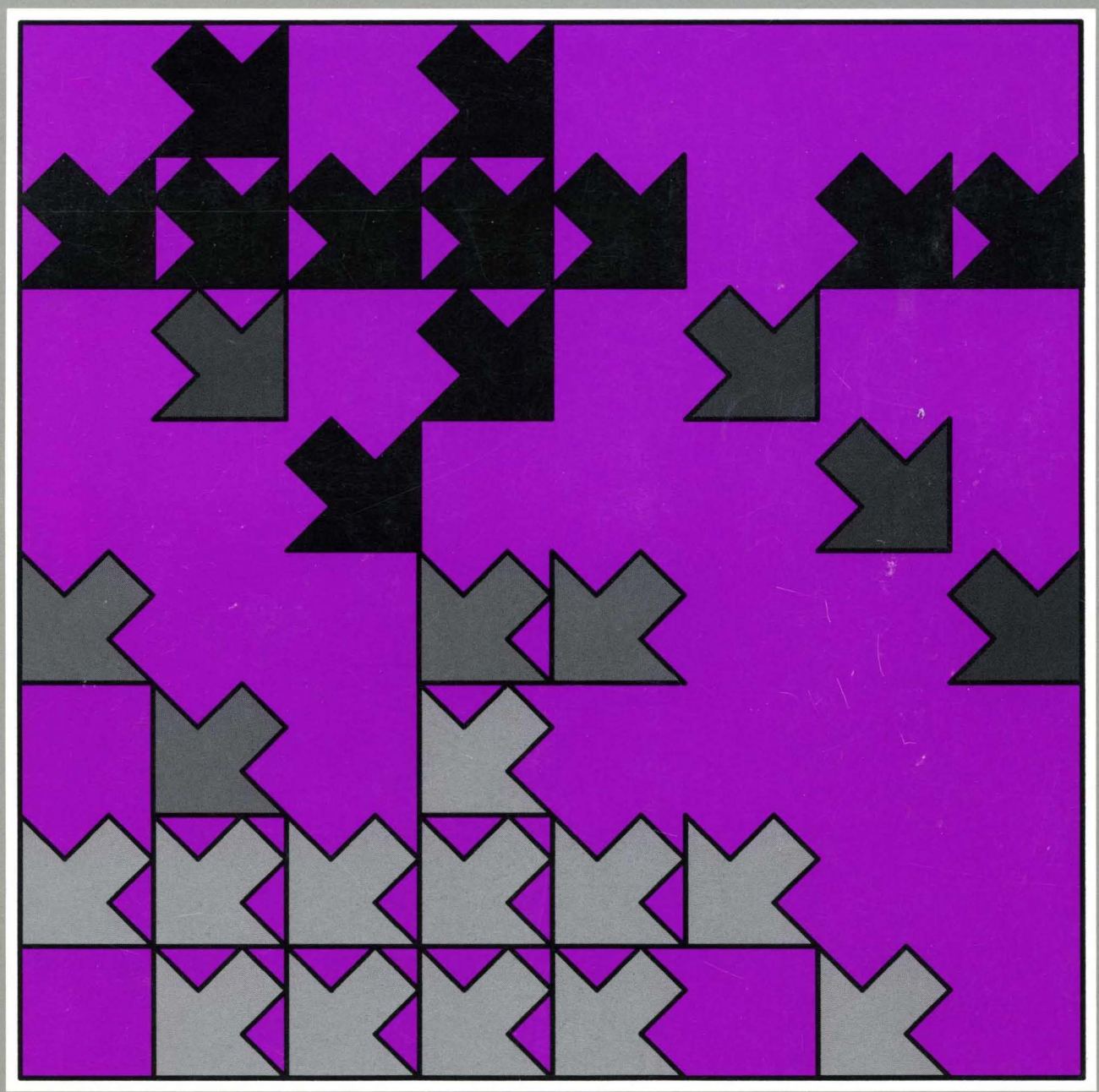
IBM

5394 Remote Control Unit

SK2T-0316-02

Introduction and Installation Planning Guide

Release 1 and Release 2



IBM

5394 Remote Control Unit

SK2T-0316-02

Introduction and Installation Planning Guide

Release 1 and Release 2

Second Edition (September, 1989)

Changes are periodically made to the information herein; any such changes will be reported in subsequent revisions or Technical Newsletters.

This publication is for planning purposes only. Also, this publication contains examples of floor plans. To illustrate as completely as possible, the examples include the names of individuals and places. The names and places are fictitious and any similarity to actual names and places is entirely coincidental.

References in this publication to IBM products, programs, or services do not imply that IBM intends to make these available in all countries in which IBM operates.

Publications are not stocked at the address given below. Requests for IBM publications should be made to your IBM representative or to the IBM branch office servicing your locality. This publication could contain technical inaccuracies or typographical errors. A form for reader's comments is provided at the back of this publication. If the form has been removed, comments may be addressed to IBM Corporation, Information Development, Department E02, P.O. Box 12195, Research Triangle Park, North Carolina, USA, 27709-2195. IBM may use or distribute whatever information you supply in any way it believes appropriate without incurring any obligation to you.

The following warning statements (required by country regulatory agencies) are applicable in the countries indicated.

United States

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: In many instances, shielded cables and connectors must be used for connection to peripherals. Proper IBM cables are available from authorized dealers. The manufacturer 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.

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet prepared by the Federal Communication Commission helpful:

How to Identify and Resolve Radio-TV Interference Problems

This booklet is available from the following:

FOB Public Contact Branch
Room 725
1919 M St. NW
Washington, DC 20554
Tele. (202) 634-1940

Consumer Assistance and
Small Business Division
Room 254
1919 M St. NW
Washington, DC 20554
Tele. (202) 632-7000

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.

About This Book

This book tells you how to plan the installation of your IBM 5394 Remote Control Unit. You can find information about cabling, planning your physical site, and ordering system components and network facilities. This book also contains some general information about data communication networks. In Appendix, you can find a Communication Worksheet that you need to complete as part of your planning process. Step-by-step instructions for completing the worksheet and appropriate reference material are included in this book. After you complete the worksheet, make sure you send it to the person who installs the IBM 5394. This person needs your planning information to complete the installation and setup process.

Who Should Read This Book

Chapter 1, "Introduction to the IBM 5394 Remote Control Unit" is for anyone seeking general information about the IBM 5394 Remote Control Unit.

The rest of the book is for the individual in charge of planning the remote installation and assumes some knowledge of data communication and network planning.

How This Book Is Organized

Chapter 1, Introduction to the IBM 5394 Remote Control Unit – This chapter provides an overview of the IBM 5394. It describes the components of a data communication system and lists supported devices.

Chapter 2, Planning Your Site – This chapter describes the operating environment required for the IBM 5394. A planning checklist is provided to help organize the installation process. The chapter also describes how to move and store the IBM 5394.

Chapter 3, Planning For Cables – This chapter describes the three most frequently used methods of cabling. It also contains cable ordering information and instructions for assembling your own twinaxial cables if you choose this type cable.

Chapter 4, Planning Your Communication Network – This chapter contains information you need to order system components and network facilities.

Chapter 5, Preparing the Communication Worksheet – This chapter provides step-by-step instructions for completing the Communication Worksheet.

Appendix, Worksheets – This appendix contains blank copies of the Communication Worksheets (SDLC, X.25, and X.21 switched).

Associated Publications

- *IBM 5394 Remote Control Unit User's Guide*, GA27-3852
- *IBM 5394 Remote Control Unit Functions Reference*, SC30-3488
- *IBM 5394 Remote Control Unit Maintenance Library*, SY27-0311
- *IBM Cabling System Planning and Installation Guide*, GA27-3361
- *IBM 5299 Terminal Multiconnector Model 3 Planning, Setup, and Maintenance Guide*, GA27-3749
- *Data Communications Concepts*, GC21-5169
- *AS/400 Communications Network Planning Guide*, GC21-9861
- *The X.25 Interface for Attaching SNA Nodes to Packet-Switched Data Networks General Information Manual*, GA27-3345

Summary of Changes

Some information relating to worksheet preparation has been moved from the first edition of this book to the *IBM 5394 Remote Control Unit User's Guide*.

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

Information has been added for the following:

- V.25 bis auto-dial
- V.35 communication.

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

Contents

Figures

Tables

Chapter 1. Introduction to the IBM 5394 Remote Control Unit

This chapter provides an overview of the IBM 5394, explains the components of a data communication system, and tells you what you need to know if you want to replace an IBM 5294 Control Unit with an IBM 5394.

Remote Work Station Attachment

With local work station attachment, you can attach display stations and printers to a control unit contained within the host system. This local attachment allows centralized data entry, display, and printing with all information processed by the host system. Local attachment allows operation through a maximum of 1525 meters (5000 feet) of twinaxial cable.

Some organizations, however, need to locate work stations further from the host system than twinaxial cable allows. These organizations can use a remote work station control unit, such as the IBM 5394, to control the operation of work stations located more than 1525 meters (5000 feet) from the host system. Using an IBM 5394, work stations in different buildings or even in different countries can share the resources of a host system by managing information exchanges over a communication network.[1] Work stations attached to the IBM 5394 are remotely attached to the host system.

Benefits of the IBM 5394 Remote Control Unit

The IBM 5394 provides access to the host system from a remote site. This makes it possible for one host system to serve the local site as well as multiple remote sites. The host system maintains centralized data bases that provide current information to all local and remote work stations when and where it is needed.

In addition, the IBM 5394 acts as an editing controller for the display stations and makes sure that the correct information is entered in each display field. The control unit can process keystrokes and fields locally without communicating with the host. This local processing can improve the response time for accepting and processing keystrokes and for providing feedback to the operator, especially when errors occur. The control unit passes print data from the host system to the printer without processing the data.

The IBM 5394 has three twinaxial ports. The control unit can support up to 16 work stations with a maximum of seven work stations attached to any port. The IBM 5394 supports communication with the host system through both analog and digital communication networks. The host system can be an IBM System/36, IBM System/38, or IBM AS/400™ system. Figure 1 on page 2 shows a sample configuration of an IBM 5394 in a data communication system.[2]

---

[1] In this book, the term "communication network" refers to the equipment and software required to transmit data signals between a host system and a remote site.

[2] The term "data communication system" refers to a configuration of data processing devices, software, and a communication network connected for information interchange.

™ AS/400 is a trademark of International Business Machines Corporation.

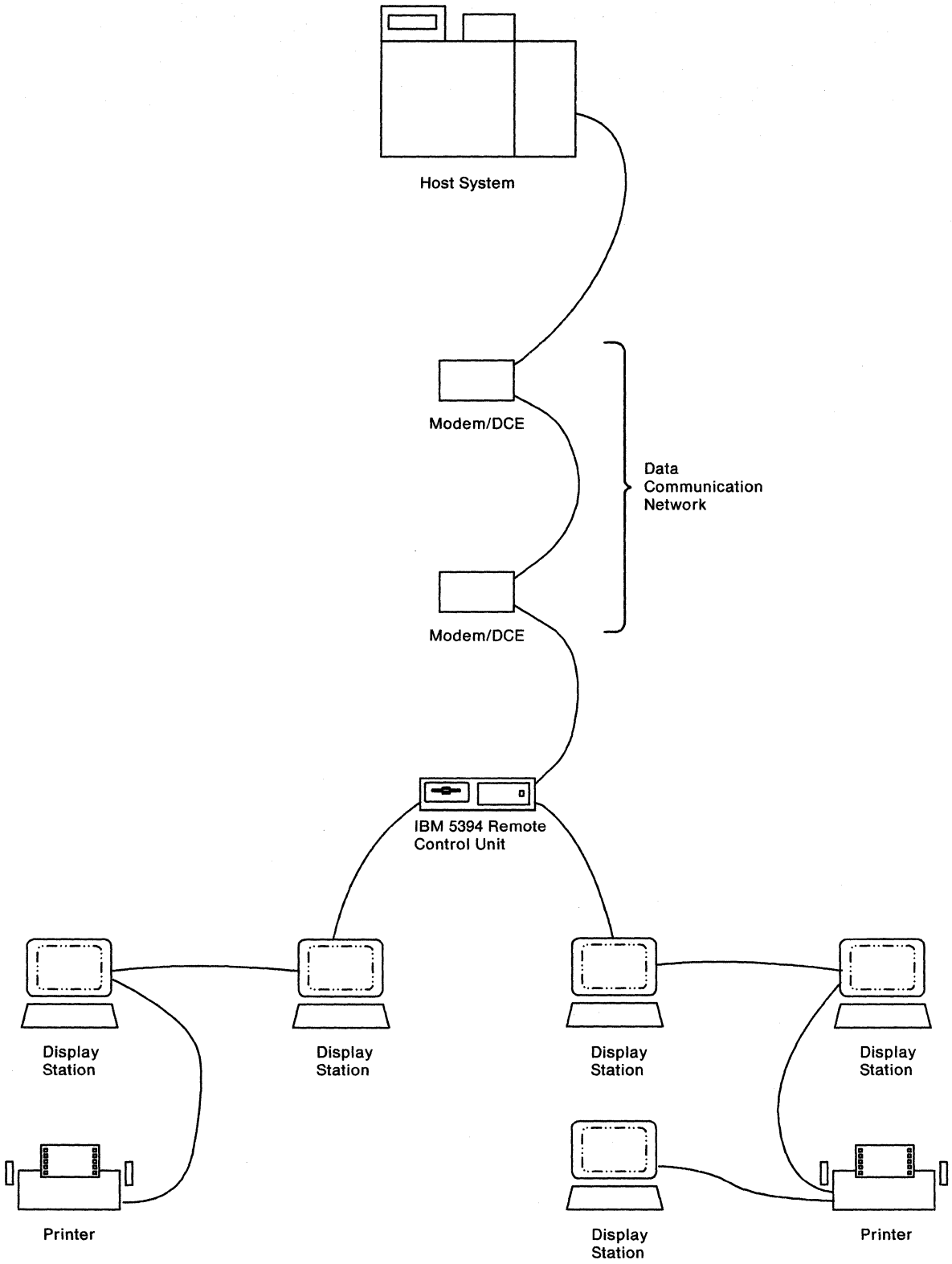


Figure 1. Sample Configuration of an IBM 5394 in a Data Communication System

Components of a Data Communication System

A data communication system consists of the following major components:

- An IBM 5394 Remote Control Unit Model 01 or 02
- The host system
- Work stations
- Communication network, including modems or data circuit-terminating equipment (DCE)
- Software.

If you need further information about data communication, refer to *Data Communications Concepts* and *AS/400 Communications Network Planning Guide.*

The IBM 5394 Remote Control Unit

The IBM 5394, shown in Figures 2 and 3, features a 3.5-inch diskette drive used to load software that handles communication, work station management, text editing functions, and customer setup. Switches on the operator panel control the operation of the control unit. Indicator lights on the panel inform the operator of the control unit status.

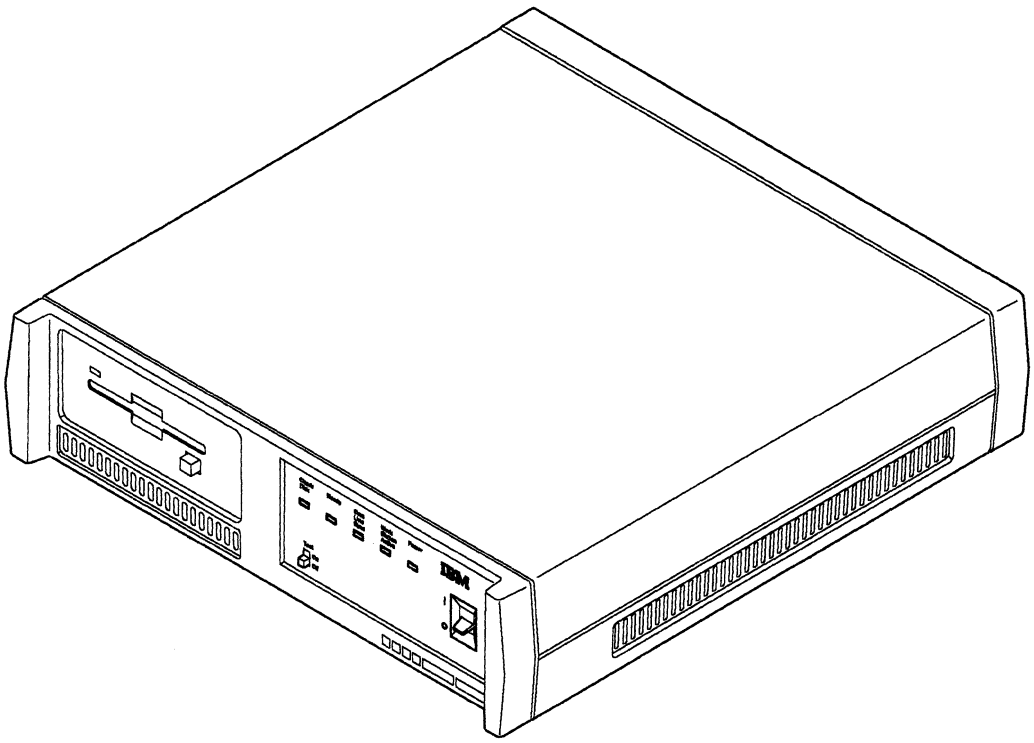


Figure 2. Front View of the IBM 5394 Remote Control Unit

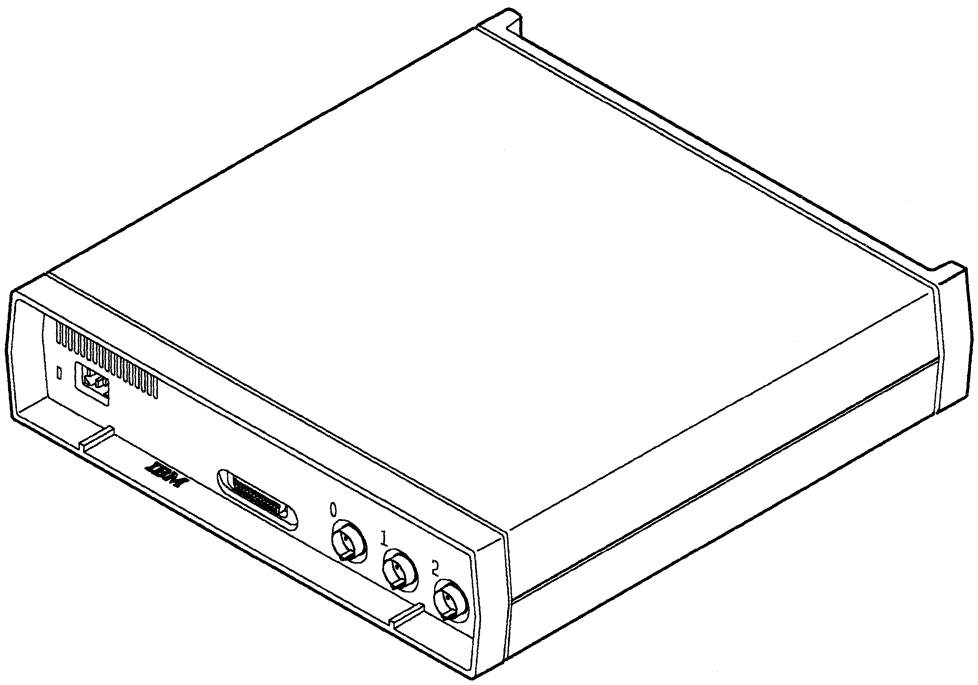


Figure 3. Back View of the IBM 5394 Remote Control Unit

IBM 5394 model selection depends on the communication network, the modem or DCE type, and the number of work stations you plan to attach. See "Selecting Your Control Unit Model" on page 48 for information on model selection.

