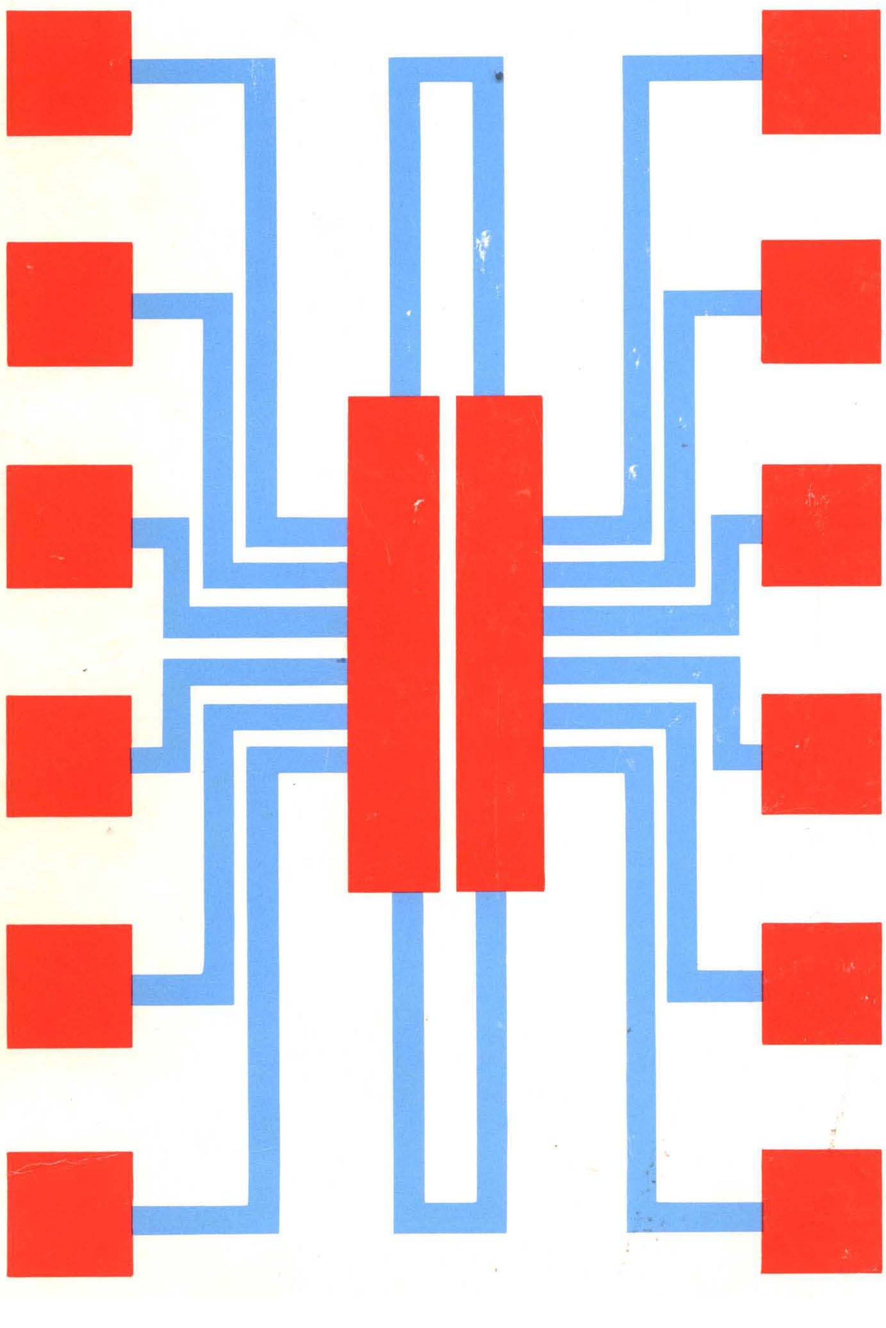
Using the IBM Cabling System with Communication Products



Using the IBM Cabling System with Communication Products

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The preceding FCC statement applies to all attaching IBM products produced for use in the USA and manufactured after December 31, 1980. A notice of compliance is affixed within the customer access area of all affected attaching products.

Second Edition (April 1986)

Changes are made periodically to the information herein; before using this publication in connection with IBM systems or equipment, consult the latest IBM publications that are applicable for the IBM systems or equipment.

