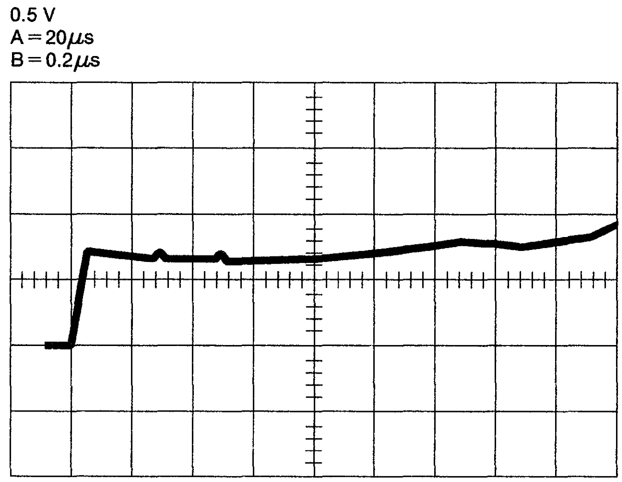



Figure 3-63. Normal Cable (Properly Terminated)

Figure 3-64 shows a cable that is shorted at the end to show downward reflection and length.

```
Length of sweep = 7.8 div
B setting = 0.2 µs/div
7.8 × 0.2 = 1.56 µs
1.56 × 99 = 154 meters or
1.56 × 324.7 = 507 feet
```

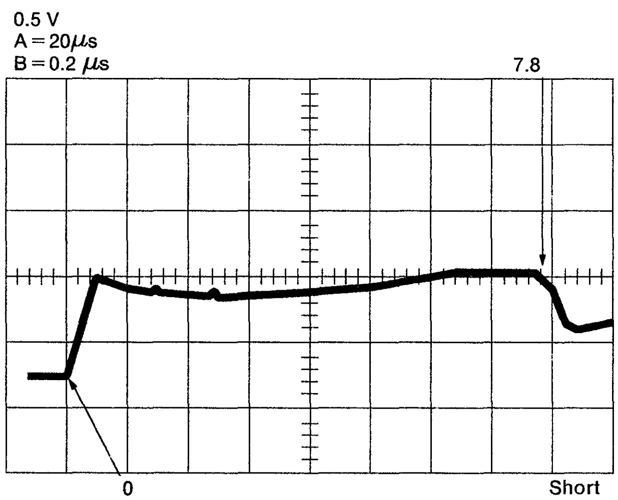



Figure 3-64. Shorted Cable

Figure 3-65 is the same as Figure 3-64 but with a higher vertical gain (0.2V/div).

The 0 points to start. Notice the two wrinkles a 1.3 and 2.5 divisions from the start. They represent very small mismatches at the work station connectors. These mismatches are at a distance of 26 meters (85 feet) and 50 meters (164 feet) from the start.

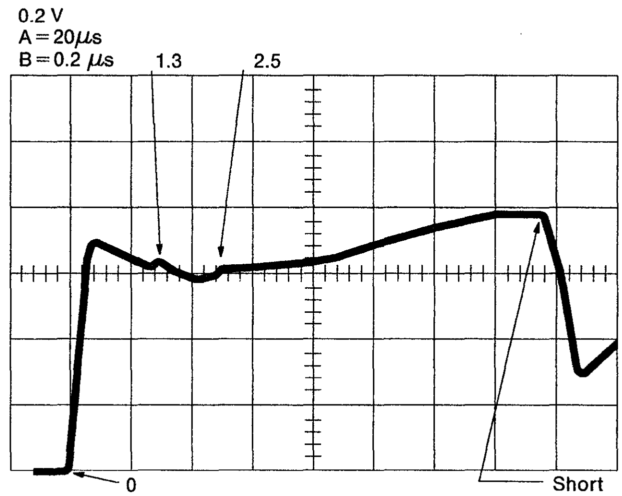



Figure 3-65. Shorted Cable (Higher Vertical Gain)

Figure 3-66 is the same as Figure 3-64 but with an open end. This is an effective way to measure the length of a cable.

The bumps at 1.3 and 2.5 indicate work station connectors. The large bump at 2.5 indicates a larger mismatch (poor connection) than at 1.3.

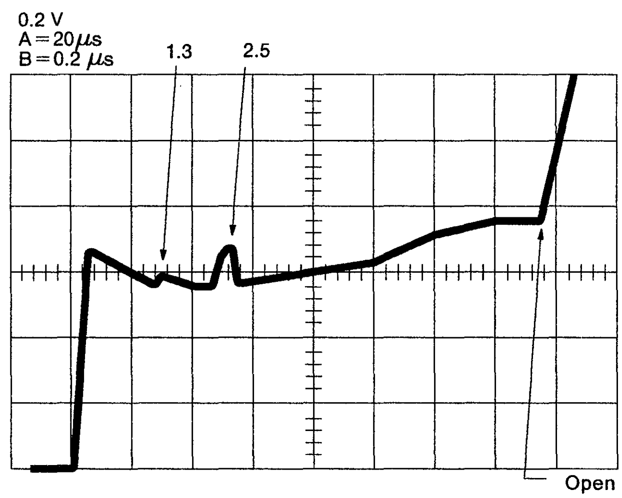



Figure 3-66. Open Cable

Figure 3-67 on page 3-135 is not a correct display of cable reflections. The multiple reflections are at 26 meters (85 feet) of a good cable with an open end. This display is caused by the wrong vertical gain setting (0.5 V/div) and the wrong B-time/div.

Only the first reflection in this figure is important and should be magnified by changing the vertical gain to 0.2 V/div and B-time to 0.05 μs/div.

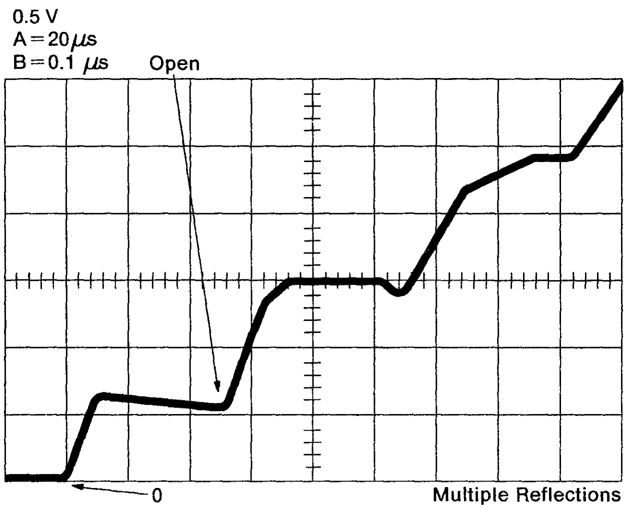



Figure 3-67. Open Cable (Wrong Oscilloscope Setting)

Figure 3-68 shows a 155-meter (510 feet) cable with one wire shorted to shield at approximately 78 meters (255 feet). The end is left open. This scope figure is valid for the twinaxial cable only.

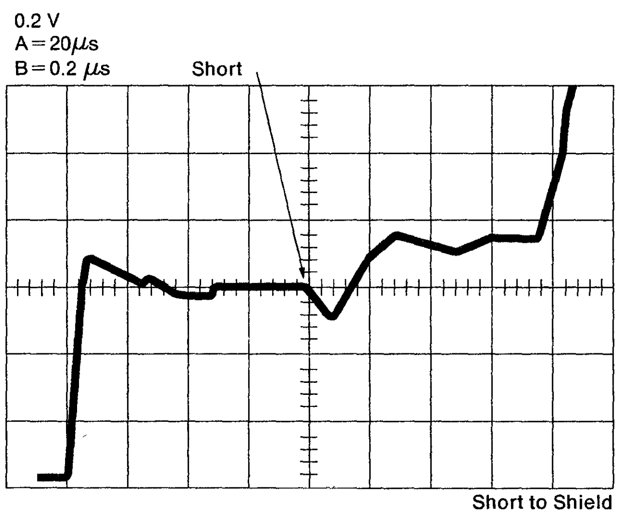



Figure 3-68. Short to Shield

Notice the steep slope changes at the arrow.

A reflection of more than 10 percent of the transmitted signal, if measured within 100 meters (328 feet) of the fault, usually indicates an undesirable impedance change.

Figure 3-69 shows the same condition as in Figure 3-68 but with the alligator clips interchanged. In this figure, the same short shows up much better, because of the incident wave signal being referenced to ground.

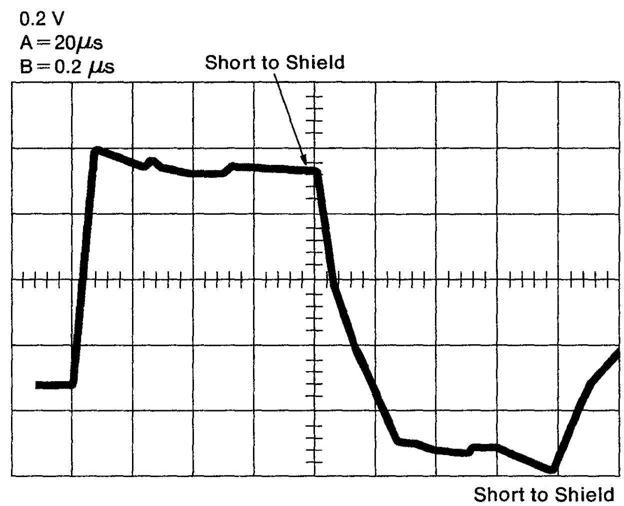



Figure 3-69. Short to Shield (Oscilloscope Leads Swapped)

## Line Continuity and Polarity Reversal Tests

You can use the following guide for testing line continuity and polarity reversals. The checks are for single line segments; however, you could use them for a complete line if the station junctions are connected by a line adapter or an IBM 5250 unit that has cable-thru (if the power is off).

### Line Continuity

The only tools you need for line continuity checks are an ohmmeter and jumpers to connect between the connector pins (signal lines) and the connector body (cable shield). When you make the following checks, all resistances should be less than the indicated values. These values apply to a 5000-foot cable. Corresponding values for shorter cables are proportionately smaller.

With both ends of the cable open and the cable not plugged into a machine, measure (at either end):

- Line to line, higher than 100 000 Ω.
- Each line to shield, higher than 100 000 Ω.

With both lines tied to the shield at the far end, measure (at nearest end):

- Line to line, less than 110 Ω.
- Each line to shield, less than 70 Ω.

### Line Polarity

After testing the line continuity and making any necessary corrections, check the polarity as follows using Figure 3-70.

With the line **A** tied to the shield at the far end, measure (at the nearest end):

- Line **A** to shield, less than 70 Ω. (If over 70 Ω, lines are crossed.)

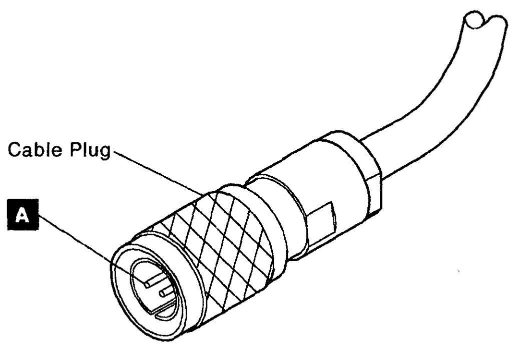



Figure 3-70. Twinaxial Cable Plug

## Work Station Twinaxial Interface Check

Do the following to check the twinaxial interface at the work station:

1. Switch the work station power off.
2. For work stations with only one twinaxial socket and no T-connector (without cable-thru), remove the twinaxial cable and go to step 9.
3. For work stations with two twinaxial sockets (with cable-thru), go to step 4.
4. Remove any connector from both work station twinaxial sockets.
5. Set the terminator switch (if present) to position 2 (not terminated). If you make this check on a 3180 display station, push in and hold the center pin on socket 2 while you make the check.
6. Check for the following resistances at *socket 1* using Figure 3-71 on page 3-137 and Table 3-51, setting the ohmmeter to a range of 1 or higher.

Table 3-51. Conductor-to-Conductor Check With Switch in Position 2.

| Positive | | Negative | |
|---|---|---|---|
| Phase A | to | phase B | > 50k Ω |
| Phase B | to | phase A | > 50k Ω |
| Phase A | to | shield | > 2000 Ω |
| Phase B | to | shield | > 2000 Ω |
| Shield | to | phase A | > 50k Ω |
| Shield | to | phase B | > 50k Ω |

7. Check for the following resistances using Figure 3-71 on page 3-137 and Table 3-52, setting the ohmmeter to the X1 scale.

Table 3-52. Socket-to-Socket Check With Switch in Position 2

| Socket 1 | | Socket 2 | |
|---|---|---|---|
| Phase A | to | phase A | < 1 Ω |
| Phase B | to | phase B | < 1 Ω |

8. Set the terminator switch (if present) to position 1 (terminated position). If you make the check on an IBM 3180 display station, the terminator is automatically on when you remove the cable from socket 2.
9. Check for the following resistances at *socket 1* using Figure 3-71 on page 3-137 and Table 3-53 on page 3-137, setting the ohmmeter to the X10 scale.

| Table 3-53. Conductor-to-Conductor Check With Switch in Position 1 | | | |
|---|---|---|---|
| **Positive** | | **Negative** | |
| Phase A | to | phase B | 100 to 200 Ω |
| Phase B | to | phase A | 100 to 200 Ω |
| Phase A | to | shield | 50 to 60 Ω |
| Phase B | to | shield | 50 to 60 Ω |
| Shield | to | phase A | 50 to 60 Ω |
| Shield | to | phase B | 50 to 60 Ω |

10. Skip this step for work stations that do not have cable-thru. Otherwise, check the following resistances using Figure 3-71 and Table 3-54, setting the ohmmeter to the 1k scale or higher.

| Table 3-54. Socket-to-Socket Check With Switch in Position 1 | | | |
|---|---|---|---|
| **Socket 1** | | **Socket 2** | |
| Phase A | to | phase A | > 100k Ω |
| Phase B | to | phase B | > 100k Ω |

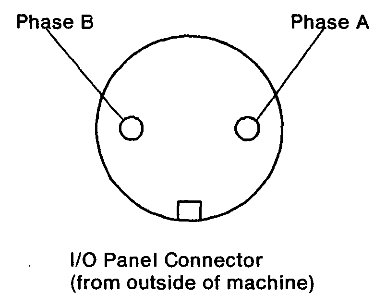



Figure 3-71. I/O Panel Connector

## IBM Cabling System Tests

This section contains tests for accessories used with the IBM Cabling System. The tests are:

- Impedance matching device or direct-connect cable check
- Twinaxial Y test
- Twinaxial terminator assembly test.

### Impedance Matching Device or Direct-Connect Cable Check

Figure 3-72 shows an impedance matching device.

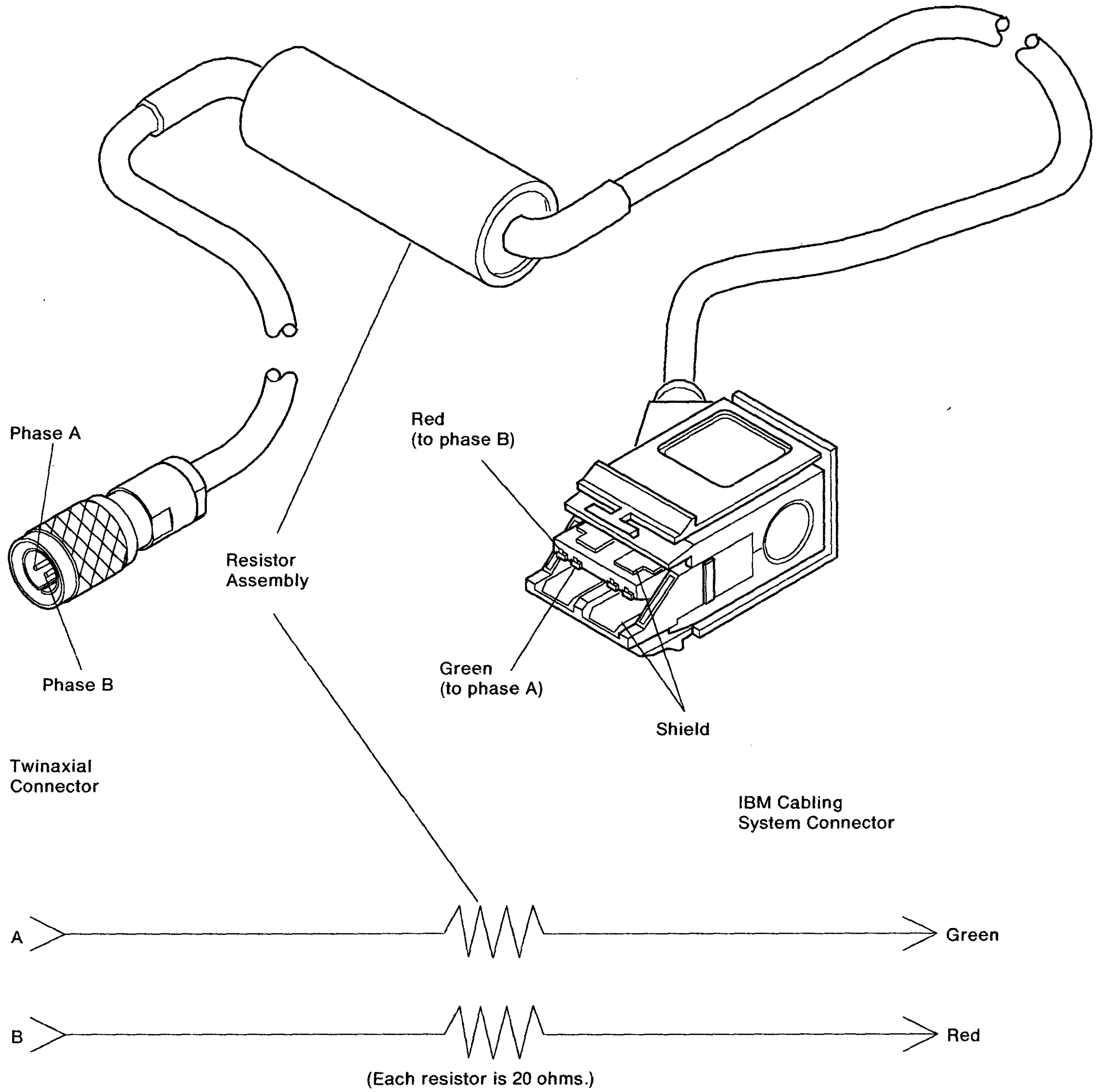



Figure 3-72. Impedance Matching Device

**Note:** The resistor assembly is not present for direct-connect cables.

Use the following procedure to test the IMD or direct-connect cable:

1. Install a test connector (see Figure 3-73) on the IBM Cabling System connector of the impedance matching device or direct connect cable.

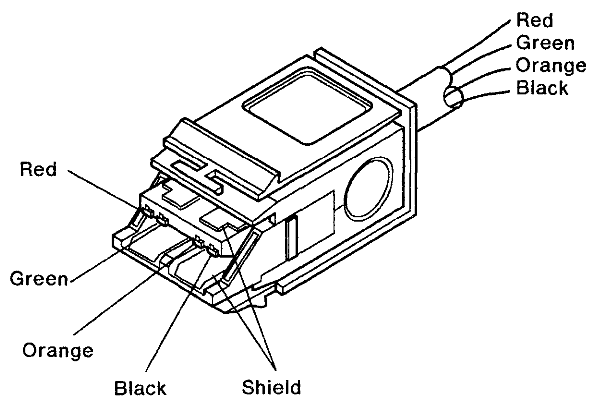



Figure 3-73. Test Connector

2. Check for resistances in Table 3-55.

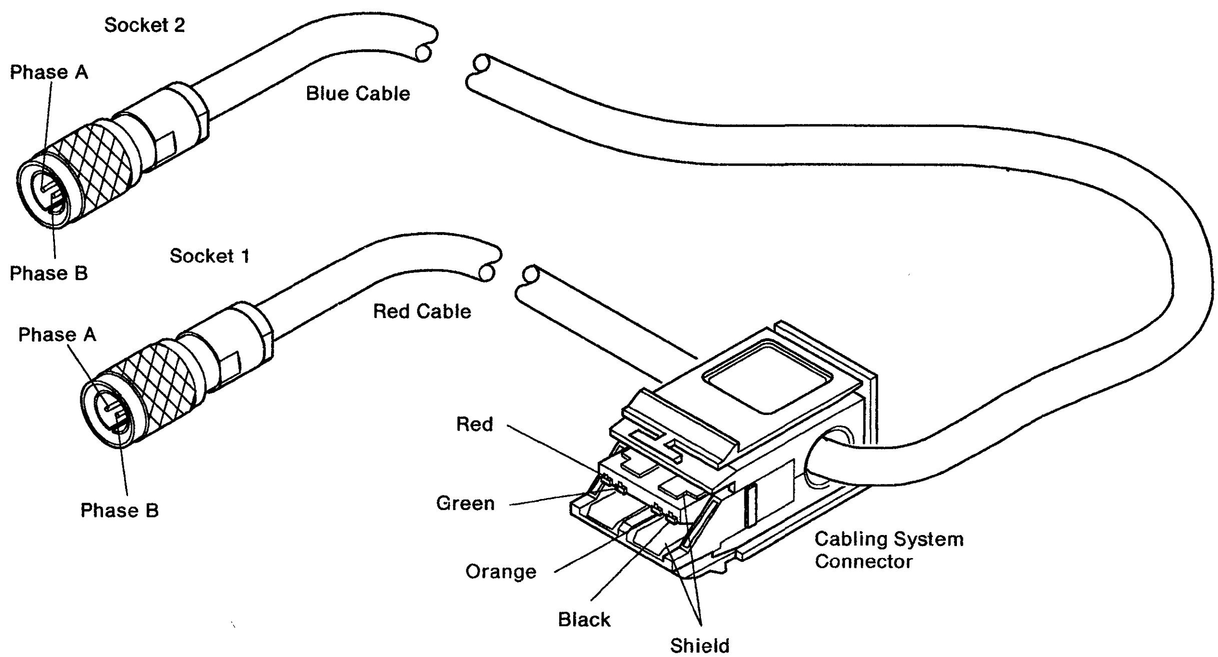
Table 3-55. IMD or Direct-Connect Cable Check

| Measure Resistance From | Resistance Measurement | |
|---|---|---|
| | **Impedance Matching Device** | **Direct Connect Cable** |
| Phase A to green | 18 to 22 Ω | < 1 Ω |
| Phase B to red | 18 to 22 Ω | < 1 Ω |
| Phase A to B | > 100k Ω | > 100k Ω |
| Phase A to shield | > 100k Ω | > 100k Ω |
| Phase B to shield | > 100k Ω | > 100k Ω |
| Twinaxial shield to cabling system shield | < 1 Ω | < 1 Ω |

## Twinaxial Y Test

A twinaxial Y is shown in Figure 3-74 on page 3-140.

**Note:** All cabling system connectors are equipped with shorting bars that function as the switches in the schematic. The contacts are open when the connector is plugged in.



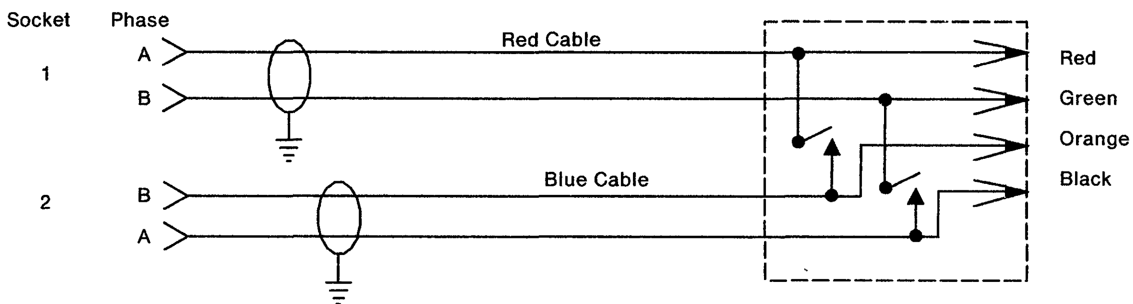




Figure 3-74. Twinaxial Y

Use the following procedure to test the twinaxial Y:

1. Install a test connector on the IBM Cabling System connector of the Y as shown in Figure 3-74.
2. Check for the resistances in Table 3-56.

Table 3-56. Twinaxial Y Test

| Measure Resistance From | Resistance Measurement |
|---|---|
| Phase A of red cable to green test lead | $< 1\,\Omega$ |
| Phase B of red cable to red test lead | $< 1\,\Omega$ |
| Phase A of blue cable to black test lead | $< 1\,\Omega$ |
| Phase B of blue cable to orange test lead | $< 1\,\Omega$ |
| Twinaxial shield to cabling system shield | $< 1\,\Omega$ |
| Phase A of red cable to phase B of red cable | $> 100\text{k}\,\Omega$ |
| Phase A of blue cable to phase B of blue cable | $> 100\text{k}\,\Omega$ |
| Each phase lead to shield | $> 100\text{k}\,\Omega$ |

## Twinaxial Terminator Assembly Test

The twinaxial terminator assembly is shown in Figure 3-75.

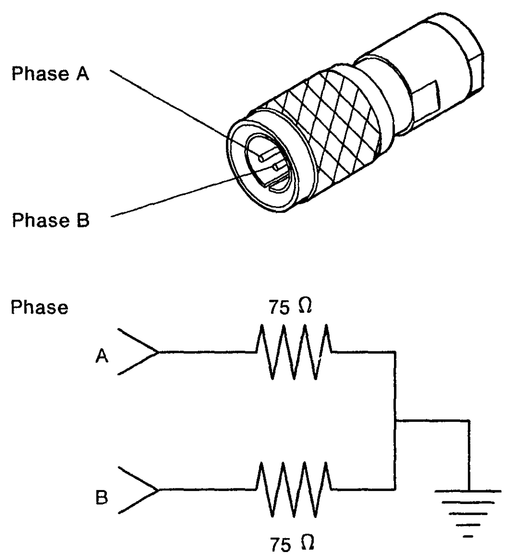



Figure 3-75. Twinaxial Terminator Assembly

To test the twinaxial terminator assembly check for the resistances in Table 3-57.

Table 3-57. Twinaxial Terminator Assembly Test

| Measure Resistance From | Resistance Measurement |
|---|---|
| Phase A to phase B | 150 Ω ± 10% |
| Phase A to shield | 75 Ω ± 10% |
| Phase B to shield | 75 Ω ± 10% |

## IBM Cabling System Data Path Tests

This section contains the test procedures for the IBM Cabling System data paths and includes the following:

- Test for cable drop from distribution panel to control unit
- Test for cable drop from distribution panel to work stations except the last work station on the data path
- Test for cable drop to last work station on the data path
- Test for cable drop between distribution panels.

A typical IBM Cabling System data path is shown in Figure 3-76. A test connector like the one shown in Figure 3-73 on page 3-139 is needed for these tests.

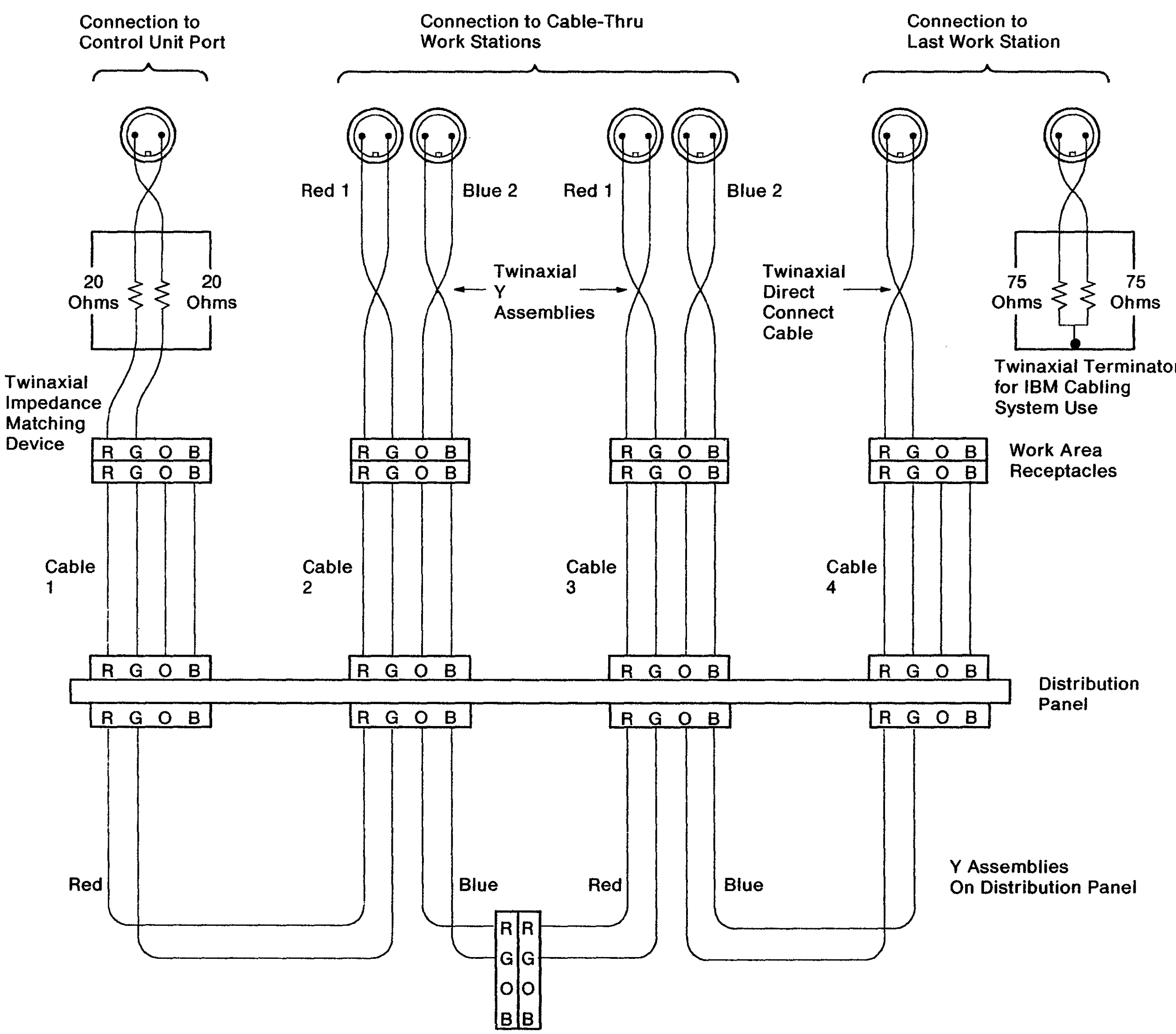



Figure 3-76. Schematic of a Simple IBM Cabling System Installation Using Twinaxial Accessories

## Test for Cable Drop from Distribution Panel to Control Unit

**Warning:** To prevent destroying any active jobs, make sure that you do not unplug the connectors for any data path other than the one being checked.