The Host System

The IBM 5394 can be attached to the following host systems:

- IBM AS/400 system
- IBM System/36
- IBM System/38.

The IBM 5394 emulates an IBM 5294 when attached to an IBM System/36 or System/38.

An IBM 5394 Model 01A or 02A attached to any of these host systems can communicate with up to four work stations. An IBM 5394 Model 01B or 02B can communicate with up to eight work stations when attached to an IBM System/36 or System/38. An IBM 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 twinaxial 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)

™ InfoWindow is a trademark of International Business Machines Corporation.

® Personal System/2 is a registered trademark of International Business Machines Corporation.

- IBM Personal System/2 with IBM System 36/38 Work Station Emulation Program (Models 8550, 8560, and 8580)
- IBM PC and 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 PC or 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.

Other Devices

The IBM 5394 also supports the following devices:

- 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.

Modems and DCEs

If you are communicating with your host system through an analog communication network, the IBM 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 IBM 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 your network is an X.21 Public Data Network or an X.25 Packet-Switched Public Data Network, your IBM 5394 and the host system are attached to the network through data circuit-terminating equipment (DCEs). The network may provide you with DCEs. If not, your network supplier should give you information for ordering this equipment. Contact your network supplier for more information.

Networks

The IBM 5394 Model 01 using the EIA 232D (CCITT V.24/V.28) communication interface can attach to the following types of networks:

- Public or private, leased or switched analog lines using a modem
- Dataphone Digital Service (DDS) using a Data Service Unit (DSU)
- X.21 Circuit-Switched or Leased-Circuit Data Networks using an X.21 bis (V.24/V.28) DCE
- X.25 Packet-Switched Data Networks using an X.21 bis (V.24/V.28) DCE.

The IBM 5394 Model 02 using the CCITT X.21 communication interface can attach to the following types of networks:

- X.21 Circuit-Switched Data Networks using an X.21 DCE
- X.21 Leased-Circuit Data Networks using an X.21 DCE
- X.25 Packet-Switched Data Networks using an X.21 DCE.

An IBM 5394 using the V.35 communication interface can attach to the following types of networks:

- DDS using a DSU
- Point-to-point leased line
- Broadband analog networks
- Point-to-point high-speed private line using Limited Distance Modems
- X.21 Circuit-Switched or Leased-Circuit Data Networks using an X.21 bis (V.35) DCE
- X.25 Packet-Switched Data Networks using an X.21 bis (V.35) DCE.

Planning for Migration to the IBM 5394 Remote Control Unit

To migrate from the IBM 5294 Control Unit or IBM 5251 Model 12 Control Unit to the IBM 5394, consider the following factors:

- **Host system support.** Make sure the IBM 5394 is supported by your host system. The IBM 5394 can be attached to the IBM AS/400 system, System/36 or System/38.
- **Cabling.** The cabling requirements of the IBM 5394 are different from the cabling requirements of the IBM 5294 Control Unit and IBM 5251 Model 12 Control Unit. Make sure that you use the communication interface cable that comes with the IBM 5394. For more information, see Chapter 3, "Planning For Cables" on page 15.
- **Configuration.** After replacing your existing control unit with an IBM 5394, you will need to reconfigure your system. For more information, see Chapter 4, "Planning Your Communication Network" on page 45.

The IBM 5394 does not contain an operator's display. If you are migrating from an IBM 5251 Model 12 Control Unit, you must have a display station attached to your system. This display station cannot be an IBM PC or Personal System/2 using AS/400 PC Support or an IBM Personal System/55 using 5250 PC/2 AD Support because these display stations cannot be used for customer setup, network attachment, or problem determination.

Chapter 2. Planning Your Site

This chapter provides information to help you prepare your site for the IBM 5394. This chapter addresses the following topics:

- Personnel considerations
- Environmental considerations
- Electrical requirements
- Space, service, and cooling requirements.

Planning Checklist

The following checklist suggests tasks that you should do before you receive your IBM 5394. Check each list item after you complete the task. Modify the check list, if necessary, to meet your specific requirements.

__ Coordinate personnel and suppliers to assist in ordering equipment and planning the remote installation:

- __ Planner
- __ Network supplier
- __ Modem supplier
- __ Hardware supplier.

__ Study the environment of the site:

- __ Temperature and humidity requirements
- __ Electrostatic discharge
- __ Electromagnetic compatibility
- __ Atmospheric contaminants.

__ Study the electrical requirements of the site.

__ Determine space, service, and cooling needs:

- __ Dimensions
- __ Service requirements
- __ Cooling requirements.

- ___ Determine cabling needs (see Chapter 3, "Planning For Cables" on page 15):
  - ___ Communication cable
  - ___ IBM Cabling System
  - ___ Twinaxial cabling
    - ___ Cable-thru
    - ___ No cable-thru
    - ___ Preassembled cables
    - ___ Bulk cables
  - ___ Twisted-pair cabling.
- ___ Prepare a floor plan showing the placement of all system components and cabling.
- ___ Order work stations, control units, modems or DCEs, cabling, and required communication network facilities. See Chapter 4, "Planning Your Communication Network" on page 45.
- ___ Complete the Communication Worksheet in Chapter 5, "Preparing the Communication Worksheet" on page 53. Send a copy of the completed worksheet to the person who will install the IBM 5394.
- ___ Order any necessary furniture.
- ___ Make sure that communication equipment for establishing communication with the host system is installed.
- ___ Make sure that correctly wired and grounded electrical outlets are installed.

Personnel Considerations

One person should be available to plan all phases of the installation. This person (the planner) is responsible for inspecting the site, gathering necessary information, and ordering equipment.

Environmental Considerations

While planning your site, consider the environmental factors discussed on the following pages.

Temperature and Humidity Requirements

Table 1 shows the temperature and humidity limits for your IBM 5394.

Table 1. Temperature and Humidity Limits

When:	Temperature Range	Relative Humidity
Operating	10 - 40°C (50 - 104°F)	8 - 80%
Not Operating	10 - 50°C (50 - 125°F)	8 - 80%
In Storage	1 - 60°C (34 - 140°F)	5 - 80%
In Shipment	-40 - 60°C (-40 - 140°F)	5 - 100%

Electrostatic Discharge

With low humidity levels, static charges generated by the movement of people, carts, furniture, and paper are more readily stored in certain types of floor construction, floor coverings, and furniture. If discharged to or near data processing or other electronic equipment, *these charges can cause intermittent interference.* To minimize electrostatic discharge:

- Avoid high-resistance floor surface material. Floor surface resistance measured between the floor surface and the building (or other applicable ground reference) should be greater than 1.5×10^5 ohms and less than 2×10^{10} ohms. The measuring method is specified in National Fire Protection Association, Inc., 56A, Chapter 462.
- Avoid carpeting that does not have antistatic properties.
- Avoid plastic seat coverings.
- Avoid low humidity levels.

Electromagnetic Compatibility

Avoid placing an IBM 5394 in an area of high electromagnetic interference that can be radiated or conducted. Such areas may exist within 500 meters (1650 feet) of radio frequency sources, such as radio-transmitting antennas (AM, FM, TV, and two-way radio), radar (FAA and military), and within 50 meters (165 feet) of certain industrial machines (induction heaters, arc welders, and insulation testers), industrial time clocks, and high-energy power lines. Other sources of electromagnetic interference may include transformers (including those installed in other units), power distribution panels (three-phase power distribution lines), rotating machinery, and certain electrical heating systems.

Some power supplies in printers, modems, and other data processing equipment may interfere with display screens and the IBM 5394 diskette drive. If you encounter an interference problem, maintain a minimum distance of 1 meter (3.3 feet) between the IBM 5394, display stations, printers, and other data processing equipment.

If any of the above electromagnetic interferences are present, determine whether special installation or product considerations are necessary to ensure normal system operation and maintenance.

Atmospheric Contaminants

Avoid environments where particulate, liquid, and gaseous atmospheric contaminants exist.

Some contaminants, for example, can cause corrosion of copper and other metals used in computer systems. Extended corrosive growth in any computer system can produce electrical short circuits or contact failures that result in system malfunctions. Corrosion can become so extensive that an entire system or machine may need to be replaced.

Electrical Requirements

CAUTION:
For your safety, you must connect equipment only to a properly wired and grounded outlet. An improperly wired outlet can place hazardous voltage on accessible metal parts of the equipment. The customer is responsible for outlet wiring.

If it becomes necessary to change the power cord, order a new power cord from your IBM sales representative. If the outlet is improperly wired, have the change made according to local or national code.

Table 2 summarizes the power requirements of the IBM 5394.

Table 2. IBM 5394 Power Requirements

Power Characteristics	Low Voltage	High Voltage
Volts AC	90-137 VRMS	180-259 VRMS
Frequency (single phase)	50/60 Hz	50/60 Hz
Current (maximum steady state)	0.9 amps @ 50/60 Hz	0.5 amps @ 50/60 Hz

Space, Service, and Cooling Requirements

The IBM 5394 is a small control unit designed to be placed on a table. Make sure the table is large enough to provide space for service clearance requirements and proper ventilation. When stacking data processing devices, rack mounting with sheet metal shelves is suggested.

Dimensions

Table 3 gives the dimensions of the IBM 5394.

Table 3. IBM 5394 Dimensions

Dimensions	
Height	11.4 cm (4.5 in)
Width	42.5 cm (16.75 in)
Depth	42.5 cm (16.75 in)
Weight	9.07 k (20 lb)

Service Requirements

Allow clearance for service personnel to inspect and maintain the unit. This helps limit the time that your IBM 5394 is offline.

One display station should be within six meters (20 feet) of the control unit for maintenance purposes. This display station should not be an IBM PC or Personal System/2 using AS/400 PC Support or an IBM Personal System/55 using 5250 PC/2 AD Support because these display stations may not display network error codes and cannot be used to run diagnostics.

Cooling Requirements

The IBM 5394 has no special cooling requirements. However, the control unit requires clearance to operate correctly. Make sure that the louvers on the back and left sides of the control unit are not blocked.

Repackaging, Moving, and Storing the IBM 5394

Follow the instructions in this section carefully if you need to store or move the IBM 5394 to a new location.

Repackaging and Moving

To pack and move your IBM 5394, do the following:

1. Make sure that all cables are labeled correctly. Disconnect the cables.
2. Place the IBM 5394 system diskette and backup diskette in a protective covering. Use a plastic sleeve or an envelope.

   Warning: Remove the diskette from the diskette drive before you move the IBM 5394.
3. Pack the IBM 5394 in its original shipping container.
   a. Open the shipping container and remove the top piece of foam packing and the plastic bag.
   b. Slip the IBM 5394 into the plastic bag with the front of the machine facing the bottom of the bag.
   c. Insert the IBM 5394 into the shipping container and adjust the machine to fit properly into the bottom piece of foam packing.
   d. Place the top piece of foam packing on top of the IBM 5394 in the shipping container and adjust for proper fit.
   e. Close and tape the container securely.

Storing

If you need to put your IBM 5394 in storage, repackage the machine in its original shipping container. Insert the IBM 5394 in the plastic bag and repack the box. Refer to the instructions in "Repackaging and Moving."

Chapter 3. Planning For Cables

This chapter provides information to help you as you plan your cabling for the IBM 5394. This information covers:

- Communication cable
- The IBM Cabling System
- Twinaxial cabling
- Twisted-Pair cabling.

This chapter also includes information on installing preassembled cables, assembling bulk cables, and preparing a floor plan. While these tasks may not be completed until setup time, this information is included here to help you make the correct cabling decisions for your installation.

Physical Limitations: Each of the ports on the IBM 5394 is capable of supporting up to seven work stations. However, no more than four work stations can be attached to the IBM 5394 Model 01A or 02A at one time. No more than eight work stations can be attached to an IBM 5394 Model 01B or 02B connected to an IBM System/36 or System/38. No more than 16 work stations can be attached to an IBM 5394 Model 01B or 02B connected to an IBM AS/400 system.

Communication Cable

A multi-wired communication cable connects the control unit and the modem or DCE. You must use the cable that comes with the IBM 5394 to make sure your control unit operates correctly. This cable includes a switch or switches for testing. See Table 4 to determine the communication cable and hardware you need.

Table 4. Communication Cables and Hardware

Interface	IBM 5394 Model	Description	IBM Part Number	Length
ANSI EIA 232D	Model 01	Communi-cation cable	6423153	6.1 meters (20 feet)
CCITT X.21	Model 02	Communi-cation cable	6168155	6.1 meters (20 feet)
CCITT V.35	See IBM Sales Rep-resentative.	Communi-cation cable	6423325	6.1 meters (20 feet)
CCITT V.35	See IBM Sales Rep-resentative.	Communi-cation cable (France and Switzerland only)	6423326	6.1 meters (20 feet)
ANSI EIA 232D	Model 01	Metric thumbscrews (Japan and South Korea only)	73X3722	N/A
ANSI EIA 232D	Model 01	Metric thumbscrews (Germany only)	25F7432	N/A

The IBM Cabling System

When you plan a new installation, you may find that the wiring in your building does not meet the voice and communication needs of your new installation.

The solution to this problem is to install a cabling system, such as the IBM Cabling System, that provides a variety of voice and data communication uses. The IBM Cabling System includes cables and cable accessories for attaching a wide variety of work stations.

The wiring design for the IBM Cabling System uses the wiring-closet distribution concept. Most of the wiring is concentrated in small rooms or closets. Work areas are wired to one or more wiring closets. After the IBM Cabling System is installed, you can change the work area configuration and wiring closets without additional costly rewiring to the building.

Note: The cables of the IBM Cabling System must not be connected with other twinaxial cabling.

Figure 4 shows an example of work station attachment using the IBM Cabling System. In this example, only one control unit port is shown; however, you can connect multiple ports in a similar manner. Actual wiring varies from one building to another. For information about installing and maintaining the IBM Cabling System, refer to the *IBM Cabling System Planning and Installation Guide*.

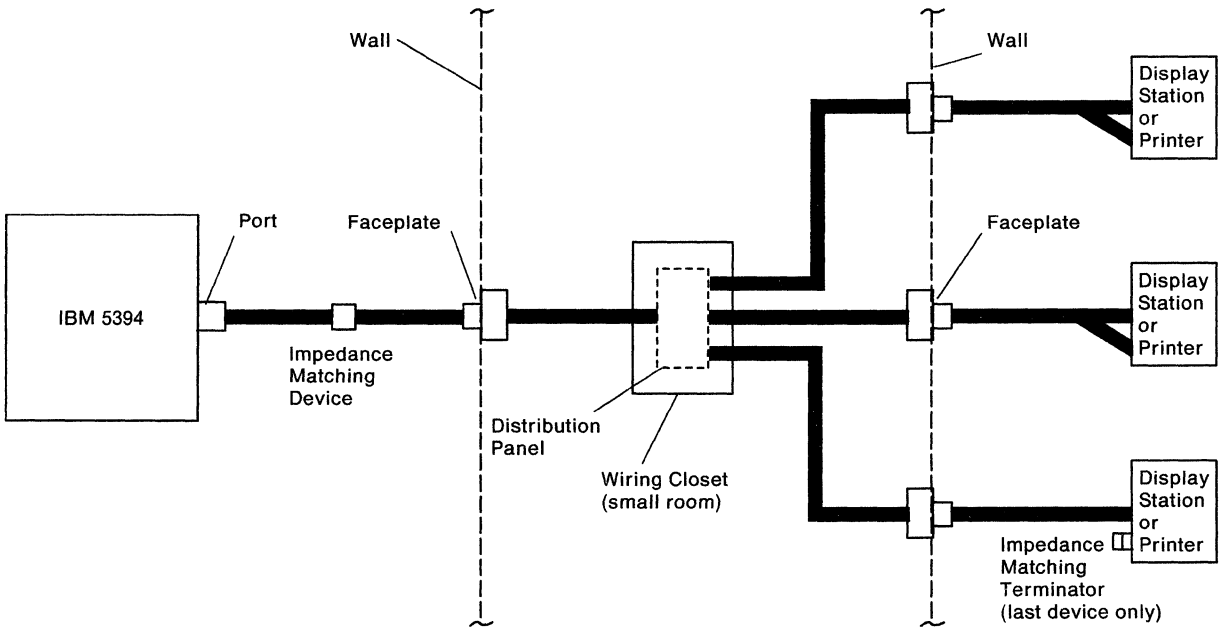


Figure 4. Work Station Attachment Using IBM Cabling System

Twinaxial Cabling

Note: To avoid interference, do not install twinaxial cables near electrical equipment or power lines that carry more than 440 volts.

Twinaxial cabling is the native cabling system for the IBM 5394. Three twinaxial ports are located on the back of the control unit.

If you plan to use twinaxial cable, you should make two decisions early in your planning: whether or not to use cable-thru and whether to use preassembled or bulk twinaxial cables.

Using Cable-Thru

If you plan to attach several work stations to a control unit, consider using cable-thru. Cable-thru allows the attachment of up to seven work stations to the same port on the control unit and saves cable cost. All work stations on a cable-thru line, except for the last work station, must have two twinaxial ports (sockets) or an auto-termination unit for cable attachment. If you are using a work station with only one twinaxial port, this work station must be the last or only work station on that control unit port. See Figure 5.

Note: The last work station on a cable-thru line can be no more than 1525 meters (5000 feet) in cable distance from your IBM 5394. One display station should be within 6 meters (20 feet) of the control unit for maintenance purposes. This display station should not be an IBM PC or Personal System/2 using AS/400 PC Support or an IBM Personal System/55 using 5250 PC/2 AD Support because these display stations may not display network error codes and cannot be used to run diagnostics.