Preface

This manual is a companion to the *IBM Cabling System Planning and Installation Guide*, GA27-3361. It describes how to use the IBM Cabling System with many of IBM's currently available communication products. Custom-designed accessories are used to attach the different types of communication products to the cabling system. For each type of product, the manual provides the following information:

- Cabling system accessories needed for the products
- Example worksheets and drawings showing how the cabling system is used to wire the products
- Planning and ordering information
- Configuration limits.

Also included are problem determination procedures and a set of appendixes. See "How to Use This Manual" for a complete description.

Prerequisite Publications

Before using this manual, you must be familiar with these publications:

- *IBM Cabling System Planning and Installation Guide*, GA27-3361

- *A Building Planning Guide for Communication Wiring*, G320-8059.

You will need to use information in the *Planning and Installation Guide* in order to complete some of the tasks in this manual. Therefore, it is important that you have a copy of that publication.

Related Publications

- *IBM Cabling System Catalog*, G570-2040

- *IBM Token-Ring Network Introduction and Planning Guide*, GA27-3677

- *IBM Token-Ring Network Installation Guide* (to be available at a later date)

- *IBM 3270 Information Display System Installation Manual—Physical Planning*, GA27-2787

- *IBM 3270 Information Display System: IBM Cabling System Supplement for Physical Planning*, GA23-0206

- *IBM 3270 Personal Computer Introduction and Preinstallation Planning*, GA23-0179
- *Introducing the IBM 3270 Personal Computer/G and /GX Workstations*, GA33-3141
- *IBM 3600 Finance Communication System Installation Manual – Physical Planning*, GA27-2766
- *IBM 4700 Finance Communication System Installation Planning Manual*, GC31-2018
- *IBM Cabling System Installation Planning Introduction for 4700 and 3600 Systems*, GC31-2524
- *IBM 4321/4331/4361 Processors Installation Manual – Physical Planning*, GA33-1577
- *IBM 3680 Programmable Store System Planning and Site Preparation Guide*, GA27-3213
- *IBM 3650 Programmable Store System Installation Manual – Physical Planning*, GA27-3167
- *IBM Multiuse Communication Loop Planning and Installation Guide*, GA27-3341
- *Guide to Multiuse Communication Loop with IBM Cabling System*, GA27-3606
- *IBM 8100 Information System Site Planning and Preparation Guide for IBM 8101, IBM 8130, IBM 8140*, GA27-2884
- *IBM Series/1 Customer Site Preparation Manual*, GA34-0050
- *IBM 5250 Information Display System Planning and Site Preparation Guide*, GA21-9337
- *IBM 5520 Administrative System Installation Manual Physical Planning*, GA23-1011
- *IBM System/36 What to Do Before Your Computer Arrives - 5360*, SBOF-4773
- *IBM System/36 What to Do Before Your Computer Arrives - 5362*, SBOF-4778
- *IBM System/38 Installation Manual – Physical Planning*, GA21-9293
- *IBM 5080 Graphics System: System Planning and Installation*, GA23-0135

- *IBM 5080 Graphics System: Site Planning and Preparation Guide*, GA23-0129
- *IBM Cabling System Problem Determination Guide for Twinaxial Applications*, GA21-9491
- *The Considerations of Physical Security in a Computer Environment*, G520-2700
- *The Considerations of Data Security in a Computer Environment*, G520-2169
- *Data Security Controls and Procedures—A Philosophy for DP Installations*, G320-5649

How to Use This Manual

If your installation contains only an IBM Token-Ring Network, go to Chapter 10. All other readers should read Chapter 1 to find out the types of IBM communication products that can be connected to the IBM Cabling System. The last section in Chapter 1 tells you how to complete a System Configuration Worksheet. This worksheet is used to record information concerning the type and location of the communication products and the accessories used to connect them to the cabling system.

The final step in completing the System Configuration Worksheet requires that you read the chapter or chapters that tell how to wire the IBM communication products in your system to the cabling system. Chapters 2 through 9 describe each type of cabling system application. At the end of each of those chapters are instructions for filling out an Attaching Products Worksheet for each group of work stations connected to one port or line on a system unit. This worksheet is used to record the types and quantity of cable accessories you will need to order. You then total these quantities from all the Attaching Products Worksheets and transfer the results to the Complete Order Summary Worksheet.

Follow the procedure described in Chapter 11 if you will need to route cable between wiring closets.