Use the following procedure to test the cable drop from the distribution panel to the control unit.

1. Make sure that you disconnect the control unit from the cabling system at the cabling system wall connector.
2. Go to the distribution panel and do the following steps using Figure 3-77:

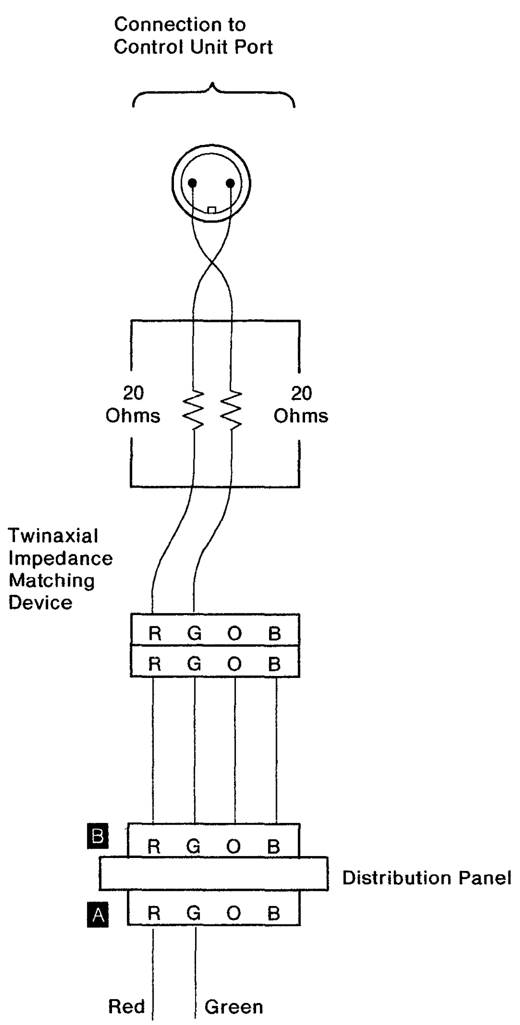



Figure 3-77. Testing Cable Drop from the Distribution Panel to the Control Unit

a. Make sure that all connectors are properly labeled so that you can restore the original configuration.

b. Disconnect the red cable of the Y (or the jumper cable) **A** that connects to the cable drop **B** going to the control unit.

c. Install a test connector on the cable drop going to the control unit at **B**.

d. Check for the resistances in Table 3-58.

**Note:** For a continuity test only, use only the first two connections shown in Table 3-58.

Table 3-58. Distribution Panel to Control Unit

| **Connect Meter Leads As Shown Below** | | **Normal Resistance** |
|---|---|---|
| **Positive** | **Negative** | |
| Red | Orange | 0 to 14 Ω* |
| Green | Black | 0 to 14 Ω* |
| Red | Green | > 5000 Ω |
| Green | Red | > 5000 Ω |
| Shield | Red | > 5000 Ω |
| Shield | Green | > 5000 Ω |

* If surge suppressors are installed on the line, the normal resistance is 36 to 54 Ω.

## Test for Cable Drop from Distribution Panel to Work Stations Except the Last Work Station on the Data Path

Use the following procedure to test the cable drop from the distribution panel to the work station:

1. Install a test connector on the red cable of the Y that is connected to the cable drop to be tested.
2. Install a test connector on the blue cable of the Y that is connected to the cable drop to be tested.

   **Note:** The test connectors are not required for this test but are recommended for ease of connection.

3. Check for the resistances in Table 3-59 on page 3-144.

   **Note:** For a continuity test only, use only the first two connections shown in Table 3-59 on page 3-144.

| Table 3-59. Distribution Panel to Work Stations Except Last Work Station | | |
|---|---|---|
| **Connect Meter Leads As Shown Below** | | **Normal Resistance** |
| **Positive at Red Cable** | **Negative at Blue Cable** | |
| Red | Red | 0 to 14 Ω* |
| Green | Green | 0 to 14 Ω* |
| Red | Green | > 5000 Ω |
| Green | Red | > 5000 Ω |
| Shield | Red | > 5000 Ω |
| Shield | Green | > 5000 Ω |
| * If surge suppressors are installed on the line, the normal resistance is 36 to 54 Ω. | | |

## Test for Cable Drop to Last Work Station on the Data Path

Use the following procedure to test the cable drop to the last work station of the data path:

1. Install the test connector on the cable drop to the last work station.
2. Check for the resistances in Table 3-60.

| Table 3-60. Last Work Station | | |
|---|---|---|
| **Connect Meter Leads As Shown Below** | | **Normal Resistance** |
| **Positive** | **Negative** | |
| Red | Green | 140 to 180 Ω* |
| Shield | Red | 65 to 95 Ω* |
| Shield | Green | 65 to 95 Ω* |
| * If surge suppressors are installed on the line, the normal resistance is 175 to 225 Ω for red to green and 90 to 110 Ω for red or green to shield. | | |

3. If only the last work station is failing, do the following steps:
   a. Disconnect the last work station from the cabling system at the cabling system wall connector.
   b. Check for the resistances in Table 3-61.

| Table 3-61. Last Work Station Failing | | |
|---|---|---|
| **Connect Meter Leads As Shown Below** | | **Normal Resistance** |
| **Positive** | **Negative** | |
| Red | Orange | 0 to 14 Ω* |
| Green | Black | 0 to 14 Ω* |
| Red | Green | > 5000 Ω |
| Green | Red | > 5000 Ω |
| Shield | Red | > 5000 Ω |
| Shield | Green | > 5000 Ω |
| * If surge suppressors are installed on the line, the normal resistance is 36 to 54 Ω. | | |

## Test for Cable Drop between Distribution Panels

Use the following procedure to test the cable drop between the distribution panels:

1. Disconnect the Y (or jumper cable) that is connected to the cable drop between panels at the distribution panel that is nearest to the control unit.
2. Go to the distribution panel at the other end of the cable drop and disconnect any Y (or jumper cable) connected at that end.
3. Install a test connector on the cable drop between panels at the distribution panel most distant from the control unit.
4. Check for the resistances shown in Table 3-62.

   **Note:** For a continuity test only, use only the first two connections shown in Table 3-62.

| Table 3-62. Between Work Stations | | |
|---|---|---|
| **Connect Meter Leads As Shown Below** | | **Normal Resistance** |
| **Positive** | **Negative** | |
| Red | Orange | 0 to 135 Ω* |
| Green | Black | 0 to 135 Ω* |
| Red | Green | > 5000 Ω |
| Green | Red | > 5000 Ω |
| Shield | Red | > 5000 Ω |
| Shield | Green | > 5000 Ω |
| * Resistance for surge suppressors has been included. Without surge suppressors, the normal resistance is 0 to 105 Ω. | | |

# Chapter 4. Service Aids

This chapter contains the following:

- Descriptions of test equipment normally available during field service
- Information about tools available from a branch office
- A series of maintenance topics that apply to some versions of the 5394.

## Standard CE Test Equipment

The only test equipment needed for most procedures in this book are a logic probe and a multimeter. The following pages describe the test equipment normally available to CEs during field service.

### General and Integrated Logic Probes

The general and integrated logic probes are described on the following pages. Figure 4-1 and Figure 4-2 on page 4-2 illustrate these logic probes.

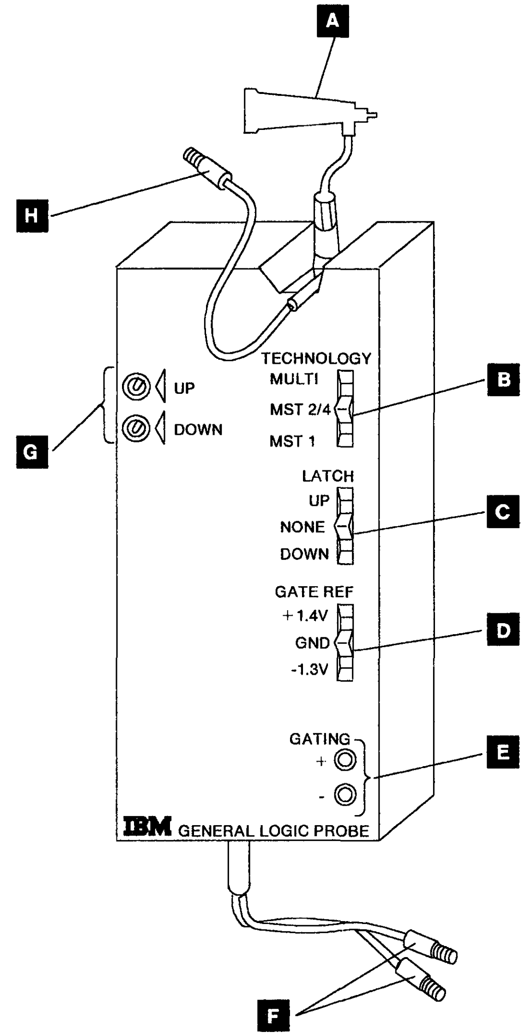



Figure 4-1. General Logic Probe

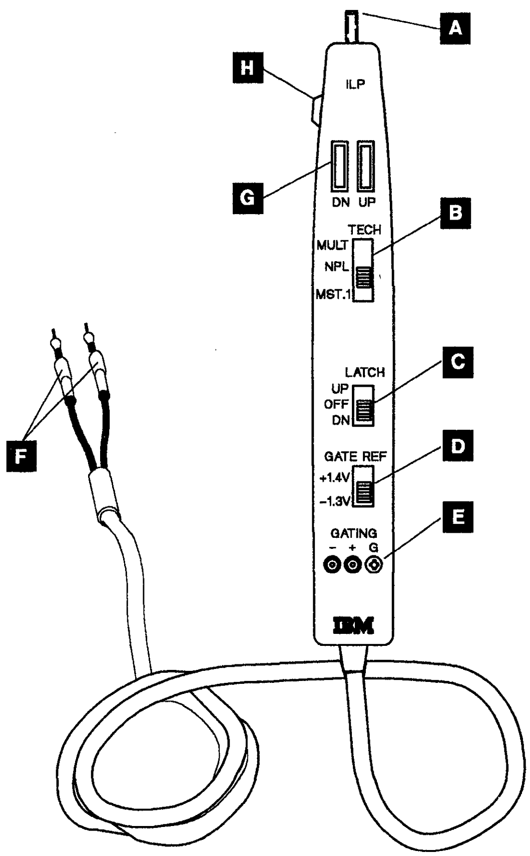



Figure 4-2. Integrated Logic Probe

## Controls and Indicators

To use the general or integrated logic probe, see Figure 4-1 on page 4-1 or Figure 4-2. The controls and indicators on these logic probes are described as follows:

**A** **Signal input lead**

Connect this lead to the line being probed.

**B** **Technology (Tech) switch**

Set this switch to MULTI (MULT).

**C** **Latch switch**

The NONE position on the general logic probe or the OFF position on the integrated logic probe is used for most of the probing in the control unit.

**D** **Gate Ref switch**

On the general logic probe, set this switch to GND; on the integrated logic probe, set this switch to +1.4 V unless a different setting is given in the MAPs.

**E** **Gating terminals**

These terminals are not normally used for probing in the control unit. The MAPs will specify connection when needed.

**F** **Power leads**

Connect the power leads to the test connector on the planar. See Figure 4-3. Connect the red lead to + 5 VDC and the black lead to GND.

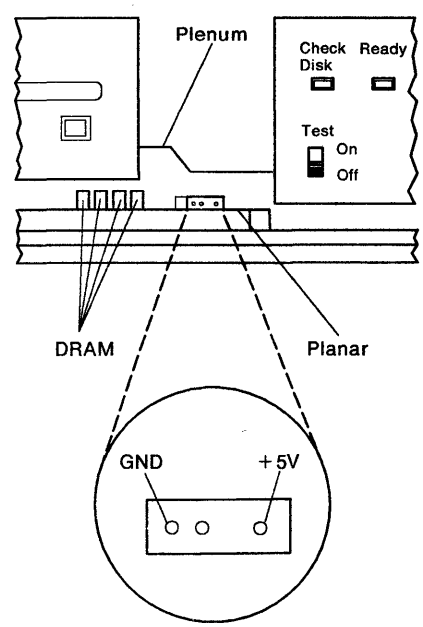



Figure 4-3. Test Connector Location

**G** **Indicators**

Indicates one of four conditions in the table below:

| **Condition** | **Lights** Up | Down |
|---|---|---|
| Correct logical up level (+) | On | Off |
| Correct logical down level (-) | Off | On |
| Pulsing between valid levels | flashing | flashing |
| (See note) | On | flashing |
| Signal level not valid | Off | Off |

**Note:** This indication is for high-frequency signals.

**H** **Signal ground lead**

Connect this lead to a frame ground point near the signal probe point.

## Accessories

You may need to use the following accessories with the logic probes:

| Accessories | IBM Part Number |
|---|---|
| Extender cable (general logic probe only) | 453605 |
| SLT ground tip | 453167 |
| SLT probe tip | 453826 |
| 6/32 pin tip | 461091 |
| Alligator clip | 461159 |
| Ground lead | 5500900 |
| Probe tip | 453718 |

# Meter

Some of the procedures in this book require a meter. For these procedures, use the digital multimeter (IBM part number 8496278) shown in Figure 4-4. This meter comes with a lead set (IBM part number 6428104).

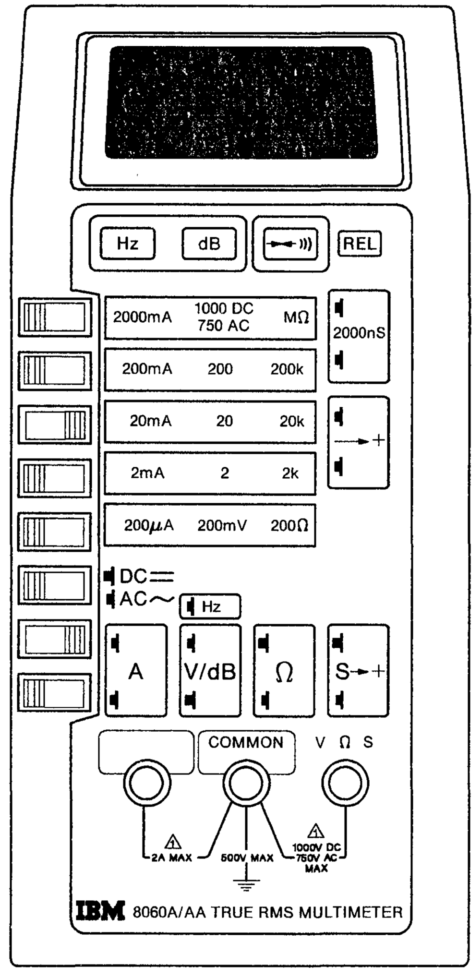



Figure 4-4. Digital Multimeter

# Special Tools

You may need the following special tools for testing:

| Tool | IBM Part Number |
|---|---|
| EIA interface tester | 453637 |
| Work Station Controller Port Tester | 59X4200 |
| EIA wrap plug | 6423419 |

## EIA Interface Tester

You can use an EIA interface tester (IBM part number 453637) to examine individual signal lines of an EIA 232D interface.

## EIA Wrap Plug

You can use this wrap plug (IBM part number 6423419) to isolate a failure to the EIA 232D cable.

## Port Tester

You can use the IBM Work Station Controller Port Tester (IBM part number 59X4200) to isolate cabling and port problems on the 5394. The port tester is shown in Figure 4-5 on page 4-5.

Attach the port tester directly to one of the following:

- A twinaxial control unit port or cable
- A twisted-pair control unit port or cable
- The twinaxial adapter on an IBM Cabling System.

The port tester monitors signals from the twinaxial ports on the 5394. Cables being checked must be connected to a 5394 twinaxial port.

**DANGER**

| |
|---|
| **Do not use the port tester during electrical storms.** |

**Warning:** Remove and connect cables carefully. You may damage connectors if you use force.

### Twinaxial Test

1. Move the Selector switch to the left (1) position.
2. Attach the appropriate port tester twinaxial connector to the port or cable you are testing, or to a twinaxial adapter attached to the port or cable you are testing.

   **Note:** If the twinaxial plug is needed, remove the twinaxial cable from the twinaxial cable holders located on the side of the port tester.
3. Push and hold the test button for 15 seconds or until one of the following occurs:
   - Only the green light comes on. This indicates that the port or cable between the port tester and the control unit is good.
   - Only the yellow light comes on. This indicates that the wires in the cable are reversed somewhere between the port tester and the control unit.
   - Neither the green nor yellow light comes on. This indicates that there is no signal on the cable between the port tester and the control unit.

     This can also indicate that:
     - The Selector switch is in the wrong position.
     - The port tester is attached to the wrong port or cable.
     - The attachment to the port or cable is not secure.
   - Both the green and yellow lights come on. This indicates that either the selector switch is in the self-test position or the port tester is not working properly.
4. Remove the port tester connector from the cable or port you tested.
5. If the twinaxial plug was used, put the twinaxial cable back into the twinaxial cable holders.

### Twisted-Pair Test

1. Move the Selector switch to the right (2) position.
2. Attach the appropriate port tester twisted-pair connector to the port or cable you are testing.

   **Note:** If you need the twisted-pair plug, remove it from the twisted-pair cable compartment located at the bottom of the port tester.
3. Push and hold the test button for 15 seconds or until one of the following occurs:
   - Only the green light comes on. This indicates that the port or cable between the port tester and the control unit is good.
   - Only the yellow light comes on. This indicates that the wires in the cable are reversed somewhere between the port tester and the control unit.
   - Neither the green nor yellow light comes on. This indicates that there is no signal on the cable between the port tester and the control unit.

     This can also indicate that:
     - The selector switch is in the wrong position.

- The port tester is attached to the wrong port or cable.
- The attachment to the port or cable is not secure.

- Both the green and yellow lights come on. This indicates that either the selector switch is in the self-test position or the port tester is not working properly.

4. Remove the port tester connector from the cable or port you tested.
5. If you used the twisted-pair plug, put the twisted-pair cable back into the twisted-pair cable compartment.

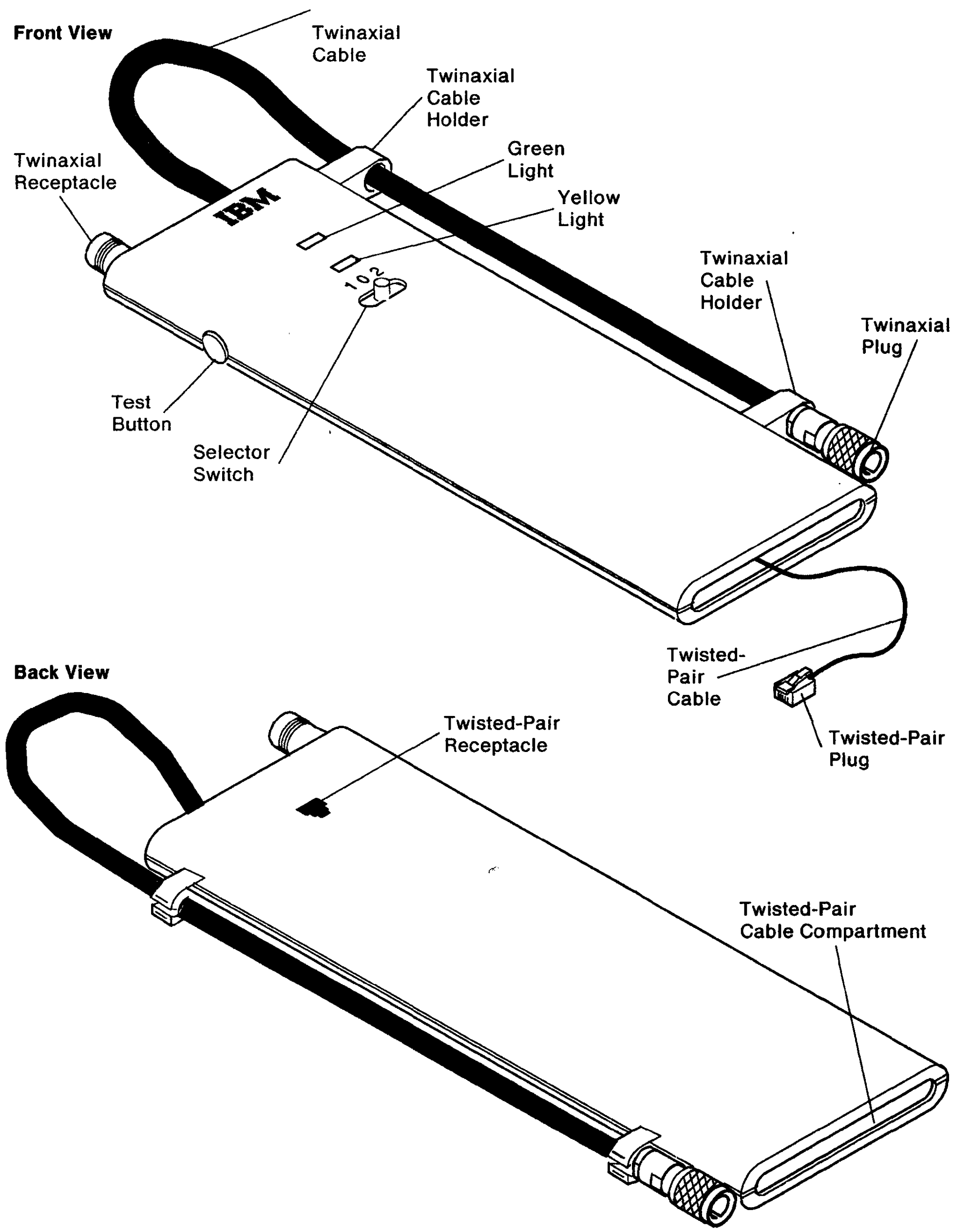



Figure 4-5. Port Tester

## Special Maintenance Topics

Since the original issue of this book, the 5394 has undergone several design changes to improve reliability and serviceability. Some of these changes affect the application of maintenance procedures for certain versions of the 5394. You should read the following topics to determine if you are servicing a control unit that requires special treatment.

### Power Supply

Some early production power supplies produce a high voltage transient on the +5 VDC line when the primary voltage is interrupted for a brief interval and then restored. Because this transient can cause DRAM failure following a power outage, these units have a protective device (clamping diode) attached to the logic probe connector on the planar.

If you are testing a 5394 that has one of these devices, you can remove it temporarily to permit use of the logic probe. However, you must replace the protective device before the end of the service call.

If you are replacing a planar that has one of these protective devices, remove the device from the old planar and install it in the same orientation on the new planar.

If you are servicing a 5394 that has had repeated DRAM failures, check to see if the protective device has been installed. If the planar does not have the protective device, and if the DRAM failures occurred immediately after power outages, replace both the defective DRAM and the power supply.

**Note:** The overvoltage transient has been corrected on new power supplies, so the protective device is not installed in current production versions of the 5394.

### Communication Cables

There are two functionally equivalent EIA 232D communication cables. One version of this cable has a single Test/Oper (wrap) switch, and the other has two switches. Because both versions of this cable are being used in the field, you must remember the following:

- To run a cable wrap test on a cable with two switches, both switches must be in the Test position before you start the test.
- For any other phase of operation, all cable switches must be in the Oper position.

### Diskette Drive

Diskette error recovery has been enhanced by the microcode for Release 1.1 and later. The enhancements include additional read retries and read verify after write, which produce a significant improvement in reliability.

Dust and other contaminants tend to accumulate on the read/write head during long periods of inactivity. Because these contaminants can damage the diskette, the current microcode drives the head to an unused area (track 60) when no diskette activity is in progress. As a result, this track generally becomes scratched over a period of time. However, the extended diskette diagnostics in ROS have also been changed so that only used tracks are checked. As a result, the 5394 ignores all effects of scratches or debris on track 60.

### Twinaxial Ports

Machines that support the V.35 communication interface use an improved twinaxial driver for the work station ports. While the new circuit can drive low amplitude signals through long cables more reliably, it also responds differently to shorted or grounded cables:

- Machines without the V.35 interface report TAC errors when driving a shorted twinaxial cable.
- Machines with the new driver circuit do not detect shorts in the external cables.
- All machines report TAC errors when the driver or receiver circuits on the planar are failing.

# Chapter 5. Theory

## Introduction

This chapter explains the operational theory of the IBM 5394, including a functional description of the control unit and descriptions of supported communication functions.

## Control Unit Description

The 5394 provides access to the host system from a remote site. Using a 5394, work stations can share the resources of a host system over a communication network. The control unit communicates with the host system through common carrier data communication facilities using Systems Network Architecture (SNA) in combination with Synchronous Data Link Control (SDLC) or X.25. Communication between the control unit and the work stations is by twinaxial or twisted-pair cable using IBM twinaxial protocol.

The control unit is available in several models, which differ in the type of physical interface and the number of work stations supported. Although all models use the same 25-pin connector at the rear of the unit, each type of communication cable has a different combination of signal lines. Because compliance with interface standards occurs only at the DCE end of the 5394 communication cable, only communication cables intended for use with the 5394 should be attached to this connector.

The 5394 supports the following communication interfaces:

- ANSI EIA 232D
- V.35
- X.21 bis
- X.21.

Models 01A and 02A support up to four work stations. Models 01B and 02B support up to 16 work stations.

The control unit has three twinaxial ports, which can support a maximum of seven work stations each. The 5394 can also be configured to emulate an IBM 5294 attached to an IBM System/36 or System/38. In Emulation mode, the 5394 supports a maximum of eight work stations.

The maximum length of twinaxial cable attached to any port is 1525 meters (5000 feet). Twisted-pair cable runs should not exceed 305.8 meters (1000 feet).

A typical 3-port configuration is shown in Figure 5-1.

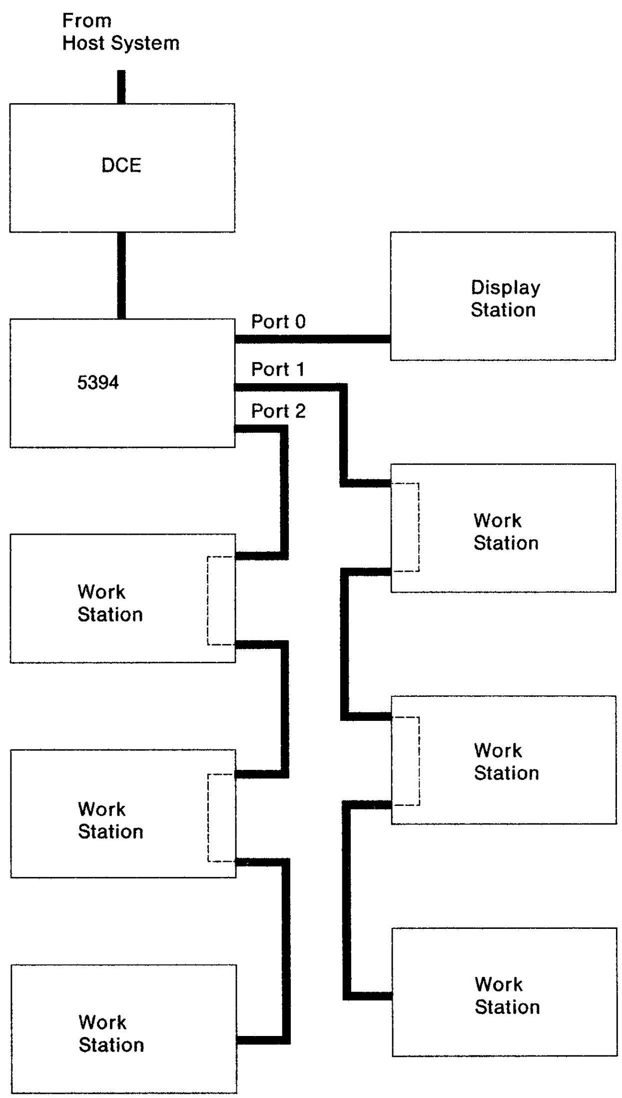



Figure 5-1. Typical 3-Port Configuration

At least one display station must be attached and located within 6 meters (20 feet) of the control unit. This display station is needed to set up and service the control unit. A list of supported work-stations, modems, and DCEs can be found in Appendix B, "Supported Attachments" on page B-1.

**Note:** Do not use the IBM PC or Personal System/2 with AS/400 PC Support, or an IBM Personal System/55 using 5250 PC/2 AD Support for CSU or diagnostics.

## Hardware Description

The control unit has a planar circuit board, a power supply, a diskette drive unit, an operator panel, a cooling fan, and covers.

### Planar

A 16-bit microprocessor unit (MPU) is located on the planar controls and directs the flow of all data moving between the host system and the attached work stations. The MPU also manages control unit resources such as the diskette drive and the operator panel.

Read-only storage (ROS) modules supply micro-program instructions to the MPU when power is initially switched on. These instructions contain the power-on diagnostics and also control all diskette memory operations. When the power-on diagnostics have completed successfully, and the operational microcode has been loaded from the system diskette, control of the MPU is transferred to the operational microcode.

The DRAM modules provide the read/write storage used to contain the operational microcode, as well as buffers, control blocks, and other changing data structures. All information exchanged between the host system, the 5394, and the attached work-stations is temporarily stored in this DRAM.

Work station control logic manages communication between the control unit and work stations through the three twinaxial ports.

The communication interface provides SDLC or X.25 protocol and one of the following communication functions:

- Model 01: EIA 232D and CCITT X.24/X.27 (V.11) or V.35.
- Model 02: X.21 physical interface.

Figure 5-2 on page 5-4 shows a block diagram for the 5394.