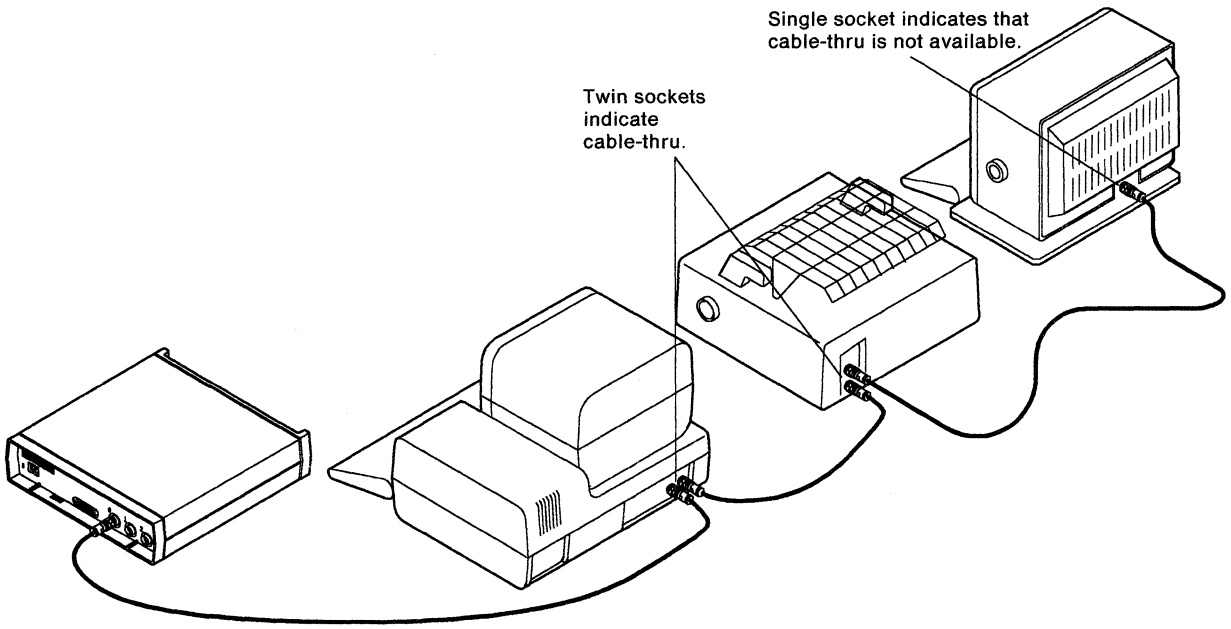


Figure 5. Sample Configuration Using Cable-Thru

When to Use Cable-Thru

Use cable-thru when you plan to attach more than one work station to a port. This normally reduces the amount of twinaxial cable required.

When Not to Use Cable-Thru

If you plan to attach no more than three work stations and they are located at relatively short distances from the control unit, compared to each other, it is better to attach work stations to separate ports on separate cables as shown in Figure 6.

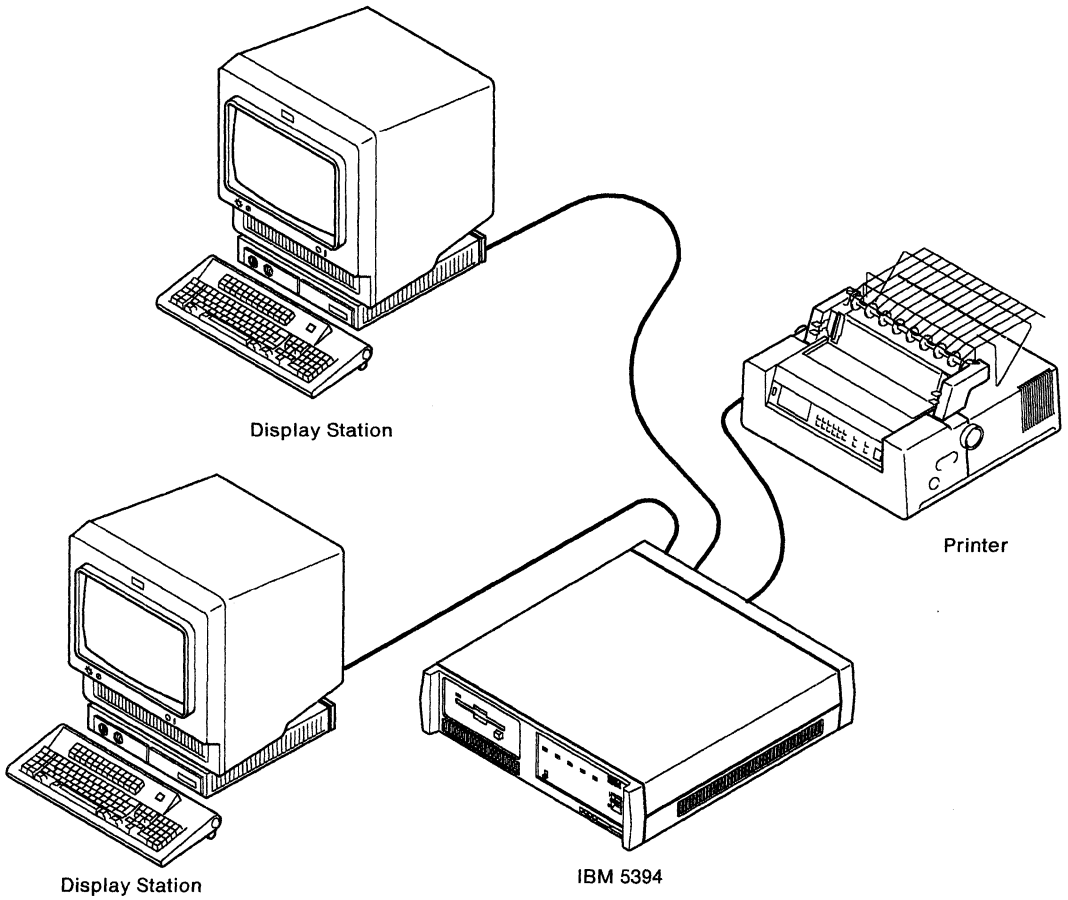


Figure 6. Sample Configuration Without Cable-Thru

Using Preassembled Cables

It is recommended that you order and use preassembled cables. If you plan to assemble your own cables, see "Assembling Bulk Cables" on page 27. When using preassembled cables, consider the following:

- The minimum distance allowed between twinaxial cable and fluorescent, neon, or incandescent lighting fixtures is 127 millimeters (5 inches).
- The minimum distance allowed between twinaxial cable and unshielded power lines or electrical equipment depends on the power consumption of the equipment:
  - 2 kVA or below: 127 millimeters (5 inches)
  - 2-5 kVA: 305 millimeters (12 inches)
  - Over 5 kVA: 610 millimeters (24 inches).
- The minimum distance allowed between twinaxial cable and unshielded power lines or electrical equipment with the signal cable enclosed in grounded metallic conduit:
  - 2 kVA or below: 63.5 millimeters (2.5 inches)
  - 2-5 kVA: 152 millimeters (6 inches)
  - Over 5 kVA: 305 millimeters (12 inches).
- The minimum distance allowed between twinaxial cable and power lines in grounded metallic conduit:
  - 2 kVA or below: 63.5 millimeters (2.5 inches)
  - 2-5 kVA: 152 millimeters (6 inches)
  - Over 5 kVA: 305 millimeters (12 inches).
- The minimum distance allowed between twinaxial cable enclosed in grounded metallic conduit and power lines enclosed in grounded metallic conduit:
  - 2 kVA or below: 30.5 millimeters (1.2 inches)
  - 2-5 kVA: 76 millimeters (3 inches)
  - Over 5 kVA: 152 millimeters (6 inches).

You can use twinaxial cable indoors or outdoors, although twinaxial cable is not recommended for direct burial without conduit. You will need some type of carrier to provide support every 3 meters (9.8 feet) for overhead installation.

Outdoor connections are permitted only if the connections are potted in a weatherproof compound. You should not install twinaxial cable under water. Also, for protection from lightning, you must attach a station protector (see "Station Protectors" on page 23) at each end of the cable that is run outdoors (for buried and overhead cables).

You can run cable in the same conduit as telephone lines.

The following is a list of suggested outdoor installation methods for twinaxial cables. Your site's exposure to lightning should determine which method you use:

- *In high lightning exposure areas,* bury cables in grounded metal conduit.
- *In average lightning exposure areas,* do one of the following:
  - Bury cables in metal conduit or in nonmetallic conduit with two AWG 6 bare copper shield wires installed 2 feet above the conduit.
  - Put overhead cables under a shield line. The shield line is a metal cable run on the same poles. (Power lines can also have a shielding effect on cables.) The signal cables must hang at least 1 meter (3.3 feet) below the shield line. Figure 7 shows shield lines used with overhead cables.

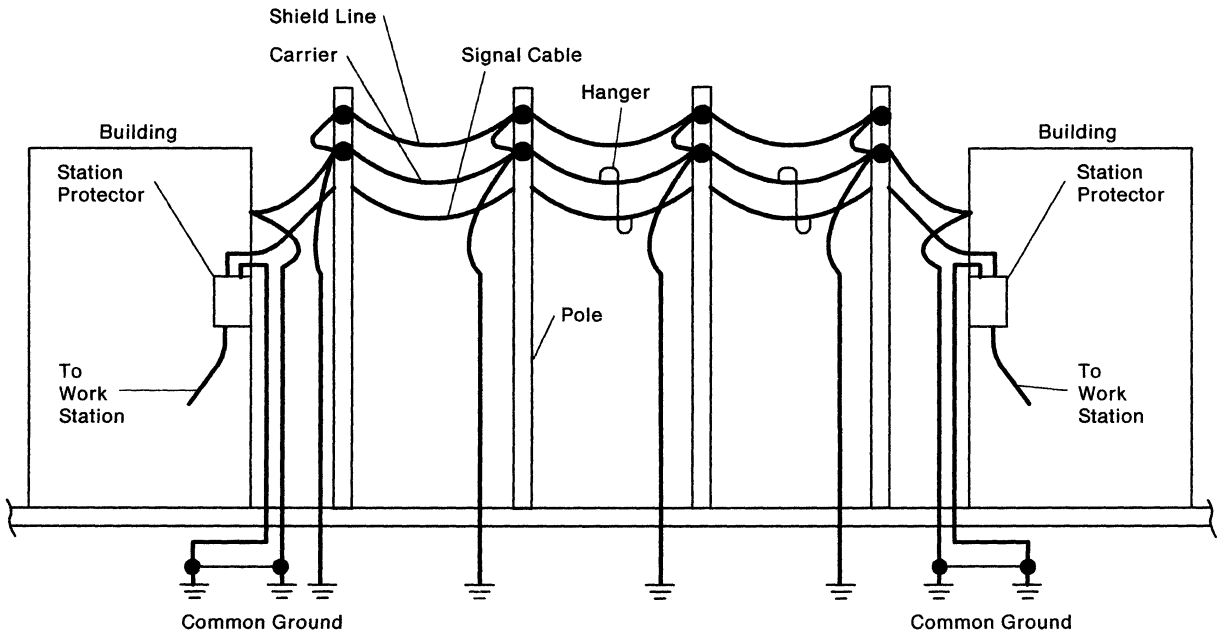


Figure 7. Using Shield Lines with Overhead Cables

Note: When you run the cable jointly with the power line, the carrier wire should be bonded to the multiground neutral (MGN). You can use the MGN instead of an earth-driven grounding rod. Bond all ground points to the power company MGN.

- *In low lightning areas,* do one of the following:
  - Bury cables in nonmetallic conduit.
  - Put overhead cables on a carrier with the carrier grounded at each end. See Figure 8.

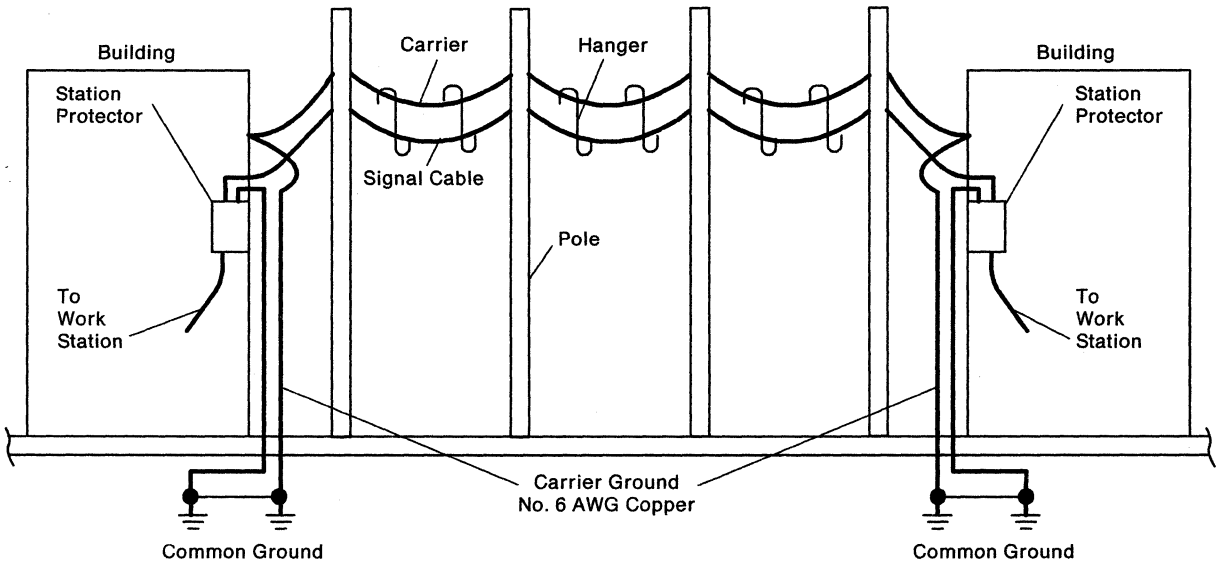


Figure 8. Using a Carrier with Overhead Cables

Note: Overhead twinaxial cables should not be the highest point in the area.

Station Protectors

Station protectors are required for each outdoor or underground circuit run. A station protector provides for grounding of the cable shield for personnel safety and contains solid-state components for unit protection. Station protectors *must be installed indoors* where the cable enters or exits the building and as close as possible to a suitable ground. Station protectors must not be installed near combustible materials or in hazardous locations, as defined in Article 500 of the National Electric Code (NEC). Also, the station protector must be grounded at the building entrance or exit point (reference Article 800-31 in NEC).

Station protectors are used in pairs. One station protector is located at each cable exit in the originating building and another station protector is located at each cable entrance to adjoining buildings. You can install only one station protector kit (two station protectors) per port; therefore, only one outdoor (or underground) cable run is allowed for each port used. See Figure 9 for placement of station protectors.

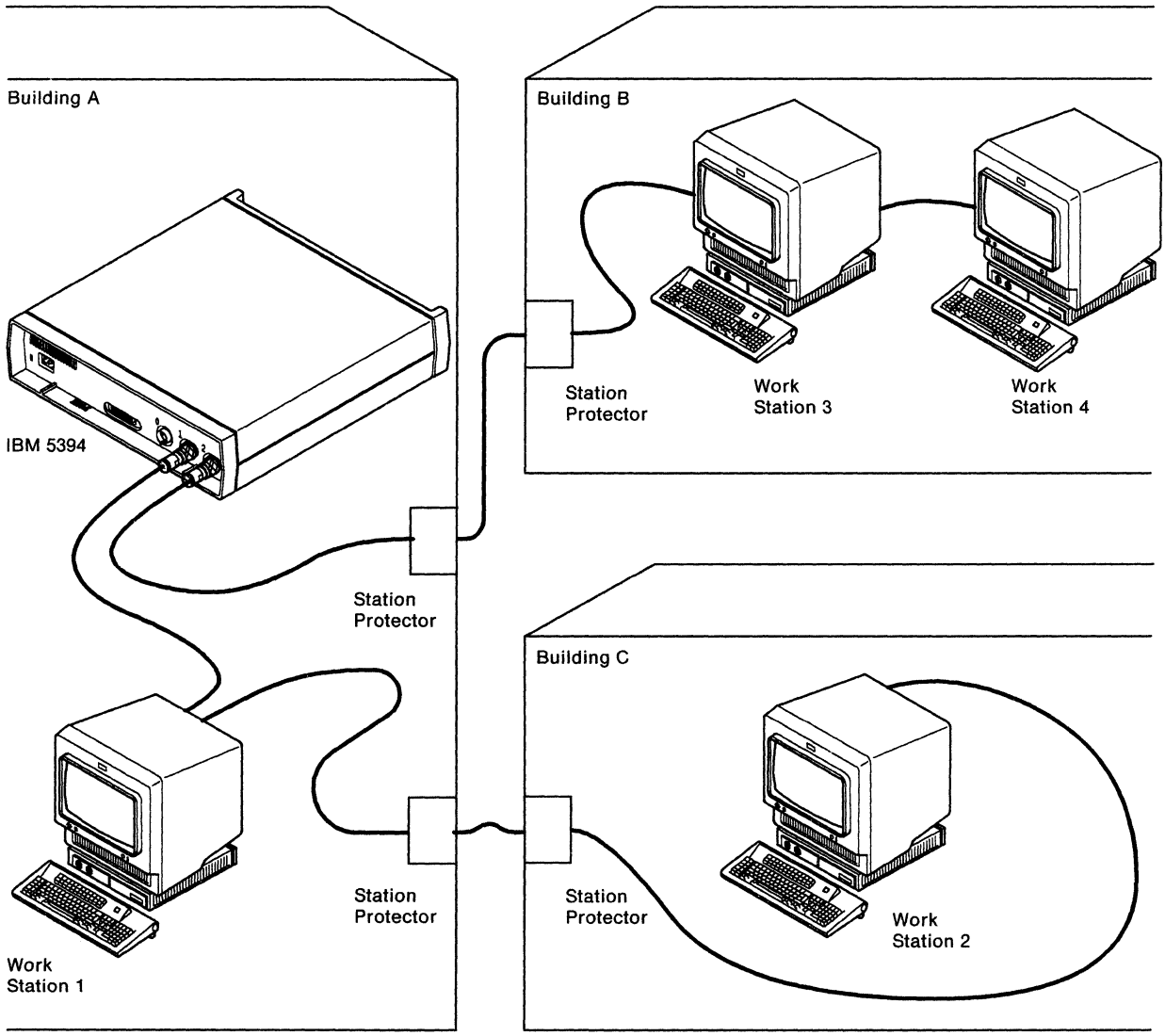


Figure 9. Station Protectors

You are responsible for supplying, installing, and maintaining station protectors. You can order the Twinaxial Station Protector Kit. (A kit consists of two station protectors and is sufficient to install one outdoor cable with a station protector at each end.) You can order single station protectors for twinaxial cable.