Chapter 12 contains the data path problem determination procedure that you perform whenever your system problem determination procedure indicates a problem in a cable or accessory. Follow the instructions in the section "The Data Path Problem Determination Procedure" to locate the problem. Use the procedures in the section "Test Procedures for Cabling System Accessories" when the data path problem determination procedure instructs you to test cabling system accessories. You will need either an IBM Cabling System Tester, an ohmmeter, or both to complete the data path problem determination procedure.

The appendixes contain additional information that you may need when planning for, testing, or installing the cabling system.

- All of the worksheets you will need are in Appendix A.
- Appendix B tells you how to configure loop wiring concentrators when they are used with loop systems.
- Appendix C contains installation instructions for some of the accessories.
- Appendix D tells you how to route cable on an equipment rack.
- Appendix E describes the IBM Cabling System Tester.
- Appendix F tells you how to make a data wire test cable and a store loop attachment assembly.
- Appendix G tells you how to test data cable using the IBM Cabling System Tester or an ohmmeter.
- Appendix H contains information about cable separation from electromagnetic sources, radio frequency interference, and ground potential difference measurement that may be needed when the problem determination procedure in Chapter 12 is performed.

How to Order IBM Publications

To request IBM publications, contact your IBM representative or the IBM branch office serving your locality.

You can obtain the *IBM Cabling System Catalog* by calling *IBM Direct.* The toll free telephone number is 1-800-IBM-2468.

If you are outside the United States, contact your local IBM branch office or local *IBM Direct* facility to order publications.

How to Order Cable and Accessories

To order cable and accessories, call the *IBM Direct* toll free telephone number above, or mail the order form provided in the *IBM Cabling System Catalog* to:

IBM Direct
Systems Products Department
One Culver Road
Dayton, New Jersey 08810

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1

Introduction

This chapter describes the communication products and cable configurations that can be used with the IBM Cabling System. This chapter also tells how to prepare the System Configuration Worksheet.

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Chapter 1

Wire Types and Communications Products 1-2
Cable Configurations and Accessories Used with IBM Communication Products 1-3
General Planning Considerations 1-4
Preparing System Configuration Worksheets 1-5

Wire Types and Communication Products

The cabling system can be used for the following wire types and IBM communication products:

Note: This list is not necessarily all-inclusive.

- Coaxial Cable Applications
  - IBM 3270 Information Display System. The cabling system is for use only with 3270 devices that connect to one of the following:
    - 3274 Control Unit with terminal adapter Types A and B
    - 3276 Control Unit
    - 3299 Terminal Multiplexer
    - 3271 or 3272 Control Unit with terminal adapter Type B.
  - IBM 3270 Personal Computer (PC), 3270-PC/G, 3270-PC/GX
  - IBM 3600 Finance Communication System (device cluster adapter devices [DCA] only)
  - IBM 4700 Finance Communication System (device cluster adapter devices [DCA] only)
  - IBM 4300 Processors (for local attachment of input/output devices)
  - IBM 5080 Graphics System.
- Twinaxial Cable Applications
  - IBM 5250 Information Display System
  - IBM 5520 Administrative System
  - IBM System/34
  - IBM System/36
  - IBM System/38.
- Finance Communication System Loop Applications
  - IBM 3600 Finance Communication System
  - IBM 4700 Finance Communication System.
- IBM Programmable Store System Applications
  - 3650 System
  - 3660 System
  - 3680 System.
- IBM Multiuse Communication Loop (MCL) Applications
  - IBM 8100 Information System

- IBM Series/1 Applications

  - IBM 3101 Display Terminal Models 23, feature #1310
  - IBM 4975 Printer Models 01L, 02L, feature #1310
  - Local Communication Controller (LCC), feature #1400
  - IBM 4980 Display Stations, feature #1250.

- IBM Token-Ring Network

Cable Configurations and Accessories Used with IBM Communication Products

The IBM Cabling System supports many of IBM's currently available communication products connected together in the following ways:

- Point-to-point wiring (IBM 3270 coaxial cable applications)

- Bus wiring (twinaxial cable applications or 5080 Graphics System terminals)

- Loop systems

  - IBM Series/1
  - Finance Communication System Loop
  - Programmable Store System
  - IBM Multiuse Communication Loop (MCL).

The three types of wiring configurations are described below. More detailed descriptions of the cable configurations and accessories for each type of application are provided in the following chapters.