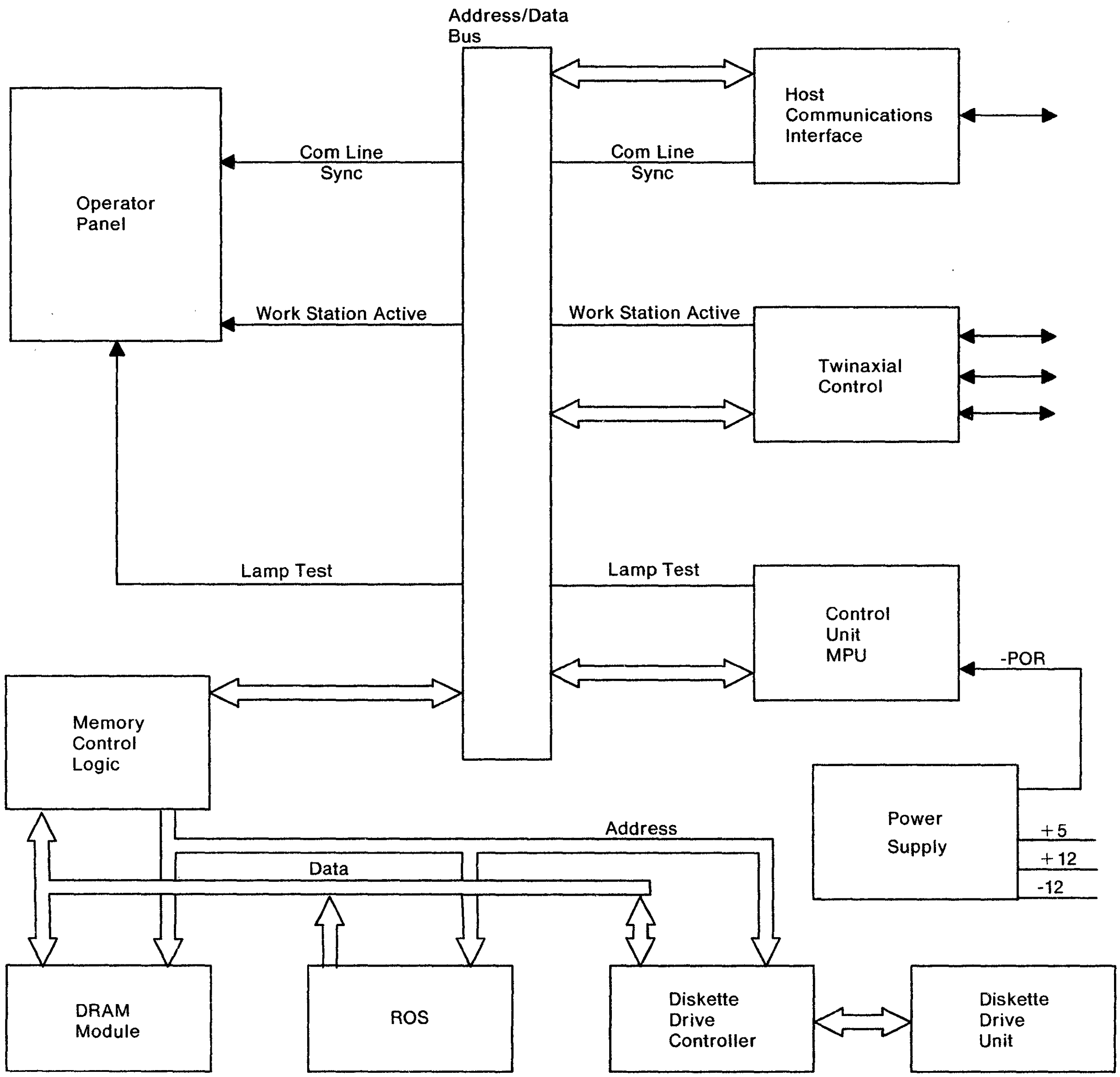



Figure 5-2. 5394 Block Diagram

## Power Supply

The power supply is a switching regulator type with internal overcurrent and overvoltage protection. It consists of a single field-replaceable unit (FRU), which provides the DC voltages and a power-on reset signal required by the electronic circuits.

## Diskette Drive

The diskette drive provides permanent storage of data when the control unit power is off. This read/write storage contains the operational microcode, configuration data, hard error log information for errors internal to the control unit, and permanent link error log information.

## Cooling Fan

The fan operates on 12 volts DC provided by the power supply. Mounted on the plenum, it delivers an efficiently distributed air flow for proper cooling of the planar components.

## Hardware Initialization

When the 5394 power is switched on, the power supply provides DC voltages to all of the logic circuits. At the same time, the power supply generates an 800 millisecond power-on reset (-POR) signal, which is used to establish stable operating conditions in the MPU, diskette controller, and communication circuits, and to turn on the operator panel LEDs for a lamp test. At the end of -POR, the MPU begins using instructions from the ROS.

These instructions:

- Test all MPU operations
- Read all ROS addresses and confirm that the ROS data matches a CRC count stored in the ROS
- Read and write all DRAM locations to assure that DRAM storage is functioning correctly
- Run diskette drive and adapter tests. See "Diskette Drive and Adapter Tests" for a complete description
- Load the contents of the diskette (including the operational microcode) into the DRAM modules.

The MPU is then placed under control of the microcode, which has been loaded into the DRAMs. This microcode:

- Initializes and tests the work station control logic
- Polls all work station addresses
- Initializes and tests the communication logic. See "Communication Interface Test" and "Twinaxial Interface Test" for a complete description of these tests
- Causes the MPU to begin processing the operational microcode.

If the power-on sequence is successful, the operational microcode turns on the operator panel Ready LED and prepares the control unit to communicate with the work stations and host.

### Diskette Drive and Adapter Tests

The following operations and checks are done on the diskette drive and adapter during the power-on sequence:

1. The diskette drive is initialized for operation.
2. The diskette drive controller, DMA, and the diskette drive interrupt are reset and the reset is verified.
3. The diskette drive motor is turned on and verified to be on.
4. The diskette drive adapter is enabled and drive line interrupts are cleared.
5. The diskette drive motor spins up to operating speed.
6. Checks are done for interrupts caused by diskette drive motor stop and restart.
7. A check is made for the presence of a diskette in the diskette drive.
8. The diskette is checked to determine if it is write-protected.
9. The cylinder IDs on track 0 are checked.
10. The boot record on the diskette is read and checked for CRC errors.

If the Test switch is set to On before the 5394 power is switched on, the following tests will also be run:

- Checks for correct cylinder IDs on RAS track 79 of system diskette
- A write test using RAS tracks 1 and 79 of system diskette
- A CRC check of all cylinders excluding RAS tracks 1 and 79.

**Notes:**

1. If the Test switch is On when the diskette tests start and the diskette is not in the diskette drive or it is write-protected, the diagnostics cause the Check Disk LED to flash and the power-on tests halt. If the Test switch is Off (normal operation), a flag is set for these conditions, and the disk tests will continue.
2. If any other of the above checks or operations fail, the power-on tests are halted, and the Check Disk LED will come on, indicating a detected hardware failure in the diskette drive or adapter.
3. If a write-protect error is found during a normal power-on sequence (Test switch Off), an error is posted to all displays that have their power switched on.
4. If the disk tests are started with the Test switch On, setting the Test switch Off within a minute and a half after the Diskette Activity LED comes on will put the tests in a loop mode. If the power-on tests have halted and the Disk Check LED indicates an error was detected, setting the Test switch to Off at that time will also start the loop. The diskette drive motor continues to run for five minutes, or until the loop is entered. You can use the loop capability to check for the presence of the proper signals to the disk drive. To stop the loop, switch the 5394 power off.

## Twinaxial Interface Test

After the diskette and adapter tests complete successfully, the following tests are run on the twinaxial interface:

- Address line compare test
- Timer 2 function test
- Memory wrap and parity test
- Auto poll test
- Station address compare test
- I/O timer tests
- I/O command tests.

If the twinaxial interface fails any of these tests, an error is logged and the communication interface tests are run. When the twinaxial interface tests complete successfully, the communication interface tests are run.

**Note:** The twinaxial interface interrupt handler is tested while the twinaxial interface tests are running and these tests may also generate errors.

### Communication Interface Test

After the twinaxial interface tests complete, the following tests and operations are done on the communication interface:

1. The interrupts are set up for a series of tests.
2. If the control unit is a Model 02, the communication interface is tested to determine if it can be set to X.21 mode. If the communication interface cannot be set to X.21 mode, the error is logged and the communication interface tests are ended.
3. The communication interface is initialized.
4. Timer 1 is tested for countdown and interrupt.
5. Timer 2 is tested for countdown and interrupt.
6. A frame is transmitted in NRZ.
7. A frame is transmitted in NRZI.
8. The transmitted frames are checked for a flag on a byte boundary.
9. The 'abort-receive status' bit is tested.
10. A test is run for a block of less than 32 bits.
11. The 'frame sequence error' bit is tested.
12. If any of these tests fail, an error is logged. If the control unit is a Model 01, the communication interface tests are completed.
13. The communication interface is initialized for X.21 operation.
14. The DCE clear error test runs.
15. The parity error and DCE error tests run.
16. The SDLC DCE clear error test runs.
17. The ready for data and the SDLC clear tests run.
18. The forced DTE clear test runs.
19. The forced DTE ready test runs.
20. If any of these tests fail, an error is logged.
21. The communication interface is left in X.21 mode.

The 5394 reads the ID code of the interface cable at the end of the communication interface test and then enters the Free Key mode.

## Microcode Overview

The 5394 microcode:

- Controls polling of attached work stations (display stations and printers)
- Receives and field checks operator keystrokes
- Translates keystrokes to EBCDIC using diskette-loaded translate table(s)
- Provides data stream processing for the attached display stations
- Handles all communication between the host system and the work stations
- Buffers print lines until the printer is able to receive new data

- Attempts to clear soft errors on attached devices
- Provides IBM 5250 data stream pass-thru support for display stations that process these data streams
- Provides intelligent printer data stream (IPDS) pass-thru support for printers that process these data streams
- Provides full screen control of the entire display screen
- Provides field control of each user-defined field with a screen field attribute
- Provides input field control to define a field as an input area to be stored in the control unit memory as field format words and field control words
- Controls operator indicators
- Maintains internal error logs in both the DRAM and on the diskette
- Installs microcode changes downloaded from the host system or contained on the system diskette
- Supports customer setup (CSU)
- Contains diagnostics for problem isolation.

# Microcode Functions

The 5394 microcode also provides functions to enhance the capabilities of attached work stations.

## Multinational Character Set

The system diskette includes both standard and multinational translation tables for 25 different language groups. These tables translate scan codes received from a display station keyboard into a character code. When a multinational translation table is selected during CSU, a particular scan code produces the same character code for all language groups. For example, according to standard translation tables, the hex code 4A produces a cent sign (¢) in the US and Canada English language group and an Å character in the Austria and Germany language group. With the international character set, code 4A corresponds to the left bracket character ([) regardless of language group.

The translation table includes a greater number of entries than those for any national language. Because the same keyboard can be used with either type of translation table, not all characters in the multinational character set correspond to a single key stroke. Such characters require double-key entry using the diacritic overstrike and hex key functions, which are also included as base functions of the 5394.

### Hex Key Function

The hex key function is available to all 5394 users. By entering hexadecimal codes on the keyboard, any EBCDIC character not available on the keyboard can be generated as needed. The hexadecimal usage of the keyboard is not permitted when the display station is in the Insert mode. See the *IBM 5394 Remote Control Unit User's Guide* for information about how to use this function.

### Diacritic Key Function

The diacritic key allows a diacritic mark to be placed where necessary. A diacritic mark indicates a modification of the usual phonetics or semantics of a particular character. For example, the tilde may denote the "ny" sound of the Spanish n, or may be used in logic or mathemathics to denote "not."

Various diacritic keys are available. However, the only diacritic that can be entered is one that appears on one of the diacritic keys on the keyboard. The diacritics commonly available are:

| | |
|---|---|
| ` | (Grave Accent) |
| ´ | (Acute Accent) |
| ~ | (Tilde) |
| ^ | (Circumflex) |
| .. | (Diaeresis) |
| C | (Cedilla for C only) |

A diacritic mark is entered above a character by pressing the desired diacritic key and then the character. The cursor remains in the same position after a diacritic key is pressed and moves when the character is entered. When the character is entered, the control unit then checks to see that the diacritic key and the character entered are valid combinations. Valid combinations for each diacritic are shown in Table 5-1 on page 5-9.

| Table 5-1. Valid Character and Diacritic Character Combination | |
|---|---|
| **Diacritic Character** | **Permitted Characters** |
| \` (Grave Accent) | Aa Ee Ii Oo Uu |
| ´ (Acute Accent) | Aa Ee Ii Oo Uu |
| ~ (Tilde) | Aa Nn Oo |
| ^ (Circumflex) | Aa Ee Ii Oo Uu |
| .. (Diaeresis) | Aa Ee Ii Oo Uu y (y is permitted only as a lowercase character) |
| ç (Cedilla) | Cc |

After the diacritic and the character combination is verified, the hexadecimal code for the character with the accent mark is written into storage for display and the cursor moves to the next position. The hex key function is used to enter diacritics not present on the keyboard.

## Copy-to-Printer Support

The copy-to-printer function allows the printing of a screen image from an attached display station on a printer attached to the control unit.

## Magnetic Stripe Reader (MSR) Support

The magnetic stripe reader (MSR) reads magnetic stripes on documents such as credit cards and identification cards.

The MSR can read documents from 0.02 millimeters (0.007 inches) to 0.12 millimeters (0.045 inches) thick at a speed of 12 to 125 millimeters (5 to 49 inches) per second.

The MSR contains a read head, an amplifier, and a document-sensing photocell.

The photocell senses a document and prepares the MSR adapter to receive the 5 bits (4 data bits and 1 parity bit) of numeric data from the MSR. The data is read from the document by the read head and amplified by the amplifier.

Data read from the document is stored in a RAM buffer in the display station. A maximum of 128 bytes of data can be stored (125 data characters plus the three SOM, EOM, or LRC characters). The MSR card checks for error conditions and sets the error bit on in all data bytes if an error is found. Error conditions checked are:

- No SOM, EOM, or LRC character
- A speed error
- A polarity error
- An LRC error.

When the MSR buffer becomes full, the data is sent to the control unit in 16-bit frames. The function of each bit in these frames is shown in Table 5-2.

| Table 5-2. MSR Frame Bit Definition | |
|---|---|
| **Bit(s)** | **Function** |
| 0-2 | Fill Bits (000) |
| 3 | Parity Bit |
| 4-6 | Work Station Address |
| 7 | MSR Installed |
| 8 | Error Bit |
| 9 | Last Data Frame |
| 10-14 | MSR Code |
| 15 | Sync |

The control unit changes the 5-bit MSR code to an EBCDIC code and writes the EBCDIC code into the input field at the display station. The 5-bit MSR codes and the corresponding EBCDIC codes are shown in Table 5-3.

Table 5-3. MSR Character Codes

| Character | MAG Stripe Reader Code Binary | MAG Stripe Reader Code Hex | EBCDIC Display Code X'NN' |
|---|---|---|---|
| 0 | 10000 | 10 | F0 |
| 1 | 00001 | 01 | F1 |
| 2 | 00010 | 02 | F2 |
| 3 | 10011 | 13 | F3 |
| 4 | 00100 | 04 | F4 |
| 5 | 10101 | 15 | F5 |
| 6 | 10110 | 16 | F6 |
| 7 | 00111 | 07 | F7 |
| 8 | 01000 | 08 | F8 |
| 9 | 11011 | 19 | F9 |
| : or OID | 11010 | 1A | 7A |
| % or SOM | 01011 | 0B | 6C |
| ∂ | 11100 | 1C | 7C |
| ¬ or FS | 01101 | 0D | 5F |
| = | 01110 | 0E | 7E |
| ? or EOM | 11111 | 1F | 6F |

The customer owns and maintains the MSR, but the work station adapter card is maintained as part of the work station.

## Selector Light Pen (SLP) Support

The selector light pen permits the operator to select the desired fields shown on the display screen. By using the light pen, the operator can select the fields without using the keyboard. The fields selected by the operator must be defined as light pen input fields by a field control word.

Best results are obtained when only one light pen field exists per display line. If two or more light pen fields must be placed on the same display line, they should be placed as far apart as possible. Other bypass or input fields may be on the same line.

## Self-Check Support (Modulus 10 and 11)

The self-check function supplies the control unit with a method for checking data in fields that contain a precalculated self-check digit entered from an attached display station keyboard.

Self-check for a field is initiated by the host system, which describes an input field as a self-check field by using the suitable field control word: B1A0 for modulus 10 and B140 for modulus 11. All fields can be specified for checking, including signed numeric, alphabetic only, numeric only, and alphanumeric fields.

All characters use the 4 low-order bits from their EBCDIC representation when the 4 low-order bits are in the 0 through 9 range. For example, the EBCDIC representation of A is C1; therefore, A equals 1. All other characters with their 4 low-order bits in the A through F range are replaced by zeros. The EBCDIC representation of percent (%) is 6C; therefore, % equals 0. See Table 5-4.

Table 5-4. Self-Check Digit

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

### Modulus 10

You can calculate modulus 10 for any field from 2 to 31 characters long. To calculate the modulus 10 check digit, do the following:

1. Multiply the units position of the field (not the check digit) by 2. Multiply the tens position of the field by 1. Go to the high-order position of the field, multiplying alternately by 2 and 1.

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

The difference is the self-check digit.

Example:

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

### Modulus 11

You can calculate modulus 11 for any field from 2 to 31 characters long. To calculate the modulus 11 check digit, do the following:

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

The difference is the self-check digit.

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

Example:

| | |
|---|---|
| Self-check field | A F 1 2 7 6 5 |
| Multiplier | 2 7 6 5 4 3 2 |
| Product | 2 42 6 10 28 18 10 |
| Sum | 2 + 42 + 6 + 10 + 28 + 18 + 10 = 116 |
| Divide | 116÷11 = 10 plus a remainder of 6 |
| Subtract | 11-6 = 5 |
| Self-check digit | 5 |
| Self-check field with check digit | A F 1 2 7 6 5 5 |

## Text Entry Assist

Text Entry Assist allows operators who use display stations attached to 5394s to use the host system Text Entry Assist program.

This function provides text entry operations such as word wrap, continuous text entry, tab entry and control, split-screen format, and prompting.

# Data Flow

The data flow between a display station attached to the control unit and the host system is described as follows:

1. When a key is pressed at the display station, a scan code is generated for that character. The scan code is put into a 16-bit frame format by the display station logic for transfer to the control unit in response to the next poll of that display station. The scan code is used by the control unit to get the represented character out of a translate table. The correct translate table is located in DRAM at this time.
2. The control unit logic verifies that the character taken from the translate table is permitted in the current field. The character is then sent back to the display station and is placed in the regeneration buffer.

3. The adapter in the display station reads the character from the regeneration storage and generates the correct bit pattern to display that character on the display screen.
4. When the Enter key is pressed, the display station signals the control unit that the data is to be sent to the host system.
5. The control unit requests the data from the display station regeneration buffer and stores the transferred data in the control unit DRAM.
6. The control unit MPU takes the data from storage, puts it in SNA format, and transmits it in the appropriate format for either SDLC or X.25 transmission.

**Note:** The SDLC communication protocol is used by the 5394, unless the X.25 protocol is being used.

# 5394 Communication Network Options

The remainder of this chapter describes the communication network options supported by the 5394. The model of 5394 used determines which communication options are available. See "Control Unit Description" on page 5-2.

## Systems Network Architecture Support

This section describes Systems Network Architecture (SNA) as it relates to the 5394. For a complete description of SNA, refer to *Systems Network Architecture Technical Overview.*

### Network Addressable Units

SNA defines network addressable units (NAUs) for data communication applications. These NAUs are divided into three major categories:

- System services control points (SSCPs)
- Physical units (PUs)
- Logical units (LUs).

**System Services Control Points:** The SSCP is a special type of NAU that resides in the host system. The SSCP provides the following services:

- Assists in starting the network
- Helps establish logical connections between other NAUs
- Assists with recovery functions
- Provides maintenance support
- Provides an interface to the network operator services.

**Physical Units:** The 5394 supports a physical unit type 1 (PU.T1). The 5394 maintains a single session between the SSCP and the PU (SS-PU) as long as the physical link exists between the host system and the control unit. The ACTIVATE PHYSICAL UNIT (ACTPU) command is not required to activate this session. The 5394 uses the SS-PU session to transfer maintenance data to the host system.

**Logical Units:** The 5394 supports LUs of type 4 (printers) and type 7 (display stations). For a list of supported work stations, see Appendix B, "Supported Attachments" on page B-1.

An SS-LU session is maintained for each active work station attached to the 5394. The ACTIVATE LOGICAL UNIT (ACTLU) command is used to establish this session. The SSCP uses the SS-LU session to send system services (SS) messages to the display. The LU uses the SS-LU session to request system and test functions, and to send LU status information to the SSCP. The LU is bound to another LU in the host system (typically an application program) by the BIND command. This command is sent on the LU-LU flow and specifies the communication rules for the LU-LU session.

### Support Characteristics

Some protocol options can be selected at the start of a session. Specific combinations of these protocol options make up various profile types. The 5394 supports characteristics of transmission services (TS) profile 7 and function management (FM) profile 7.

**Transmission Services Profile:** The TS profile specifies the transmission control (TC) options to be used in a session. The 5394 uses a subset of TS profile 7 that:

- Supports the following session control commands:
  - ACTIVATE LOGICAL UNIT (ACTLU)
  - DEACTIVATE LOGICAL UNIT (DACTLU)

- BIND
- UNBIND.

- Does not support the following commands:
  - START DATA TRAFFIC (SDT)
  - CLEAR
  - REQUEST RECOVERY (RQR)
  - SET AND TEST SEQUENCE NUMBERS (STSN).
- Allows bidirectional pacing on normal flow
- Does not allow sequence numbers on normal flow
- Specifies maximum request/response unit (RU) sizes for function management data in TS usage field of BIND command
- Does not support cryptography.

The session is *in brackets* after the BIND command (BIND sender is in send state).

**Function Management Profile:** The FM profile specifies the data flow control (DFC) and the function management data services (FMDS) options to be used in sessions. The 5394 supports the following parts of FM profile 7:

- DFC commands:
  - SIGNAL
  - LU STATUS (LUSTAT)
  - CANCEL
  - REQUEST SHUTDOWN (RSHUTD).
- Multiple RU chains are allowed.
- Normal Flow mode is half-duplex flip-flop (HDX-FF).
- Immediate Request mode is used for display stations and printers.
- Delayed Request mode is optional for printers.
- Immediate Response mode is used.
- Chains must flow request definite response (RQD), request exception response (RQE), or request no response (RQN). However, the 5394 does not send chains RQN.
- RQE chains must include a change-of-direction (CD) bit.
- End bracket (EB) is not used.
- Chain sender is responsible for error recovery.
- FM headers are not allowed.
- Data compression is not supported.
- An alternate code set is not supported by the 5394.

## SNA Path Information Unit

The 5394 supports two methods of transferring SNA information and commands: Synchronous Data Link Control (SDLC) frames and X.25 link access protocol-balanced (LAPB) frames. Figures 5-3 and 5-4 show the SNA path information units (PIUs) as they appear in the SDLC frame and X.25 packet. Within the PIU, the encoding scheme is the same for both SDLC and X.25. On X.21 networks, data is transferred within an SDLC frame.

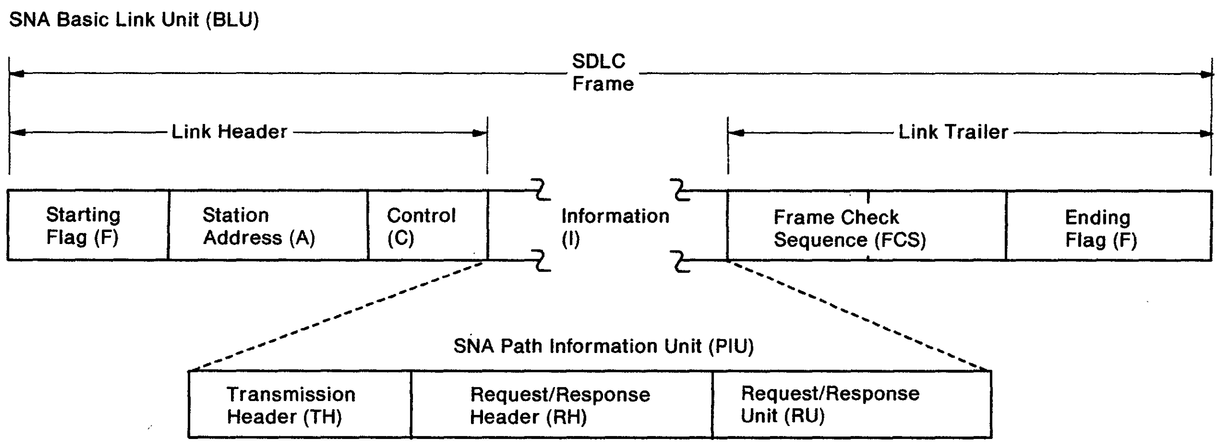



Figure 5-3. SDLC SNA Path Information Unit

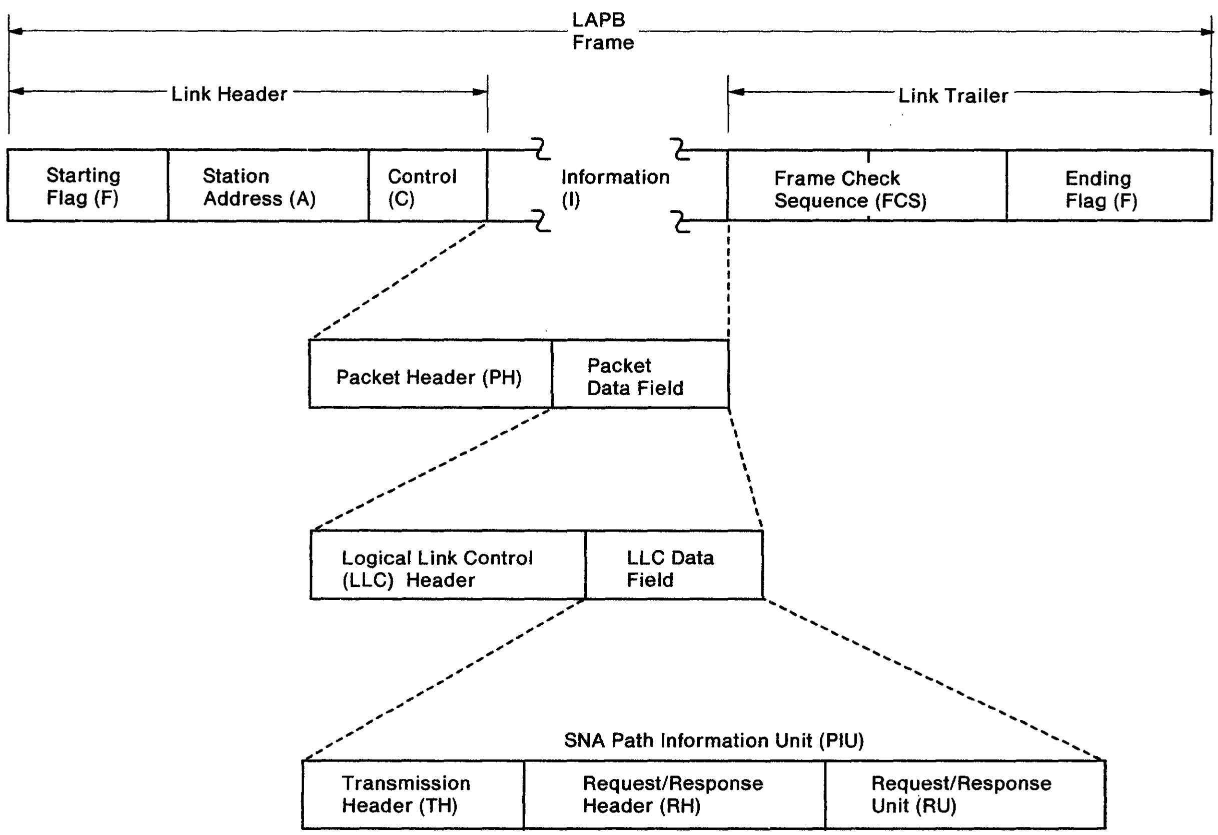



Figure 5-4. X.25 SNA Path Information Unit

The PIU is subdivided into three fields: the transmission header (TH), the request/response header (RH), and the request/response unit (RU).

**Transmission Header:** Table 5-5 shows the format for the transmission header (TH). Bits 0 through 6 of byte 0 are fixed for any communication involving the 5394. These values indicate that the format identification (FID) is FID-3 and that segmenting is not permitted. The FID describes the physical link characteristics. For a complete description of SNA FID characteristics, see *Systems Network Architecture, Format and Protocol Reference Manual:Architectural Logic.* FID-3 also defines the 2-byte TH format.

Table 5-5. Transmission Header Format

| Byte | Bits | Code | Description |
|---|---|---|---|
| **0** | 0-3 | 0011 | **Format Identifier**. FID-3 for control unit. Mapping field. Always 11 |
| | 4-5 | 11 | for control unit (no segmenting). |
| | 6 | 0 | Reserved |
| | 7 | 0 | Normal flow indicator |
| | | 1 | Expedited flow indicator |
| **1** | | | **Local Session Identifier** (see note) |
| | 0-1 | 00 | SS - PU session |
| | | 01 | SS - LU session |
| | | 11 | LU - LU session |
| | | 10 | Not valid |
| | 2-7 | | Local station address (also known as unit address) |

**Note:** For the control unit, an SS - PU session has an LSID of X'00'. An LU - LU session with an attached work station, which has a unit address of 02, has an LSID of X'C2'.

Bit 7 of byte 0 is set when the command is an expedited-flow command. Expedited-flow commands are inserted ahead of all pending commands in the receiving station request/response queue. When this bit is cleared, the request/response is added to the end of the queue.

Byte 1 of the TH is the local session identifier (LSID). Bits 0 and 1 indicate the session type for this frame. Bits 2 through 7 are used to address the individual LUs within the control unit. For SS-PU sessions, bits 2 through 7 are cleared.

To determine the local station address for an attached work station, multiply the port number (0, 1, or 2) by the unit address for the device (0 through 6) and convert this number to hexadecimal. The unit address is set at each work station either by rocker switches or by software. Refer to the work station documentation to interpret the switch settings for each device.