Order station protectors from your IBM sales representative. If you want to connect the station protectors to your lines before the work stations arrive, specify an earlier ship date.

To facilitate system recovery in the event of electrical damage, order extra station protectors when you place your initial order.

Install the station protectors so that the components in them can be easily inspected. Do not install these protectors in areas where unauthorized persons might come in contact with them.

Note: Cables are attached to the station protectors with the same connectors that attach to the system. Therefore, when you order equipment, allow two additional connectors for each station protector in your configuration.

Grounding Recommendations

It is important to provide good grounding (grounding conductor and grounding electrode) for the station protector. The following is a list of the minimum recommended requirements for station protector grounding. The grounding conductor:

- Should be AWG 6 wire or larger
- Should be less than 3 meters (9.8 feet) long
- Should run in a straight line to a grounding electrode that has a ground resistance of less than 10 ohms.

You should also provide common grounding between the station protector, the utility ground, and all extensive metal components in the vicinity of the system. (This prevents side flashes caused by lightning.) The conductor used for interconnecting grounds should be at least AWG 6 wire.

DANGER

> **Never work on equipment, or connect or disconnect signal cables during periods of lightning activity.**

Install the station protectors in line with the cable as it enters or exits a building. The station protectors should be permanently mounted in the building. See Figure 10.

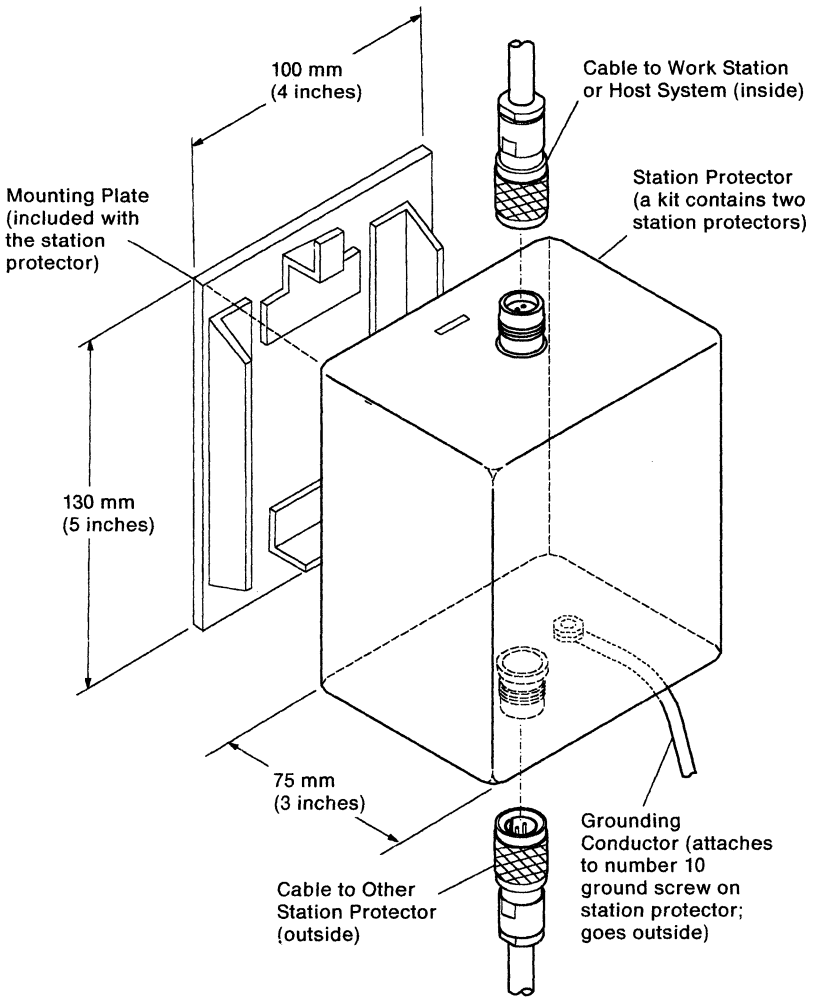


Figure 10. Station Protector Installation

Note: It is important that the grounding conductor is on the same side of the station protector as the cable leading to the outside of the building.

The station protector is owned and maintained by the customer. You can use the following procedures to check an IBM-supplied station protector. Refer to Figure 11 before beginning these procedures.

Disconnect the cables from the station protector before you make the checks. This disconnects the work stations from the system.

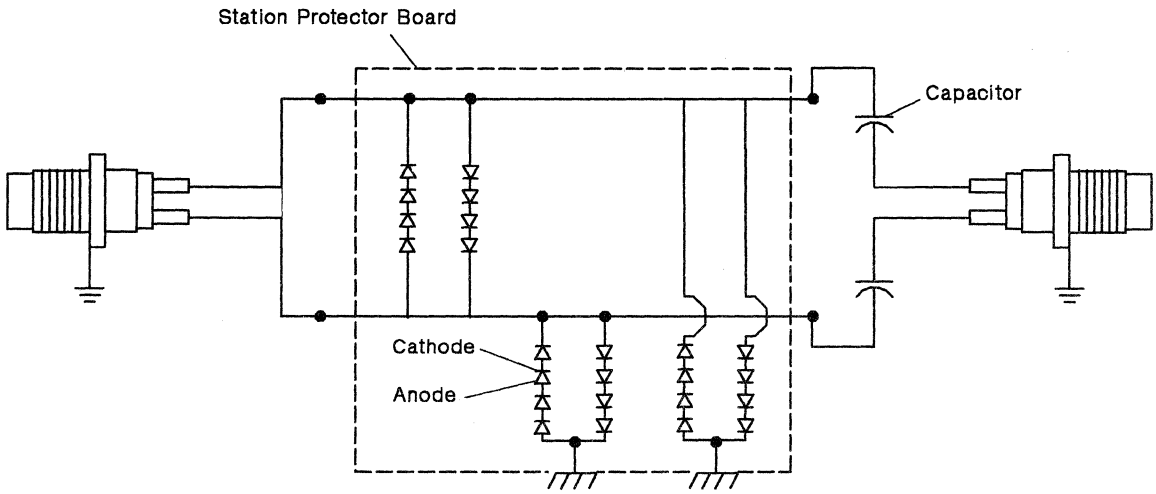


Figure 11. Station Protector Board

To check the diodes:

1. Check each diode with the negative (-) lead connected to the anode and the positive (+) lead connected to the cathode. The resistance should exceed 10,000 ohms.
2. Check each diode with the negative (-) lead connected to the cathode and the positive (+) lead connected to the anode. The resistance should be less than 2000 ohms.
3. Check for burned or damaged components.

To check the capacitors:

1. Before each reading, short the capacitors by placing a screwdriver or metal bar across the leads.
2. Set the volt-ohm meter (VOM) to R x 100K.
3. Touch the meter leads across the leads of a capacitor. There should be a noticeable instantaneous meter deflection (toward the 0 end of the scale) as the capacitor is charging up. Then the needle on the VOM will drop back to the high end of the scale.

   If the deflection is present, the capacitor is good. No deflection indicates a defective capacitor. No deflection could also result from using a VOM set at a range that is too low.

Assembling Bulk Cables

If you purchase bulk twinaxial cables, assemble them as follows. Refer to the illustrations following these instructions for dimensions and assistance in completing these procedures. If you use connectors provided by a company other than IBM, use the instructions provided by the manufacturer.

1. Make sure that the connector kit has all of the required parts. See Figure 12 for location of the cable layers.

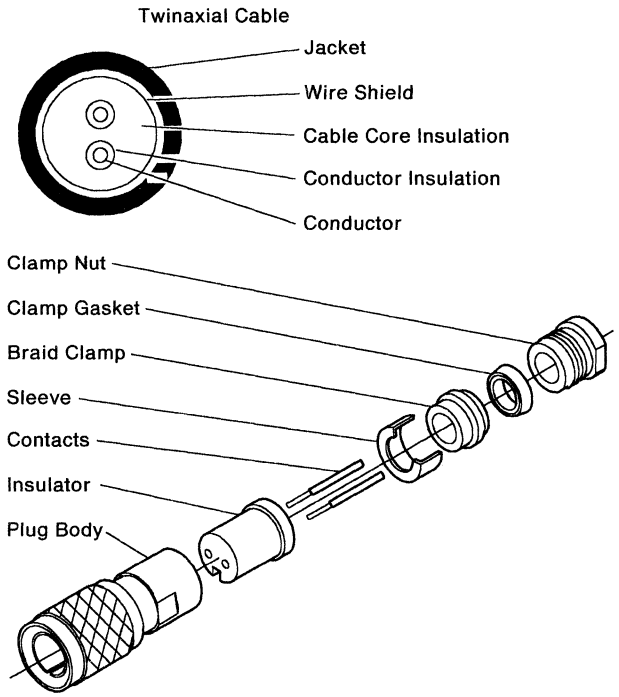


Figure 12. Cable Layers

2. Cut the end of the cable sharp and square. Then slide a clamp nut and clamp gasket over the cable jacket and trim the jacket to the dimension given in Figure 13. Push the wire shield back to expose the inner insulation core, and cut the core and conductors to the dimension shown (16 millimeters [0.63 inch]). Slide the wire shield back over the core, and taper it to a point for ease of braid clamp assembly in step 3 on page 29.

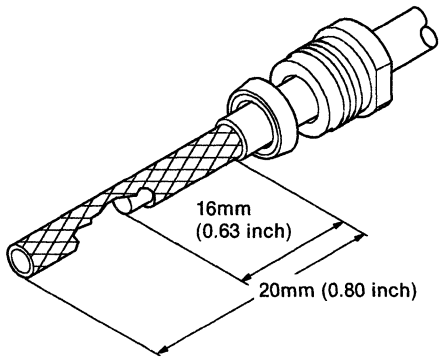


Figure 13. Cable Core and Conductors

Note: If you are assembling a Teflon cable, install the heat-shrink tubing before you continue with step 3 on page 29. See Figure 14.

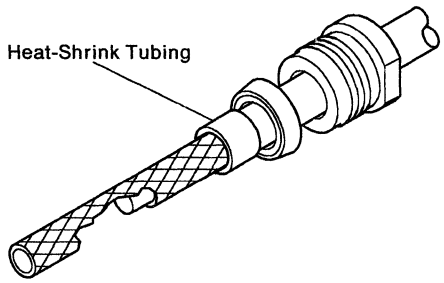


Figure 14. Heat-Shrinking Tubing

3. Slide a braid clamp over the braid, as shown in Figure 15, so that its inner shoulder butts against the cable jacket. Then fold the shield back over the braid clamp and trim below the shoulder.

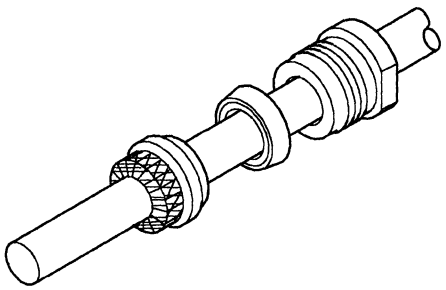


Figure 15. Braid Clamp

Note: Placement of braid wires over the braid clamp must be uniform to provide good radio frequency (RF) connection of the shield and to prevent breaking the shield strands.

4. Cut the cable core and the conductor insulation to the dimensions shown in Figure 16. *Do not nick the conductors or the insulation.* If the braid is frayed, retrim the braid as in step 2 on page 28.

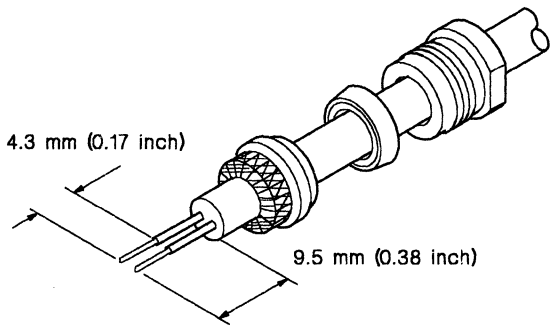


Figure 16. Cutting the Cable Core

5. Slide the sleeve over the cable core and press the sleeve against the braid wires.
6. Using a noncorrosive solder at minimum heat, solder the contacts to the conductors. See Figure 17. Clean off any excess solder.

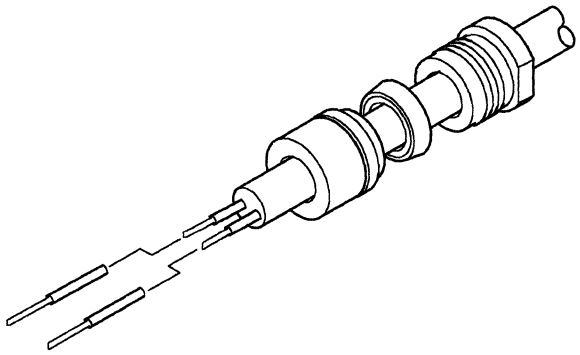


Figure 17. Soldering the Contacts

7. Bend the conductors and the contacts out at right angles to the cable axis (approximately 6.4 millimeters [0.25 inch]) as shown in Figure 18. Then bend the conductors and contacts back parallel to each other.

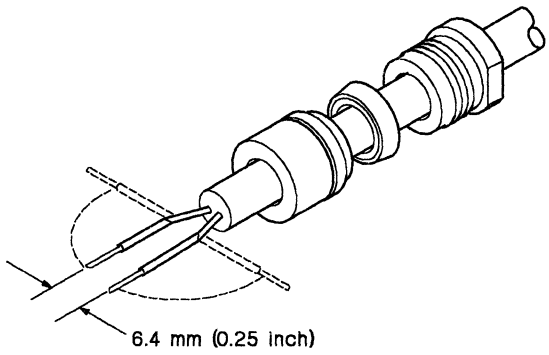


Figure 18. Bending the Conductors

8. Slide the insulator over the contacts and the cable so that the insulator butts against the sleeve. Press all parts together. The contact on the bare copper lead of the cable goes into the insulator hole that has a dot next to it. See Figure 19.

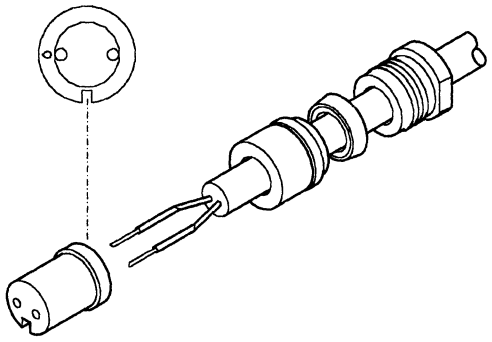


Figure 19. Insulator

9. Insert the assembly into the connector body, aligning the polarizing slot in the insulator with the polarizing pin inside the plug body as shown in Figure 20. Tighten the clamp nut with 5.7 to 6.8 Newton meters (N.m) (50 to 60 inch-lb) torque. Do not allow the cable and plug body to twist as the clamp nut is tightened.

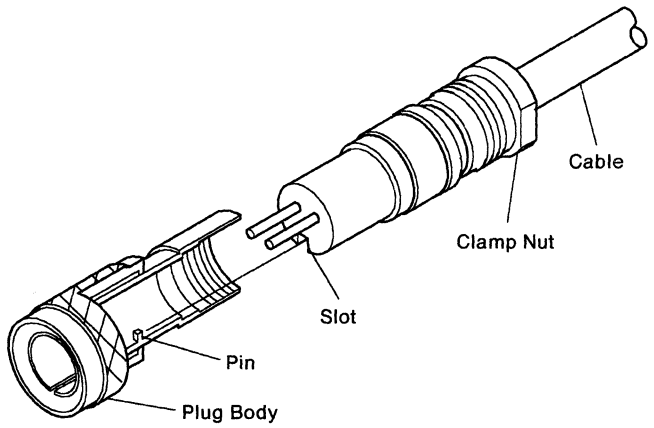


Figure 20. Assembly

10. Check for shorts between the conductors and between each conductor and connector body.

Cable-to-Cable Adapters

Do not splice cables. Instead, connect them with an adapter. This adapter and the attached cable connectors should be covered with shrink or insulated tubing to prevent accidental grounding of the connection.

Figure 21 illustrates the cable adapter for joining twinaxial cables.

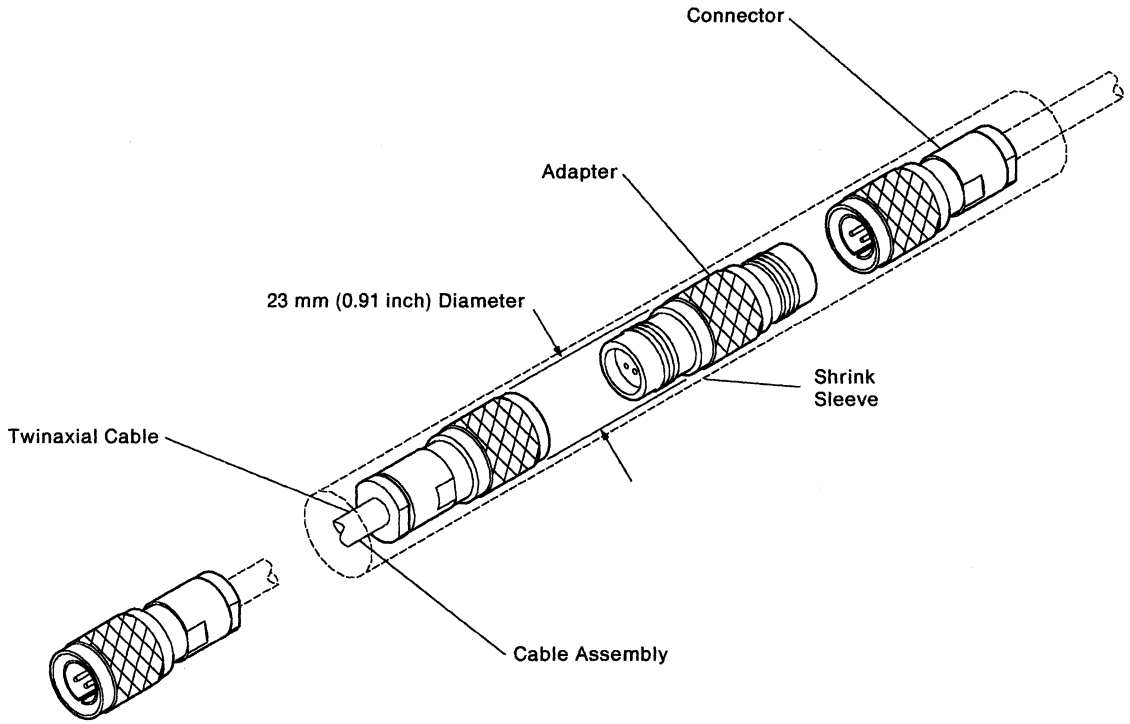


Figure 21. Cable Adapter

Line Continuity and Polarity Tests

Installation of cabling should include completion tests to make sure that there are no faults, no high-resistance connections, and no circuit imbalances. The tests for faults make sure there are:

- No open circuits in individual conductors or shields
- No short circuits between conductors of the same pair
- No grounds on individual conductors, either between a conductor and a shield or between a conductor and a grounded object
- No reversed polarities.