Point-to-Point Wiring

In point-to-point wiring, each user location is connected to a concentration point by an individual cable. An example is the IBM 3270 Display System, where each device is attached to a controlling unit port with a separate coaxial cable.

Bus Wiring

Some of the systems supported by the IBM Cabling System configure the cable as a bus by starting at the controlling unit, daisy chaining each work station in a serial fashion and terminating the bus at the last work station. This daisy chaining is accomplished by using Y assemblies at the terminals and at the distribution panel. An example of how bus wiring is used in configuring the IBM 5520 Information Display System is given in Chapter 3.

Loop Wiring

In loop or ring wiring configurations, the cables are routed from one device location to the next and return to the starting point. The Multiuse Communication Loop, an example of loop wiring, is discussed in Chapter 6.

The loop wiring concentrator (LWC) is one of the unique features of the method used to configure loop systems with the IBM Cabling System. The LWC has eight radial ports for attaching up to eight devices to the loop. Multiple LWCs may be connected together to form larger loop configurations.

Note: The data connector, used in all of the configurations described above, has been designed to be self-shorting when disconnected. This feature is useful to bus and loop wiring configurations. When the data connector is disconnected from its mate, the receive data path is automatically connected to the transmit data path. This creates an effective bypass of the disconnected port and permits the remainder of the loop or bus system to continue operation.

General Planning Considerations

In planning for your building wiring, you must consider not only today's needs but also your anticipated growth and the relocation of personnel.

When routing cable for controller rooms, consider the following:

- The maximum number of devices that can be connected to each existing and planned controller
- The expected distribution of those devices served by the wiring closet or closets
- The expected attenuation may be greater depending on:
  - Cable type
  - Length of run
  - Frequency of the system used.

When routing cable between wiring closets, consider running the cables through a nearby wiring closet, if the cables run near that closet.

Preparing System Configuration Worksheets

Note: If you are planning for the IBM Token-Ring Network, you will not need this section. Go to Chapter 11.

Each of the communication product systems that you plan for will usually consist of the IBM Cabling System, a controlling unit, one or more work stations, and accessories for connecting the controlling unit and work stations to the cabling system. The controlling unit may have more than one port, with a group of work stations connected to each port.

The accessories needed to connect the controlling unit and work stations to the cabling system will vary among the communication systems. They are described in the chapters that follow and are listed, along with their abbreviations, at the bottom of the System Configuration Worksheet.

Accurate system configuration records will help you find problems or reconfigure the system when necessary. Follow the instructions below to complete a System Configuration Worksheet for each group of work stations connected to one port or line on a controlling unit. Fill out the worksheet before connecting accessories at the distribution panel.

You will need the completed Work Area Worksheets and the Cable Schedule (from the *IBM Cabling System Planning and Installation Guide*) to complete the System Configuration Worksheet. Figure 1-1 shows an example of a completed worksheet.

To get started, remove the System Configuration Worksheet from Appendix A and make several photocopies of it.

1. Attachment Description

   a. In the first block under "Attachment Description," write in the *system* or *controller name* and the number of the port that the cable is connected to.

   b. In the remaining blocks under "Attachment Description," record the following information for each *work station*:

      - Name of work station
      - Type of work station
      - Work station address
      - Operator's name and/or telephone number.

2. Cable Information

   Refer to Figure 1-2 for instructions on how to record the "cable information" for undercarpet cable. Figure 1-3 shows an example of a system wired with undercarpet cable. Follow the instructions below when recording cable information for all other cable types.

   a. In the blocks under "Cable Runs from (Wall)," record the work area location number from the Work Area Worksheet. (See "Planning and Ordering Procedure" in Chapter 4 of the *IBM Cabling System Planning and Installation Guide* for information on the Work Area Worksheet.)

   b. In the space under "Cable & Cable Length," draw in the cables that run from the work area to the distribution panel and any cables that run from one wiring closet to another.

      Label each cable with its cable number and length. The length of a cable can be found on the Work Area Worksheets. The cable number can be found either on the label on the faceplate where the cable terminates or on the Cable Schedule. (See "Keeping Records of Cables" in Chapter 3 of the *IBM Cabling System Planning and Installation Guide.*)

   c. In the blocks under "Cable Runs to (Panel)," record the distribution panel locations where the cables drawn in step 2b terminate. The distribution panel locations are on the Cable Schedule and faceplates.