**Request/Response Header:** Tables 5-6 and 5-7 show the format for the request/response header (RH). The RH is a 3-byte field that defines how the RU is to be interpreted.

| Table 5-6 (Page 1 of 2). Request Header Format | | |
|---|---|---|
| **Byte** | **Bits** | **Description** |
| 0 | 0 | Request/response indicator (RRI)<br>0 = Request |
| | 1-2 | Request/response unit category (CAT)<br>00 = Function management data (FMD)<br>01 = Network control (NC) (not supported)<br>10 = Data flow control (DFC)<br>11 = Session control (SC) |
| | 3 | Reserved (always a 0). |
| | 4 | Format indicator (FI) for SC and DFC RUs:<br>0 = Format 0 (invalid)<br>1 = Format 1<br>For FMD RUs, SS-PU and SS-LU session:<br>0 = No network services (NS) header present<br>1 = NS header present<br>For FMD RUs, and LU-LU session:<br>0 = No FM header present<br>1 = FM header present (not supported) |
| | 5 | Sense data included indicator (SDI)<br>0 = No sense data<br>1 = Sense data included |
| | 6-7 | Chain control<br>00 = Middle of chain<br>01 = Last of chain<br>10 = First of chain<br>11 = Only in chain |
| 1 | 0 | Definite response 1 indicator (DR1I) |
| | 1 | Reserved (always a 0) |
| | 2 | Definite response 2 indicator (DR2I) |

| Table 5-6 (Page 2 of 2). Request Header Format | | |
|---|---|---|
| **Byte** | **Bits** | **Description** |
| | 3 | Exception response indicator (ERI). Used in conjunction with DR1I and DR2I to indicate the form of the RSP requested.<br><br>**DR1I DR2I ERI DEFINITION**<br>0 0 0 No response (RQN)<br>0 0 1 Reserved<br>1 0 0 Definite response (RQD 1/2)<br>0 1 0<br>1 1 0<br>1 0 1 Exception response (RQE 1/2)<br>0 1 1<br>1 1 1 |
| | 4-5 | Reserved (always 00) |
| | 6 | Queued response indicator<br>0 = Bypass TC queue<br>1 = Use TC queue |
| | 7 | Pacing indicator<br>0 = No pacing<br>1 = Pacing |
| 2 | 0 | Begin bracket indicator (BBI) (always a 0) |
| | 1 | End bracket indicator (EBI) (always a 0) |
| | 2 | Change direction indicator (CDI)<br>0 = Do not change direction<br>1 = Change direction |
| | 3 | Reserved (always 00) |
| | 4 | Code selection indicator (CSI)<br>0 = Code 0<br>1 = Code 1 (not supported) |
| | 5 | Enciphered data indicator (EDI)<br>0 = RU is not enciphered<br>1 = RU is enciphered (not supported) |
| | 6 | Padded data indicator (PDI)<br>0 = RU is not padded<br>1 = RU is padded (not supported) |
| | 7 | Reserved for LU types 4 and 7 (always a 0) |

| Table 5-7. Response Header Format | | |
|---|---|---|
| **Byte** | **Bits** | **Description** |
| 0 | 0 | Request/response indicator (RRI)<br><br>1 = Response |
| | 1-2 | Request/response unit category (CAT)<br><br>00 = Function management data (FMD)<br>01 = Network control (NC) (not supported)<br>10 = Data flow control (DFC)<br>11 = Session control (SC) |
| | 3 | Reserved |
| | 4 | Format indicator (FI), used to indicate an SNA formatted RU:<br><br>0 = Format 0 (invalid)<br>1 = Format 1<br><br>For FMD RUs, SS-PU and SS-LU session:<br><br>0 = No network services (NS) header present<br>1 = NS header present<br><br>For FMD RUs, and LU-LU session:<br><br>0 = No FM header present<br>1 = FM header present (not supported) |
| | 5 | Sense data included indicator (SDI).<br><br>0 = No sense data<br>1 = Sense data is included in the first 4 bytes of the RU |
| | 6-7 | Chain control. Only in a chain (always 11 for a response). |
| 1 | 0 | Definite response 1 indicator (DR1I)<br><br>0 = Positive response<br>1 = Negative response |
| | 1 | Reserved (always 0). |
| | 2 | Definite response 2 indicator (DR2I)<br><br>0 = Positive response<br>1 = Negative response |
| | 3 | Response type indicator (RTI) |
| | 4-5 | Reserved |
| | 6 | Queue response indicator (QRI)<br><br>0 = Bypass TC queue<br>1 = Use TC queue |
| | 7 | Pacing indicator (PI)<br><br>0 = No pacing<br>1 = Pacing |
| 2 | 0-7 | Reserved |

## SNA Commands and Responses

This section describes the SNA commands and responses unique to the 5394. For a complete description of SNA commands and responses, refer to *Systems Network Architecture Technical Overview*.

Figure 5-5 summarizes the SNA commands supported by the 5394. Some commands are found on several of the rightmost nodes of the diagram (CANCEL, for example). This indicates that the request is available to both partners in the current session.

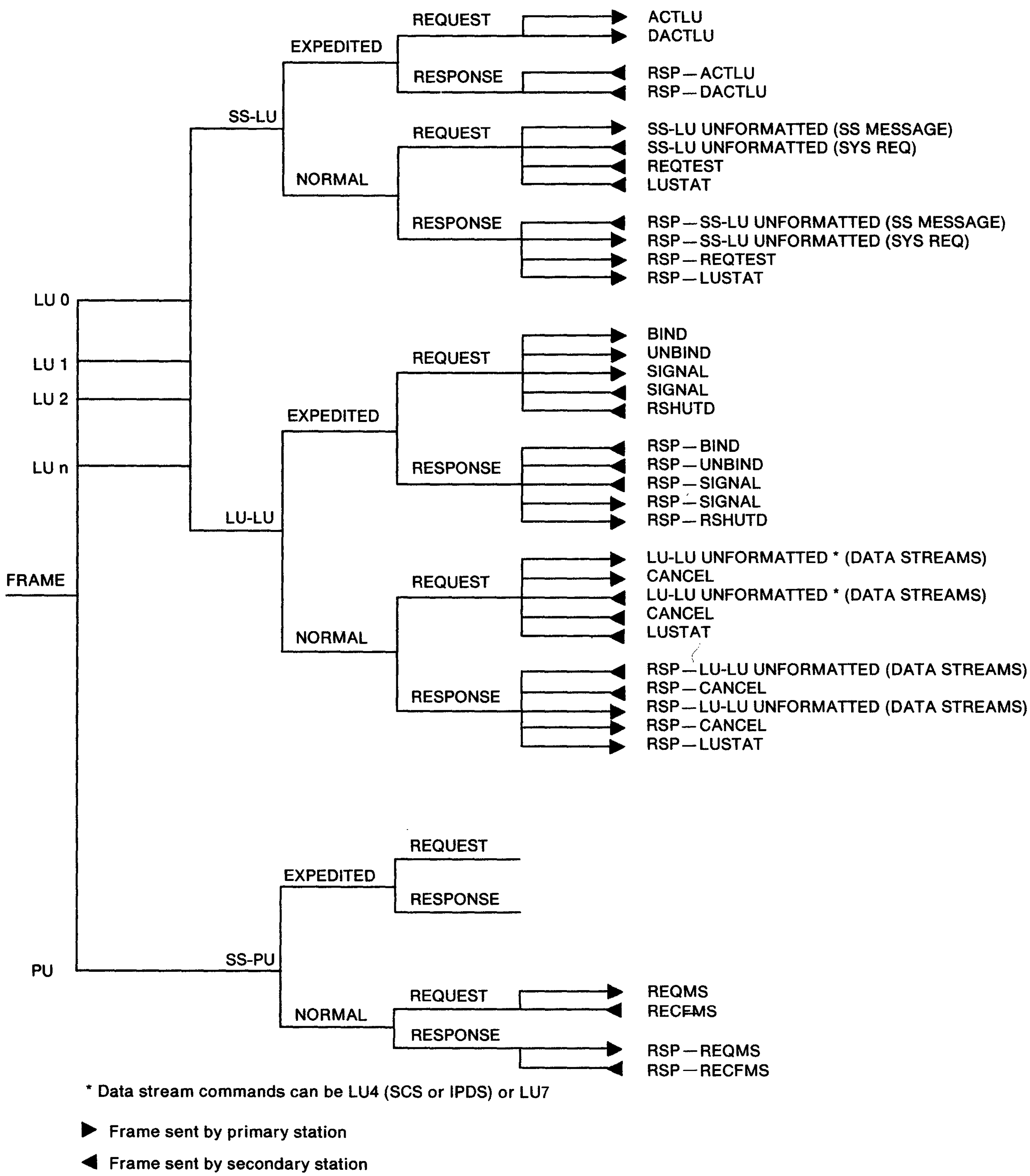



Figure 5-5. SNA Command Summary

**ACTLU:** The host system uses the ACTIVATE LOGICAL UNIT (ACTLU) command to initialize the SS-LU session for each work station attached to the 5394. Table 5-8 shows the format of the ACTLU command. Table 5-9 shows the response sent by the 5394. The host system examines byte 5, bits 0 and 1, to determine whether the LU is a printer or a display station.

Table 5-8. The ACTLU Command RU Format

| Bytes | Bits | Field | Value | Description |
|---|---|---|---|---|
| 0 | 0-7 | Code | X'0D' | ACTLU command |
| 1 | 0-7 | Activation type | X'01' or X'02' | Cold activation or ERP activation |
| 2 | 0-3 | FM profile | X'0' | FM profile 0 |
| | 4-7 | TS profile | X'1' | TS profile 1 |

Table 5-9. The ACTLU Response RU Format

| Bytes | Bits | Field | Value | Description |
|---|---|---|---|---|
| 0 | 0-7 | Code | X'0D' | ACTLU command |
| 1 | 0-7 | Activation type | X'01' | Cold activation |
| 2 | 0-3 | FM profile | X'0' | Same as ACTLU request |
| | 4-7 | TS profile | X'1' | Same as ACTLU request |
| 3 | 0-7 | Control Vector key | X'00' | Key = '00' |
| 4 | 0-7 | Max RU size on SS-LU normal flow by either half-session | X'84' | 128 bytes maximum |
| 5 | | **LU Capabilities** | | |
| | 0-1 | Host allowed to send SS requests on SS-LU flow | B'00' or B'10' | Printer - SS requests not allowed<br>Display - SS requests allowed |
| | 2 | LU able to process RUs on LU-LU flow (including BIND) | B'0' or B'1' | LU available<br>LU powered down, or unrecoverable hardware error. |
| | 3-7 | Reserved | B'00000' | |
| 6 | | **LU Capabilities** | | |
| | 0-7 | Reserved | X'00' | |
| 7 | 0-7 | Reserved | X'00' | |

**BIND:** The BIND command and response specify the protocols that the primary and secondary LUs use when communicating with each during an LU-LU session. The BIND command establishes an LU-LU session between the host system and the requested work station. The host system sends a BIND request to the control unit on the LU-LU expedited flow. The control unit checks the BIND request and returns either a positive or negative response. A negative response indicates that there is an invalid BIND parameter or BIND type, or that the LU is already in session.

Tables 5-10 and 5-11 show the format of the BIND command and response for display stations (LU.T7) and printers (LU.T4).

For more information on the BIND command, refer to *Systems Network Architecture, Technical Overview*.

Table 5-10 (Page 1 of 2). BIND Command and Response RU Format for Display Stations LU.T7

| Bytes | Bits | Field | Value | Description |
|---|---|---|---|---|
| 0 | 0-7 | Request code | X'31' | BIND command |
| 1 | 0-3 | Format | B'0000' | Format 0 * |
| | 4-7 | Type | B'0000' | Cold (negotiable) * |
| 2 | 0-7 | FM profile | X'07' | FM profile 7 |
| 3 | 0-7 | TS profile | X'07' | TS profile 7 |
| 4 | | **FM Usage (primary)** | | |
| | 0 | Chaining use | B'1' | Multiple RU chains allowed |
| | 1 | Request mode | B'0' | Immediate Request mode |
| | 2-3 | Chain response | B'11' | Definite or exception responses |
| | 4-5 | Reserved | B'00' | |
| | 6 | Compression | B'0' | No compression |
| | 7 | Send end bracket | B'0' | Will not send EB |
| 5 | | **FM Usage (secondary)** | | |
| | 0 | Chaining use | B'1' | Multiple RU chains allowed |
| | 1 | Request mode | B'0' | Immediate Request mode |
| | 2-3 | Chain response | B'11' | Definite or exception responses |
| | 4-5 | Reserved | B'00' | |
| | 6 | Compression | B'0' | No compression |
| | 7 | Send end bracket | B'0' | Will not send EB |
| 6 | | **FM Usage (common)** | | |
| | 0 | Reserved | B'0' | |
| | 1 | FM headers | B'0' | FM headers not allowed |
| | 2 | Bracket reset | B'0' | Reset state is in-bracket |
| | 3 | Bracket termination rule | B'1' | Rule 1 (conditional) |
| | 4 | Code set | B'0' | No alternate code set |
| | 5 | Sequence number | B'0' | Not available |
| | 6 | Bracket initiation stop (BIS) | B'0' | BIS not sent |
| | 7 | Reserved | B'0' | |
| 7 | 0-1 | Normal/Flow mode | B'10' | Half-duplex flip-flop (HDX-FF) |
| | 2 | Recovery responsibility | B'0' | Contention loser (primary) |
| | 3 | Brackets contention winner or loser | B'0' | Secondary is winner |
| | 4-6 | Reserved | B'000' | |
| | 7 | HDX-FF reset state | B'1' | BIND sender reset to send state |

Table 5-10 (Page 2 of 2). BIND Command and Response RU Format for Display Stations LU.T7

| Bytes | Bits | Field | Value | Description |
|---|---|---|---|---|
| 8 | | **TS Usage (8-13)** | | |
| | 0 | Staging indicator (secondary) | B'x' | Same as BIND request |
| | 1 | Reserved | B'x' | Same as BIND request |
| | 2-7 | Secondary send pacing count | B'xxxxxx' | Same as BIND request |
| 9 | 0-1 | Reserved | B'00' | * |
| | 2-7 | Secondary receive pacing count | B'000000' | No pacing count * |
| 10 | 0-7 | Max. RU size sent by secondary on normal flow | X'85' | 256 bytes |
| 11 | 0-7 | Max. RU size sent by primary on normal flow | X'xx' | Same as BIND request unless RU byte 11 > RU byte 10, then set RU byte 11 = RU byte 10. |
| 12 | 0 | Staging indicator (primary) | B'0' | If BIND request byte 12, bit 0=0, then BIND response byte 12, bits 0-7 are same as BIND request byte 12, bits 0-7. If BIND request byte 12, bit 0=1, then BIND response byte 12, bits 0-7 are same as BIND response byte 9, bits 0-7. |
| | 1 | Reserved | B'x' | |
| | 2-7 | Primary send pacing count | B'xxxxxx' | |
| 13 | 0-1 | Reserved | B'xx' | Same as BIND request |
| | 2-7 | Primary receive pacing count | B'xxxxxx' | Same as BIND request |
| | | **PS Profile (14-25)** | | |
| 14 | 0 | PS usage format | B'0' | Basic format |
| | 1-7 | LU type | B'0000111' | LU.T7 (display station) |
| 15-23 | 0-7 | Reserved | | |
| 24 | 0 | Reserved | B'0' | |
| | 1-7 | Display screen size | B'0000010' | 1920 (24 x 80) |
| 25 | 0-6 | Reserved | B'0000000' | |
| | 7 | IPL (download) | B'x' | BIND response If byte 25, bit 7=0, then no download. If byte 25, bit 7=1, then request download. |

* Negative response generated if invalid parameter specified in this field of the BIND request.

Table 5-11 (Page 1 of 3). BIND Command and Response RU Format for Printers LU.T4

| Bytes | Bits | Field | Value | Description |
|---|---|---|---|---|
| 0 | 0-7 | Request code | X'31' | BIND command |
| 1 | 0-3 | Format | B'0000' | Format 0 * |
| | 4-7 | Type | B'0000' | Cold (negotiable) * |
| 2 | 0-7 | FM profile | X'07' | FM profile 7 |
| 3 | 0-7 | TS profile | X'07' | TS profile 7 |
| 4 | | **FM Usage (primary)** | | |
| | 0 | Chaining use | B'1' | Multiple RU chains allowed |
| | 1 | Request mode | B'1' | Delayed Request mode |
| | 2-3 | Chain response | B'11' | Definite or exception response |
| | 4-5 | Reserved | B'00' | |
| | 6 | Compression | B'0' | No compression |
| | 7 | Send end bracket | B'0' | Will not send EB |
| 5 | | **FM Usage (secondary)** | | |
| | 0 | Chaining use | B'1' | Multiple RU chains allowed |
| | 1 | Request mode | B'0' | Immediate Request mode |
| | 2-3 | Chain response | B'11' | Definite or exception response |
| | 4-5 | Reserved | B'00' | |
| | 6 | Compression | B'0' | No compression |
| | 7 | Send end bracket | B'0' | Will not send EB |
| 6 | | **FM Usage (common)** | | |
| | 0 | Reserved | B'0' | |
| | 1 | FM headers | B'0' | FM headers not allowed |
| | 2 | Bracket reset | B'0' | Reset state is in-bracket |
| | 3 | Bracket termination rule | B'1' | Rule 1 (conditional) |
| | 4 | Code set | B'0' | No alternate code set |
| | 5 | Sequence number | B'0' | Not available |
| | 6 | Bracket initiation stop (BIS) | B'0' | BIS not sent |
| | 7 | Reserved | B'0' | |
| 7 | 0-1 | FM Transaction mode | B'10' | Half-duplex flip-flop (HDX-FF) |
| | 2 | Recovery responsibility | B'0' | Contention loser (primary) |
| | 3 | Brackets contention winner or loser | B'0' | Secondary is winner |
| | 4-6 | Reserved | B'000' | |
| | 7 | HDX-FF reset state | B'1' | BIND sender reset to send state |
| | | **TS Usage (8-13)** | | |
| 8 | 0 | Staging indicator (secondary) | B'x' | Same as BIND request |
| | 1 | Reserved | B'x' | Same as BIND request |
| | 2-7 | Secondary send pacing count | B'xxxxxx' | Same as BIND request |
| 9 | 0-1 | Reserved | B'00' | |
| | 2-7 | Secondary receive pacing count | B'0000xx' | If BIND RU9=1 or 2, then RSP=REQ<br>If BIND RU9=0,3,5...255, then RSP= X'03' |
| 10 | 0-7 | Max. RU size sent by secondary on normal flow | X'85' | 256 bytes |

Table 5-11 (Page 2 of 3). BIND Command and Response RU Format for Printers LU.T4

| Bytes | Bits | Field | Value | Description |
|---|---|---|---|---|
| 11 | 0-7 | Max. RU size sent by primary on normal flow | X'xx' | Same as BIND request unless RU byte 11 > RU byte 10, then set RU byte 11 = RU byte 10. |
| 12 | 0 | Staging indicator (primary) | B'0' | If BIND request byte 12, bit 0=0, then BIND response byte 12, bits 0-7 are same as BIND request byte 12, bits 0-7. If BIND request byte 12, bit 0=1, then BIND response byte 12, bits 0-7 are same as BIND response byte 9, bits 0-7. |
| | 1 | Reserved | B'x' | |
| | 2-7 | Primary send pacing count | B'xxxxxx' | |
| 13 | 0-1 | Reserved | B'xx' | Same as BIND request |
| | 2-7 | Primary receive pacing count | B'xxxxxx' | Same as BIND request |
| | | **PS Profile (14-25)** | | |
| 14 | 0 | PS usage format | B'0' | Basic format |
| | 1-7 | LU type | B'0000100' | LU.T4 (printer) |
| | | **Primary Send Direction of Flow (15-18)** | | |
| 15 | | **Print Data Stream Profile** | | |
| | 0 | Base DSP | B'1' | Supported |
| | 1 | GDS subset | B'1' | Supported |
| | 2 | RJE SCS subset | B'0' | Not supported |
| | 3 | WP final form | B'0' | Not supported |
| | 4 | WP raw form | B'0' | Not supported |
| | 5 | Reserved | | |
| | 6 | Dual pitch printer | B'0' | Not supported |
| | 7 | Proportional ESC | B'0' | Not supported |
| 16 | 0-7 | **Additional Media** | X'00' | No additional media |
| 17 | | **Console Data Stream Profile** | | |
| | 0-3 | Console definition | X'0' | No console support |
| | 4-7 | Reserved | X'0' | |
| 18 | | **FM and FMH Usage** | | |
| | 0 | SS FM data | B'0' | Not Supported |
| | 1-7 | FM header bits | B'0000000' | |
| | | **Secondary Send Direction of Flow (19-22)** | | |
| 19 | 0-7 | Print data stream profile | X'00' | No send capability |
| 20 | 0-7 | Additional media | X'00' | No send capability |
| 21 | 0-7 | Console data stream profile | X'00' | No send capability |
| 22 | 0-7 | FM and FMH usage | X'00' | No send capability |
| 23 | | **Code Selection** | | |
| | 0-3 | Repertoire | B'1000' | EBCDIC |
| | 4-5 | Main code | B'00' | EBCDIC |
| | 6-7 | Reserved | B'00' | |
| 24 | | **General Characteristics** | | |
| | 0-1 | Reserved | B'00' | |
| | 2 | Data direction | B'0' | BIND sender may send first |

| Table 5-11 (Page 3 of 3). BIND Command and Response RU Format for Printers LU.T4 | | | | |
|---|---|---|---|---|
| **Bytes** | **Bits** | **Field** | **Value** | **Description** |
| | 3 | Reserved | B'0' | |
| | 4 | Attended mode | B'0' | BIND receiver will initiate attended mode |
| | 5 | Alternate mode | B'0' | BIND receiver will not alternate attended and unattended modes |
| | 6-7 | Reserved | B'00' | |
| 25 | | **NCI Characteristics** | | |
| | 0 | Image data | B'0' | Not supported |
| | 1 | Speech data | B'0' | Not supported |
| | 2-6 | Reserved | B'00000' | |
| | 7 | IPL (Download) | B'x' | Same as BIND request |
| * Negative response generated if invalid parameter specified in this field of the BIND request | | | | |

**CANCEL:** The CANCEL command stops a partially transmitted chain of FMD commands. The CANCEL command is sent only when a chain is in progress. The 5394 sends a CANCEL on the normal LU-LU flow when it receives a negative response to a command in the current chain. The request code (RU byte 0) for CANCEL is X'83'.

**DACTLU:** The DEACTIVATE LOGICAL UNIT (DACTLU) command ends an SS-LU session. DACTLU is sent on the expedited SS-LU flow. The 5394 sends a positive response when the deactivation is complete. The request code (RU byte 0) for DACTLU is X'0E'.

**LUSTAT:** The LU STATUS (LUSTAT) command is used to report error conditions during an LU-LU or SS-LU session. The request code (RU byte 0) for LUSTAT is X'04'. The 5394 sets the CD bit when it sends LUSTAT on an LU-LU session. Bytes 1 through 4 of the RU for an LUSTAT command contain the status information, which is summarized in Table 5-12 on page 5-26.

| Table 5-12. LUSTAT Status Field (RU Bytes 1-4) | | |
|---|---|---|
| **Status** | **Description** | **Session Type** |
| 00000103 | Display data stream parameter error (format table resequencing error) | LU-LU |
| 00000287 | Display data stream parameter error (self-check field >33 bytes) | LU-LU |
| 00000288 | Display data stream parameter error (invalid self-check FCW) | LU-LU |
| 00010000 | 1. Sent when a station is powered on but only if an ACTLU was received while the station was powered off | SS-LU |
| | 2. Sent when station becomes available after a permanent hardware error occurs (LUSTAT 08310000 condition resolved) | SS-LU |
| | 3. Sent when display contention error is resolved (-RSP 082D0100 condition resolved) | SS-LU or LU-LU |
| | 4. Sent when display becomes available after IPL is completed (only if a BIND was rejected) | SS-LU |
| 00020000 | Sent after printer receives a request with CD bit on | LU-LU |
| 08310000 | Sent when display is powered off or has unrecoverable hardware error while in session (RSHUTD also sent) | SS-LU |

**REQTEST:** The REQUEST TEST (REQTEST) command is used to request that a test procedure be loaded and run. The format of the REQTEST RU as sent by the 5394 is summarized in Table 5-13.

The operator initiates a REQTEST by pressing the Test Request key sequence. "Key Sequences" on page 3-40 defines the Test Request key sequence for all supported keyboards.

| Table 5-13. REQTEST RU Format | | | | |
|---|---|---|---|---|
| **Bytes** | **Bits** | **Field** | **Value** | **Description** |
| 0-2 | | **Network Services Header** | | |
| 0 | 0-1 | Involves PU or LU | B'00' | Either PU or LU |
| | 2-7 | Header type | B'000001' | Network Services header |
| 1 | 0 | Domain | B'0' | Same domain |
| | 1 | Reserved | B'0' | |
| | 2-7 | NS category | B'000011' | Maintenance Services |
| 2 | 0-7 | Request code | X'80' | REQTEST command |
| 3 | 0-7 | Network name 1 | X'00' | No name present |
| 4 | 0-7 | Network name 2 | X'00' | No name present |
| 5 | 0-7 | Procedure name | X'00' | No name present |
| 6 | 0-7 | Requester ID | X'00' | No ID present |
| 7 | 0-7 | Password | X'00' | No password present |
| 8 | 0-7 | User Field | X'00' | No user data present |

**REQMS:** The host system sends the REQUEST MAINTENANCE STATISTICS (REQMS) command to request the error log and statistical counters from the 5394. The 5394 replies to the REQMS with a RECFMS containing the formatted error log and counters. Table 5-14 provides the format of the REQMS command.

Table 5-14. REQMS Format

| Bytes | Bits | Field | Value | Description |
|---|---|---|---|---|
| 0-2 | | **Network Services Header** | | |
| 0 | 0-1 | Involves PU or LU | B'01' | PU only |
| | 2-7 | Header type | B'000001' | Network Services header |
| 1 | 0 | Domain | B'0' | Same domain |
| | 1 | Reserved | B'0' | |
| | 2-7 | NS category | B'000011' | Maintenance Services |
| 2 | 0-7 | Request code | X'04' | REQMS command |
| 3-6 | 0-31 | CNM header | X'xxxxxxxx' | Not checked by the 5394 but echoed in the RECFMS response |
| 7 | 0 | Reset indicator | B'0' or | Ignore. The 5394 always resets data when RECFMS is sent in reply. |
| | | | B'1' | Reset data when RECFMS is sent in reply. |
| | 1 | Reserved | B'0' | |
| | 2-7 | Type code | B'000001' or B'000100' | Type code of 1 or Type code of 4 |

**RECFMS:** The 5394 sends the RECORD FORMATTED MAINTENANCE STATISTICS (RECFMS) command when it receives a REQMS from the host system or when one of the statistical counters overflows. Byte 7, bit 0, indicates the reason for the RECFMS. Table 5-15 shows the format for the first 13 bytes of the RECFMS command.

Table 5-15. RECFMS Format (Bytes 1-13)

| Bytes | Bits | Field | Value | Description |
|---|---|---|---|---|
| 0-2 | | **Network Services Header** | | |
| 0 | 0-1 | Involves PU or LU | B'01' | PU only |
| | 2-7 | Header type | B'000001' | Network Services header |
| 1 | 0 | Domain | B'0' | Same domain |
| | 1 | Reserved | B'0' | |
| | 2-7 | NS category | B'000011' | Maintenance Services |
| 2 | | Request code | X'84' | RECFMS command |
| 3-6 | | CNM header | X'xxxxxxxx' | Solicited RECFMS (echoed from bytes 3-6 of REQMS) |
| | | | X'00000000' | Unsolicited |
| 7 | 0 | Solicitation Indicator | B'1' or B'0' | Reply request (REQMS) or Unsolicited |
| | 1 | Not last request Indicator | B'0' | Last request |
| | 2-7 | Type code | B'000001' or B'000100' | Type code of 1 or Type code of 4 |
| 8-11 | | Node identification | | |
| | 0-11 | Block number | X'045' or X'05F' | 5294 compatibility mode<br>5394 mode |
| | 12-31 | ID Number | X'000xx' | xx = Station address |
| 12-13 | 0-15 | Reserved | X'0000' | |

Table 5-16 shows the format of bytes 14 through 17 of the RECFMS command type 1.

Table 5-16. RECFMS Type 1 (Bytes 14-17)

| Bytes | Bits | Field | Value | Description |
|---|---|---|---|---|
| 14-15 | 0-15 | Test frames received | X'xxxx' | Sum of communication counters 0060 and 0061 |
| 16 | 0-7 | Reserved | X'00' | |
| 17 | 0-7 | Test frames received without error | X'xx' | Communication counter 0061 |

The format of a RECFMS type 4 contains X'FF' in byte 14. The contents of the statistical counters and the error log begin at byte 15 of the RECFMS type 4 response. Table 5-17 provides the format of the counters when sent. The 5394 returns only those counters with nonzero content. The error log entries begin immediately following the last statistical counter sent in the RECFMS. Table 5-18 shows the format of each entry in the log. The control unit clears the error log after sending an RECFMS regardless of the Reset Indicator bit received in the REQMS command.

Table 5-17. RECFMS Counter Format

| Counter | Length | LSID | SRC | Sense Data |
|---|---|---|---|---|
| 60 | X'05' | X'00' | X'0060' | 1 byte counter |
| 61 | X'05' | X'00' | X'0061' | 1 byte counter |
| 62 | X'05' | X'00' | X'0062' | 1 byte counter |
| 63 | X'05' | X'00' | X'0063' | 1 byte counter |
| 64 | X'05' | X'00' | X'0064' | 1 byte counter |
| 65 | X'05' | X'00' | X'0065' | 1 byte counter |
| 66 | X'05' | X'00' | X'0066' | 1 byte counter |
| 67 | X'05' | X'00' | X'0067' | 1 byte counter |
| 68 | X'05' | X'00' | X'0068' | 1 byte counter |
| 69 | X'05' | X'00' | X'0069' | 1 byte counter |
| 6A | X'05' | X'00' | X'006A' | 1 byte counter |
| 6B | Not Used | | | |
| 6C | X'05' | X'00' | X'006C' | 1 byte counter |
| 6D | X'05' | X'00' | X'006D' | 1 byte counter |
| 6E | X'09' | X'00' | X'006E' | X'00' + 4 byte counter |
| 6F | X'09' | X'00' | X'006F' | X'00' + 4 byte counter |

Table 5-18. Error Log Entry Format

| Byte | Description |
|---|---|
| 0 | Number of bytes in entry |
| 1 | Logical Session ID |
| 2,3 | SRC |
| 4 | Sense Byte 0 (if present)* |
| 5 | Sense Byte 1 (if present)* |
| 6 | Sense Byte 2 (if present)* |
| 7 | Sense Byte 3 (if present)* |
| 8 | Sense Byte 4 (if present)* |

* SRCs X'0040' through X'0045', X'0047' through X'0048', and X'0050' through X'0053' have no sense bytes included in the log entry. SRCs X'0046' and X'0054' have 4 sense bytes included in the log entry.