Use the following guidelines for testing line continuity and polarity. Complete these tests for individual cable segments. You can test a complete cable if the station junctions are connected with an adapter or a work station with cable-thru (if the power is off).

Line Continuity: The only tools required for line continuity checks are a VOM and jumpers to connect between the connector pins (signal lines) and the connector body (cable shield). When you make the following checks, the resistance values measured should fall within the indicated ranges for the maximum 1525 meters (5000 feet).

With both ends of the cable open and the cable not plugged into a machine, measure (at either end):

- The resistance between conductors
- The resistance between each conductor and the shield.

Each reading should be greater than 1,000,000 ohms. A reading of less than 1,000,000 ohms means there is a short.

With both lines tied to the shield at the far end, measure (at the nearer end):

- The resistance between conductors (should be less than 110 ohms)
- The resistance between each conductor and the shield (should be less than 70 ohms).

A reading of greater than 110 or 70 ohms, respectively, means there is an open.

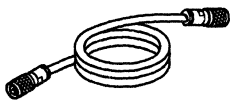
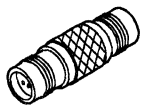
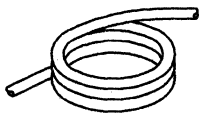
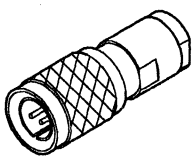
Line Polarity: After testing the line continuity and making any necessary corrections, check the polarity as follows:

With conductor A of the cable plug tied to the shield at the far end, measure (at the nearer end) the resistance between conductor A and the shield. The reading should be less than 70 ohms. A reading of greater than 70 ohms means the lines are crossed.

You must maintain the polarity of the line for each cable segment and for the entire cable run to ensure proper machine operation.

Ordering Information: Table 5 on page 34 provides ordering information for twinaxial cable.

Table 5. Ordering Information for Twinaxial Cable

Part Name	Twinaxial Cable Indoor or Outdoor
Cable Assembly (cable in specified length with connectors at both ends) **Note:** For each cable, determine the distance from the work station to the device to which it will be attached (host, control unit, or another work station); then add 3.6 meters (12 feet), which provides a sufficient length of cable to reach the cable connection on the devices on both ends of the cable.	IBM part number 7362267 (with vinyl covering) IBM part number 7362062 (with Teflon [1] covering) 
Adapter (cable-to-cable)	IBM part number 7362230 Amphenol part number 82-5588 
Bulk Cable (cable in specified length, without connectors)	IBM part number 7362211 (with vinyl covering) IBM part number 7362061 (with Teflon covering) IBM part number 483619 [2] (tubing used with Teflon covered cables) 
Connector (single pronged connector) Connector Kit (two pronged connectors)	IBM part number 7362229 Amphenol part number 82-5589 AMP 22724-1 IBM part number 7362268 (for vinyl-covered cable) IBM part number 7362063 (for Teflon-covered cable) 

[1] Trademark of E.I. du Pont de Nemours & Co., Inc.

[2] Two pieces of this tubing are included with a connector kit for Teflon-covered cables.

Table 6 lists bulk cable specifications for twinaxial cable with vinyl covering.

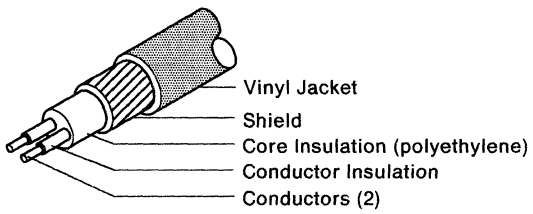


Table 6. Bulk Cable Specifications for Twinaxial Cable with Vinyl Covering		
Conductor	AWG wire size	20
	Stranding	7 x 28
	Material	Copper
	Coating	Tin (1 conductor only)
	Resistance	11 ohms maximum per 305 m (1000 ft)
Insulation	Material	Polyethylene
	Outside diameter	6.1 mm (0.24 in) nominal
Shield	Material	Tinned copper
	Type	Braid, 34 AWG, 7 ends/24 carriers, 9.7 ± 10% picks/inch
	Coverage	95% minimum
	Resistance	3 ohms maximum per 305 m (1000 ft)
Jacket	Material	Vinyl
	Color	Black
	Average single wall thickness	0.76 mm (0.029 in)
	Outside diameter	8.25 mm (0.325 in) nominal
Rating	Dielectric strength	4500 VDC for 3 sec at 28°C (82°F)
Capacitance		53.1 pF/m (16.2 pF/ft) maximum
Impedance, characteristic		111 ± 5% ohms at 0.5 MHz 107 ± 5% ohms at 1 MHz 105 ± 5% ohms at 2 MHz and above
Attenuation @ 100 MHz		4.5 dB/30.5 m (100 ft) maximum at 25°C (77°F) 4.7 dB/30.5 m (100 ft) maximum at 80°C (176°F)
Velocity of propagation		66% ± 5%
Operating environment		-40°C to 80°C (-40°F to 176°F) 10% to 90% relative humidity

Table 7 lists bulk cable specifications for twinaxial cable with Teflon covering.

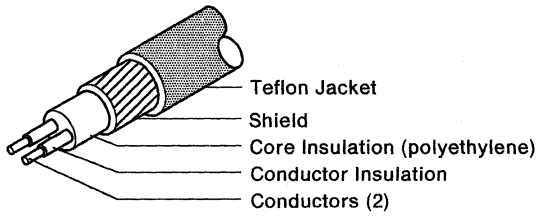


Table 7. Bulk Cable Specifications for Twinaxial Cable with Teflon Covering		
Conductor	AWG wire size	20
	Stranding	7 x 28
	Material	Copper
	Coating	Tin (1 conductor only)
	Resistance	11 ohms maximum per 305 m (1000 ft)
Core Insulation	Material	Teflon
	Outside diameter	6.1 mm (0.24 in) nominal
Shield	Material	Tinned copper
	Type	Braid, 34 AWG, 8 ends/16 carriers, 10.1 ± 10% picks/25.4 mm (in)
	Coverage	95% minimum
	Resistance	3 ohms maximum per 305 m (1000 ft)
Jacket	Material	Teflon
	Color	Translucent (white, natural, or light gray)
	Average single wall thickness	0.63 mm (0.025 in)
	Outside diameter	7.00 mm (0.275 in) nominal
Rating	Dielectric strength	4500 VDC for 3 sec at 28°C (82°F)
Capacitance		53.1 pF/m (16.2 pF/ft) maximum
Impedance, characteristic		111 ± 5% ohms at 0.5 MHz 107 ± 5% ohms at 1 MHz 105 ± 5% ohms at 2 MHz and above
Attenuation @ 100 MHz		4.5 dB/30.5 m (100 ft) maximum at 25°C (77°F) 4.7 dB/30.5 m (100 ft) maximum at 80°C (176°F)
Velocity of propagation		65% - 75%
Operating environment		-40°C to 105°C (-40°F to 221°F) 10% to 90% relative humidity

Twisted-Pair Cabling

As a cost-saving alternative to twinaxial cabling, consider using twisted-pair cabling. Twisted-pair cabling is the same type wiring found in most commercial telephone installations. Installation is limited to wire conforming to IBM Type 3 specifications.

Twisted-pair cabling is susceptible to crosstalk and interference from local transmissions. In addition, this type of cabling does not accurately maintain communication signals over as great a distance as does twinaxial cabling. Maximum allowable cable lengths between the host system and the work stations are shorter than for twinaxial cabling.

Avoid cable runs greater than 305.8 meters (1000 feet). Also, make sure the cables do not run close to power lines or other communication lines, and avoid looping or wrapping the cable around devices.

Twinaxial to Telephone Twisted-Pair Adapters

To use twisted-pair cabling, you must use Twinaxial to Telephone Twisted-Pair Adapters (TTPAs). TTPAs connect directly to the ports on the back of the IBM 5394, as well as to the sockets on the display stations and printers, allowing the use of twisted-pair cabling between. Use the host (beige) TTPA, illustrated in Figure 22, to attach to the control unit. Use the work station (black) TTPA to attach to the work station.

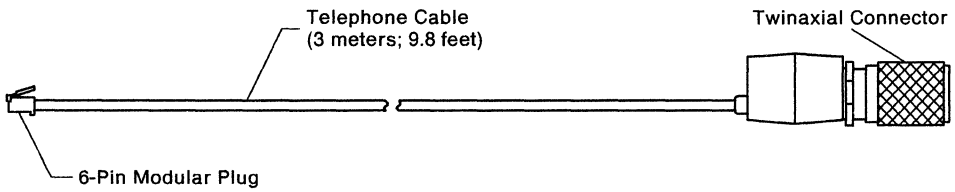


Figure 22. Twinaxial to Telephone Twisted-Pair Adapter (TTPA)

The cable-thru option is not available with twisted-pair cabling. This limits the number of work stations to one per port unless you use an IBM 5299 Terminal Multiconnector.

IBM 5299 Terminal Multiconnector

The IBM 5299 Terminal Multiconnector allows you to attach more than one work station per port when using twisted-pair cabling. With the IBM 5299, illustrated in Figure 23, you can connect up to seven work stations or printers to a single port on the IBM 5394. (The IBM 5299 does not, however, increase the *total* number of work stations that can be attached to the control unit.) For more information about the use of twisted-pair cabling and associated devices, refer to the *IBM 5299 Terminal Multiconnector Planning, Installation, and Problem Analysis Guide*. Figure 24 on page 39 shows a sample configuration using an IBM 5299 Terminal Multiconnector.

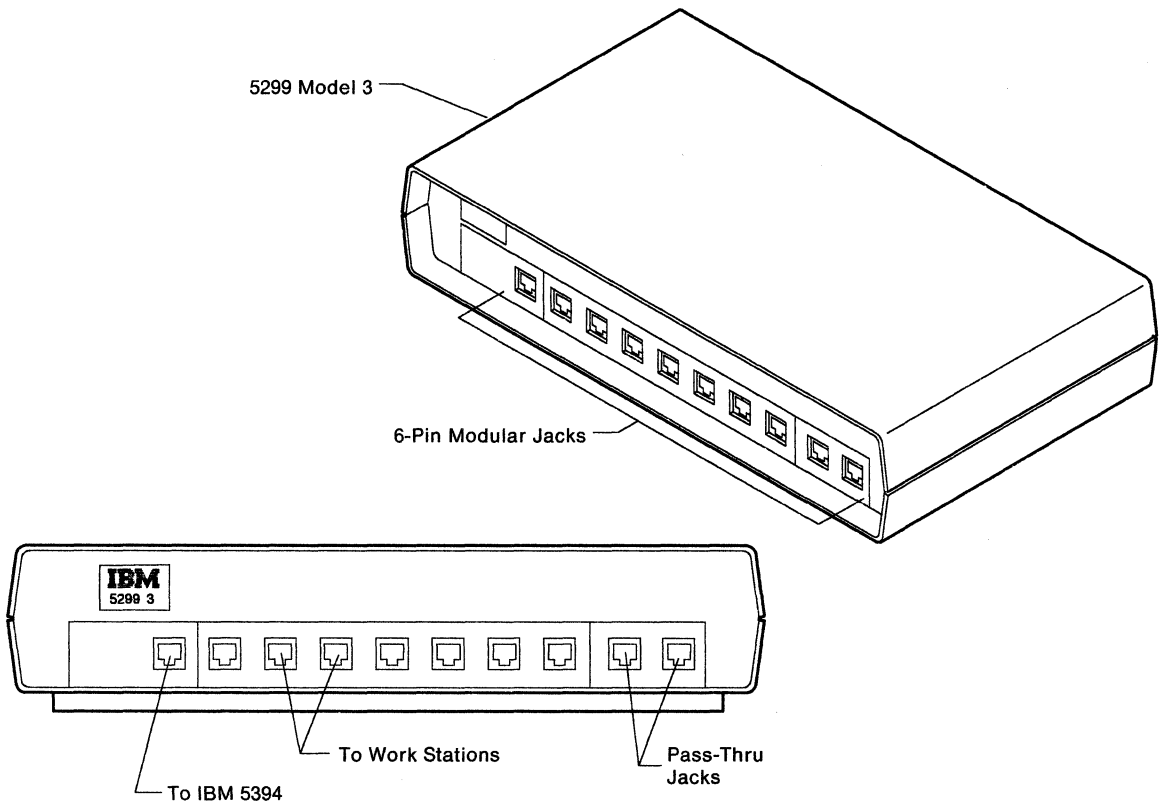


Figure 23. IBM 5299 Terminal Multiconnector

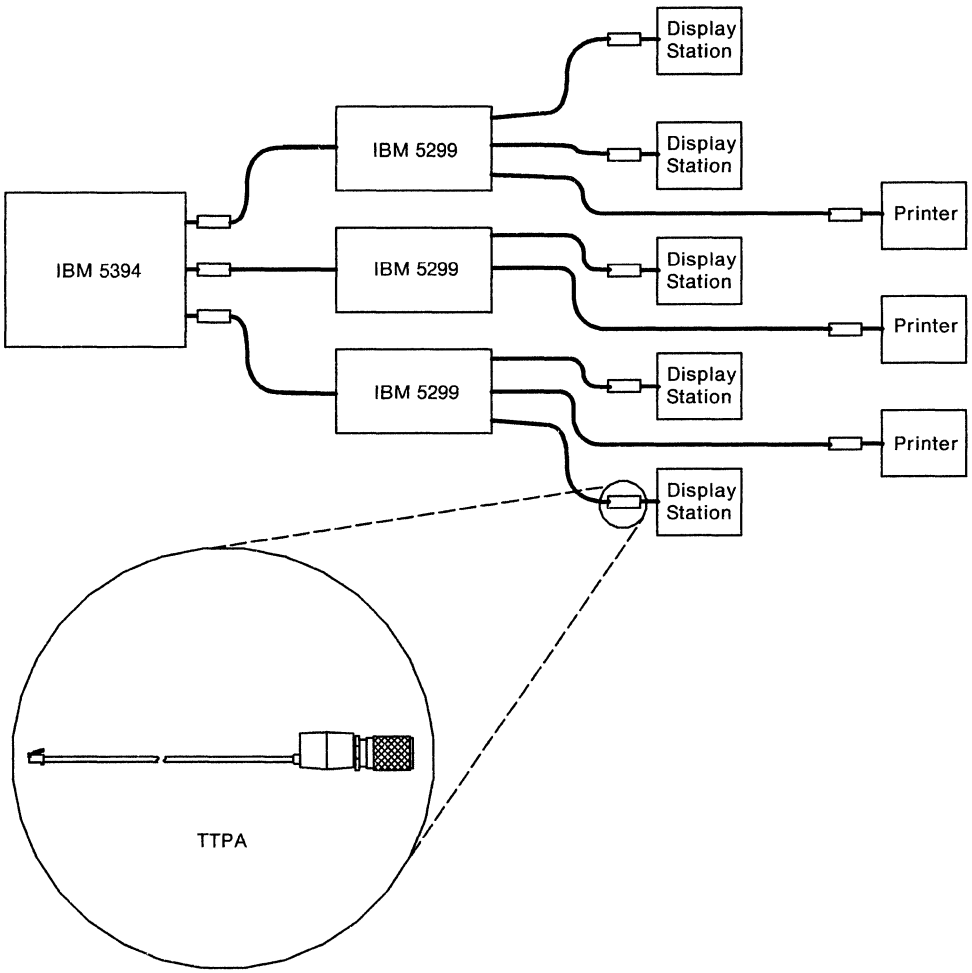


Figure 24. Sample Configuration Using an IBM 5299 Terminal Multiconnector

Preparing the Floor Plan

Your floor plan should be accurate and drawn to scale so you can determine the cable paths and cable lengths. The floor plan will be used by the person who sets up the control unit and attached work stations.

Drawing the Floor Plan

To begin preparing the floor plan, do the following:

1. Find any existing floor plans you may have. If none are available, get some chart paper or plain paper to draw on.
2. Draw the layout of your office or offices from an aerial view. First draw the walls, doors, and windows. Then include the location of the following:
   - Desks, file cabinets, and other office equipment
   - Telephones
   - Power receptacles.

   Identify each room with a name or number. You may also want to identify offices or work areas with individuals' names. See Figure 25 on page 40.