3. Accessories Information

   a. Read the appropriate sections of the rest of this manual to determine which of the cabling system accessories you will need for your system. Under "Accessories in Work Area" and "Accessories on Equipment Rack," draw in the accessories and label them with the suggested abbreviations listed at the bottom of the worksheet. If your system uses color-coded accessories, be sure to indicate the color code on each of the cables.

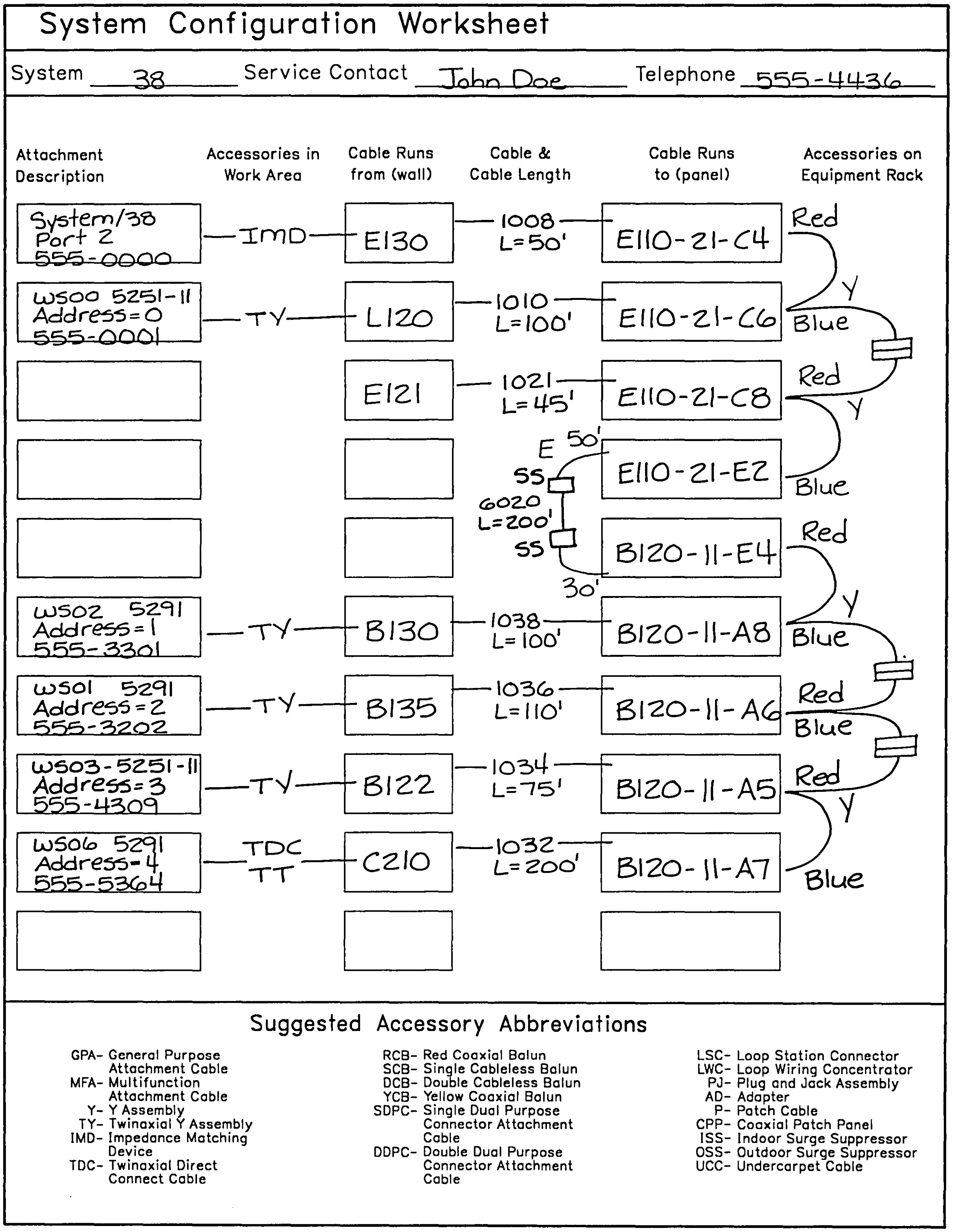
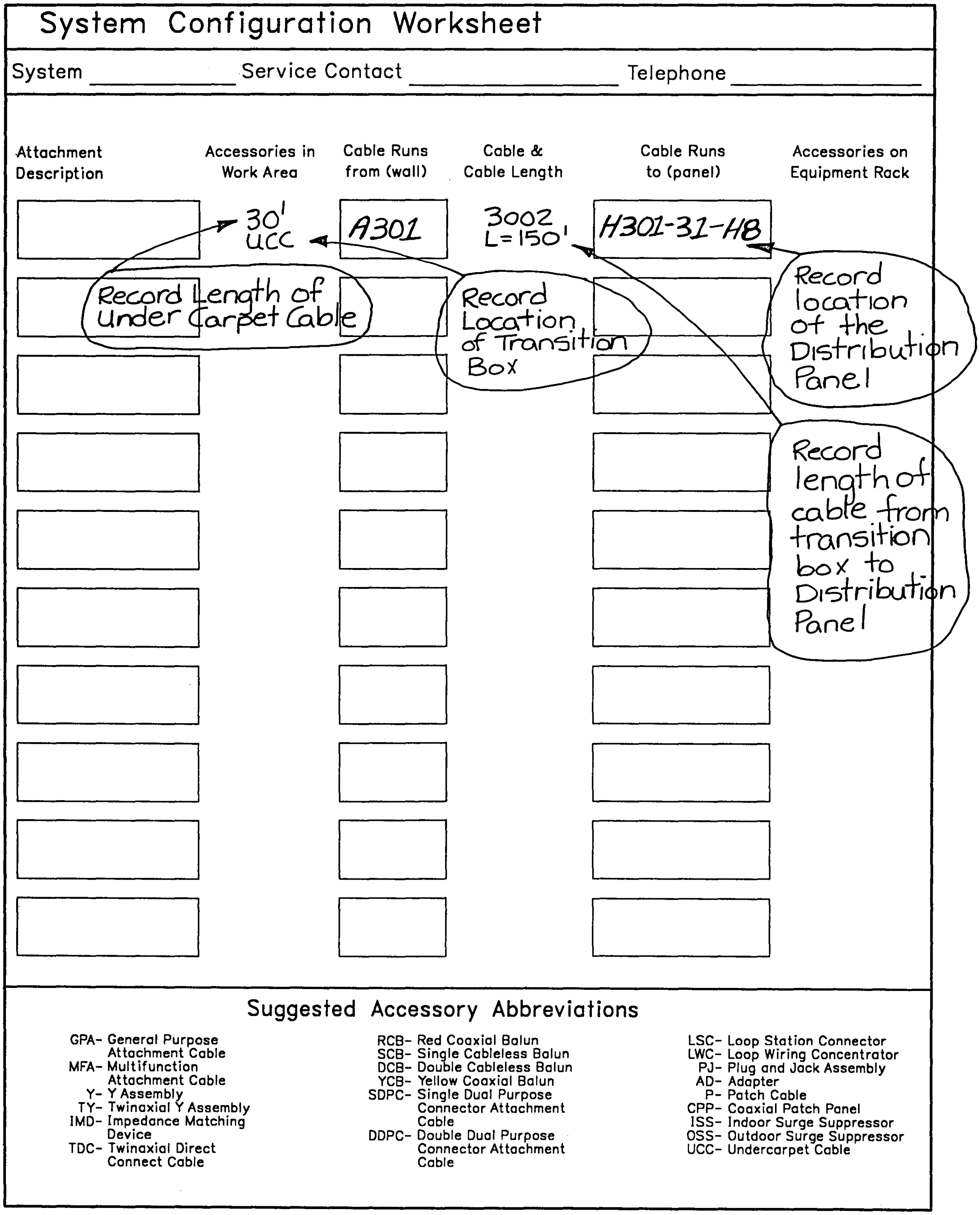