SRCs X'0070' through X'0098' have all 5 bytes included in the log entry. The three-byte SRCs of the X.25 and X.21 communication modes do not follow the standard layout of the log. These SRCs are stored on bytes 2, 3, and 4 of the log.

SRCs X'0060' through X'006A' and X'006C' have 1 sense byte. SRCs X'006E' and X'006F' have 5 sense bytes. These SRCs are sent to the host system without being logged.

Display stations and printers use all 5 sense bytes to report information to the log. Table 5-19 describes the information contained within the 5 sense bytes.

Table 5-19. Sense Byte Information

| Sense Byte | Sense Bits * | Information |
|---|---|---|
| 0 | | **Switches** |
| | 0 | Temporary error |
| | 1 | Link hardware error |
| | 2 | Quiesce |
| | 3 | Direct memory access overrun |
| | 4 | The expected data stream was too short |
| | 5 | The expected data stream was too long |
| | 6 | Unexpected condition encountered |
| | 7 | Timer 1 is hung in busy mode |
| 1 | | **Switches** |
| | 0 | Reserved |
| | 1 | No response received |
| | 2 | Transmit activity check (TAC) |
| | 3 | Twinaxial port is defective |
| | 4 | Received parity error |
| | 5 | Wrong length information |
| | 6 | Wrong address |
| | 7 | Even/odd parity stop |
| 2 | | **Poll Response 1** |
| | 0 | Unexpected condition encountered |
| | 1 | Transmission parity error |
| | 2 | RESV (term) |
| | 3 | Printer unit available |
| | 4 | Unclaimed OS |
| | 5-7 | *Unexpected exceptions* |
| | B'001' | Null/attribute |
| | B'010' | Activate |
| | B'011' | RESV |
| | B'100' | Command |
| | B'101' | Buffer |
| | B'110' | Register |
| | B'111' | Power-on sequence |
| 3 | | **Poll Response 2** |
| 4 | | **Printer Status or Switches** |
| | 0 | Missed Act Wrt |
| | 1 | Scan code error |
| | 2-7 | Reserved |

* If the bit is 1 (on), the condition applies. If the bit is 0 (off), the condition did not take place.

**RSHUTD:** The REQUEST SHUTDOWN (RSHUTD) command is sent by the control unit to the host system to indicate that it is ready to end the current LU-LU session. The RSHUTD command is always sent on the expedited flow. The 5394 sends RSHUTD when an unrecoverable hardware failure occurs during an active session. The request code (RU byte 0) for RSHUTD is X'C2'.

**SIGNAL:** The SIGNAL command is used to pass a signal code from LU to LU. SIGNAL is not affected by the state of the normal flow. SIGNAL is always sent and received on the LU-LU expedited flow and is used by higher level protocols to assist with device timeouts and Help key functions. The request code (RU byte 0) for SIGNAL is X'C9'. The 4-byte signal code contained in RU bytes 1-4 is summarized in Table 5-20.

Table 5-20. SIGNAL Code Definition

| Status Field | Description |
|---|---|
| 00000001 | Turn on the display Message Waiting indicator and sound the audible alarm. |
| 00000002 | Resume data transfer.<br>Sent when a printer intervention required error is resolved.<br>SIGNAL 000302xx reports the error. |
| 00000005 | Turn off the display Message Waiting indicator. |
| 00010000 | Sent when the host system requests the CD bit back to send a request on the LU-LU normal flow. |
| 00010001 | Sent when the operator presses the Attention key on the display station. |
| 0002xxxx | Sent when the operator presses the display station Help key while in error state. The 2-byte error code (xxxx) is encoded as four binary-coded decimal digits. This error code reflects the current error code displayed in columns 2-5 of the display error line. |
| 0003022x * | Invalid command or parameter. |
| 0003023x | Print check. |
| 0003024x | Forms check. |
| 0003025x | Normal periodic condition (EOF reached or unit not ready). |
| 0003026x | Printer data stream error. |
| 0003028x | Printer, print check or ribbon check. |

* Refer to your printer documentation for specific information on 000302xx class errors.

**UNBIND:** The UNBIND command ends the LU-LU session. The host system sends this command on the LU-LU expedited flow. The control unit accepts any valid UNBIND command when the LU is in an LU-LU session. All LU-LU session parameters and SNA states are reset after the UNBIND command, and the control unit sends the host system a positive response.

Table 5-21 shows the format of the UNBIND command. The UNBIND response includes only the request code (RU byte 0).

Table 5-21. UNBIND Command Format

| Bytes | Bits | Field | Value | Description |
|---|---|---|---|---|
| 0 | 0-7 | Request code | X'32' | UNBIND command |
| 1 | 0-7 | UNBIND type | X'01' | Normal end of session* |
| | | | X'06' | Invalid session parameters* |

* Any value is accepted here.

## Synchronous Data Link Control Support

Synchronous Data Link Control (SDLC) supplies a protocol that manages code-transparent, serial-by-bit information transfer between nodes that are joined by data links. The 5394 supports data transmission in only one direction at a time (referred to as half-duplex transmission) and must always be the secondary station.

The link connection can have a point-to-point or multipoint configuration; a point-to-point link may be nonswitched or switched. SDLC includes comprehensive detection and recovery procedures for transmission errors that may be introduced onto the link.

This section describes the components of SDLC implemented in the 5394. For a comprehensive description of SDLC, refer to the *Synchronous Data Link Control Concepts* book.

### SDLC Transmissions

All transmissions using SDLC are carried in frames. The frame contains all the commands, responses, and information that is being transmitted. Frames are 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, the poll bit is set on in the last frame only and the receiving station sends a response frame only after receiving 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 frames 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.

## Frame Format

Figure 5-6 shows the organization of an SDLC frame. The transmission frame is bounded by a unique flag sequence. The 5394 recognizes the transmission of continuous flags as interframe time fill.

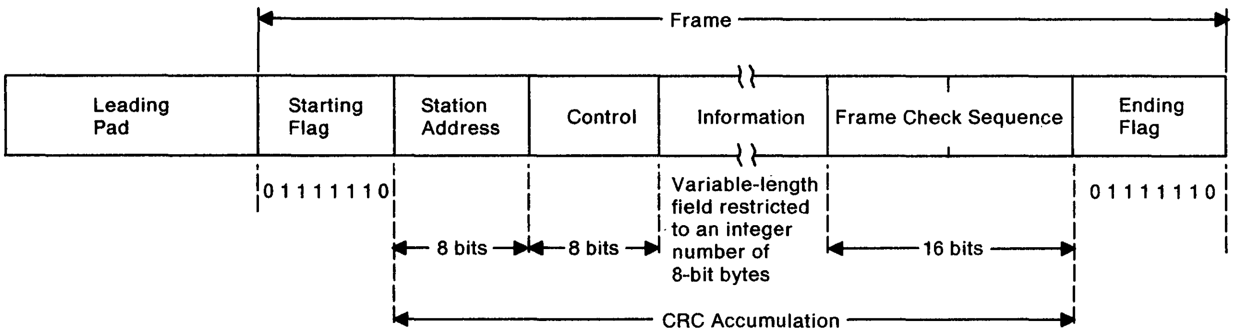



Figure 5-6. SDLC Frame Organization

**Leading Pad:** This field, although not a part of the SDLC frame, is shown here because of its relationship with the frame. When the *leading pad required* bit is set in the configuration record, the SDLC adapter inserts a synchronization byte into the data stream before the starting flag sequence. The leading pad byte is used to obtain or maintain synchronization of the modem clock following a line turnaround.

**Starting Flag:** The starting flag starts the frame. The starting flag also causes transmission error checking to start with the first non-flag character. It is made up of 8 bits with a configuration of X'7E' (01111110). This flag serves as a reference to show the position of the address and the control fields.

**Address Field:** The address (A) field of the SDLC frame always contains the network address of the 5394, whether the control unit is transmitting to or receiving from the host system. The 5394 recognizes and responds to a broadcast address (all bits set) as well as to its own network address.

**Control Field:** The control (C) field of an SDLC frame defines the frame's function. The 5394 supports three types of SDLC commands and responses:

- Unnumbered commands and responses
- Supervisory commands and responses
- Sequenced information (I) frames.

See "SDLC Commands and Responses" on page 5-34 for a description of the command field encoding for each of these frame types.

The 5394 supports modulo 8 frame numbering and an 8-bit control field. The 5394 does not support modulo 128 frame numbering and does not use the extended (16-bit) control field format.

**Information Field:** The information (I) field is not present in all frames. The I-field can contain any valid EBCDIC character, 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 I-field contains the date to be moved over the data link from place to place in the network. The data contained in this field is checked for validity by the frame check sequence field. The I-field can contain up to 256 bytes of information, plus 5 bytes of header information, for a total length of 261 bytes for the control unit.

**Frame Check Sequence:** SDLC uses a bit accounting method called cyclic redundancy check (CRC) to ensure data validity. The transmitting unit applies a mathematical formula to the A-, C-, and I-fields of the frame and places the 16-bit result in the frame check sequence (FCS) field prior to transmission. The receiving unit applies the same formula and compares the results. If the result differs from the transmitted FCS, the receiving unit discards the frame. The erroneous frame and all subsequent frames are retransmitted. Refer to *Synchronous Data Link Control Concepts* for the FCS-generating polynomial and its applications.

**Ending Flag:** The ending flag ends the frame and transmission error checking. It is made up of 8 bits with a configuration of X'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.

## SDLC Commands and Responses

The 5394 supports the following types of SDLC commands:

- Unnumbered commands and responses – These commands handle mode setting, reporting, and transmission tests.
- Supervisory commands and responses – These commands are responsible for traffic management. They acknowledge sequenced I-frames and indicate when the receiving station is ready to accept additional frames.
- Information frames – These frames carry the SNA information.

Figure 5-7 shows the control field format for the three types of SDLC frames supported.

| | Binary Configuration | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Format[1] | Sent Last | Poll/Final Bit | Sent First | Acronym | Command | Response | I-field Prohibited | Resets Nr and Ns | Confirms Frames Through Nr-1 | Definitions |
| U | 100 | P | 0011 | SNRM | X | | X | X | | Set Normal Response mode. |
| U | 000 | F | 1111 | DM | | X | X | | | Disconnected mode. This station is offline. |
| U | 010 | P | 0011 | DISC | X | | X | | | Disconnect. Enter Normal Disconnect mode (go on hook if switched). |
| U | 011 | F | 0011 | UA | | X | X | | | Unnumbered Acknowledgment. Acknowledge U commands. |
| U | 100 | F | 0111 | FRMR | | X | | | | Frame Reject. Invalid command received; must receive SNRM or DISC to reset FRMR condition. |
| U | 101 | P/F | 1111 | XID | X | X | | | | Exchange Station Identification. |
| U | 111 | P/F | 0011 | TEST | X | X | | | | Test. Used to test a link. The I-field may contain test data. |
| S | Nr | P/F | 0001 | RR | X | X | X | | X | Receive Ready. The sender is ready to receive. |
| S | Nr | P/F | 0101 | RNR | X | X | X | | X | Receive Not Ready. The sender is not ready to receive. |
| I | Nr | P/F | Ns 0 | I | X | X | | | X | Sequenced I-frame. |

[1] U = unnumbered, S = supervisory, I = information.

Figure 5-7. SDLC Commands and Responses

The XID, FRMR, TEST, and I-frame commands contain data in the information field that is unique to the 5394.

**XID:** The XID command is used by the host system to solicit the identification of the 5394. Table 5-22 defines the I-field contents sent to the host system by the 5394.

Table 5-22. 5394 XID Response Format

| Bytes | Bits | Value | Description |
|---|---|---|---|
| 0 | 0-3 | X'1' | XID format 1 |
| | 4-7 | X'1' | PU type 1 |
| 1 | 0-7 | X'14' | XID field length |
| 2-5 | 0-11 | X'045' or | 5294 Emulation mode |
| | | X'05F' | 5394 mode |
| | 12-23 | X'000' | Reserved |
| | 24-31 | X'xx' | Station Address |
| 6-7 | 0-15 | X'0000' | Reserved |
| 8 | 0-1 | B'00' | Reserved |
| | 2 | B'0' | Secondary station is sender |
| | 3 | B'0' | Reserved |
| | 4-7 | X'0' | Half-duplex operation |
| 9 | 0-7 | X'30' | Segmenting not supported |
| 10-11 | 0-15 | X'0105' | Max. I-frame length (261 bytes) |
| 12 | 0-3 | X'0' | Reserved |
| | 4-7 | X'0' | SDLC profile |
| 13 | 0-1 | B'00' | Reserved |
| | 2 | B'0' | SIM/RIM not supported |
| | 3-7 | B'00000' | Reserved |
| 14-15 | 0-15 | X'0000' | Reserved |
| 16 | 0-7 | X'07' | Max. I-frames can be received |
| 17 | 0-7 | X'00' | Reserved |
| 18 | 0-7 | X'00' | Reserved |
| 19 | 0-7 | X'00' | Reserved |

**FRMR:** Frames received with a valid FCS can still be erroneous. The 5394 considers frames invalid if:

- The control field specifies an invalid or unsupported command.
- The I-field was too long to fit into the receiving station buffers.
- An I-field was included with a command in which I-fields are not allowed.
- A sequenced I-frame was received with an unexpected sequence number.

After receiving an invalid frame, the 5394 returns a FRMR stating the cause. The FRMR is sent with a 3-byte description of the invalid frame immediately following the control field. Table 5-23 shows the format for the FRMR response.

Table 5-23. FRMR Format

| Byte | Description |
|---|---|
| 0 | The C-field of the rejected frame |
| 1 | B'Nr\0\Ns\0':<br>Nr = The 3-bit receive count prior to the rejected frame<br>Ns = The 3-bit send count prior to the rejected frame |
| 2 | B'0000zyxw'<br>z = Sequencing error<br>y = I-field longer than that supported by the 5394 (>261 bytes)<br>x = Illegal I-field is present<br>w = Invalid or unsupported command has been received |

Since SDLC provides its own error recovery system, system reference codes are not reported directly to the operator. However, the control unit maintains statistical counters in DRAM. The host system can request these counters and the error log (maintained on diskette) with the SNA commands REQMS and RECFMS. For more information on these commands, see "Systems Network Architecture Support" on page 5-12.

**TEST:** The TEST command is sent by the host system to solicit a TEST response from the control unit. This command may contain an optional I-field (up to 261 bytes). The control unit returns a TEST response containing a copy of this I-field.

**I-Frame:** The I-frames contain the SNA PIUs. For more information about the contents of the I-frame, see "Systems Network Architecture Support" on page 5-12.

### Operating Modes

SDLC supports two operating modes:

- Normal Response mode (NRM) – The 5394 is placed in NRM after receiving an SNRM command from the host system. I-frames may be exchanged in this mode.
- Normal Disconnected mode (NDM) – The 5394 is placed in NDM after receiving a DISC command from the host system. Once in this mode, the control unit responds only to SNRM, XID, DISC, and TEST commands. The control unit returns a DM response to all other commands until an SNRM is received.

## X.25 Packet-Switched Network Support

X.25 uses a process called packet-switching, which routes and transfers user data and control information. The information transmitted is contained in packets that identify the sender and receiver by a unique address. The communication line within the X.25 network is busy only during the transmission of a packet. After this operation is accomplished, the line is released for the use of other packets.

Packet-switched data networks (PSDNs), such as an X.25 network, allow multiple users to share communication lines or channels. PSDNs are an alternative to networks made up of lines dedicated to a pair of users or multiple users.

The 5394 includes support for attachment to X.25 PSDNs. Unless specifically stated in this book, the 5394 adheres to the following standards:

- CCITT Recommendation X.25 "Interface Between Data Terminal Equipment (DTE) and Data Circuit-Terminating Equipment (DCE) for Terminals Operating in the Packet Mode and Connecting to Public Data Networks by Dedicated Circuit," Geneva 1976 and 1980, Malga-Torremolinos 1984.
- *The X.25 Interface for Connecting SNA Nodes to Packet-Switched Data Networks, General Information Manual.*
- *The X.25 1984 Interface for Connecting SNA Nodes to Packet-Switched Data Networks, General Information Manual.*

## X.25 Functional Support

The X.25 PSDN makes use of four communication levels to facilitate the transport of user data and control information between DTEs. The 5394 and the host system are referred to as DTEs in the PSDN's naming convention.

The four levels of a X.25 PSDN are responsible for the following functions:

- X.25 Physical Level - The mechanical, electrical, functional, and procedural characteristics needed to activate, maintain, and deactivate the physical link between DTE and DCE.
- X.25 Link Level - The link access procedure for the interchange of data across the link between DTE and DCE.
- X.25 Packet Level - The packet format and control procedure for the exchange of packets containing control and user data between DTE and DCE.
- X.25 Logical Link Control (LLC) Level - The level that provides enhanced capabilities above the packet level. These capabilities include link connection and disconnection between DTEs, link test, operational mode selection, and identification exchange between DTEs.

The following changes were made to the 5394 to conform to CCITT Recommendation X.25 (1984):

- Support of expanded facility fields of up to 109 bytes in Call Request, Incoming Call, Call Accepted, and Call Connected packets
- Support of expanded DTE cause codes in Clear Request, Clear Indication, Reset Request, Reset Indication, Restart Request, and Restart Indication packets to allow use of CCITT and SNA diagnostic codes
- Support of non-zero address length and facility length fields in Clear Request and Clear Indication packets
- Support of the receipt of extended Clear Confirmation packets.

## X.25 Optional Facilities

The 5394 supports the following X.25 optional facilities:

- Closed user group
- Priority traffic (DATAPAC network only)
- Reverse charging
- Throughput class selection
- Flow control negotiation
- Recognized Private Operating Agencies (RPOA) selection.

## X.25 Physical Level

The 5394 Model 01 can be attached to an X.25 PSDN using a CCITT V.24/V.28 or V.35 physical interface and an X.21 bis DCE. Using this configuration, the 5394 can communicate at line speeds from 2400 bps up to 19,200 bps.

Model 02 can be attached to an X.25 PSDN using a CCITT X.24/X.27 electrical interface and an X.21 DCE. When attached this way, the 5394 can communicate at line speeds from 2400 bps up to 64,000 bps.

## X.25 Link Level

The link-level procedure used to control the state of the DTE to DCE interface is LAPB. LAPB is a subset of high-level data link control (HDLC) as specified by the International Standards Organization (ISO), Class BA with options 2 and 8. Figure 5-8 shows the format of a LAPB frame. The flag and frame check sequence fields are functionally equivalent to the same components of an SDLC frame. See "Frame Format" on page 5-33 for a description of these fields. The station address and control fields for X.25 are defined below. When a data packet contains an LLC information frame, the LLC data field contains an SNA PIU. For more information about the PIU, see "SNA Path Information Unit" on page 5-13.

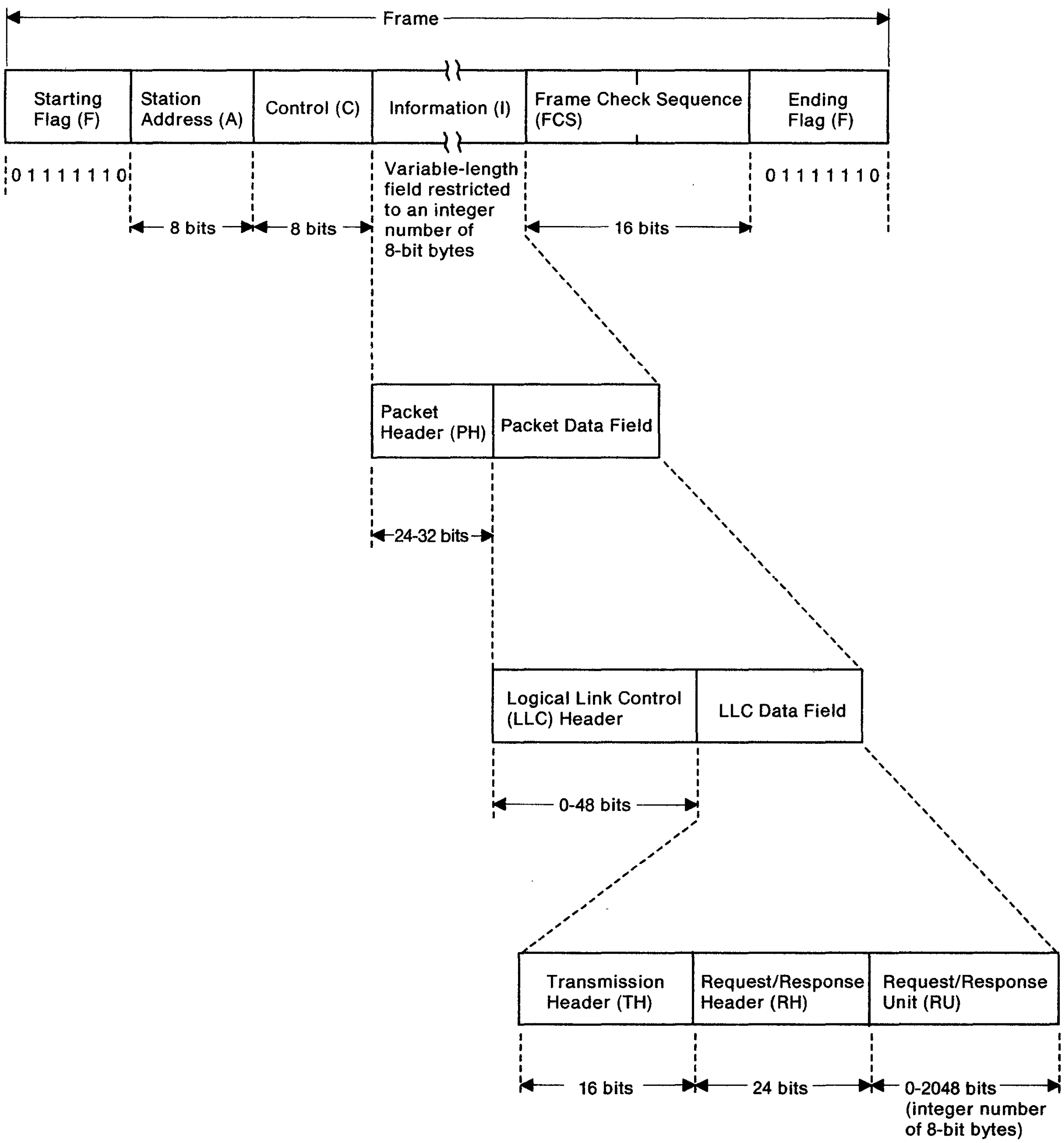



Figure 5-8. LAPB Frame Format

**LAPB Addressing:** Since the LAPB exchange is between the 5394 and its DCE, the address field is used differently than in SDLC. The 5394 transmits a frame with X'01' in the address field if it is a command and X'03' if it is a response. The DCE transmits an address field of X'03' with commands and X'01' with responses.

**LAPB Command:** At the link level, the 5394 supports three types of frames. These are:

- Unnumbered frames
- Supervisory frames
- Information frames.

These frame types are similar to SDLC frame types. However, they govern only the exchange of information between the 5394 and its DCE. End-to-end logical link control is handled at the LLC layer and is transparent to the LAPB commands and responses. The LAPB commands are encoded into the control field as they are in SDLC. Figure 5-9 lists the supported LAPB commands and responses and provides the control field encoding for the LAPB frames.

| Format[1] | Binary Configuration Sent Last | Poll/Final Bit | Sent First | Acronym | Command | Response | I-field Prohibited | Resets Nr and Ns | Confirms Frames Through Nr-1 | Definitions |
|---|---|---|---|---|---|---|---|---|---|---|
| U | 001 | P | 1111 | SABM | X | | X | X | | Set Asynchronous Balanced mode. |
| U | 000 | F | 1111 | DM | | X | X | | | Disconnected mode. This station is in disconnected state. |
| U | 010 | P | 0011 | DISC | X | | X | | | Disconnect. Enter Normal Disconnect mode. |
| U | 011 | F | 0011 | UA | | X | X | | | Unnumbered Acknowledgment. Acknowledge U commands. |
| U | 100 | F | 0111 | FRMR | | X | | | | Frame Reject. Invalid frame received, Nr count out of range, I-field too long, or I-field present when not allowed. |
| S | Nr | P/F | 0001 | RR | X | X | X | | X | Receive Ready. The sender is ready to receive. |
| S | Nr | P/F | 0101 | RNR | X | X | X | | X | Receive Not Ready. The sender is not ready to receive. |
| S | Nr | P/F | 1001 | REJ | X | X | X | | X | Reject. Request retransmission of I-frames, starting with frame numbered Nr. |
| I | Nr | P | Ns 0 | I | X | | | | X | Sequenced I-frame. |

[1] U = unnumbered, S = supervisory, I = information.

Figure 5-9. LAPB Command Summary

## X.25 Packet Level

The X.25 packet is carried in the information field of a LAPB I-frame. (Refer to Figure 5-8 on page 5-38.) The IBM 5394 supports several different packet types that are used for establishing and clearing calls, recovering from errors, and transferring data to and from the host system.

At the packet level, two classes of services are defined:

- Permanent Virtual Circuits (PVC) - These circuits appear to the DTE as dedicated or leased lines.
- Switched Virtual Circuits (SVC) - These circuits appear to the DTE as switched lines and allow the placement of virtual calls to other DTEs on the network.

### Basic Structure of Packets

Packets transferred across the DTE/DCE interface consist of at least three octets. These three octets contain a general format identifier (GFI), logical channel identifier (LCI) and a packet-type identifier (PTI). Other fields are appended to packets as required.

Figure 5-10 shows the general structure of an X.25 packet.

| Bits | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| | General Format ID | | | | Logical Channel Group Number | | | |
| Byte 0 | Q | D | M128 | M8 | | | | |
| Byte 1 | Logical Channel Number | | | | | | | |
| Byte 2 | Packet Type Identifier | | | | | | | |
| Byte 3 • • • • • Byte n | Packet Data Field | | | | | | | |

Figure 5-10. General Packet Structure

**General Format Identifier (GFI): Bit 0 (Q Bit)** is used only when qualified logical link control (QLLC) is selected. This bit is set to 1 in a data packet when a QLLC header is present. The QLLC header is present for all QLLC commands except on a QLLC data frame and in control packets. In these cases, the Q bit is set to 0. The Q bit is also 0 when other LLC protocols (ELLC and PHS) are used.

**Bit 1 (D Bit)** indicates Delivery Confirmation Requested. IBM DTEs do not support delivery confirmation. This bit is always set to 0 in packets sent by the IBM 5394. When received, a Clear Request or Reset Request packet is sent with diagnostic code X'E9' (invalid D bit setting).

**Bits 2 and 3 (M128 and M8 Bits)** are used to indicate that either Modulo 128 or Modulo 8 sequence numbering is being used at the packet level. This is a customer setup parameter. Bit 2 is set for Modulo 128 operation, and Bit 3 is set for Modulo 8 operation. Bit 2 and Bit 3 are mutually exclusive.

**Logical Channels:** Logical channels are used to enable simultaneous virtual calls and PVCs. Each virtual call and PVC is assigned a logical channel group number (0 through X'F') and a logical channel number (less than or equal to X'FF'). For virtual calls, a logical channel group number and logical channel number are assigned during the call setup phase. The range of logical channels used for virtual calls is agreed upon with the network supplier at the time of subscription to the service. For PVCs, logical channel group numbers and logical channel numbers are assigned for each PVC supported at the time of subscription.

The logical channel group number and the logical channel number may be managed as a single 12-bit entity (logical channel identifier, or LCI). Logical channel X'000' is not valid for SVCs and PVCs.

A network subscription can support multiple virtual circuits, but the 5394 can communicate over only one virtual circuit (either PVC or SVC) at a time.

**Packet Type Identifier (PTI):** Table 5-24 summarizes the packet types supported in the 5394 and provides the PTI encoded in byte 2.

Table 5-24. Supported Packet Types

| DCE to DTE | | DTE to DCE | | Service | |
|---|---|---|---|---|---|
| **PTI** | **Packet Type** | **PTI** | | **SVC** | **PVC** |
| X'0B' | Incoming Call | X'0B' | Call Request | X | |
| X'0F' | Call Connected | X'0F' | Call Accepted | X | |
| X'13' | Clear Indication | X'13' | Clear Request | X | |
| X'17' | DCE Clear Confirmation | X'17' | DTE Clear Confirmation | X | |
| X'xx' * | DCE Data | X'xx' * | DTE Data | X | X |
| X'x1' * | Receive Ready (RR) | X'x1' * | RR | X | X |
| X'x5' | Receive Not Ready (RNR) | | | X | X |
| X'1B' | Reset Indication | X'1B' | Reset Request | X | X |
| X'1F' | Reset Confirmation | X'1F' | Reset Confirmation | X | X |
| X'FB' | Restart Indication | X'FB' | Restart Request | X | X |
| X'FF' | Restart Confirmation | X'FF' | Restart Confirmation | X | X |
| X'F1' | Diagnostic | X'F1' | | X | X |

* See the following figures for these values.