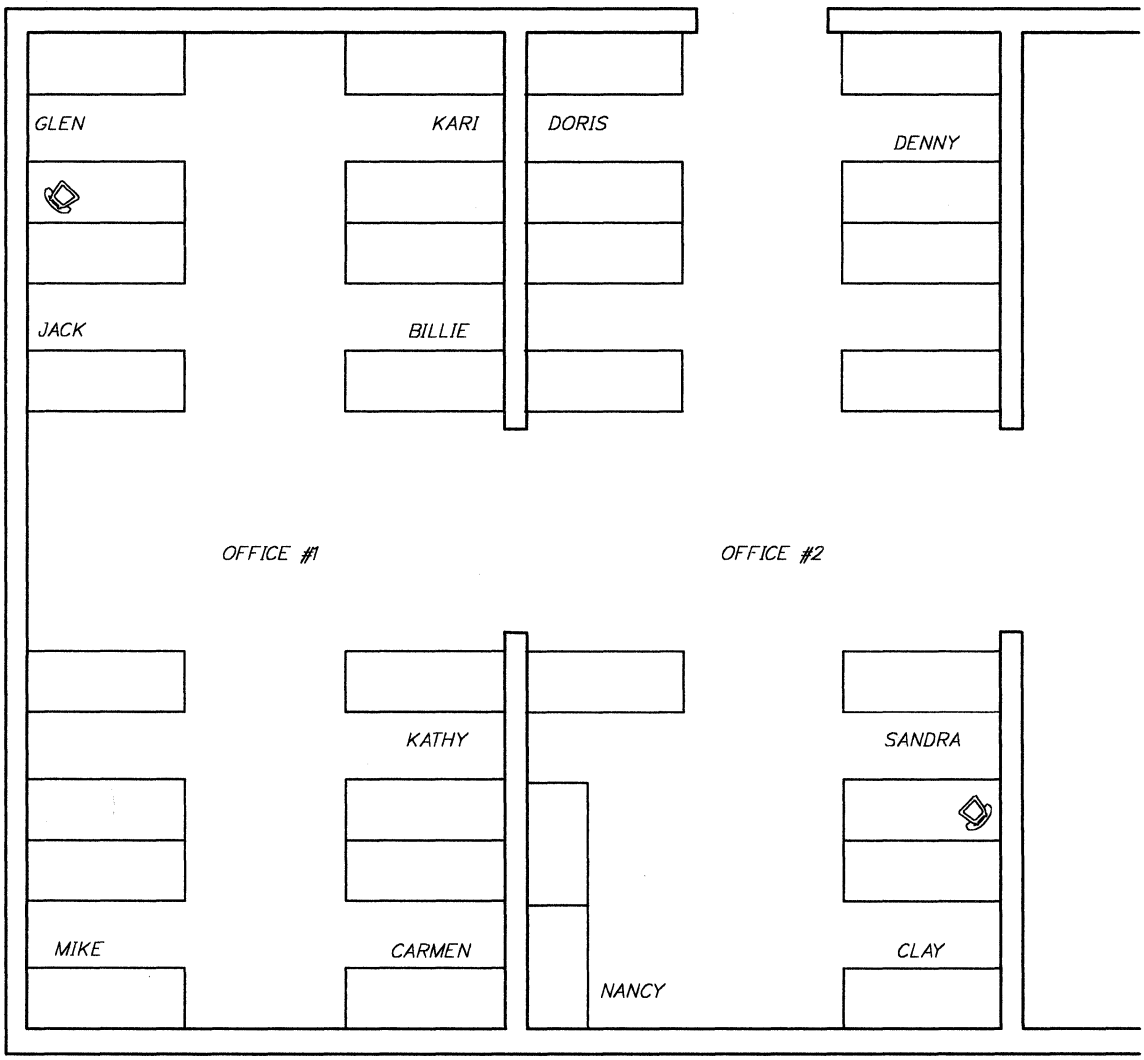


Figure 25. Office Layout

3. Add control units, display stations, and printers. Record the device type of each as shown in Figure 26 on page 41.

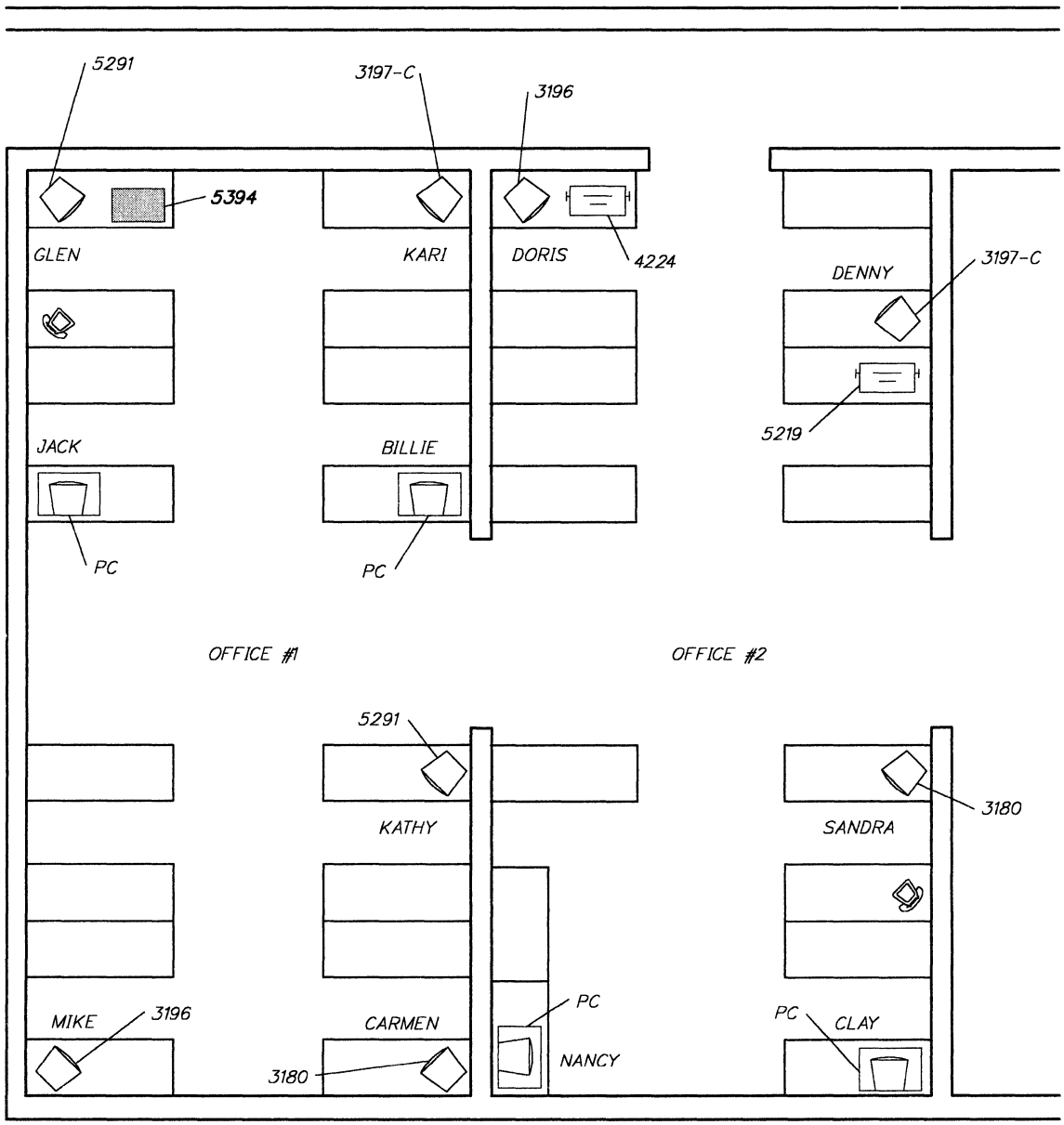


Figure 26. Device Locations

Drawing the Cable Paths

Consider the following before drawing your cable paths:

- Each of the three ports on the IBM 5394 can support up to seven work stations. Remember, no more than four work stations can be attached to a Model 01A or 02A and no more than 16 work stations can be attached to a Model 01B or 02B.
- To have cable-thru capability, work stations must have two sockets for attaching cables. Before drawing a cable path between work stations, make sure that the work stations have two sockets.
- If you are using twinaxial cabling, the last work station on a cable-thru line can be no more than 1525 meters (5000 feet) in cable distance from the IBM 5394.

To draw the cable paths, do the following:

1. Draw the cable path from the first port of the IBM 5394 to the first device (display station, printer, or IBM 5299 Terminal Multiconnector) attached to it. Label this cable "Cable 1."

   Note: If you have an IBM 5299 Terminal Multiconnector, you may need to follow additional cabling rules. Refer to the *IBM 5299 Terminal Multiconnector Model 3 Planning, Setup, and Maintenance Guide* for specific information.

2. Continue drawing cable paths to the remaining devices. Your floor plan should resemble the example shown in Figure 27.

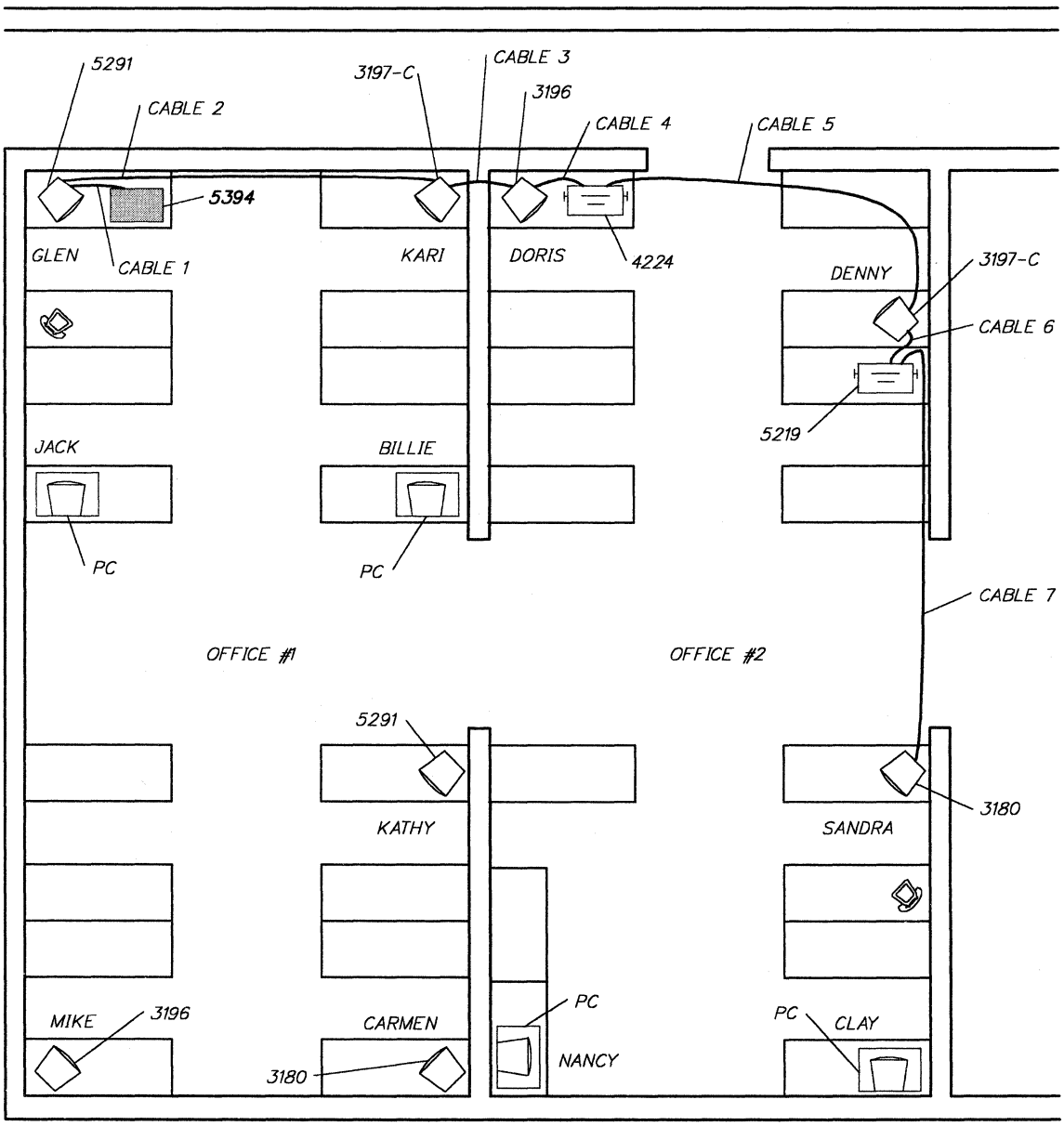


Figure 27. Floor Plan with Cabling

Determining the Cable Lengths

Before you can order work station cables, you must know the required length of each cable.

To determine cable length, do the following:

1. Look at your floor plan to determine the cable path distances. Measure cable length from the connector of one device to the connector of the next. Be sure to consider the intended cable route, including diagonal and vertical cable runs.
2. If you have a raised floor, allow a minimum of 0.6 meter (2 feet) at both ends of a connection for slack in the cable.
3. Add 0.9 meter (3 feet) for the connection to a display station or printer.

   Figure 28 shows the cable path distance between two attached display stations. In this example, the cable that needs to be ordered or assembled is 5.1 meters (17 feet) long.

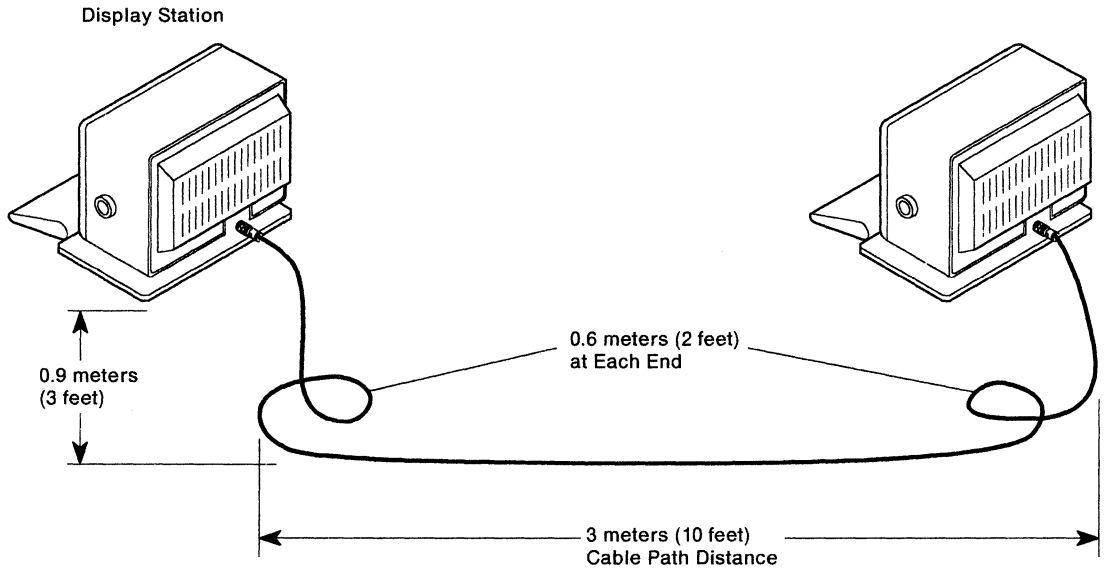


Figure 28. Cable Length for Cable 2

4. Allow enough cable to move the devices for servicing.

5. After you determine the length of each cable, record these lengths in a cabling schedule on the floor plan. See Figure 29.

SCHEDULE OF CABLES-PORT 1	
CABLE 1	4'-0"
CABLE 2	17'-0"
CABLE 3	6'-6"
CABLE 4	3'-0"
CABLE 5	18'-6"
CABLE 6	3'-0"
CABLE 7	20'-6"

Figure 29. Schedule of Cables

6. Review the final layout to make sure that cable lengths do not exceed limitations, that all devices have correct clearances, and that all cable path considerations have been reviewed.
7. Repeat these steps to attach devices to the other ports.

Chapter 4. Planning Your Communication Network

This chapter contains information you need to select system components and network facilities. Use the information in this chapter to:

- Determine the transmission speed your system needs
- Select optional facilities for X.25 and X.21 switched networks
- Select the correct control unit model
- Order your modems or DCEs.

Determining Transmission Speed

You should determine the total transmission speed your system requires before contacting your network representative. Determine the total transmission speed required as follows:

1. Refer to Table 8 on page 46.
2. Determine the transmission speed you need for the total number of display stations. For example, if you have 15 display stations with medium usage on each communication line, you need 9600 bps or higher. If you have more than one control unit on a multipoint communication line, include all the display stations attached to all the control units on that line.
3. Refer to Table 9 on page 46.
4. Determine the transmission speed you need for *each* printer. Add the transmission speeds needed for each printer to find the total transmission speed required for all printers. For example, if you have an IBM 5219 Model D01 (400 bps) and an IBM 5256 Model 3 (1200 bps), you need a transmission speed of 1600 bps.
5. Add the number in step 2 to the number in step 4 to find your total transmission speed.
6. Refer to Table 10 on page 47 for the data transmission speed available for each IBM 5394 physical interface. Make sure that your total transmission speed does not exceed these limits.
7. Use this information to order your modems or DCEs.

Table 8. Transmission Speeds for Display Stations

Number of Display Stations Per Communication Line	Transmission Speed Required		
	Light Usage	Medium Usage	Heavy Usage
1 to 5	2400 bps	2400 or 4800 bps	2400 or 4800 bps
6 to 10	2400 or 4800 bps	4800 or 9600 bps	9600 bps or higher
11 to 15	4800 or 9600 bps	9600 bps or higher	19,200 bps or higher
16 or greater	9600 bps	19,200 bps or higher	48,000 bps or higher

Notes:

1. Depending on your particular applications and usage, the network type and speed shown may or may not offer satisfactory performance.
2. Instead of using a higher speed to achieve satisfactory performance, it may be more cost effective to use two or more smaller multipoint networks at lower speeds.
3. If the number of display stations shown are attached by three or more work station control units, on a multipoint line, the next higher transmission speed may be required.
4. If you plan to attach and use printers on the same network at the same time that the display stations are in maximum usage, the transmission speed may need to be increased to achieve the rated throughput for the printers.

Table 9 (Page 1 of 2). Transmission Speeds for Printers

Type of Printer	Transmission Speed Required	Printer Throughput Rate (Characters per Second or Lines per Minute)
5219 Model D01 5256 Model 1	400 bps	40 characters per second
5219 Model D02	600 bps	60 characters per second
5256 Model 2	800 bps	80 characters per second
5256 Model 3	1200 bps	120 characters per second
4210 Model 1 4214 Model 2 4224 Model 101	2000 bps	200 characters per second
4224 Model 102 4224 Model 1C2 4224 Model 1E2	4000 bps	400 characters per second
4224 Model 1E3	6000 bps	600 characters per second
5224 Model 1	3080 bps	140 lines per minute
5224 Model 2	5280 bps	240 lines per minute
5225 Model 1	6160 bps	280 lines per minute
5225 Model 2	8800 bps	400 lines per minute
4234 Model 2	9020 bps	410 lines per minute
3812 Model 2	10,560 bps	480 lines per minute
5225 Model 3	10,780 bps	490 lines per minute

Table 9 (Page 2 of 2). Transmission Speeds for Printers

Type of Printer	Transmission Speed Required	Printer Throughput Rate (Characters per Second or Lines per Minute)
5225 Model 4	12,320 bps	560 lines per minute
5262 Model 1	13,750 bps	625 lines per minute
4234 Model 012	17,600 bps	800 lines per minute
3816 Model 01S	21,120 bps	960 lines per minute
6262 Model T12	26,400 bps	1200 lines per minute
6262 Model T14	30,800 bps	1400 lines per minute

Notes:

1. If you are using a supported printer that is not listed in this table, refer to the printer throughput rate in the third column to find the required transmission speed.
2. This table assumes 132 characters per line for printers rated in lines per minute.
3. This table does not take into consideration modem and system turnaround time.

Table 10. Available Data Transmission Speeds

Physical Interface	Transmission Speed Available
EIA 232D (CCITT V.24/V.28)	2400 bps to 19,200 bps
CCITT V.35	2400 bps to 56,000 bps
CCITT X.21	2400 bps to 64,000 bps

Selecting Network Facilities

You can order your X.25 or X.21 switched network subscription with support for optional network facilities. The facilities available vary from network to network.

X.25 Network Facilities

The IBM 5394 supports the following X.25 network facilities:

- Closed user group selection (basic format only)
- Flow control negotiation
- Reverse charging
- Priority traffic (DATAPAC network only)
- Throughput class negotiation
- Recognized Private Operating Agencies (RPOA) selection (basic format only).