Figure 1-1. Example of a Completed System Configuration Worksheet



System Configuration Worksheet

System ____________ Service Contact ________________ Telephone ______________

Attachment Description	Accessories in Work Area	Cable Runs from (wall)	Cable & Cable Length	Cable Runs to (panel)	Accessories on Equipment Rack
	30' UCC	A301	3002 L=150'	H301-31-H8	

Record Length of Under Carpet Cable

Record Location of Transition Box

Record location of the Distribution Panel

Record length of cable from transition box to Distribution Panel

Suggested Accessory Abbreviations

GPA- General Purpose Attachment Cable
MFA- Multifunction Attachment Cable
Y- Y Assembly
TY- Twinaxial Y Assembly
IMD- Impedance Matching Device
TDC- Twinaxial Direct Connect Cable

RCB- Red Coaxial Balun
SCB- Single Cableless Balun
DCB- Double Cableless Balun
YCB- Yellow Coaxial Balun
SDPC- Single Dual Purpose Connector Attachment Cable
DDPC- Double Dual Purpose Connector Attachment Cable

LSC- Loop Station Connector
LWC- Loop Wiring Concentrator
PJ- Plug and Jack Assembly
AD- Adapter
P- Patch Cable
CPP- Coaxial Patch Panel
ISS- Indoor Surge Suppressor
OSS- Outdoor Surge Suppressor
UCC- Undercarpet Cable

Figure 1-2. Example of How to Record Undercarpet Cable on System Configuration Worksheet