The format of the packet header varies for Receive Ready (RR), Receive Not Ready (RNR), and Data packets, depending on the modulus selected. Figure 5-11 shows the format of the RR packet when Modulo 8 is being used.

| Bits | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| Byte 0 | General Format ID: 0 | 0 | 0 | 1 | Logical Channel Group Number | | | |
| Byte 1 | Logical Channel Number | | | | | | | |
| Byte 2 | P(R) ** | | | 0 | 0 | 0 | 0 | 1 |

Figure 5-11. RR Packet Format in Modulo 8

Figure 5-12 shows the format of the RR packet when Modulo 128 is being used.

| Bits | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| Byte 0 | General Format ID: 0 | 0 | 1 | 0 | Logical Channel Group Number | | | |
| Byte 1 | Logical Channel Number | | | | | | | |
| Byte 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Byte 3 | P(R) ** | | | | | | | 0 |

** P(R) = Packet receive sequence number used to provide packet-level acknowledgment.

Figure 5-12. RR Packet Format in Modulo 128

Figure 5-13 shows the format of the RNR packet sent by the DCE when Modulo 8 is being used.

| Bits | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| | General Format ID | | | | Logical Channel Group Number | | | |
| Byte 0 | 0 | 0 | 0 | 1 | | | | |
| Byte 1 | Logical Channel Number | | | | | | | |
| Byte 2 | P(R) ** | | | 0 | 0 | 1 | 0 | 1 |

Figure 5-13. RNR Packet Format in Modulo 8

Figure 5-14 shows the format of the RNR packet sent by the DCE when Modulo 128 is being used.

| Bits | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| | General Format ID | | | | Logical Channel Group Number | | | |
| Byte 0 | 0 | 0 | 1 | 0 | | | | |
| Byte 1 | Logical Channel Number | | | | | | | |
| Byte 2 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| Byte 3 | P(R) ** | | | | | | | 0 |

** P(R) = Packet receive sequence number used to provide packet-level acknowledgment.

Figure 5-14. RNR Packet Format in Modulo 128

Figure 5-15 shows the format of the Data packet when Modulo 8 is being used.

| Bits | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| | General Format ID | | | | Logical Channel Group Number | | | |
| Byte 0 | Q | 0 | 0 | 1 | | | | |
| Byte 1 | Logical Channel Number | | | | | | | |
| Byte 2 | P(R) ** | | | M *** | P(S) * | | | 0 |
| Bytes 3-n | User Data | | | | | | | |

Figure 5-15. Data Packet Format in Modulo 8

Figure 5-16 shows the format of the Data packet when Modulo 128 is being used.

| Bits | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| | General Format ID | | | | Logical Channel Group Number | | | |
| Byte 0 | Q | 0 | 1 | 0 | | | | |
| Byte 1 | Logical Channel Number | | | | | | | |
| Byte 2 | P(S) * | | | | | | | 0 |
| Byte 3 | P(R) ** | | | | | | | M *** |
| Bytes 4-n | User Data | | | | | | | |

* P(S) = Packet transmitted sequence number used to provide packet-level acknowledgment.

** P(R) = Packet receive sequence number used to provide packet-level acknowledgment.

*** M = More data bit (used for segmentation.)

Figure 5-16. Data Packet Format in Modulo 128

**Packet Data Field:** The packet data field can contain additional information such as DTE addresses, facility information, and cause and diagnostic codes, and call user data.

RR and RNR packets have no packet data fields. Data packets can contain SNA PIUs within the LLC data.

For more information on data that can be included in the different packet types, refer to *The X.25 Interface for Attaching SNA Nodes to Packet-Switched Data Networks, General Information Manual*.

## Logical Link Control

The 5394 provides three forms of logical link control (LLC) for use with X.25 PSDNs. These LLCs are contained only in data packets and provide end-to-end link-level support (similar to SDLC) to the SNA layer.

- Qualified logical link control (QLLC) — QLLC employs the qualified data indicator or 'Q bit' in data packets to identify when a QLLC header is present. For data packets that contain end user data (SNA PIUs), a QLLC header is not present and therefore the Q bit is off.
- Enhanced logical link control (ELLC) — ELLC uses extended formats in data packets to provide error detection facilities and optional retransmission recovery procedures.
- Physical services header (PSH) — PSH is used to maintain compatibility with earlier model IBM DTEs and is encoded in data packets.

The type of LLC used during a session is determined in one of the following ways:

- The protocol identifier of an Incoming Call packet specifies LLC type (SVC only).
- The 5394 operator specifies LLC type when entering a Call Request (SVC only) or an Open (PVC only).
- The default LLC is used when not specified in an Open or Call Request. The default LLC is selected during customer setup procedures.

Figure 5-17 lists all of the supported commands and responses for each of the three LLC types and indicates which are transmitted and received by the 5394. Commands and responses with similar functions are listed on the same line along with their SDLC equivalents. For example, LSABME, QSM, PSCONTACT, and SNRM all control link activation.

| Cmd | | **ELLC** | Resp | | Cmd | | **QLLC** | Resp | | Cmd | | **PSH** | Resp | | **SDLC Equivalent** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R | T | | R | T | R | T | | R | T | R | T | | R | T | |
| √ | √ | LI | | | √ | √ | DATA | √ | √ | √ | √ | DATA | √ | √ | I |
| √ | | LSABME | | | √ | | QSM | | √ | √ | | PSCONTACT | | | SNRM |
| √ | | LDISC | | | √ | | QDISC | | √ | √ | | PSDISC | | | DISC |
| √ | | LXID | | √ | √ | | QXID | | √ | √ | | PSXID | | √ | XID |
| √ | | LTEST | | √ | √ | | QTEST | | √ | √ | | PSTEST | | √ | TEST |
| | | LUA | | √ | | | QUA | | √ | | | PSCONTACT | | √ | UA |
| | | | | | | | | | | | | PSDISC | | √ | UA |
| √ | √ | LRR | √ | √ | √ | √ | QRR | | | | | | | | RR |
| √ | | LRNR | √ | | | | | | | | | | | | RNR |
| | | LREJ | √ | √ | | | | | | | | | | | REJ |
| | | LDM | √ | √ | | | QDM | | | | | | | | DM |
| | | LPDUR | √ | | | | | | | | | | | | FRMR |

R = Valid data packets received by the 5394
T = Packet transmitted by the 5394

Figure 5-17. Logical Link Control Summary

*The X.25 Interface For Attaching SNA Nodes To Packet-Switched Data Networks, General Information Manual* contains a comprehensive discussion of usage and format for all three LLC types.

**Operator Call Placement:** The 5394 allows the display station operator to initiate a Call Request on an SVC. The operator selects destination, LLC type, and extended X.25 network facilities. Table 5-25 on page 5-44 summarizes the selections available to the operator. To place a call, the operator enters a System Request key sequence. The operator then enters the commands and parameters. If the 5394 operator omits a parameter, the default value (assigned at control unit setup) is used. The 5394 operator specifies optional facilities by delimiting entries with commas. For example:

```
C,N0524,L031,P128,W2,R,Q
```

places a call (C) to the network address (N) 0524 using logical channel (L) 031. A packet size (P) of

128 bytes is requested with a window size (W) of two packets. Reverse billing (R) and qualified logical link control (Q) are requested with this call as well. A password, if required, is entered in the same way:

C,N0524,L031,P128,XGEORGE,W2,R,Q (GEORGE = password)

Table 5-25. Call and Answer Parameters

| Char. Used | Meaning | O | C | A | Default |
|---|---|---|---|---|---|
| L | Logical channel | √ | √ | √ | 001 |
| X | Password | | √ | √ | N/A |
| N | Network address | | √√ | √ | Network address of first incoming call |
| W | Window size | √ | √ | √* | Setup |
| P | Packet size | √ | √ | √ | Setup |
| F | Facilities | | √ | | N/A |
| R | Reverse charging | | √ | | N/A |
| U | Closed-user group | | √ | | N/A |
| E | ELLC | √ | √ | | Setup |
| Q | QLLC | √ | √ | | Setup |

O = OPEN command
C = CALL command
A = ANSWER command
√ = Optional
√√ = Required
* = Specifying N in an answer is valid but ignored
Setup = Parameter entered during initial configuration of control unit.

If L (Logical Channel) is not specified with the ANSWER command on an incoming call, any logical channel will be answered.

**Operator Call Answering:** The operator may indicate to the 5394 how a call is to be answered. For example:

```
A,XROMEO,L031
```

answers an incoming call on logical channel (L) 031 with the password (X) of ROMEO. If flow control negotiation facilities are allowed, the operator may also specify packet and window sizes in the ANSWER command (A).

**Automatic Call Answering:** The Release 2 system diskette supports configuration for single SVC answer only. If the 5394 is configured for this type of circuit, manual options are not permitted. The 5394 establishes the communication link without any operator action by:

- Using the logical channel selected by the network
- Not checking either the telephone number or the password of the call.

**Opening a Logical Channel:** When using PVCs, call establishment procedures are not required to begin communication. However, the operator may select the logical channel to be used with the OPEN command (O). If the logical channel is omitted, the first data packet received establishes the logical channel number.

**Network Link-Level Error Recovery:** The Release 2 system diskette supports automatic link-level error recovery for single PVC and single SVC (answer only) circuits. When a link-level error occurs during data transfer, the network attempts to recover from the error condition by calling the control unit. The control unit then uses any operator options supplied to answer the call and restore the communication link. However, if the 5394 is using a Release 1 system diskette, or if it is configured for multiple PVCs or SVCs, operator action is necessary to recover from a link-level error.

**Ending a Session:** When the display station operator chooses to reject the incoming call, the DETACH command (D) causes a DISC to be issued at the link level, ending the exchange. The DETACH command is valid whenever the LLC link with the host system is inactive. The LLC is in the mode equivalent to the SDLC Normal Disconnect mode.

The DETACH command is entered by pressing the System Request key sequence and typing a D.

### X.21 Public Data Network Support

CCITT Recommendation X.21 describes the DTE to DCE interface for attaching to X.21 Public Data Networks. This recommendation covers the electrical interface, the interface states, and the rules for making transitions from one state to another. The interface states and transition rules govern the following:

- Physical link establishment
- Call placement
- Error detection and handling at the physical link level
- Call clearing.

When a 5394 Model 02 is connected to an X.21 circuit-switched line, the interface states and transition rules supply a formal structure for establishing a circuit to the host system. Once this circuit is established, the interface enters the data-transfer state, and the 5394 uses SDLC and SNA protocols for transmission of user data.

When a 5394 Model 02 is connected to an X.21 leased line, the interface remains in the data-transfer state. As a result, the control unit does not require the X.21 state transition rules, and SDLC and SNA serve as the operative protocols during all phases of operation.

When a 5394 Model 01 is attached to an X.21 Public Data Network through an X.21 bis DCE, the 5394 does not support circuit switching and uses only SDLC and SNA for transmission of user data. For circuit-switching support, the X.21 bis DCE must provide the switching capability.

## Network Facilities

The 5394 supports the following X.21 functions:

- Abbreviated address calling
- Charge transfer
- Closed user group
- Closed user group with outgoing access
- Direct call
- Incoming calls barred
- Outgoing calls barred
- Registration/cancelation of user facilities
- Redirection of call
- Recognized Private Operating Agency (RPOA).

The work station operator can change the facility registration parameters. The procedure for changing these parameters is as follows:

1. Press the System Request key sequence.
2. Enter the facility registration for the parameter to be changed.
3. Press the Enter key.

Contact your network supplier to determine the format of the facility registration parameters.

## X.21 Switched-Circuit Operations

The operation of work stations attached to the 5394 is based on interactive terminal support and is dependent on the communication link. A call must be established and the data link must be connected for work station operation. With X.21 switched, the 5394 supports automatic call establishment (call is made following a work station key sequence) and automatic call clearing. The host system or a control unit operator can initiate the call or call clearing.

If the communication link is not established, the control unit recognizes a System Request key sequence as an indicator that the operator wants to place a call. The control unit then sets up one input field, 78 characters long, for the operator to enter call information or facility requests. The System Request key sequence is defined for all supported keyboards in "Key Sequences" on page 3-40.

**Normal Call Initiation (Address Call):** The work station operator initiates a normal call in the following sequence:

1. Press the System Request key sequence.
2. In the input field, type the network call information. This is the network address for the appropriate host system. An optional plus (+) character may serve as an end delimiter. Contact your network supplier for a list of facilities supported.
3. Press the Enter key.

**Direct Call Initiation:** The work station operator initiates a direct call in the following sequence:

1. Press the System Request key sequence.
2. Press the Enter key.

Under these conditions, the control unit makes a direct call request. The request is made to the network to place a call to a network address that the operator previously selected using facility registration.

**Call Clearing Initiation:** Calls are cleared under the following conditions:

- The control unit initiates call clearing with a DTE-clear-request sequence as part of an error or timeout recovery procedure.
- The work station operator clears the call when the control unit is in the data transfer phase but not in Normal Response mode, by entering the System Request key sequence and the character D.
- The DCE issues a clear-indication to the control unit.
- The host system issues an SDLC DISCONNECT (DISC) command. The 5394 responds with a UA and initiates a DTE-clear-request sequence.

## Short Hold Mode

In Short Hold mode (SHM), the link between two stations is established and maintained only when there is data to transfer. The 5394 supports SHM but will not initiate an SHM session. The host system determines and controls the SHM operation.

To start an SHM session, either the host system or the remote display station initiates a call to the network. The call then proceeds as any other X.21 call. When the interface reaches the ready-for-data state and the SDLC operation starts, the host system sends a Format 1 XID command (see Table 5-26 on page 5-47) specifying the SHM operation.

After SHM is selected by the XID exchange, the host system sends an SDLC SNRM command to start the SHM session. At any time in the session when the host system does not have any frames to transmit or acknowledge, the host system can clear the connection. Either the host system or the remote display station can call to reestablish the connection.

The XID command sent by the host system contains the dial digits for the host system. The control unit uses these dial digits to reconnect the link. These digits are received in EBCDIC code. The control unit uses these digits on each reconnection attempt. When the control unit initiates a reconnection, the control unit translates the EBCDIC codes to the International Alphabet (IA5) codes. If SHMDIALN = 0 (see Table 5-26 on page 5-47), or if the configuration bit direct call is set on, the control unit issues a direct call request to the network for reconnection.

In SHM, when a work station has data to send to the host system and the X.21 connection is not active, the control unit uses the dial digits that were received in the XID command and makes the reconnect attempt. When the reconnection is made and the X.21 data transfer phase is entered, the host system must send an XID with the SHM status indicator (SHSI) 'on' to continue the same SHM session. After the XID exchange, the host system sends an SDLC RECEIVE READY command to enable the control unit to send the work station data.

To end the SHM session, the host system sends the DISC command to put the control unit in NDM and clears the connection.

The control unit interprets a clear request received during NRM as SHM line disconnects. The control unit disconnects the line and maintains the SNA session in progress. An SHM reconnection is necessary to continue or end the session.

**Short Hold Mode XID Format:** The 5394 responds to a Format 0 or Format 1 XID command, but does not issue the command. The control unit always responds with a Format 1 XID response. See Table 5-26.

The host system sends the XID command to solicit an XID response from the control unit when a session is to be established or reconnected.

Table 5-26. Short Hold Mode XID Response

| Bytes | Bits | Field | Value | Description |
|---|---|---|---|---|
| 0 | 0-3 | XID format | X'1' | Format 1 |
| | 4-7 | Node type | X'1' | PU.T1 |
| 1 | 0-7 | XID I-field length | X'14'<br>or<br>X'nn' | Format 1, not SHM<br>or<br>Format 1, SHM |
| 2-5 | 0-11 | Block number | X'045'<br>or<br>X'05F' | 5294 Emulation mode<br>or<br>5394 mode |
| | 12-31 | ID number | X'000xx' | xx = SDLC station address |
| 6-7 | 0-15 | Reserved | X'0000' | |
| 8 | 0-3 | Transmission type | X'0' | Sender is secondary |
| | 4-7 | Transmission mode | X'0' | Half-duplex |
| 9 | 0-3 | Segmenting bits | X'3' | Segmenting not supported |
| | 4-5 | Reserved | B'00' | |
| | 6 | SHM Status indicator (SHSI) | B'0'<br>or<br>B'1' | SHM session is reset<br>or<br>SHM session is active |
| | 7 | SHM indicator (SHI) | B'1' | SHM is supported |
| 10-11 | 0-15 | Max I-field length | X'0105' | 261 bytes maximum |
| 12 | 0-7 | SDLC profile | X'00' | Only value defined |
| 13 | 0-1 | Reserved | B'00' | SREJ not supported |
| | 2 | SIM/RIM support | B'0' | SIM/RIM not supported |
| | 3-7 | Reserved | B'00000' | |
| 14-15 | 0-15 | Reserved | X'0000' | |
| 16 | 0-7 | Max I-frames received | X'07' | |
| 17 | 0-7 | Reserved | X'00' | |
| 18 | 0-7 | Reserved | X'00' | |
| 19 | 0-7 | SHMDIALN: Number of dial digits | X'nn' | Number between X'00' and X'0F' |
| 20-n | | SHMDIALD: Dial digits | X'Fx' | Dial digits (x=0-9) |

**Short Hold Mode Retries:** The 5394 can retry reconnection attempts that fail because of network events. The interval between retries and the number of retries are determined from setup parameters. If the 5394 exhausts the retry counter, it posts the reason for the last retry failure to the operator, logs a permanent link error, and ends the SHM session.

The following events result in SHM retries:

- A call progress signal (CPS) is received.

  All 2x and 6x CPSs are retried. Other CPSs are retried if they were specified during customer setup. Invalid CPSs are retried.
- A recoverable timeout condition is detected by the control unit.
- A DCE-clear-indication is received during call reconnection.
- A parity error is detected during call reconnection.

## Communication Codes

The 5394 using X.21 circuit-switched functions can receive messages and exchange information with the network by using the International Alphabet No. 5 7-bit code. The 5394 supports the receipt of decimal digits 0 through 9 and colon (:) as well as the control codes listed in Table 5-27.

The 5394 responds to DCE-defined CPSs such as number busy, access barred, and changed numbers. The 5394 also recognizes CPSs starting with shift-in (SI) characters. The 5394 discards other DCE network information received and posts no operator messages.

The 5394 supports the transmission of all International Alphabet No. 5 codes to accommodate the network registration facility usage, but it does not check message syntax. Data entered by the operator is translated from EBCDIC to IA5 characters with odd parity and sent to the network. If a keyboard character not included in the IA5 character set is entered, the 5394 translates that entry to a NULL.

The 5394 makes sure that the transmitted network messages are appended with a + character delimiter. The delimiter is either entered by the operator or is automatically added. Table 5-28 on page 5-49 lists the control codes used in messages sent by the network.

Table 5-27. Control Codes Received

| Code | Definition |
|---|---|
| BEL | Indicates an incoming call when preceded by a minimum of two SYN characters and the 5394 is in state 1. |
| SYN | A character that precedes all transmission and may be embedded within transmission to maintain synchronization. |
| SI | Shift in. Used in Japanese network only. Follows SYN SYN and precedes call progress signals or DCE-provided information. |
| + | An ending delimiter that indicates end-of-transmission (EOT). |
| , | A field separator used to separate fields in call progress signals or DCE-provided information. |
| / | Indicates the start of DCE-provided information. Must be preceded by SYN SYN and information must be followed by a +. |
| * | Indicates the start of DCE-provided calling and called line identification. Must be preceded by SYN SYN and information must be followed by a +. |

| Table 5-28. Control Codes Sent | |
|---|---|
| **Code** | **Definition** |
| SYN | A character that precedes all transmissions and may be embedded within transmissions to maintain synchronization. |
| NUL | A character used for fill purposes. The NUL character may be inserted into a data stream without affecting the information content. It is used by the 5394 to replace any operator-entered character that does not have an equivalent in the IA5 alphabet. |
| . | Indicates the start of an abbreviated address selection sequence. Must be preceded by SYN SYN, and the address must be followed by a +. |
| , | Used to separate facility request signals within a facility request block that contains two or more facility request signals, or used to separate facility registration/cancellation signals within a facility registration/cancellation block that contains two or more facility registration/cancellation signals. |
| / | Used to separate fields (request code, indicator, parameter, or address) within a facility registration/cancellation signal. |
| − | Terminating delimiter of facility request or facility registration/cancellation blocks. Must be followed by a +. |
| + | Ending delimiter used to indicate the end-of-transmission (EOT). Used for all transmissions. |
| **nnn** | If preceded by SYN SYN and ended by a +, the sequence **nnn...n** is an address selection sequence. If preceded by SYN SYN and ended by a − and then a +, the sequence **nnn...n** is a facility block. |

## X.21 Network States

The 5394 recognizes the X.21 network interface states as defined in *CCITT Recommendation X.21: Interface between Data Terminal Equipment (DTE) and Data Circuit-Terminating Equipment (DCE) for Synchronous Operation on Public Data Networks* (Geneva, 1972; as amended 1976, 1980, and 1984).

The circuit reference conditions used to describe the 5394 operations are shown in Table 5-29.

| Table 5-29. Circuit Reference Conditions | | | |
|---|---|---|---|
| **Symbol** | **Circuit** | **Name** | **Conditions** |
| c | Circuit C | Control | On or Off |
| i | Circuit I | Indicate | On or Off |
| r | Circuit R | Receive | 1 or 0 |
| t | Circuit T | Transmit | 1 or 0 |

**Initial Conditions Following Power On:** Following the power-on sequence, the control unit is initialized to a DCE-uncontrolled-not-ready state with circuits t = 0 and c = Off. The control unit maintains this state during initialization. The control unit does not check the state of the DCE during this period. Circuits R and I can be in any condition. The control unit then presents ready to the DCE (t = 1 and c = Off) and waits for a DCE-ready (r = 1, i = Off).

**Receive Conditions:** A BEL character preceded by two or more adjacent SYN characters signals an incoming-call from the DCE. The control unit then accepts the call (t = 1 and c = On) unless there is a call-collision.

The control unit receives X.21 network messages only in the call establishment phase. For an incoming call, the messages must be preceded by the following sequence of characters:

1. Two or more SYN characters
2. One or more BEL characters
3. Two or more SYN characters.

For an outgoing call, the control unit must be in the DTE-waiting state (state 5), and the message must be preceded by two or more SYN characters.

The control unit recognizes the first plus (+) character in the message as the end of the message.

When the control unit reaches the ready-for-data state, the control unit switches automatically to the SDLC operation.

The SDLC operation is ended if an X.21 DCE-clear (16 zeros with i = Off), is detected.

**Transmit Conditions:** X.21 is a duplex protocol; therefore, the control unit transmit will not be enabled unless receive is active. This is necessary to receive and report network response to call-request. When transmit is enabled, the control unit will progress through the calling states: call-request, proceed-to-select, selection-signals, and DTE-waiting. Following proceed-to-select state 3 (r = plus (+) character and i = Off), the control unit will typically transmit two SYN characters followed by the message characters or the select data and the end of message delimiter (plus (+) character). The control unit will then transmit continuous ones (1s) that signal DTE-waiting state until either the ready-for-data state (r = 1 and i = On) or a call-clear state (r = 0 and i = Off) is signaled by the DCE.

If a direct call is initiated, the control unit bypasses the selection-signal state 4 and does not transmit SYN or other IA5 characters. In this case, the control unit will immediately transmit continuous ones (1s) that signal DTE-waiting state. The control circuit will be on for 24-bit times (c = 1) before the control unit initiates data-transfer (Circuit T held at t = 1).

**Timeout Conditions:** The 5394 detects timeout conditions specified in the CCITT Recommendation X.21. Refer to the CCITT Recommendation X.21 for more information.

**DCE-Clear-Confirmation:** When the control unit signals DTE-clear-request (t = 0 and c = Off), T5 timeout is set and is not cleared unless a DCE-clear-confirmation (r = 0 and 1 = Off) followed by a DCE-ready (r = 1 and 1 = Off) is received.

**DCE-Controlled-Not-Ready:** The 5394 handles the DCE-controlled-not-ready (CNR) state in two ways.

- If the control unit receives the DCE CNR during the call-control phase, it handles the DCE CNR as a DCE clear condition.
- If the control unit receives the DCE CNR during the data-transfer phase, it ignores the DCE CNR. Normal SDLC error recovery handles the lost data as necessary.

**Call-Collisions:** Call-collisions can occur under the following conditions:

- A network incoming call is indicated at the same time as or immediately after the control unit sends a call-request.
- A network incoming call is indicated while the control unit is processing an operator-initiated call.
- A network incoming call is indicated while the control unit is in SHM, and the work station operator has taken an action requiring the control unit to reconnect the link.

If the DCE indicates an incoming call (r = SYN,SYN,BEL and i = Off) during or immediately after the control unit has sent a call-request (t = 0 and c = On), the control unit takes no action. The DCE either drops the incoming call and proceeds with the call-request selection sequence or attempts to establish the incoming call. If the DCE drops the incoming call, that call is not recognized. If the DCE attempts to establish the incoming call, the control unit utilizes the call-request sequence timeout to end its call-request.

If the display station operator is in the process of making a call (System Request key sequence pressed and call-request not yet sent to the DCE) and an incoming call is indicated, the control unit posts an error to the operator and logs the error. The control unit then sends a clear-request to the DCE (t = 0 and c = Off).

If the control unit is in SHM and the display station operator is in the process of reestablishing the link, the control unit cancels the call, increments the call-collision counter, and responds to the incoming call.

**Call-Progress-Signal:** The 5394 supports all call progress signals (CPS) specified in the CCITT Recommendation X.21.

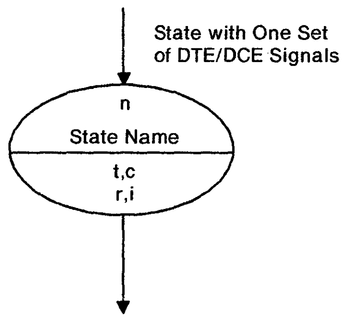
If a CPS is received during an incoming call, the call is cleared and a permanent link error is posted and logged.

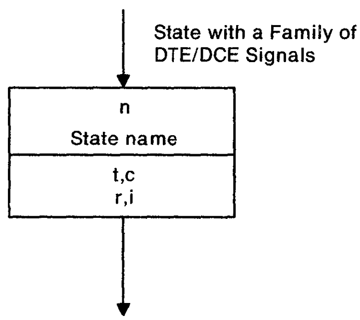
If a CPS is received during an operator-initiated (outgoing) call, the recovery depends on the CPS received.

- **Group 0 CPS (0x)**. If the DCE takes no action within 60 seconds, a DTE-clear-request is issued and a permanent link error is posted and logged.
- **All other CPS groups**. If a DCE-clear-indication is not received within 6 seconds, a DTE-clear-request is issued and a permanent link error is posted and logged.

Refer to "Short Hold Mode Retries" on page 5-48 for information on the effect of CPSs during SHM reconnection.

**Interface State Diagrams:** Recommendation X.21 defines the transitions between interface states that are allowed by all telecommunication administrations. The recognized state transitions for each of the four phases of a data communication operation are shown by state diagrams. Figure 5-18 shows the definitions for the symbols that are used in state diagrams. Figure 5-19 shows the states used for nonswitched operation (X.21 nonswitched public data network or X.25 packet-switched network).




| | | |
|---|---|---|
| n | = | State number |
| t | = | Signal on T circuit |
| c | = | Signal on C circuit |
| r | = | Signal on R circuit |
| i | = | Signal on I circuit |
| T | = | Transmit interchange circuit |
| C | = | Control interchange circuit |
| R | = | Receive interchange circuit |
| I | = | Indication interchange circuit |
| D | = | DTE or DCE data signals |
| 0 | = | Steady binary 0 condition |
| 1 | = | Steady binary 1 condition |
| 01 | = | Alternate binary 0 and binary 1 |
| X | = | Any value |
| Off | = | Continuous off (binary 1) |
| On | = | Continuous on (binary 0) |
| IA5 | = | Characters from International Alphabet Number 5 (CCITT Recommendation V.3) |
| BEL | = | IA5 character, 0/7 |
| SYN | = | IA5 character, 1/6 |
| + | = | IA5 character, 2/11 |
| ↓ | = | Transition between states |

Figure 5-18. Definitions of Interface State Diagrams

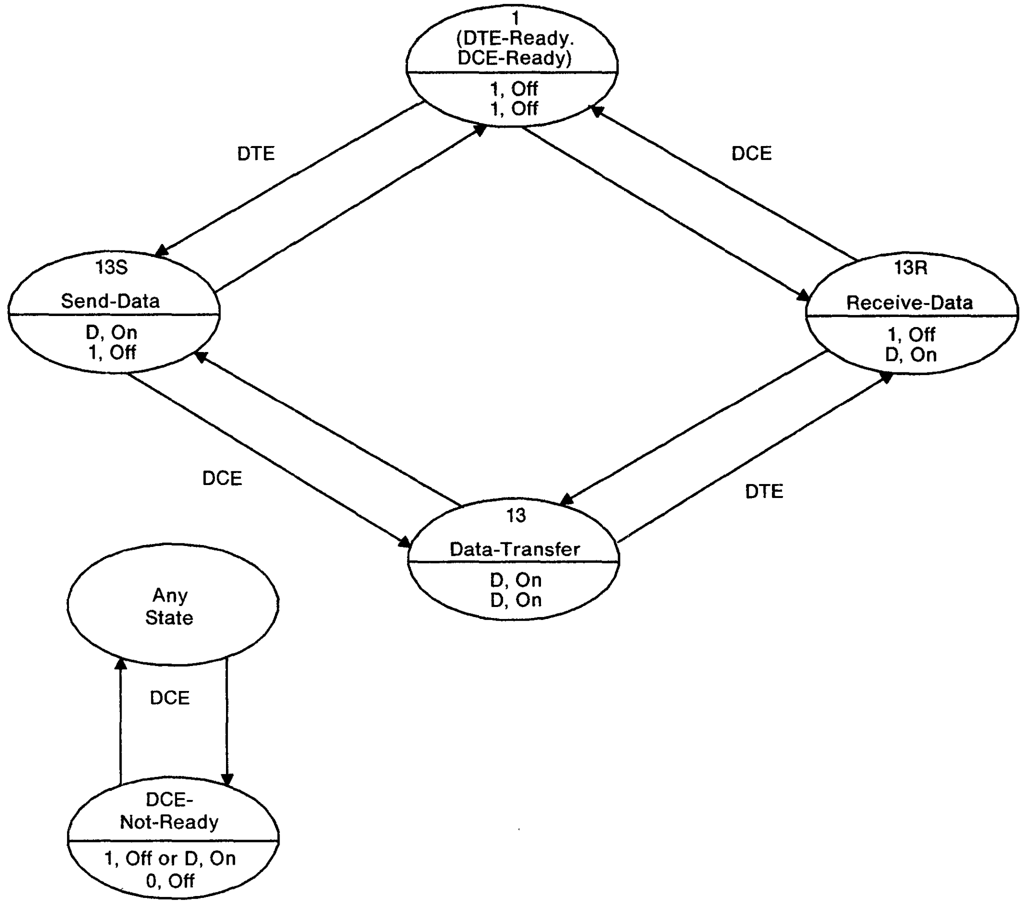
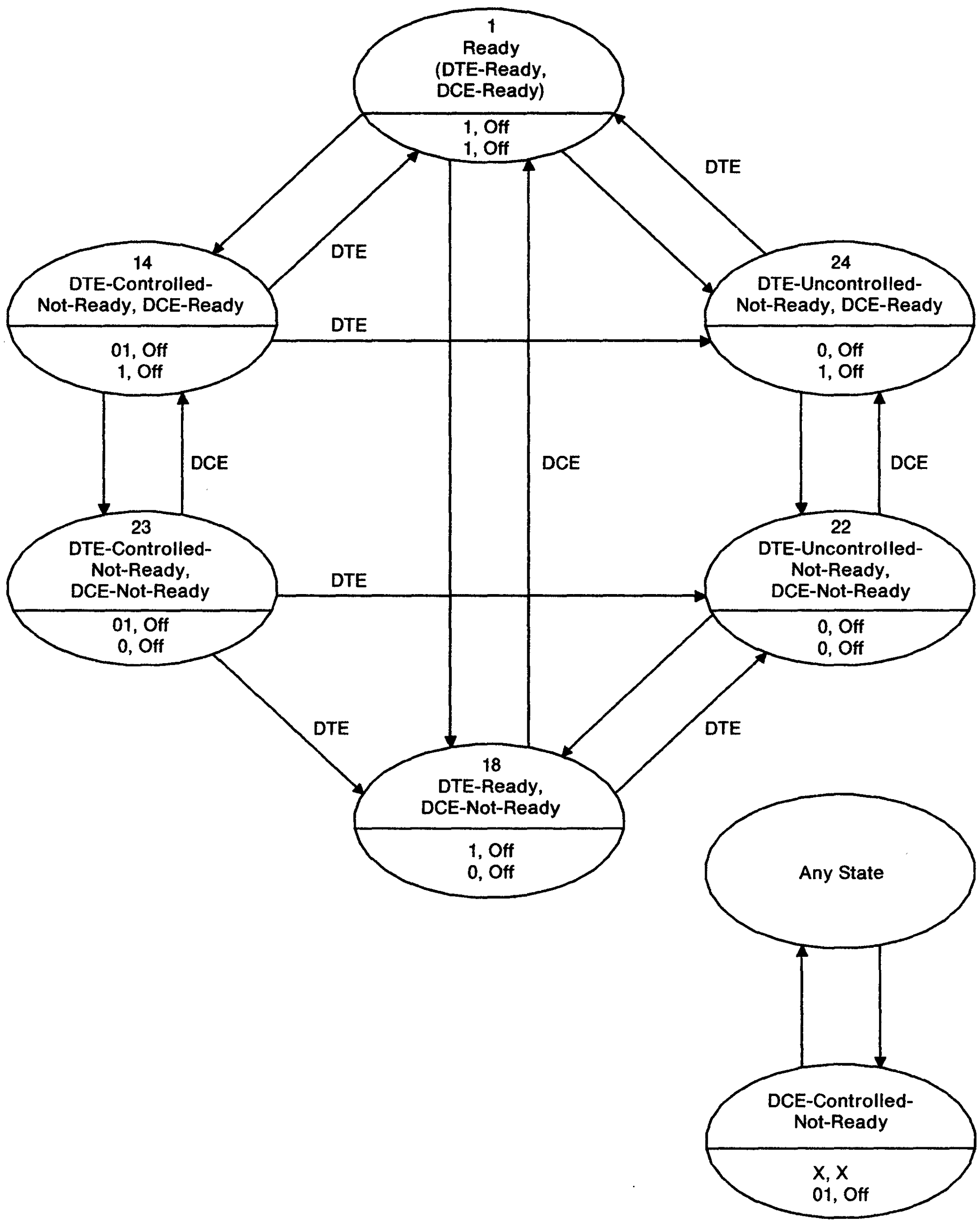



Figure 5-19. Data Transfer Phase Interface State Diagram. X.21 Nonswitched Public Data Network or X.25 Packet-Switched Network Operation with X.21 Electrical (X.24/X.27) Interface

Figure 5-20 and Figure 5-21 show the states used for X.21 circuit-switched public data network operation.