For Release 2, X.25 performance has been improved by optimizing the request/response unit (RU) size for each packet size. This performance enhancement is more evident when communicating with an IBM System/38 or IBM AS/400 system than with an IBM System/36. For the IBM System/36, 512-byte packets provide maximum performance when transmitting and receiving large blocks of data. For the IBM System/38 and IBM AS/400 system, the use of 512-byte packets does not provide a significant performance advantage over 256-byte packets.

X.21 Switched Network Facilities

The IBM 5394 supports the following X.21 switched network facilities:

- Abbreviated address calling
- Charge transfer
- Closed user group
- Closed user group with outgoing access
- Direct call
- Incoming calls barred
- Outgoing calls barred
- Registration or cancelation of user facilities
- Redirection of call
- Recognized Private Operating Agency (RPOA) selection.

Note: The IBM 5394 does not support the use of Logical Channel 0.

All of these facilities may not be available from your network. You can also use other facilities if they do not require any special support from your IBM 5394. Contact your network supplier to determine what facilities are available.

Selecting Your Control Unit Model

IBM 5394 model selection depends on the communication network, the modem or DCE type, and the number of work stations you plan to attach. Use Table 11 on page 49 to determine the model you need.

Table 11. IBM 5394 Model Selection

If you are using this line type:	This type modem or DCE:	And you plan to attach this many work stations*:	You need this model IBM 5394:
Analog switched or nonswitched	EIA 232D (CCITT V.24/V.28)	4 or fewer	Model 01A
		5 or more	Model 01B
High speed analog or digital	CCITT V.35		See IBM Sales Representative.
X.21 Public Data Network switched or nonswitched	X.21 bis (CCITT V.24/V.28)	4 or fewer	Model 01A
		5 or more	Model 01B
X.21 Public Data Network switched or nonswitched	X.21 bis (CCITT V.35)		See IBM Sales Representative.
X.21 Public Data Network switched or nonswitched	X.21	4 or fewer	Model 02A
		5 or more	Model 02B
X.25 Packet-Switched Public Data Network	X.21 bis (CCITT V.24/V.28)	4 or fewer	Model 01A
		5 or more	Model 01B
X.25 Packet-Switched Public Data Network	X.21 bis (CCITT V.35)		See IBM Sales Representative.
X.25 Packet-Switched Public Data Network	X.21	4 or fewer	Model 02A
		5 or more	Model 02B

* If your host system is an IBM System/36 or System/38, you can attach up to eight work stations. If your host system is an IBM AS/400 system, you can attach up to 16 work stations.

Your IBM sales representative can also help you select the model you need.

Selecting Your Modems or DCEs

If you are communicating with your host system through an analog communication network, the IBM 5394 and the host system are attached to the communication line through modems. If you are using an X.25 or X.21 network, the IBM 5394 and the host system are attached to the network through DCEs.

Your network may provide you with modems or DCEs. If not, your network supplier should give you information for ordering this equipment.

Modems

When ordering a modem, select a transmission speed that is greater than the total transmission speed you determined in "Determining Transmission Speed" on page 45. If you use lower speeds, your remote installation performance may be noticeably decreased. Higher transmission speeds provide greater throughput.

Make sure that the remote site modem is compatible with the host system modem. For example, both modems must transmit at the same speed and use the same mode of transmission.

If you are purchasing a modem, or your network supplier is providing it for you, you must consider the following:

- The transmit and receive clocking must be provided by the modem.
- For modems that operate in half-duplex mode, set the modem for Request To Send (RTS) controlled by the IBM 5394. A constant Ready for Sending (RFS) from the modem is not allowed.

  For modems that operate in duplex mode, set the modem for RTS controlled by the IBM 5394.
- It is recommended that the modem have a carrier controlled by RTS (switched carrier). You can use a modem with continuous carrier only if the IBM 5394 is attached to a point-to-point duplex communication line. (For point-to-point duplex lines, the IBM 5394 has RTS on continuously and continuous carrier is not normally required.)
- The signal ground is connected to the IBM 5394 frame ground. Therefore, the signal ground should not be connected to the frame ground in the modem.
- If local loopback is available on your modem, it must operate as follows:
  - Local loopback must be initiated by EIA 232D interface pin 18.
  - Data Set Ready (DSR) must be on while the local loopback test is running.
- If you have a switched line modem, it must operate as follows:
  - Autoanswer must be controlled by Data Terminal Ready (DTR) or Connect Data Set To Line (CDSTL) only.
  - EIA 232D interface pin 22 (Calling Indicator) must have EIA 232D signal levels.

- If you are using V.25 bis auto-dial (Release 2 only), your modem must support and be set for:
  - V.25 bis addressed call
  - Synchronous bit oriented format for exchanging messages
  - Incoming call indication on EIA 232D interface pin 22 (calling indicator).
- The modem you select may not be approved for direct attachment to your network. Contact your network supplier to determine if you need an external data coupler.

Table 12 provides additional information on some supported IBM modems. For a complete list of supported IBM modems, see "Modems and DCEs" on page 6.

Table 12 (Page 1 of 2). Modem Information

IBM Modem	Line Speed	Interface	Duplex Support	Switched/ Nonswitched	Multipoint Support
3833-1	2400	EIA 232D/V.24	Half/full	Nonswitched	Yes
3834-1	4800	EIA 232D/V.24	Half/full	Nonswitched	Yes
3863-1	2400	EIA 232D/V.24	Half/full	Nonswitched	Yes
3863-2	2400	EIA 232D/V.24	Half	Switched	No
3864-1	4800	EIA 232D/V.24	Half/full	Nonswitched	Yes
3864-2	4800	EIA 232D/V.24	Half	Switched	No
3865-1	9600	EIA 232D/V.24	Half/full	Nonswitched	No
3865-2	9600	EIA 232D/V.24	Half/full	Nonswitched	Yes
3868-1	2400	EIA 232D/V.24	Half/full	Nonswitched	Yes
3868-2	4800	EIA 232D/V.24	Half/full	Nonswitched	Yes
3868-3	9600	EIA 232D/V.24	Half/full	Nonswitched	No
3868-4	9600	EIA 232D/V.24	Half/full	Nonswitched	Yes
3872-1	2400	EIA 232D/V.24	Half/full	Both	Yes
3874	4800	EIA 232D/V.24	Half/full	Both	Yes
5811-10,18	2400-19,200	EIA 232D/V.24	Half/full	Nonswitched	Yes
5811-20,28	2400-19,200	EIA 232D/V.24	Half/full	Nonswitched	Yes
5812-10,18	2400-19,200	EIA 232D/V.24	Half/full	Nonswitched	Yes
5821-10 (DSU/CSU)	2400-19,200 56,000	EIA 232D/V.24 and V.35	Full	Nonswitched	Yes
5822-10 (DSU/CSU)	2400-19,200 56,000	EIA 232D/V.24 and V.35	Full	Nonswitched	Yes
5842-1	2400	EIA 232D/V.24	Full	Switched	No
5853-1	2400	EIA 232D/V.24/ V.25 bis	Full	Switched	No
5865-1,2,3	9600	EIA 232D/V.24	Half/full	Nonswitched	Yes

Table 12 (Page 2 of 2). Modem Information

IBM Modem	Line Speed	Interface	Duplex Support	Switched/ Nonswitched	Multipoint Support
5866-1,2,3	14,400	EIA 232D/V.24	Half/full	Nonswitched	Yes
5868-51,52	9600	EIA 232D/V.24	Half/full	Nonswitched	Yes
5868-61,62	14,400	EIA 232D/V.24	Half/full	Nonswitched	Yes
7861	4800-19,200	EIA 232D/V.24	Half/full	Nonswitched	Yes
7868	4800-19,200	EIA 232D/V.24	Half/full	Nonswitched	Yes

DCEs

If your IBM 5394 is a Model 01, request the following DCE options from your network supplier:

- The signal ground is connected to the IBM 5394 frame ground. Therefore, the signal ground should not be connected to the frame ground in the DCE.
- If local loopback is available on your DCE, it must operate as follows:
  - Local loopback must be initiated by EIA 232D interface pin 18
  - DSR must be on while the local loopback test is running.

If your IBM 5394 is a Model 02, request the following DCE options from your network supplier:

- The signal ground is connected to the IBM 5394 frame ground. Therefore, the signal ground should not be connected to the frame ground in the DCE.
- If an option is available that causes the transmitted data to be looped back on the receive data lines, and the selection is controlled by a DCE front panel switch, select that option.

Chapter 5. Preparing the Communication Worksheet

This chapter provides a step-by-step guide for completing the Communication Worksheet.

The worksheet you complete depends on the physical interface and line type your communication network uses. Refer to Table 13 to determine which Communication Worksheet you need. Before you begin, make a copy of the appropriate blank worksheet in Appendix, "Worksheets" on page 65.

Table 13. Communication Worksheet

If you have this interface:	**And this line type:**	**Complete this worksheet:**
EIA 232D (CCITT V.24/V.28) or CCITT V.35	Analog Switched or Nonswitched	SDLC Communication Worksheet — Go to page 54.
CCITT X.21 bis (V.24/V.28 or V.35)	X.21 Public Data Network Switched or Nonswitched	SDLC Communication Worksheet — Go to page 54.
CCITT X.21	X.21 Public Data Network Non-switched	SDLC Communication Worksheet — Go to page 54.
CCITT X.21	X.21 Public Data Network Switched	X.21 Switched Communication Worksheet — Go to page 61.
CCITT X.21 bis (V.24/V.28 or V.35)	X.25 Packet-Switched Public Data Network	X.25 Communication Worksheet — Go to page 56.
CCITT X.21	X.25 Packet-Switched Public Data Network	X.25 Communication Worksheet — Go to page 56.

SDLC Communication Worksheet

Complete this worksheet for SDLC communication.

SDLC Communication Worksheet Example

See "Instructions for Completing the SDLC Communication Worksheet" on page 55.

IBM 5394 SDLC Communication Worksheet	
A Host system type and location	_____
B IBM 5394 model number	_____
C IBM 5394 location	_____
D IBM 5394 SDLC station address	_____
E Modem or DCE model number	_____
F Modem configuration information (Fill in the blank or circle the appropriate choice in each column):	
F1 Modem or DCE type	_____
F2 Half-duplex	Duplex
F3 Multipoint (or fan-in/out modem)	Point-to-point
F4 NRZI	NRZ
F5 DTR	CDSTL
F6 Leading pad not required	Leading pad
F7 Local loopback not supported	Local loopback
G V.25 bis auto-dial option information (Complete G1 and G2 if you selected auto-dial switched in F1 .)	
G1 V.25 bis timeout (in seconds)	_____
G2 V.25 bis call information saved to diskette	Call information not saved

Send the completed worksheet to the remote location to ensure correct installation of the IBM 5394 Remote Control Unit.

Instructions for Completing the SDLC Communication Worksheet

A Fill in the name and location of your IBM host system. The IBM 5394 is supported by:

- IBM AS/400 system
- IBM System/36
- IBM System/38.

If you have a switched line, your IBM 5394 can communicate with more than one host system. Fill out a separate worksheet for each host system. Make sure the information in **F** is the same on all worksheets.

B Enter the model number of your IBM 5394. If you do not know your model number, see Table 11 on page 49.

C Fill in the location of the IBM 5394.

D Fill in the station address of your IBM 5394. Valid entries are X'01' to X'FE'. This must be the same as the address used by the host system to identify this control unit.

E Fill in the modem or DCE model number.

F Answer the following questions. Fill in the blank or circle the appropriate choice in lines **F1** through **F7** on your worksheet.

If you are purchasing a modem, refer to your modem documentation or contact your modem supplier to obtain the necessary information.

If your network supplier is providing the modem or DCE, contact your network supplier.

Note: If your IBM 5394 is a Model 02, you only need to circle the appropriate choice in **F3** on your worksheet.

F1 Fill in the modem or DCE type. Choose one of the following:

- Nonswitched
- Manual-dial switched
- V.25 bis auto-dial switched.

V.25 bis is available for Release 2 only.

F2 Is your modem half-duplex or duplex?

F3 Is your communication line multipoint or point-to-point?

Note: If you are using a modem that provides DTE interface fan-in/out, such as the IBM 5865 Model 3, and you are using a point-to-point line to attach several IBM 5394 control units to your host system, circle multipoint.

F4 Does your modem documentation recommend nonreturn to zero inverted (NRZI) or nonreturn to zero (NRZ) encoding? This must match the configuration information for NRZI/NRZ at the host site. If no recommendation is made, circle NRZI.

Note: If your IBM 5394 Model 01 is attached to an X.21 network, circle NRZ.

F5 Does your modem use interface pin 20 for Data Terminal Ready (DTR) or Connect Data Set to Line (CDSTL)?

Note: In the U.S.A. and Canada, circle DTR.

F6 Does your modem require a leading pad prior to the SDLC flag? This must match the configuration at the host site.

Note: If your IBM 5394 Model 01 is attached to an X.21 network, circle leading pad not required.

F7 Does your modem support local loopback initiated by interface pin 18?

G Complete this section if you selected auto-dial switched (V.25 bis) in **F1**. V.25 bis is available for Release 2 only.

G1 Fill in the maximum number of seconds allowed to establish a call connection when using V.25 bis. Valid entries are X'01' to X'FF'. The default value is 60 seconds (X'3C').

G2 If your modem supports V.25 bis, should the call information (phone number) be saved on the IBM 5394 system diskette and redisplayed each time a V.25 bis auto-dial call is attempted? (You may choose not to save the phone number for security reasons.)

The SDLC Communication Worksheet is complete. Send the completed worksheet to the remote site to ensure correct installation of the IBM 5394.

X.25 Communication Worksheet

Complete this worksheet for X.25 communication.

X.25 Communication Worksheet Example

See "Instructions for Completing the X.25 Communication Worksheet" on page 58.

IBM 5394 X.25 Communication Worksheet

A Host system type and location _____

B IBM 5394 model number _____

C IBM 5394 location _____

D IBM 5394 station address _____

E X.25 subscription data:

E1 Packet level sequence numbering (Modulo 8 or Modulo 128)

E2 Packet window size _____

E3 Link window size _____

F X.25 configuration data:

F1 Packet size (64 bytes, 128 bytes, 256 bytes, or 512 bytes)

F2 Circuit type _____

F3 Flow control negotiation allowed (yes or no)

F4 Manual options allowed (yes or no)

F5 Local loopback supported (yes or no)

G X.25 software data:

G1 Reverse charging accepted (yes or no)

G2 Logical link control (PSH, QLLC, or ELLC)

G3 Special network attachment (yes or no)

G4 Link initialization control (network only *or* network and control unit)

G5 Network subscription (1980 or 1984)

G6 Diagnostics code (1984 SNA, 1984 ISO, or 1980 SNA)

H Retry parameters:

H1 Number of retries _____

H2 Seconds between retries _____

Send the completed worksheet to the remote site to ensure correct installation of the IBM 5394 Remote Control Unit.

Instructions for Completing the X.25 Communication Worksheet

A Fill in the name and location of your IBM host system. The IBM 5394 is supported by:

- IBM AS/400 system
- IBM System/36
- IBM System/38.

If you have a switched virtual circuit (SVC) or multiple permanent virtual circuits (PVCs), you can attach the IBM 5394 to more than one host system. Fill out a separate worksheet for each host system. Make sure the information in **E**, **F**, **G**, and **H** is the same on all worksheets.

B Enter the model number of your IBM 5394. If you do not know your model number, see Table 11 on page 49.

C Fill in the location of the IBM 5394.

D Fill in the station address of your IBM 5394. Valid entries are X'01' to X'FE'. This must be the same as the address used by the host to identify this control unit.

E This information depends on your X.25 network subscription. Contact your network supplier for this information.

E1 Circle the packet sequence numbering scheme your network uses. The IBM 5394 supports modulo 8 and modulo 128.

E2 Enter the packet window size. If you selected modulo 8 in **E1**, valid entries are X'2' to X'7'. If you selected modulo 128, valid entries are X'2' to X'F'.

E3 Enter the link window size. Valid entries are X'1' to X'7'.

F Select the appropriate value for lines **F1** through **F5**.

F1 Circle one of the following packet sizes:

- 64 bytes
- 128 bytes
- 256 bytes
- 512 bytes (Release 2 only).

Consider the following when selecting this value:

- If your IBM 5394 uses only one virtual circuit, enter the number for the packet size of that virtual circuit.
- If your IBM 5394 uses multiple virtual circuits, enter the number for the packet size used most often.

F2 Enter the circuit type for your subscription. Valid entries are:

- Single PVC
- Single SVC (answer only)
- Single SVC (call allowed)
- Multiple SVCs
- Multiple PVCs.

F3 Does your subscription include the flow control negotiation facility?

F4 Circle yes if you would like to allow the operator to enter all keyboard entered (manual) options when opening a PVC, placing a call on an SVC, or answering a call on an SVC. Circle no if the network address, the logical channel ID, and the password are the only options the operator needs to enter.

Notes:

1. If F2 is set for a single PVC, and F4 is set for manual options not allowed, the IBM 5394 automatically opens the PVC when the power switch is set to on (|).
2. For Release 2 only: If F2 is set for a single SVC (answer only) and F4 is set for manual options not allowed, no operator action is required to establish communication following power-on or to reestablish communication following successful error recovery. The telephone number and password of the incoming call are not checked, and the logical channel of the incoming call is used.

   If F4 is set for manual options allowed, the entered options are saved and used to reestablish communication without operator action following network link error recovery.
3. If the packet size or window size options are used on an SVC, you must subscribe to the flow control negotiation facility (F3).

F5 Does your DCE support local loopback initiated by interface pin 18?

G This information specifies some of the software selectable X.25 information. For a complete discussion of IBM's implementation of X.25 recommendations, refer to *The X.25 Interface for Attaching SNA Nodes to Packet-Switched Data Networks General Information Manual.*

Circle the correct choice for each item.

G1 Do you subscribe to the reverse charging facility?

G2 Which logical link control (LLC) facility will you be using? Valid entries are:

- Physical services headers (PSH)
- Qualified logical link control (QLLC)
- Enhanced logical link control (ELLC).

Note: This must be the same as the LLC used by your host system.

G3 Will the IBM 5394 be attached to a Telenet[3]-type network? Telenet-type networks will expect the IBM 5394 to respond with UNNUMBERED ACKNOWLEDGMENT (UA) when polled with the DISCONNECT (DISC) command before sending Set Asynchronous Balanced mode (SABM). If the IBM 5394 will not be attached to a Telenet-type network, it will respond with Disconnect mode (DM) to a DISC received before sending SABM.

G4 Will the IBM 5394 be attached to a network that requires that the link initialization be done by the network only, or can link initialization be done by either the control unit or the network?