**Note:** The DCE and DTE (5394) must signal each state 24 bit-times or until the DCE or DTE indicates that the state has been recognized by changing states. The DTE (5394) must not change states as a result of the DCE changing state until the DCE-signaled state has existed for at least 16 bit-times.

Figure 5-20. Quiescent Phase Interface State Diagram: Circuit-Switched Operation

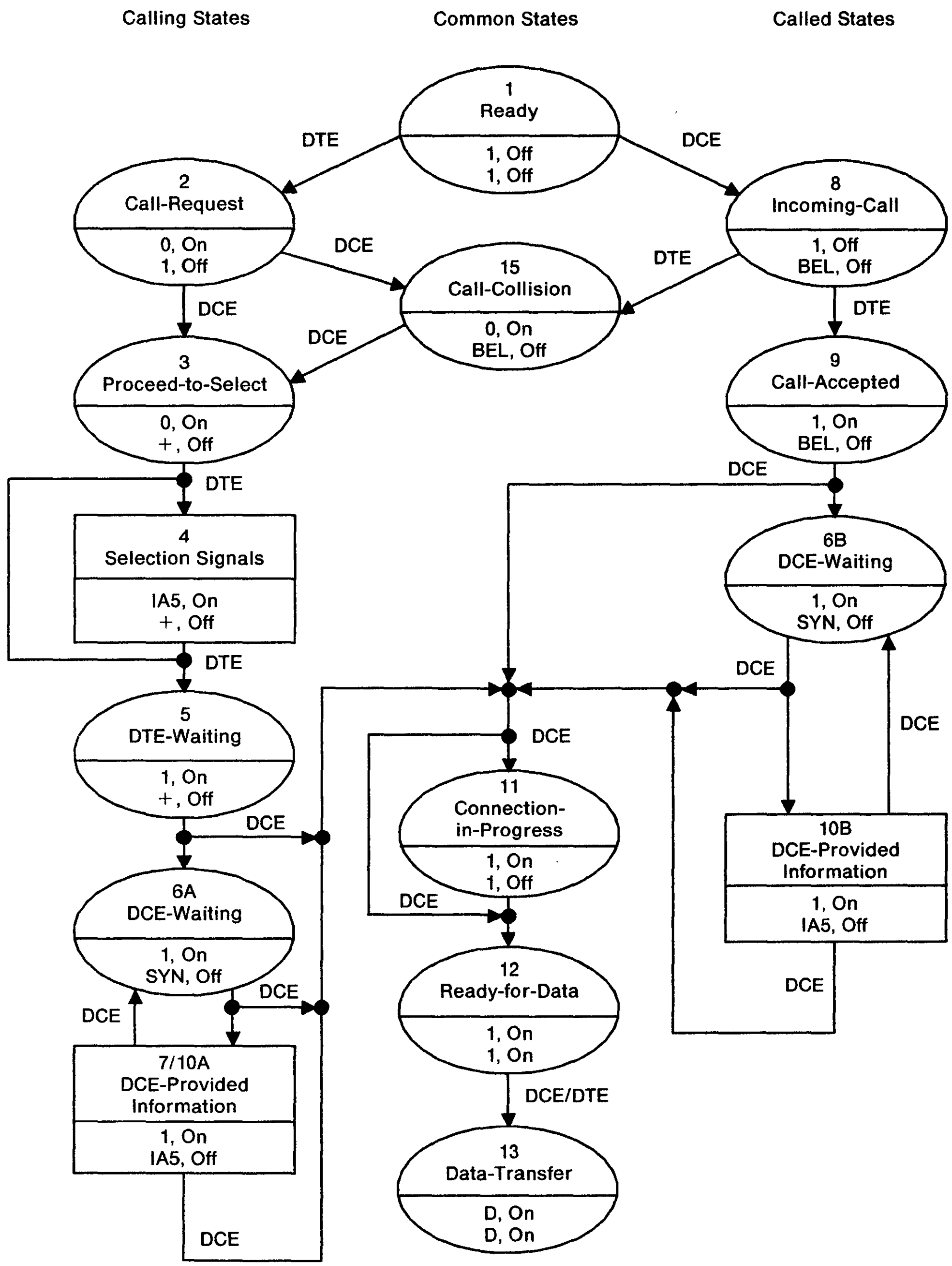



Figure 5-21. Call Establishment Phase and Data Transfer Phase Interface State Diagram: Circuit-Switched Operation

**Switched Network Call and Answer Sequences:** Table 5-30 shows the sequence of states used for calling on an X.21 switched network. Table 5-31 on page 5-57 shows the sequence of states for answering on an X.21 switched network. The condition of the transmit data, control data, receive data, and indicate lines for the X.24/X.27 interface between the control unit and the DCE is also shown.

The sequence shown is for normal operation. Most states have timeouts for error recovery.

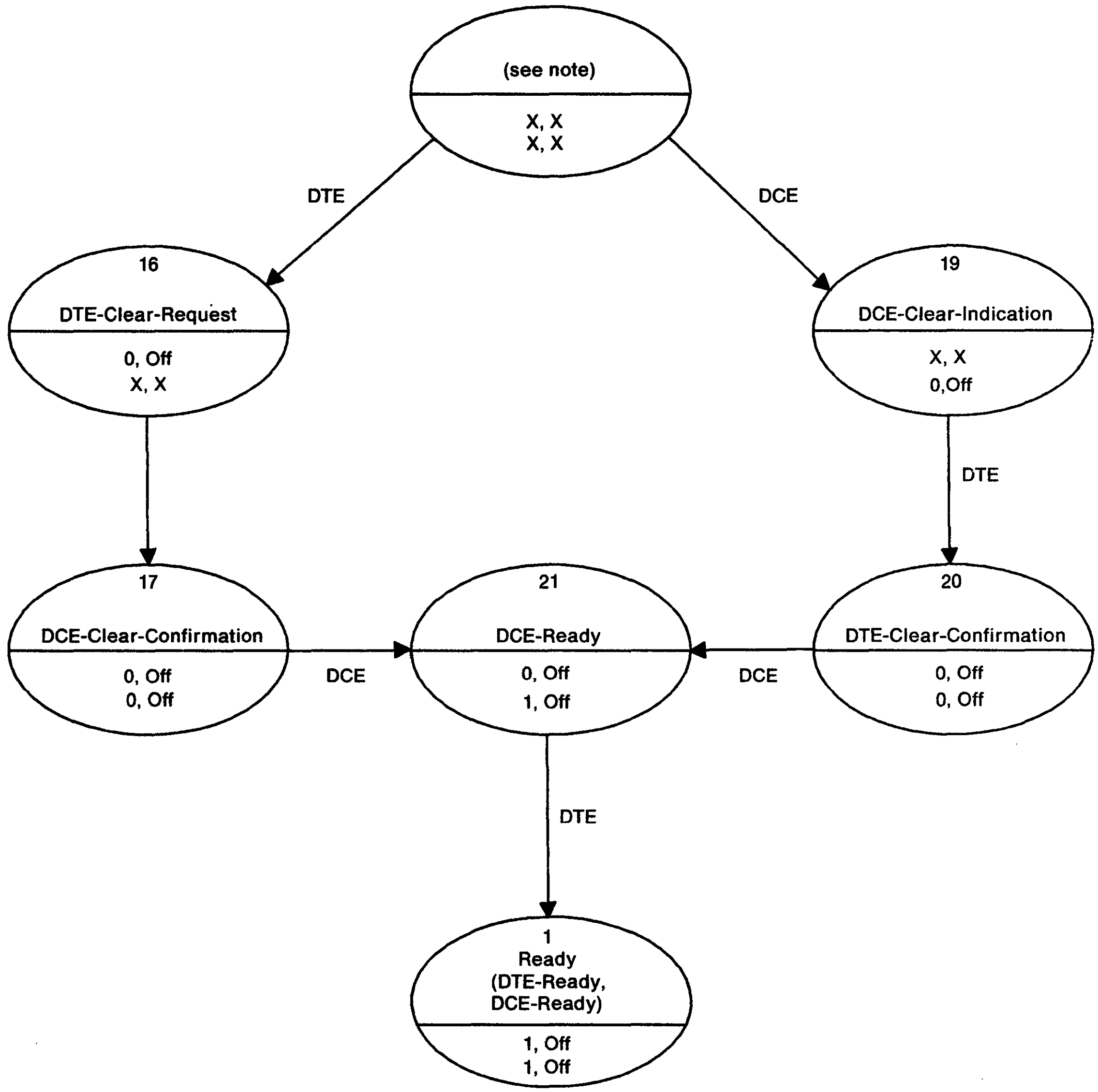
Table 5-30. Switched Network Calling Sequence

| State | Description | Transmit | Control | Receive | Indicate |
|---|---|---|---|---|---|
| 1 | The 5394 and the DCE are ready for operation. | 1 | Off | 1 | Off |
| 2 | The 5394 asks the DCE to place a call. | 0 | On | 1 | Off |
| 3 | The DCE responds with a proceed-to-select signal. | 0 | On | SYN SYN + ... | Off |
| 4 | The 5394 responds with selection signals. This state is bypassed for direct call. | SYN SYN selection signals + | On | + ... | Off |
| 5 | DTE-waiting. | 1 | On | + ... | Off |
| 6A | DCE-waiting. This state may be bypassed for some calls. | 1 | On | SYN ... | Off |
| 7/10a | The DCE responds with a CPS or DCE-provided information. The DCE is placing a call to a remote station (optional state). | 1 | On | SYN SYN CPS + | Off |
| 11 | The DCE signals that the connection has started (optional state). | 1 | On | 1 | Off |
| 12 | The connection to the remote station is complete (ready for data). | 1 | On | 1 | On |
| 13 | The data-transfer can start. Data-transfer is done using SDLC protocol in half-duplex mode. SDLC operation is the same as SDLC switched operation after a call is established. | Data | On | Data | On |

| Table 5-31. Switched Network Answering Sequence | | | | | |
|---|---|---|---|---|---|
| **State** | **Description** | **Transmit** | **Control** | **Receive** | **Indicate** |
| 1 | The 5394 and the DCE are ready. | 1 | Off | 1 | Off |
| 8 | The DCE indicates an incoming call. | 1 | Off | SYN SYN BEL... | Off |
| 9 | The 5394 accepts the incoming call. | 1 | On | BEL... | Off |
| 6B | The DCE waits (optional state). | 1 | On | SYN SYN SYN... | Off |
| 11 | The DCE signals that the connection has started. This state may be bypassed. | 1 | On | 1 | Off |
| 12 | The connection to the host system is complete (ready for data). | 1 | On | 1 | On |
| 13 | The data-transfer can start. Data-transfer is done using SNA/SDLC protocols in half-duplex mode. SDLC operation is the same as SDLC switched operation after a call is established. | Data | On | Data | On |

After data-transfer is complete, the call clearing phase is entered. The host system causes the 5394 to initiate call clearing by sending an SDLC DISCONNECT (DISC) command.

Figure 5-22 provides the state diagram for the call-clearing phase.




**Note:** This can be any state shown in Figure 5-21 except ready (state 1).

Figure 5-22. Call Clearing Phase State Diagram

Table 5-32 shows the sequence of states used for call clearing after normal data-transfer operation.

**Note:** The active levels for X.21 signals are:

0 for data lines

On for control lines.

| Table 5-32. Call Clearing after Normal Data-Transfer Operation | | | | | |
|---|---|---|---|---|---|
| **State** | **Description** | **Transmit** | **Control** | **Receive** | **Indicate** |
| 13 | The 5394 recognizes the end of data-transfer as a result of receiving an SDLC DISC command from the host system. | 1 | On | Data (SDLC DISC) | On |
| 16 | The 5394 initiates call clearing by sending a clear-request to the DCE. | 0 | Off | 1 | On |
| 17 | The DCE recognizes the end of the data transfer (acknowledgment of the clear-request from the 5394). | 0 | Off | 0 | Off |
| 21 | The DCE returns to the ready state. | 0 | Off | 1 | Off |
| 1 | The 5394 returns to the ready state. | 1 | Off | 1 | Off |

Table 5-33 shows the sequence of states used for call clearing after facility registration or an 5394-detected error.

| Table 5-33. Call Clearing after an 5394-Detected Error | | | | | |
|---|---|---|---|---|---|
| **State** | **Description** | **Transmit** | **Control** | **Receive** | **Indicate** |
| XX | The 5394 recognizes that a call clearing is required due to a detected error. | | | | |
| 16 | The 5394 signals a clear-request to the DCE. | 0 | Off | Can be 0/1 | Can be On/Off |
| 17 | The DCE acknowledges the clear-request from the 5394 (a DCE-clear-confirmation). | 0 | Off | 0 | Off |
| 21 | The DCE returns to the ready state. | 0 | Off | 1 | Off |
| 1 | The 5394 returns to the ready state. | 1 | Off | 1 | Off |

Table 5-34 shows the sequence of states used for call clearing after a DCE or network-detected error or a clear-request by the remote DTE (host system).

Table 5-34. Call Clearing after a DCE/Network-Detected Error or a Clear-Request by the Remote DTE (Host System)

| State | Description | Transmit | Control | Receive | Indicate |
|---|---|---|---|---|---|
| XX | The DCE/network recognizes that a call clearing is required due to an error or a clear-request by the remote (host system) DTE. | | | | |
| 19 | The DCE signals a clear-indication to the 5394. | Can be 0/1 | Can be On/Off | 0 | Off |
| 20 | The 5394 acknowledges the clear-indication from the DCE (a DTE clear-confirmation). | 0 | Off | 0 | Off |
| 21 | The DCE returns to the ready state. | 0 | Off | 1 | Off |
| 1 | The calling station returns to the ready state. | 1 | Off | 1 | Off |

**Recognized Interface State Transitions:** In the CCITT Recommendation X.21, the condition of the interchange circuits determines what is happening at the interface. Throughout the process of data transfer, the DTE uses the transmit (T) and control (C) interchange circuits to signal to the DCE what action to take. The DCE uses the receive (R) and indication (I) interchange circuits to signal to the DTE what action to take. Figure 5-23 lists the interface states that are defined by Recommendation X.21.

| State Number | State Name | DTE Circuits | | DCE Circuits | | DTE Transition to State No. | DCE Transition to State No. | Time-Limit / Timeout Transition | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | T | C | R | I | | | To State No. | Time-Limit/ Timeout No. | Terminated by State No. |
| 1 | Ready | 1 | Off | 1 | Off | 2, 13S, 14, 24 | 8, 13R, 18 | 1 | T7 | 8 |
| 2 | Call-request | 0 | On | 1 | Off | --------- | 3, 15 | 1 | T1 | 3 |
| 3 | Proceed-to-select | 0 | On | + | Off | 4, 15 | --------- | 19 | T11, T12 | 4, 5 |
| 4 | Selection-signal | IA5 | On | + | Off | 5 | --------- | 19 | T13 | EOS |
| 5 | DTE-waiting | 1 | On | + | Off | --------- | 6A, 11, 12 | 16 | T2 | 7, 10, 12, 19 |
| 6A | DCE-waiting | 1 | On | SYN | Off | --------- | 7, 10, 11, 12 | -- | ------- | -------- |
| 6B | DCE-waiting | 1 | On | SYN | Off | --------- | 10b, 11, 12 | -- | ------- | -------- |
| 7 | Call-progress-signal | 1 | On | IA5 | Off | --------- | 6A, 10, 11, 12 | 16 | T3A, T3B | 7, 10, 12, 19 |
| 8 | Incoming-call | 1 | Off | BEL | Off | 15, 9 | --------- | 1 | T14A, T14B | 9, 15 |
| 9 | Call-accepted | 1 | On | BEL | Off | --------- | 6B, 11, 12 | 16 | T4 | 10b, 12, 19 |
| 10 | DCE-provided information | 1 | On | IA5 | Off | --------- | 6A, 11, 12 | -- | ------- | -------- |
| 10b | DCE-provided information | 1 | On | IA5 | Off | --------- | 6B, 11, 12 | -- | ------- | -------- |
| 11 | Connection-in-progress | 1 | On | 1 | Off | --------- | 12 | -- | ------- | -------- |
| 12 | Ready-for-data | 1 | On | 1 | On | --------- | 13 | -- | ------- | -------- |
| 13 | Data-transfer | D | On | D | On | 13R | 13S, DCE-not-ready | -- | ------- | -------- |
| 13R | Receive-data | 1 | Off | D | On | 13 | 1 | -- | ------- | -------- |
| 13S | Send-data | D | On | 1 | Off | 7 | 13 | -- | ------- | -------- |
| 14 | DTE-controlled-not-ready DCE-ready | 01 | Off | 1 | Off | 1, 24 | 23 | -- | ------- | -------- |
| 15 | Call-collision | 0 | On | BEL | Off | --------- | 3 | -- | ------- | -------- |
| 16 [1] | DTE-clear-request | 0 | Off | X | X | --------- | 17 | 18 | T5 | 21 |
| 17 | DCE-clear-confirmation | 0 | Off | 0 | Off | --------- | 21 | -- | ------- | -------- |
| 18 | DTE-ready DCE-not-ready | 1 | Off | 0 | Off | 22 | 1 | -- | ------- | -------- |
| —— | DCE-not-ready | D | On | 0 | Off | --------- | 1, 13, 13S | -- | ------- | -------- |
| 19 [1] | DCE-clear-indication | X | X | 0 | Off | 20 | --------- | 24 | T15 | 20 |
| 20 | DTE-clear-confirmation | 0 | Off | 0 | Off | | 21 | 18 | T6 | 21 |
| 21 | DCE-ready | 0 | Off | 1 | Off | 1 | --------- | 24 | T16 | 1 |
| 22 | DTE-uncontrolled-not-ready DCE-not-ready | 0 | Off | 0 | Off | 18 | 24 | -- | ------- | -------- |
| 23 | DTE-controlled-not-ready DCE-not-ready | 01 | Off | 0 | Off | 18, 22 | 14 | -- | ------- | -------- |
| 24 | DTE-uncontrolled-not-ready DCE-ready | 0 | Off | 1 | Off | 1 | 22 | -- | ------- | -------- |
| —— | DCE-controlled-not-ready | X | X | 1 | Off | -------- | -------- | -- | ------- | -------- |
| Any State [2] | -------- | X | X | X | X | 16 | 19 | -- | -------- | -------- |

[1] DCE-clear-indication (state 19) or DTE-clear-request (state 16) may be entered from any state except ready (state 1).

[2] Other transitions are not considered valid.

Figure 5-23. X.21 Interface State Transitions and Applicable Timeouts

# Chapter 6. Parts Catalog

## How To Use This Parts Catalog

• SIMILAR ASSEMBLIES: If two assemblies contain a majority of identical parts, they are broken down on the same list. Common parts are shown by one index number. Parts peculiar to one or the other of the assemblies are listed separately and identified by description.

• AR: (As Required) in the Units column indicates that the quantity is not the same for all machines.

• NP: (Non-Procurable) in the Units column indicates that the part is non-procurable and that the individual parts or the next higher assembly should be ordered.

• NR: (Not Recommended) in the Units column indicates that the part is procurable but not recommended for field replacement, and that the next higher assembly should be ordered.

• R: (Restricted) in the Units column indicates that the part has a restricted availability.

• INDENTURE: The indenture is marked by a series of dots located before the parts description. The indenture indicates the relationship of a part to the next higher assembly. For example:

| Indenture | Relationship of Parts |
|---|---|
| (No dot) | MAIN ASSEMBLY |
| (One dot) | • Detail parts of a main assembly |
| (One dot) | • Sub assembly of the main assembly |
| (Two dot) | • • Detail part of a one-dot sub assembly |
| (Two dot) | • • Sub assembly of a one-dot sub assembly |
| (Three dot) | • • • Detail part of a two-dot sub assembly |

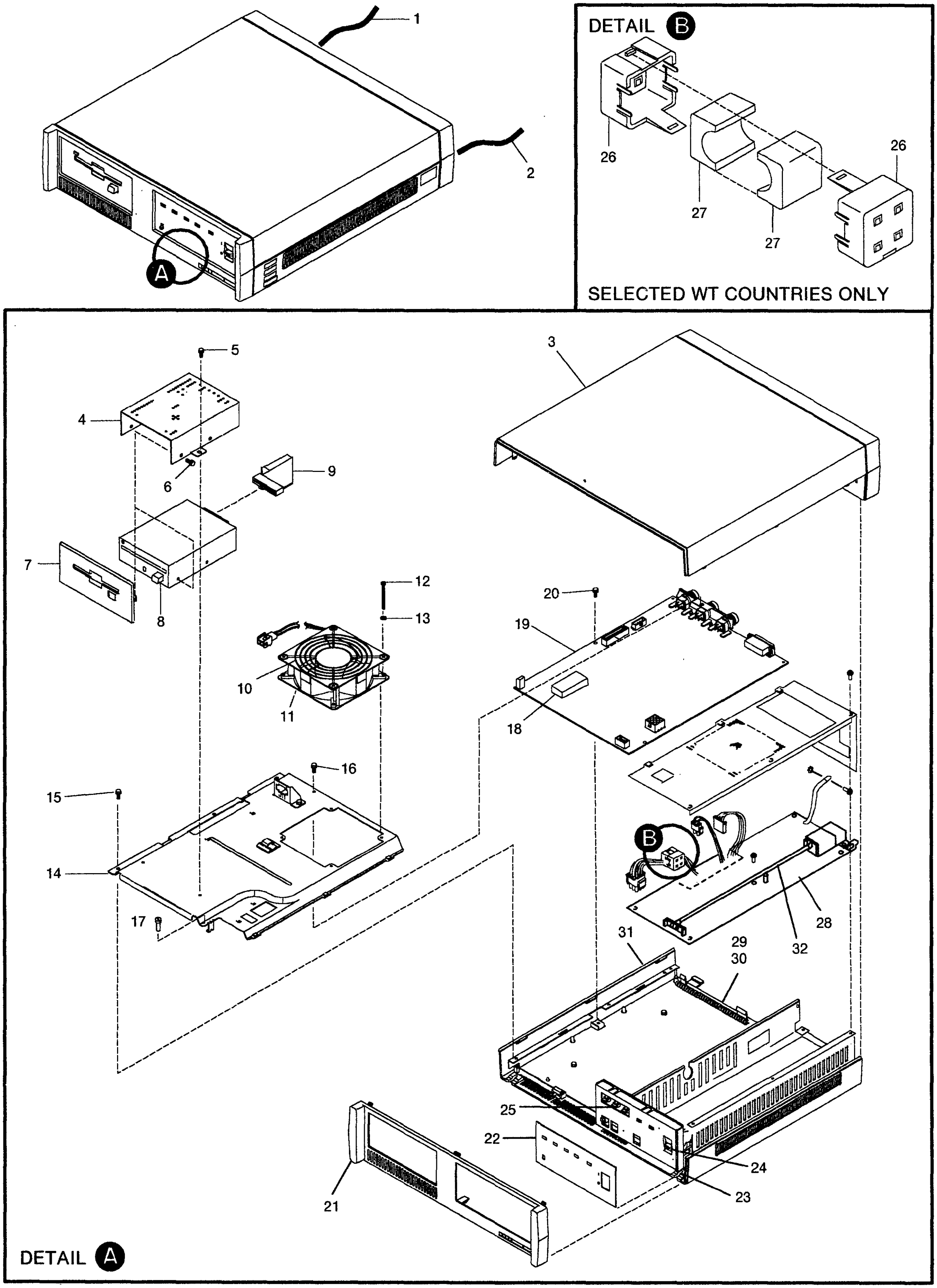
### Assembly *n*: EXAMPLE ASSEMBLY

| Asm – Index | Part Number | Units | Description |
|---|---|---|---|
| *n* – | | 1 | Cover Asm.Rear-Red |
| – | | 1 | Cover Asm.Rear-White |
| | | | For Next Higher Assembly,See 1-2 |
| –1 | 5373637 | 1 | • Seal,Top |
| –2 | 5356429 | 2 | • Clip,Retaining |
| –3 | 1847630 | R | • Finger Stock Asm |
| –4 | 1847602 | NR | • • Chanel,Finger Stock |
| –5 | 5373639 | AR | • Seal,Bottom |
| –6 | 5356429 | 2 | • Clip,Retaining |
| –7 | | NP | • Cover,Rear,Without Paint |
| –8 | 416629 | 2 | • Screw,Panel |

## Assemblies

# Catalog Section

# Assembly 1: 5394 Logic Element



| Asm – Index | Part Number | Units | Description |
|---|---|---|---|
| 1– | | NP | Final Assembly 5394 |
| –1 | | NP | • Communication Cable For Cable Part Numbers See Asm 2 |
| –2 | | NP | • Line Cord Asm For Line Cord Part Numbers See Asm 2 |
| –3 | 96X6161 | 1 | • Cover,Top |
| –4 | 96X6159 | NP | • Cover,Diskette |
| –5 | 1621832 | 2 | • Screw,Thd Form Hex Wshr HD-M4 X 5 Long |
| –6 | 1673723 | 4 | • Screw,Hex HD Cap-M4 X 8 Long |
| –7 | 6428799 | 1 | • Bezel Asm |
| –8 | 72X6056 | 1 | • Drive Asm,Disk- 2MB. |
| –9 | 96X6162 | 1 | • Cable Asm-Diskette Drive |
| –10 | 6168801 | NP | • Guard,Fan |
| –11 | 25F7209 | 1 | • Fan Asm |
| –12 | 1621155 | 4 | • Screw,Pan HD-M3 X 40 Long |
| –13 | 1622302 | 4 | • Washer,Flat- 3.2 ID X 7 OD X .5 Thk |
| –14 | 6428797 | NP | • Plenum Asm |
| –15 | 1621832 | 3 | • Screw,Thd Form Hex Wshr HD-M4 X 5 Long |
| –16 | 1673723 | 1 | • Screw,Hex HD Cap-M4 X 8 Long |
| –17 | 1621176 | 1 | • Screw,Pan HD-M3 X 4 Long |
| –18 | 68X6190 | 1 | • DRAM (Dynamic Random Access Memory) |
| –19 | | 1 | • Planar Board Asm- EIA Model A |
| –19 | | 1 | • Planar Board Asm- X.21 Model A |
| –19 | | 1 | • Planar Board Asm- EIA Model B |
| –19 | | 1 | • Planar Board Asm- X.21 Model B |
| –20 | | 2 | • Screw,Thd Form Hex Wshr HD-M4 X 5 Long |
| –21 | | NP | • Cover,Front |
| –22 | 96X6165 | 1 | • Operator Panel Overlay (English) |
| –22 | 96X6166 | 1 | • Operator Panel Overlay (French) |
| –22 | 96X6167 | 1 | • Operator Panel Overlay (Spanish) |
| –22 | 96X6168 | 1 | • Operator Panel Overlay (Portuguese) |
| –22 | 96X6169 | 1 | • Operator Panel Overlay (Japanese) |
| –22 | 96X6171 | 1 | • Operator Panel Overlay (Italian) |
| –22 | 96X6172 | 1 | • Operator Panel Overlay (German) |
| –23 | 73X4049 | 1 | • Cover,Operator Panel- Front |
| –24 | 5606690 | 1 | • Actuator,Power- White |
| –25 | 96X6379 | 1 | • Card Asm,Operator Panel |
| –26 | 62X1148 | 2 | • Case |
| –27 | 62X1146 | 2 | • Core |
| –28 | 39F7859 | 1 | • Power Supply- 110V |
| –28 | 39F7860 | 1 | • Power Supply- 220V |
| –29 | 6428801 | 1 | • Finger Stock- 32 Finger |
| –30 | 6428802 | 1 | • Finger Stock- 5 Finger |
| –31 | | NP | • Cover,Bottom |
| –32 | 73X3759 | 1 | • Power Actuator Cable |

## Assembly 2: Line Cord And Cable Assemblies

| Asm – Index | Part Number | Units | Description |
|---|---|---|---|
| 2–1 | 1838573 | 1 | Line Cord(EMEA & AFE,250V) |
| –2 | 1838584 | 1 | Line Cord(US/Canada,125V, Hospital Service) |
| –3 | 1838587 | 1 | Line Cord(US/Canada,125V,6Ft. Hospital Service,Chicago) |
| –4 | 6428835 | 1 | Line Cord(EMEA,125V) |
| –5 | 6952290 | 1 | Line Cord(AFE,250V) |
| –6 | 6952299 | 1 | Line Cord(EMEA,AFE,US/Canada,125V) |
| –7 | 6952301 | 1 | Line Cord(US/Canada,125V,6FT.,Chicago) |
| –8 | 6952310 | 1 | Line Cord(AFE,250V) |
| –9 | 6952319 | 1 | Line Cord(EMEA & AFE,250V) |
| –10 | 6952328 | 1 | Line Cord(EMEA,250V) |
| –11 | 6952337 | 1 | Line Cord(AFE,125V,Twist Lock,Japan) |
| –12 | 6952346 | 1 | Line Cord(EMEA & AFE,250V) |
| –13 | 6952355 | 1 | Line Cord(EMEA & AFE,250V) |
| –14 | 6952364 | 1 | Line Cord(EMEA,250V) |
| –15 | 6952373 | 1 | Line Cord(EMEA & AFE,250V) |
| –16 | 6952382 | 1 | Line Cord(EMEA,250V) |
| –17 | 7842124 | 1 | Line Cord(AFE,250V,Twist Lock,Mexico) |
| –18 | 7842140 | 1 | Line Cord(US/Canada,125V,6Ft., Twist Lock,Chicago) |
| –19 | 7842142 | 1 | Line Cord(AFE,US/Canada,125V, Twist Lock,Nicaragua) |
| –20 | 25F7432 | 1 | Communication Cable (EIA,20Ft.,Germany ONLY) |
| –21 | 6168155 | 1 | Communication Cable(X.21,20FT.) |
| –22 | 6423153 | 1 | Communication Cable(EIA,20FT.) |
| –23 | 73X3722 | 1 | Communication Cable (EIA,20Ft.,Japan and S. Korea ONLY) |
| –24 | 73X3759 | 1 | Power Actuator Cable |

# Part Number Index

# Appendix A. CE Log

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# Appendix B. Supported Attachments

This appendix lists the host systems, work stations, modems, and DCEs that can be attached to the IBM 5394.

## Host Systems

The 5394 can be attached to the following host systems:

- IBM AS/400 system
- IBM System/36
- IBM System/38.

A 5394 Model 01A or 02A attached to any of these host systems can communicate with up to four work stations. A 5394 Model 01B or 02B can communicate with up to eight work stations when attached to a System/36 or System/38. A 5394 Model 01B or 02B attached to an IBM AS/400 system can communicate with up to 16 work stations.

## Work Stations

The IBM 5394 supports the following work stations:

- IBM 3179 Color Display Station Model 2
- IBM 3180 Display Station Model 2
- IBM 3196 Display Station Models A10, A20, B10, and B20
- IBM 3197 Display Station Models C10, C20, D10, D20, D40, W10, and W20
- IBM InfoWindow™ 3476
- IBM 3812 Printer Models 1 and 2
- IBM 3816 Printer Model 01S
- IBM 4210 Printer Model 1
- IBM 4214 Printer Model 2
- IBM 4224 Printer Models 101, 102, 1C2, 1E2, and 1E3
- IBM 4234 Printer Models 2 and 012
- IBM 5219 Printer Models D01 and D02
- IBM 5224 Printer Models 1 and 2
- IBM 5225 Printer Models 1, 2, 3, and 4
- IBM 5227 Printer Models 1, 2, 3, and 5
- IBM 5251 Display Station Models 11 and 999
- IBM 5256 Printer Models 1, 2, and 3
- IBM 5262 Printer Model 1
- IBM 5291 Display Station Models 1 and 2
- IBM 5292 Color Display Station Models 1 and 2
- IBM 5295 Display Station Models 1, 2, 0C2, and LK1
- IBM 5317 Printer Model 1
- IBM 5327 Printer Model 1
- IBM 6262 Printer Models T12 and T14
- IBM PC with Enhanced 5250 Emulation Program (Models 5150, 5155, 5160, 5162, and 5170)
- IBM Personal System/2® with Enhanced 5250 Emulation Program (Models 8525 and 8530)
- IBM Personal System/2 with IBM System 36/38 Work Station Emulation Program (Models 8550, 8560, and 8580)
- IBM PC or Personal System/2 with AS/400 PC Support
- IBM Personal System/55 with IBM Japanese 5250 Personal Computer/2 AD (5250 PC/2 AD) Support.
- IBM Personal System/55 with 5250 emulation programs (Models 5530, 5540, 5550, 5560, and 5570).

  **Note:** An IBM Personal System/2 using AS/400 PC Support or an IBM Personal System/55 using 5250 PC/2 AD Support cannot be used for customer setup and network attachment, and may not display network error codes.

The IBM 5394 supports the following IBM PS/55 and IBM 5295 attached printers:

- IBM 5553 Printer Models B01, B02, BC1, BH1, BK1, and BP1
- IBM 5557 Printer Model B01
- IBM 5563 Printer Models B02 and H02
- IBM 5572 Printer Model B01
- IBM 5575 Printer Models B01, B02, BC1, BC2, F01, F02, FH1, and FK1
- IBM 5577 Printer Models B01, B02, F01, F02, FC1, FC2, and G01.

All IBM 5394 models support the following work station functions:

- National language support
- Selector light pen
- DisplayWrite
- Magnetic stripe reader

- IBM 5294 Emulation
- Self-check
- Copy-to-printer.

## Modems and DCEs

If the host system is communicating through an analog communication network, the 5394 and the host system are attached to the communication line through modems. The transmitting modem converts the digital signals to analog signals and transmits these signals over the communication line. The receiving modem converts the analog signals back to digital signals. The transmitting modem and the receiving modem must be compatible. For example, the modems must transmit data at the same speed and use the same modulation methods. The 5394 supports the following IBM modems:

- IBM 3833 Model 1
- IBM 3834 Model 1
- IBM 3863 Models 1 and 2
- IBM 3864 Models 1 and 2
- IBM 3865 Models 1 and 2
- IBM 3868 Models 1, 2, 3, and 4
- IBM 3872 Model 1
- IBM 3874
- IBM 3875
- IBM 5811 Models 10, 18, 20, and 28
- IBM 5812 Models 10 and 18
- IBM 5821 Model 10
- IBM 5822 Model 10
- IBM 5842 Model 1
- IBM 5853 Model 1
- IBM 5865 Models 1, 2, and 3
- IBM 5866 Models 1, 2, and 3
- IBM 5868 Models 51, 52, 61, and 62
- IBM 7861
- IBM 7868.

If the network is an X.21 public data network or an X.25 packet-switched public data network, the 5394 and the host system are attached to the network through data circuit-terminating equipment (DCEs). The network may provide the DCEs.

## Other Devices Supported

The following devices are also supported by the 5394:

- IBM 5208 (ASCII-5250) Line Protocol Converter
- IBM 5209 (3270-5250) Line Protocol Converter
- IBM 5299 Model 3 Terminal Multiconnector
- ROLMbridge 5250 Line Protocol Converter Model 46815B
- IBM 7820 ISDN Terminal Adapter

# List of Acronyms and Abbreviations

**Ω** Ohms

**uf** Microfarad

**us** Microsecond

**AC** Alternating current

**ACTLU** Activate logical unit

**ACTPU** Activate physical unit

**addr** Address

**adj** Adjust

**adv** Advance

**alpha** Alphabetic

**ALU** Arithmetic and logic unit

**ANSI** American National Standards Institute

**ASCII** American National Standard Code for Information Interchange

**BBI** Begin bracket indicator

**BIS** Bracket initiation stop

**BIU** Basic information unit

**BLU** Basic link unit

**bps** Bits per second

**BTU** Basic transmission unit

**CCITT** International Consultative Committee on Telegraph and Telephone

**CD** Change of direction

**CDI** Change direction indicator

**CDSTL** Connect data set to line

**CE** Customer engineer

**char** Character

**CI** Calling indicator

**clk** Clock

**CMOS** Complimentary metal-oxide semiconductor

**comm** Communication

**CNM** Communication network management

**CNR** DCE-controlled-not-ready

**CPS** Call progress signal

**CSI** Code selection indicator

**CRC** Cyclic redundancy check

**CSR** Customer service representative

**CSU** Customer setup

**CV** Converter

**DAA** Data access arrangement

**DACTLU** Deactivate logical unit

**dB** Decibel

**dBm** Decibel based on one milliwatt

**DC** Direct current

**DCD** Data carrier detect

**DCE** Data circuit-terminating equipment

**det** Detector

**DFC** Data flow control

**DI** Data indicator

**diag** Diagram (figure)

**DISC** Disconnect

**DM** Disconnect mode

**DR** Data ring

**DR1I** Definite response 1 indicator

**DR2I** Definite response 2 indicator

**DRAM** Dynamic random access memory

**drvr** Driver

**DSP** Data stream profile

**DSR** Data set ready

**DT** Data tip

**DTE** Data terminal equipment

**DTR** Data terminal ready

**DXE** Data transmit enable

**EB** End bracket

**EBCDIC** Extended binary-coded decimal interchange code

**EBI** End bracket indicator

**EC** Engineering change

**EDI** Enciphered data indicator

**EIA** Electronics Industries Association

**ELLC** Enhanced logical link control

**EOC** End of chain

**EOM** End of message

**EOQ** End of command queue

**ERAP** Error recording analysis procedure

**ERI** Exception response indicator

| | |
|---|---|
| **ERP** | Error recovery procedure |
| **FCC** | Federal Communication Commission (US only) |
| **FCS** | Frame check sequence |
| **FI** | Format indicator |
| **FID** | Format identification |
| **FM** | Function management |
| **FMD** | Function management data |
| **FMDS** | Function management data services |
| **FMH** | Function management header |
| **FMR** | Frame reject |
| **FRMR** | Frame reject |
| **FRU** | Field-replaceable unit |
| **FSK** | Frequency shift keying |
| **GFI** | General format identifier |
| **gnd** | Ground |
| **HDLC** | High-level data link control |
| **HDX-FF** | Half-duplex flip-flop |
| **HE** | Hard error log |
| **hex** | Hexadecimal |
| **HH MM SS** | Hours, minutes, and seconds |
| **Hz** | Hertz |
| **I/O** | Input/output |
| **ID** | Identification |
| **I-field** | Information field |
| **I-frame** | Information frame |
| **IOB** | Input/output block |
| **IPDS** | Intelligent printer data stream |
| **IPDU** | Information protocol data unit |
| **IPL** | Initial program load |
| **ISO** | International Standards Organization |
| **ITC** | Individual table of contents (in a machine history) |
| **IWS** | Intelligent work station |
| **LAPB** | Link access protocol-balanced |
| **LCI** | Logical channel identifier |
| **LED** | Light-emitting diode |
| **LH** | Link header |
| **LL** | Leased (nonswitched) line |
| **LLC** | Logical link control |
| **LPDA** | Link problem determination aids |
| **LRC** | Longitudinal redundancy check |
| **LSID** | Logical session identifier |
| **LU** | Logical unit |
| **LUSTAT** | Logical unit status |
| **MAP** | Maintenance analysis procedure |
| **MDT** | Modified data tag |
| **mem** | Memory |
| **mem req** | Memory request |
| **MHz** | Megahertz |
| **MI** | Mode indicate |
| **MIC** | Mode indicate common |
| **mm** | Millimeter |
| **MPU** | Microprocessing unit |
| **ms** | Millisecond |
| **ms/div** | Milliseconds per division |
| **MSR** | Magnetic stripe reader |
| **N/C** | Normally closed |
| **N/O** | Normally open |
| **NAU** | Network addressable unit |
| **NDM** | Normal disconnect mode |
| **NRM** | Normal response mode |
| **NRZ** | Nonreturn-to-zero |
| **NRZI** | Nonreturn-to-zero inverted |
| **NS** | Network services |
| **NVRAM** | Non-volatile random access memory |
| **OS** | Outstanding status |
| **P-P** | Peak-to-peak |
| **P/F** | Poll/final frame bit |
| **PC** | Printed circuit |
| **PDI** | Padded data indicator |
| **PI** | Pacing indicator |
| **PIU** | Path information unit |
| **PLE** | Permanent link error |
| **POR** | Power-on reset |
| **PS** | Physical services |
| **PSDN** | Packet-switched data network |
| **PSH** | Physical services header |
| **PSN** | Public switched network |
| **PTI** | Packet-type identifier |
| **PTT** | Post Telephone and Telegraph Administration |

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|---|---|
| **PU** | Physical unit |
| **PVC** | Permanent virtual circuit |
| **QLLC** | Qualified logical link control |
| **QRI** | Queue response indicator |
| **RAM** | Random access memory (storage) |
| **rcvd** | Received |
| **rcvr** | Receiver |
| **RECFMS** | Record formatted maintenance statistics |
| **ref** | Reference |
| **req** | Request |
| **REQMS** | Request maintenance statistics |
| **REQTEST** | Request test procedure |
| **RFS** | Ready for sending (also known as CTS) |
| **RH** | Request/response header |
| **RJE** | Remote job entry terminal |
| **RLSD** | Received line signal detector |
| **RMS** | Root-mean-square |
| **RNR** | Receive not ready |
| **ROS** | Read-only storage |
| **RPOA** | Recognized private operating agency |
| **RQD** | Request definite response |
| **RQE** | Request exception response |
| **RQN** | Request no response |
| **RR** | Receive ready |
| **RRI** | Request/response indicator |
| **RSET** | Received signal element timing (receiver clock) |
| **RSHUTD** | Request shutdown |
| **rsp** | Response |
| **rt** | Right |
| **rt adj B fill** | Right adjust blank fill |
| **RTI** | Response type indicator |
| **RTS** | Request to send |
| **RU** | Request/response unit |
| **SA** | Station address |
| **SABM** | Set asynchronous balanced mode |
| **SC** | Session control |
| **SCS** | SNA character string |
| **SDI** | Sense data included indicator |
| **SDLC** | Synchronous data link control |
| **sel** | Select |
| **serdes** | Serializer/deserializer |
| **SET** | Signal element timing |
| **SHM** | Short hold mode |
| **SLP** | Selector light pen |
| **SLT** | Solid logic technology |
| **SNA** | Systems Network Architecture |
| **SNBU** | Switched network backup |
| **SNRM** | Set normal response mode |
| **SOM** | Start of message |
| **SRC** | System reference code |
| **SS** | System services |
| **SSCP** | System services control point |
| **stat addr** | Station address |
| **SVC** | Switched virtual circuit |
| **sync** | Synchronization |
| **sys** | System |
| **TAC** | Transmit activity check |
| **TB** | Terminal block |
| **TC** | Transmission control |
| **TCB** | Task control block |
| **TD** | Transmitted data |
| **TDR** | Time domain reflectometry |
| **TH** | Transmission header |
| **TS** | Transmission service |
| **TSET** | Transmitted signal element timing (transmit clock) |
| **UA** | Unnumbered acknowledgment |
| **US** | United States |
| **USOC** | Universal service order code |
| **V** | Volts |
| **VAC** | Volts alternating current |
| **VDC** | Volts direct current |
| **VOM** | Volt-ohm meter |
| **WT** | World Trade |
| **XLCA** | X.21 line communication adapter |
| **XID** | Exchange station identification |
| **xmit** | Transmit |

# Glossary

**analog transmission**. A signal transmission that is continuously variable in amplitude, frequency, phase, or some combination of all three. (Data characters in a terminal are coded in a DC square wave voltage or in specially identified pulses or signal levels, and are referred to as digital signals. Voice or voice-compatible signals are usually AC voltages that are not easily identified and are known as analog signals.)

**attenuation**. A decrease in decibels of power in a transmission signal.

**auto-answer**. A feature that permits a station to respond, without operator action, to a call that it receives over a switched line.

**backup MAP**. A continuation of the main MAP that is used to isolate an intermittent problem or failure.

**BEL**. The bell character.

**beveled edge**. The edge of a module that is at an angle.

**buffer**. A storage area that is temporarily reserved for input/output operations.

**cable-thru**. A method of cabling that allows multiple work stations to be attached to a single cable path.

**carrier**. A continuous signal at a specific frequency that can be modulated or impressed with a second (information-carrying) signal.

**common carrier**. In the USA, a government-regulated private company (such as a telephone or telegraph company) that furnishes the general public with telecommunication service facilities.

**communication cable**. The EIA 232D or CCITT X.21 cable used to attach the IBM 5394 to a modem or DCE.

**communication facility**. The term used to identify a nonswitched or switched network (dial-up).

**communication network**. The equipment and software required to transmit data signals between a host system and a remote site.

**concurrent mode**. An operating mode of the control unit that allows certain diagnostics to be done at the same time that the control unit is doing normal operations.

**control unit**. A device that manages the flow of data between work stations and a host system. Some control units do error checking, error handling, and error recovery procedures, and provide certain editing features to the display station.

**coupler**. See *data coupler.*

**customer setup (CSU)**. The unpacking, assembly, connecting, and checkout of IBM CSU-designated machines by user personnel according to a sequence of instructions provided by IBM. CSU is done without the use of tools and without help from IBM personnel.

**customer engineer (CE)**. An individual who provides field services for IBM products.

**data access arrangement (DAA)**. (Canada, Japan, and US. For the US, applies only when the attaching device is not FCC registered.) An electrical isolation device, required by common carriers enabling attachment of privately owned data terminal equipment and telecommunication equipment to a network. It provides DC voltage isolation and limits excessive signal levels into the telecommunication line from the modem. See *data coupler.*

**data circuit-terminating equipment (DCE)**. The equipment that does the signal conversion and coding between the data terminal equipment (DTE) and the communication line.

**data coupler**. An electrical isolation device usually required by a common carrier to attach to the carrier's switched telephone lines. This is also referred to as a data access arrangement or protective coupler.

**data link**. The equipment and protocols used for sending and receiving data.

**data packet**. The type of data grouping used to send information from one DTE to another DTE attached to an X.25 packet-switched network.

**data set ready (DSR)**. A control signal associated with the EIA 232D physical interface that is active when the modem or DCE is ready to begin data transfer.

**data stream**. A continuing flow of data.

**data-derived clocking**. A characteristic of the modem operation when the synchronization of receive clock signals is dependent on the presence of receive data transitions; that is, receive data is not continuous 0-bits or 1-bits.

**data terminal equipment (DTE)**. A term for any machine, such as the IBM 5394 or its host system, that is connected to a network.

**decibel**. A unit for expressing the ratio of two amounts of electric or acoustic signal power.

**dedicated mode**. An operating mode of the control unit in which all the resources of the control unit are used for diagnostic purposes and no other operations can be done.

**dynamically**. A condition where information is displayed continuously as conditions change.

**earphone**. A piece of test equipment that is attached to the dB adapter and used to listen for communication line signals.

**echo**. A wave that is returned to its starting point as a result of reflection or other causes.

**echo clamp duration**. The time that a signal line is forced inactive in order to prevent echoes from being detected.

**emulation**. The imitation of all or part of one system by another (primarily by hardware) so that the imitating system accepts the same data, runs the same programs, and achieves the same results as the imitated system.

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

**enhanced logical link control (ELLC)**. A type of logical link control used in X.25 communication.

**error log**. A record of errors that is kept internally by the control unit.

**exclusion key**. A key on the telephone handset that transfers the telephone line from the handset to the data coupler.

**facility**. An optional network service.

**flag**. The bit pattern that SDLC uses to identify the start and end of the SDLC frame.

**frame**. A single transmission of variable length (32-bit minimum format) that SDLC uses for transmission of data over a communication network.

**half-duplex**. A method of data transmission in which data can be transmitted in both directions, but not at the same time.

**header**. A prefix or preface that describes the type of information, and sometimes the quantity of information, that follows. The control field of the SDLC frame contains five bytes of SNA header information.

**hexadecimal**. A number system with a base of 16. (Valid digits range from 0 through F.)

**host system**. In a communication system, the computer that provides end-users with services such as computation and data bases, and that usually does network control functions.

**ideographic**. A character set consisting of both graphics and pictograms, and often other types of symbols, such as Japanese characters.

**inactive**. Not active. No electrical potential.

**individual table of contents (ITC)**. A list of all logic part numbers and locations that is included with the machine history.

**initialization**. A process that prepares for the beginning of another process.

**interface**. A shared boundary between two functional units, defined by functional characteristics, common physical interconnections, and signal characteristics.

**International Consultative Committee on Telegraph and Telephone**. (CCITT) A United Nations committee that suggests worldwide standards for communication interconnections.

**line turnaround**. The time required to reverse the direction of transmission from send-to-receive or receive-to-send when using a half-duplex communication line.

**leased line**. See *nonswitched line*.

**local session identifier (LSID)**. An 8-bit sequence in the transmission header for SNA that contains the logical unit address and session path information.

**local unit ID**. A customer-assigned identification.

**log**. See *error log*

**local loopback**. A test procedure done to verify the operation of the local modem.

**log on**. The procedure done at a display station that can include entering the logon command, a password, or other specified security information.

**logical link control**. Information included in data packets for X.25 that provides end-to-end link level type functions to the SNA layers in the host and the IBM 5394.

**logical unit (LU)**. An SNA term that describes a work station attached to the control unit.

**logical unit ID**. A customer-assigned identification.

**logical link control (LLC)**. Information included in data packets for X.25 that provides end-to-end link-level type functions to the SNA layers in the host and the 5394.

**loopback**. The connecting of the input and output lines of a device for testing.

**maintenance**. A section of this manual that includes locations, procedures, and diagnostic aids.

**make/break key**. A key that, when pressed and released, generates a scan code.

**mandatory fill**. An information field that must be completely filled to be correct.

**menu**. A list of options that can be selected to request work station tests.

**microcode**. A set of instructions for a processing unit located in memory.

**microprocessing**. An operation of the MPU.

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

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

**microseconds per division (us/div)**. A setting on the oscilloscope.

**microwave**. An electromagnetic wave in the radio-frequency range of 300 to 30,000 megahertz.

**milliseconds per division (ms/div)**. A setting on the oscilloscope.

**modem (modulator-demodulator)**. A device that converts digital data from a computer to an analog signal that can be transmitted on a telecommunication line and converts the analog signal received to data for the computer.

**multiframe response**. More than one frame or multiple frames of data that are transmitted.

**multiplexer**. A device for handling multiple signals over a signal line.

**nonreturn to zero (NRZ)**. A data encoding method where a change in voltage indicates a one (1).

**nonreturn to zero inverted (NRZI)**. A data encoding method.

**nonswitched line**. A communication line that is permanently connected, always available, and does not require dialing to establish communication.

**nonsynchronous modem**. A modem that does not supply clock signals and that requires clocking from the attached device.

**normal operating mode**. Operating mode that exists after 5394 power is switched on with the Test switch set to Off and the Ready LED has come on.

**Nr count**. The sequence number of the next expected Ns field of the next I frame received.

**Ns count**. The number of sequence frames in SDLC that have been sent.

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

**off-hook**. A telephone set in use.

**on-hook**. A telephone set not in use.

**options**. The selections on a display screen menu for test requests.

**pacing**. A method by which a receiving station controls the rate of transmissions of a sending station to prevent overrun.

**packet**. Information transmitted through a packet-switched network is divided up and inserted into packets. These usually consist of control information fields giving destination, sequence number, optional facilities, and often a user data area. Various kinds of packets are used to transmit error codes and supervise the virtual circuit.

**packet-switching**. The transfer of data by means of addressed packets that occupy the network channel only during actual transmission. The channel is available for the simultaneous transfer of packets belonging to other network users. The network determines the optimum routing of each individual packet during, rather than prior to, the transmission from a DTE.

**parity**. A system to ensure that a byte was received as it was transmitted. In a system that uses "even" parity, with seven bits plus a parity, if the sum of the first seven bits is an odd number, a one would be put in the eighth bit to make sure the sum of all bits an even number. In "odd" parity, a zero would be put in the eighth bit so that the sum of all bits would be an odd number.

**permanent virtual circuit (PVC)**. The packet-switched equivalent of a leased line. The 5394 and its host system appear to the user to be permanently connected.

**P/F**. Poll bit for primary station; final frame bit for secondary station.

**physical services header (PSH).** A type of logical link control used in X.25 communication.

**physical unit (PU).** An SNA term for the secondary station (the control unit).

**planar.** The basic printed circuit electronic board.

**plenum.** A cover used to divert the flow of air over the planar.

**poll.** The method a primary station (host system) or a secondary station (control unit) uses to request other work stations to transmit or receive data.

**port.** The hardware coupling used to attach the work stations to a control unit.

**Post Telegraph Telephone (PTT).** A name used to describe a World Trade operating agency that controls the transportation of information (postal, voice, or data).

**protocol.** A set of instructions, requests, and responses providing a means of controlling the transfer of data between devices.

**public switched network (PSN).** A communication facility owned by a telephone company through which subscribers can be connected by dialing the unique telephone number of another subscriber.

**qualified logical link control (QLLC).** A type of logical link control used in X.25 communication.

**read-only storage (ROS).** Storage containing instructions and data that can be read but not changed.

**read/write storage (R/W).** Storage, usually used for data, that can be both written and read.

**Recommendation X.21.** A recommendation for interfaces set by the CCITT and amended periodically. The X series of recommendations defines standards for data transmission interfaces. X.21, specifically, defines the interface between data terminal equipment and public data networks for digital leased and circuit-switched synchronous services.

**Recommendation X.25.** A recommendation for interfaces set by the CCITT and amended periodically. The X series of recommendations defines standards for data transmission interfaces. X.25, specifically, defines the interface between data terminal equipment and packet-switched networks.

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

**remote loopback.** A test procedure that verifies the operation of the local modem, the remote modem, and the communication lines between them.

**retry.** To send frames of information a number of times by the control unit until the frames are accepted by the display station without an error.

**ripple level.** A voltage measurement.

**root-mean-squared (RMS).** Indicates the effective value of an AC voltage.

**segmenting.** In SNA, the dividing of a basic information unit (BIU) into two or more path information units (PIU).

**serializer/deserializer (serdes).** A register that is used to send data from the display station to the control unit, one bit at a time. The data is entered serially and read out parallel, or it is entered parallel and read out serially.

**session.** The period of time during which programs or devices can communicate with each other; the time that starts when an operator signs on the system and ends when the operator signs off the system.

**square wave.** The rectangular waveform that varies periodically and abruptly from one to the other of two uniform values.

**subscription.** An agreement between a user and a PTT/network supplier for the use of certain network services and optional facilities.

**switched network backup (SNBU).** An optional facility that allows a user to specify a switched line to be used as an alternate path if the primary line becomes unavailable or unusable.

**switched virtual circuit (SVC).** A switched virtual circuit is the packet-switched service equivalent of a switched line. It allows communication between the 5394 and one of several possible host systems.

**synchronous data link control (SDLC).** A form of communication line control used to transfer data over a communication line.

**synchronous modem.** A modem that supplies the clock signals that control the transfer of data between the control unit and the modem. Contrast with *nonsynchronous modem*.

**system reference code (SRC).** A system-generated code, either four or six digits, indicating an error or condition. This code is displayable on any attached display station.

**systems network architecture (SNA)**. A set of rules for controlling the transfer of information in a data communication network.

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

**threshold (receive levels)**. A specific voltage level that is compared to a signal in order to determine whether that signal is active or inactive.

**timeout**. A time interval allotted for certain actions to occur (such as response to a poll) before corrective action is taken.

**transmit activity check**. An error condition detected by the work station adapter on the control unit planar when the data transmitted to the twinaxial line does not match the output from the work station adapter.

**transition**. A point in time when a voltage or signal change occurs between two specified levels.

**transmission coding**. Non-return-to-zero change-on-ones recording (NRZI) or non-return-to-zero recording (NRZ).

**twinaxial cable**. A shielded cable with two conductors surrounded by insulating material and a conductive sleeve. It is used to pass information between devices separated by up to 1524 meters (5000 feet). See also *twisted-pair cable*.

**twisted-pair cable**. An unshielded cable with two or more pairs of insulated copper wire twisted together at a minimum of two twists per foot. This type of cable is commonly used in telephone installations for voice transmission. It can also be used for data transmission. However, twisted-pair cable is subject to interference and line loss, and therefore is limited to lengths of 365.8 meters (1200 feet) when used to interconnect work stations attached to the IBM 5394.

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

**unit address**. The address used to define each remote work station. This address is determined for the remote configuration (customer setup) and must be obtained for use by the host system.

**vary off**. Procedure the host system operator uses to take the 5394 offline.

**vary on**. Procedure the host system operator uses to bring the 5394 online.

**V.24**. List of definitions for interchange circuits between the DTE and the DCE (include, but is not limited to, interchange circuits defined in EIA 232D).

**V.28**. Electrical characteristics for unbalanced double-current interchange circuits (these characteristics are identical to those defined in EIA 232D).

**work station**. An I/O device that allows either the transmission of data or the reception of data (or both) from a host system. A work station is either a display station or a printer.

**work station address**. The address set by the operator during setup of the work stations. This address may be set on rocker switches, by keyboard entry, or by control panel entry.

**World Trade**. Any of the countries in Europe, Asia, Africa, and South America served by IBM.

**XLCA**. A feature card that was used in the IBM 5294, but is not used in the IBM 5394.

**X.21**. See *Recommendation X.21*.

**X.21 bis**. A type of data circuit-terminating equipment that converts signals between EIA signal lines and those associated with an X.21 interface.

**X.24**. List of definitions for interchange circuits between the DTE and the DCE on public data networks.

**X.25**. See *Recommendation X.25*.

**X.27**. Electrical characteristics for balanced double-current interchange circuits for general use with integrated circuit equipment in the field of data communication.

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