G5 Which CCITT X.25 Recommendation must the IBM 5394 support? Valid entries are a 1980 subscription or a 1984 subscription.

G6 Which format of diagnostics codes will be used by the IBM 5394? Valid entries are:

- 1984 Systems Network Architecture (SNA) format diagnostics codes.
- 1984 International Standards Organization (ISO) format diagnostics codes.
- 1980 SNA format diagnostics codes.

Notes:

1. If **G5** is set for 1980 subscription, **G6** must be set for 1980 SNA format diagnostic codes.
2. The diagnostic code format of the IBM 5394 must match the host site.

H Enter the following information used by the IBM 5394 for retries:

H1 Enter the number (in hexadecimal) of retries your DCE should make to reestablish a virtual circuit. Valid entries are X'00' to X'FF'. The default number is 10 (X'0A'). Your network supplier may impose restrictions on this value to limit network congestion.

H2 Enter the time (in seconds) between retry attempts. Valid entries are X'01' to X'3C'. The default is 3 seconds (X'03'). This value may also be restricted. Contact your network supplier for restrictions.

The X.25 Communication Worksheet is complete. Send the completed worksheet to the remote site to ensure correct installation of the IBM 5394.

---

[3] Telenet, a trademark of the Telenet Communication Corporation.

X.21 Switched Communication Worksheet

Complete this worksheet for X.21 switched communication.

X.21 Switched Communication Worksheet Example

See "Instructions for Completing the X.21 Switched Communication Worksheet" on page 62.

IBM 5394 X.21 Switched Communication Worksheet

A Host system type and location _____

B IBM 5394 model number _____

C IBM 5394 location _____

D IBM 5394 SDLC station address _____

E X.21 network ID# _____

F Short Hold mode (SHM) retries:

F1 Number of retries _____

F2 Delay between retries _____

F3 Direct call support (yes or no)

G Retry of optional call progress signals:

_____,_____,_____,_____,

_____,_____,_____,_____.

Send the completed worksheet to the remote site to ensure correct installation of the IBM 5394 Remote Control Unit.

Instructions for Completing the X.21 Switched Communication Worksheet

A Fill in the name and location of your IBM host system. The IBM 5394 is supported by:

- IBM AS/400 system
- IBM System/36
- IBM System/38.

You can attach the IBM 5394 to more than one host system. Fill out a separate worksheet for each host system. Make sure the information in **F** and **G** is the same on all worksheets.

B This worksheet is valid only for the IBM 5394 Model 02. If you do not have a Model 02, see Table 13 on page 53 to determine the correct communication worksheet for your IBM 5394. If you do not know your model number, see Table 11 on page 49.

C Fill in the location of the IBM 5394.

D Once the switched circuit is established, the control unit uses SDLC for data transmission. Fill in the SDLC station address of your IBM 5394. Valid entries are X'01' to X'FE'. This must be the same as the address used by the host to identify this control unit.

E Fill in the X.21 network ID # (IBM 5394 telephone number). Your network supplier will provide you with this number. It can be from 1 to 15 decimal digits.

F Enter the following information used by the IBM 5394 to do Short Hold mode (SHM) retries. Do not enter information if SHM is not used.

F1 Enter the number of retries that you want your IBM 5394 to make to reestablish the link to the host during SHM operations. Valid entries are X'00' to X'FF'. The default is five (X'05'). Your network supplier may impose restrictions on this value.

F2 Enter the number of seconds between retry attempts during SHM. Valid entries are X'1' to X'F'. This value may also be restricted by your network supplier to alleviate network congestion. The default is 6 seconds (X'06'). To limit network congestion, make sure that the time between retries on your IBM 5394 is greater than the time between retries on your host system.

F3 Circle yes if the IBM 5394 will use the host system XID dial digits to reestablish the link. Circle no if the IBM 5394 will not use dial digits to initiate SHM reconnection.

G During SHM link reestablishment, the IBM 5394 will automatically retry all 2x and 6x call progress signals (CPS) received from the network using the parameters specified in **F**. The IBM 5394 can retry other CPSs. You can specify retry of up to eight optional CPSs. Table 14 shows the CPSs that can be optionally retried. Since 2x and 6x codes are automatically retried, they are not included in this table.

Check your national requirements before you enter these codes.

Enter up to eight codes in space **G**.

Table 14. Optional Call Progress Signals

Code	Significance
01	Terminal called
02	Redirected call
03	Connect when free
04	Private network reached
05	Public network reached
41	Access barred
42	Changed number
43	Not obtainable
44	Out of order
45	Controlled not ready
46	Uncontrolled not ready
47	DCE power off
48	Invalid facility request
49	Network fault in local loop
51	Call information service
52	Incompatible user class of service
71	Long-term network congestion
72	RPOA out of order

The X.21 Switched Communication Worksheet is complete. Send the completed worksheet to the remote site to ensure correct installation of the IBM 5394.

Appendix. Worksheets

This appendix contains the following blank Communication Worksheets:

- SDLC Communication Worksheet
- X.25 Communication Worksheet
- X.21 Switched Communication Worksheet.

For information on completing these worksheets, see Chapter 5, "Preparing the Communication Worksheet" on page 53.

IBM 5394 SDLC Communication Worksheet

A	Host system type and location	_____
B	IBM 5394 model number	_____
C	IBM 5394 location	_____
D	IBM 5394 SDLC station address	_____
E	Modem or DCE model number	_____
F	Modem configuration information (Fill in the blank or circle the appropriate choice in each column):	
F1	Modem or DCE type	_____
F2	Half-duplex	Duplex
F3	Multipoint (or fan-in/out modem)	Point-to-point
F4	NRZI	NRZ
F5	DTR	CDSTL
F6	Leading pad not required	Leading pad
F7	Local loopback not supported	Local loopback
G	V.25 bis auto-dial option information (Complete G1 and G2 if you selected auto-dial switched in F1.)	
G1	V.25 bis timeout (in seconds)	_____
G2	V.25 bis call information saved to diskette	Call information not saved

Send the completed worksheet to the remote location to ensure correct installation of the IBM 5394 Remote Control Unit.

IBM 5394 X.25 Communication Worksheet

A Host system type and location _____

B IBM 5394 model number _____

C IBM 5394 location _____

D IBM 5394 station address _____

E X.25 subscription data:

E1 Packet level sequence numbering (Modulo 8 or Modulo 128)

E2 Packet window size _____

E3 Link window size _____

F X.25 configuration data:

F1 Packet size (64 bytes, 128 bytes, 256 bytes, or 512 bytes)

F2 Circuit type _____

F3 Flow control negotiation allowed (yes or no)

F4 Manual options allowed (yes or no)

F5 Local loopback supported (yes or no)

G X.25 software data:

G1 Reverse charging accepted (yes or no)

G2 Logical link control (PSH, QLLC, or ELLC)

G3 Special network attachment (yes or no)

G4 Link initialization control (network only *or* network and control unit)

G5 Network subscription (1980 or 1984)

G6 Diagnostics code (1984 SNA, 1984 ISO, or 1980 SNA)

H Retry parameters:

H1 Number of retries _____

H2 Seconds between retries _____

Send the completed worksheet to the remote site to ensure correct installation of the IBM 5394 Remote Control Unit.

IBM 5394 X.21 Switched Communication Worksheet

A Host system type and location _____

B IBM 5394 model number _____

C IBM 5394 location _____

D IBM 5394 SDLC station address _____

E X.21 network ID# _____

F Short Hold mode (SHM) retries:

F1 Number of retries _____

F2 Delay between retries _____

F3 Direct call support (yes or no)

G Retry of optional call progress signals:

_____,_____,_____,_____,

_____,_____,_____,_____.

Send the completed worksheet to the remote site to ensure correct installation of the IBM 5394 Remote Control Unit.

List of Acronyms and Abbreviations

amps	amperes
ANSI	American National Standards Institute
ASCII	American National Standard Code for Information Exchange
AWG	American Wire Gage
bps	Bits per second
CCITT	International Telegraph and Telephone Consultative Committee
CDSTL	Connect data set to line
CPS	Call progress signal
CSU	Customer setup or Channel Service Unit
DCE	Data circuit-terminating equipment
DDS	Dataphone Digital Service
DM	Disconnect mode
DSR	Data set ready
DSU	Data Service Unit
DTE	Data terminal equipment
DTR	Data terminal ready
EBCDIC	Extended binary-coded decimal interchange code
EIA	Electronics Industries Association
ELLC	Enhanced logical link control
ISO	International Standards Organization
kVA	Kilovolt-ampere
LLC	Logical link control
MGN	Multiground neutral
NEC	National Electric Code
NEMA	National Electrical Manufacturer's Association
NRZ	Nonreturn to zero
NRZI	Nonreturn to zero inverted
PSH	Physical services header
PSN	Public switched network
PTT	Post Telegraph Telephone
PVC	Permanent virtual circuit
QLLC	Qualified logical link control
RF	Radio frequency
RFS	Ready for sending
RPOA	Recognize private operating agency
RTS	Request to send
SABM	Set asynchronous balanced mode
SDLC	Synchronous data link control
SHM	Short hold mode
SNA	Systems network architecture
SNBU	Switched network backup
SVC	Switched virtual circuit
TTPA	Twinaxial to telephone twisted-pair adapter
WT	World Trade
VDC	Volts direct current
VOM	Volt-ohm meter
XMIT	Transmit

Glossary

analog network. A type of communication network that carries analog signals.

cable-to-cable adapter. A device used to connect two cable ends together. An adapter is used instead of a splice.

cabling system. A system of communication wiring installed in a building to connect computers and communication equipment.

cable-thru. A method of cabling that allows multiple work stations to be attached to a single cable path.

call progress signal(cps). A call control signal transmitted from the DCE to the calling DTE to indicate the progress of the establishment of a call, the reason why the call could not be established, or any other network condition.

circuit type. The type of circuit that connects two remote locations. Analog circuits and X.21 circuits can be point-to-point switched, point-to-point nonswitched, or multipoint nonswitched. X.25 circuit types can be either permanent virtual circuit (PVC) or switched virtual circuit.

closed user group. A group of locations that can communicate among themselves, but cannot call, or receive calls from, any location outside the group. This facility allows a limited number of users to communicate with either the control unit or the host system, and thus increases security. You can usually obtain this service at a nominal fee, or it may be provided as a basic service with your network subscription. On some networks, you can specify different closed user groups for different applications, if your subscription includes more than one group and a closed user group index is included in the connection setup instructions. Variations that allow calls to or from a device outside the group may be available depending on the network.

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 cable used to attach the IBM 5394 to a modem or DCE.

communication network. The equipment and software required to transmit data signals between a host system and a remote site.

configuration. The arrangement of a computer system or network as defined by the nature, number, and chief characteristics of its functional units. See system configuration.

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.

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.

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 communication system. A configuration of data processing devices, software, and a communication network connected for information interchange.

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 management. The process of controlling the acquisition, analysis, storage, retrieval, and distribution of 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 terminal equipment (DTE). A term for any machine, such as the IBM 5394 or its host system, that is connected to a network.

digital data network. A communication network that uses digital transmission (that is, information is transmitted in digital form as a serial stream of pulses).

direct attachment. Attachment of work stations to a host system without intermediate control units.

direct call. An optional X.21 network facility that permits calling without requiring the operator to provide address selection signals.

display screen. The presentation surface of a cathode ray tube used to display graphics or alphanumeric information.

display station. An input/output device containing a display screen and an attached keyboard.

duplex. A method of data transmission in which the data can be transmitted in both directions simultaneously. (Also known as full duplex.)

electrostatic discharge. An undesirable discharge of static electricity that can damage equipment and degrade electrical circuitry.

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.

enhanced logical link control. A type of logical link control used in X.25 communication.

external modem. A modem that is not integrated into the DTE.

fan-in/out modem. A modem that uses a point-to-point line to attach multiple control units to the host system. Each control unit operates as if it were part of a multipoint line and processes only the data addressed to it.

field. One or more consecutive positions on the display screen set up for a specific type of data.

flow control negotiation. The ability to alter the packet size and packet window size. These may be changed from call to call if the network subscription allows flow control negotiation.

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.

hexadecimal. A number system with base 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.

IBM Cabling System. A permanently installed wiring system that eliminates the need to rewire when work stations are moved from one location to another within an office complex. It allows transmission of data at very high speeds.

International Telegraph and Telephone Consultative Committee. An organization of common carriers and other interested parties who meet periodically to define standards that they will mutually adopt.

interface. A shared boundary between two functional units, defined by functional characteristics, common physical interconnections, and signal characteristics.

interface adapter. A device that connects two machines having connectors with different physical characteristics.

leading pad. A byte inserted into the data stream to synchronize the modem.

leased line. See *nonswitched line*.

line conditioning. The process of adding certain devices to an analog line to improve the quality of the data signal.

link window size. The maximum number of I-frames that can be sent from the control unit without receiving an acknowledgment from the network. Valid values are 1 through 7.

local loopback. A test procedure that verifies the operation of the local modem.

logical channel. In packet mode operation, a sending channel and a receiving channel that together are used to send and receive data over a data link at the same time. Several logical channels can be established on the same data link by interleaving the transmission of packets.

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.

manual options. Options that allow the operator to change call parameters from one call to the next.

migration. The process of changing to a new operating environment, usually to a new release or version of a system.

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.

modulo. In a sequence of numbers, the modulo number indicates the point at which the sequence returns to 0. For example, modulo 8 = 012345670123...

multipoint line. A data link that connects three or more data stations. A multipoint line is always nonswitched.

nonreturn to zero. A data encoding method.

nonreturn to zero inverted. A data encoding method.

nonswitched line. A communication line that is permanently connected, always available, and does not require dialing to establish communication.

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 size. The maximum number of bytes allowed in the user data area of a data packet. A default value, usually 128 bytes, is assigned at subscription time. On some networks, the packet size can be altered from call to call.

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.

packet window size. Maximum number of packets that can be sent without receiving an acknowledgment.

permanent virtual circuit (PVC). The packet-switched equivalent of a leased line. The IBM 5394 and its host system appear to the user to be permanently connected.

physical services header(PSH). A type of logical link control used in X.25 communication.

point-to-point line. A data link that interconnects two DTEs. It can be either switched or nonswitched.

port. The hardware coupling used to attach 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, and/or data).

power cord. A cord that plugs into a wall outlet supplying electrical power.

printer. A device that produces printed output.

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. A type of logical link control used in X.25 communication.

Recommendation V.25 bis. A recommendation for interfaces set by the CCITT and amended periodically. V series defines standards for interfaces and voice board modems. V.25 bis defines automatic calling/answering for the general switched telephone network using the 100-series interchange circuits.

Recommendation V.35. V.35 includes the definition of a communication interface composed of five single-ended interchange lines and separate differential lines for transmit data, transmit clock, receive data, and receive clock signals.

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.

remote attachment. Attachment of work stations to a host system through communication lines, and usually through an intermediate control unit.

remote loopback. A test procedure that verifies the operation of the local modem, the remote modem, and the communication lines between them.

remote work station. A work station that is attached to the host system through communication lines.

reverse charging acceptance. This facility allows the network to pass reversed-charge calls to the DTE.

reversed charging. Reversed charging allows virtual calls to be billed to the DTE receiving the call.

short hold mode (SHM). An X.21 switched communication option that allows a link between two stations to remain established only when there is data to transfer. The IBM 5394 supports, but does not initiate, an SHM session. The host system determines and controls SHM sessions.

station protector. A device used on the system cable to offer protection against lightning for attachments made in different buildings.

subscription. An agreement between a user and a PTT/network supplier for the use of certain network services and optional facilities.

switched line. A connection between computers or devices that is established by dialing.

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 IBM 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.

system configuration. A process that determines the devices, programs, and methods that form a data processing system.

system operator. A person who uses the display station that is designated as the system console to activate certain system functions, and to control and monitor system operation.

systems network architecture (SNA). A set of rules for controlling the transfer of information in a data communication network.

telecommunication. The transmission of data between locations by telephone line, telegraph, radio, satellite, television, or microwave media.

terminal multiconnector. A device used to connect up to seven work stations to a single port on the IBM 5394. The IBM 5299 Terminal Multiconnector can be used when cable-thru is inappropriate or unavailable.

terminator switch. A switch used to terminate the system cable on the last work station when cable-thru is used, and to provide a feed-through path for other stations on the cable-thru line.

throughput. A measure of the amount of work done by a computer system over a given period of time.

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.

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.

V.25 bis. See *Recommendation V.25 bis*.

V.35. See *Recommendation V.35*.

virtual call. A call placed on a switched virtual circuit.

virtual circuit. A logical connection between two DTEs, which enables them to exchange information according to a standard communication procedure with the sequence of information preserved. A virtual circuit occupies transmission capacity only when the data is actually being transmitted.

window. The maximum number of packets that the DTE is authorized to transmit and have outstanding at any given time. It is the basic flow control mechanism in X.25 and protects the network from accepting packets faster than they can be accepted by the remote DTE. The window can also be used by a DTE to prevent transmission of packets from the network if the DTE is unable to queue them. A default window size, usually 2, is assigned at subscription time. In some networks, this can be altered for a given virtual call.

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 station. 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.

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.25. See *Recommendation X.25*.

Index

IBM 5394 Remote Control Unit
Introduction and Installation
Planning Guide

READER'S COMMENT FORM

Publication No. SK2T-0316-02

This manual is part of a library that serves as a reference source for systems analysts, programmers, and operators of IBM systems. You may use this form to communicate your comments about this publication, its organization, or subject matter, with the understanding that IBM may use or distribute whatever information you supply in any way it believes appropriate without incurring any obligation to you.

Note: Copies of IBM publications are not stocked at the location to which this form is addressed. Please direct any requests for copies of publications, or for assistance in using your IBM system, to your IBM representative or to the IBM branch office serving your locality.

Possible topics for comment are:

Clarity Accuracy Completeness Organization Coding Retrieval Legibility

If you wish a reply, give your name, company, mailing address, date, and location of your local IBM branch office:

_____

_____

_____

_____

_____

What is your occupation? _____

Number of latest Newsletter associated with this publication: _____

Thank you for your cooperation. No postage stamp necessary if mailed in the U.S.A. (Elsewhere, an IBM office or representative will be happy to forward your comments or you may mail directly to the address in the Edition Notice on the back of the title page.)

SK2T-0316-02

Reader's Comment Form

Fold and tape | Please Do Not Staple | Fold and tape

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO. 40 ARMONK, N.Y.

POSTAGE WILL BE PAID BY ADDRESSEE

International Business Machines Corporation
Dept. E02
P.O. Box 12195
Research Triangle Park, N.C. 27709-9990

Fold and tape | Please Do Not Staple | Fold and tape

IBM®

Part Number
26F0009

File Number
5394-09

Printed in U.S.A.