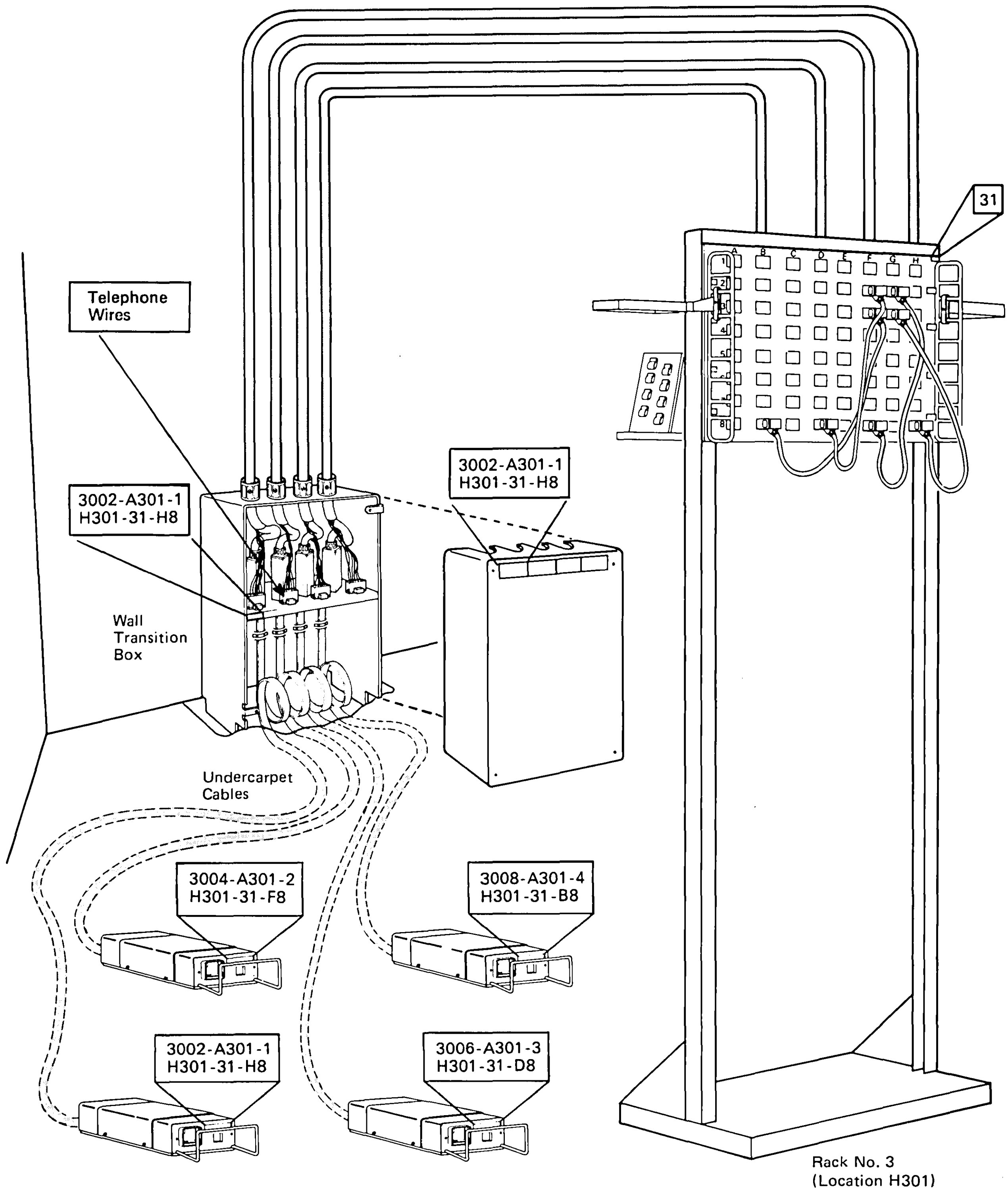


Figure 1-3. Example of a System Wired with Undercarpet Cable

2

How to Use the Cabling System for 3270 Coaxial Cable Applications

This chapter describes how to use the cabling system to wire IBM systems that use coaxial connectors and cables to attach system devices.

Contents Chapter 2

General Planning Considerations 2-2
Coaxial Cable and Coaxial Patch Panel Labeling 2-3
Wiring between Control Units and Equipment Rack 2-4
Outdoor Cable Runs 2-4
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Yellow Coaxial Balun Assembly 2-6
Coaxial Patch Panel 2-6
Dual Purpose Connector (DPC) Attachment Cable 2-7
3299 Mounting Shelf 2-7
Using the 3299-1 and 3299-2 Terminal Multiplexers 2-12
3299 Terminal Multiplexer Labeling 2-13
Planning and Ordering Procedure for Coaxial Accessories 2-19
Configuration Limits 2-20

General Planning Considerations

The cabling system can be used to wire the following *coaxial* systems:

- IBM 3270 Information Display System. The cabling system is used with 3270 devices that connect to one of the following:

  - 3274 Control Unit with terminal adapter Types A and B
  - 3276 Control Unit
  - 3299 Terminal Multiplexer
  - 3271 or 3272 Control Unit with terminal adapter Type B.

- IBM 3270 Personal Computer (PC), 3270-PC/G, 3270-PC/GX.

- IBM 4700 and 3600 Finance Communication Systems. (This chapter is for device cluster adapter [DCA] devices. For information on how to use the cabling system for loop applications, see Chapter 4.)

- IBM 4300 Processor attachment of input/output devices.

This chapter supplements the wiring information contained in the following IBM publications:

- *IBM 3270 Information Display System Installation Manual— Physical Planning*, GA27-2787

- *IBM 3270 Information Display System: IBM Cabling System Supplement for Physical Planning*, GA23-0206

- *IBM 3270 Personal Computer Introduction and Preinstallation Planning*, GA23-0179

- *Introducing the IBM 3270 Personal Computer/G and /GX Workstations*, GA33-3141

- *IBM 3600 Finance Communication System Installation Manual— Physical Planning*, GA27-2766

- *IBM 4700 Finance Communication System Installation Planning Manual*, GC31-2018

- *IBM Cabling System Installation Planning Introduction for 4700 and 3600 Finance Communication Systems*, GC31-2524

- *IBM 4321/4331/4361 Processors Installation Manual— Physical Planning*, GA33-1577.

(For information on how to get the above publications, see "How to Order IBM Publications" in the Preface of this manual.)

Before using this chapter you must complete:

- The planning for your coaxial system (using one of the above IBM publications)
- The general planning and ordering procedure in Chapter 4, "How to Plan for and Order Cables and Accessories" in the *IBM Cabling System Planning and Installation Guide*, GA27-3361.

Coaxial Cable and Coaxial Patch Panel Labeling

Use the following procedure to label coaxial patch panels and coaxial cables that run between a controller and a wiring closet.

1. Assign a floor location number to the controller (for example, D101).
2. Label each coaxial cable with the controller location number and a suffix number (for example, D101-1, D101-2,..., D101-19, D101-20).
3. Label each coaxial patch panel with a unique four-digit unit identification number. All of the coaxial patch panels in your installation should be labeled with consecutive numbers, starting with "0001" for the first patch panel. Place the unit identification number in the designated space on the front of the patch panel. For example, the coaxial patch panel in Figure 2-2 is labeled "0014."
4. This labeling information should be entered on the Cable Schedule because it is routing information. (The Cable Schedule is described in "Keeping Records of Cables" in Chapter 3 of the *IBM Cabling System Planning and Installation Guide*.)

Wiring between Control Units and Equipment Rack

It is recommended that you install control units in wiring closets. However, if this is not possible, use either of the following methods for the cable run between the control unit and equipment rack.

- Cable types 6, 8, and 9 have higher attenuation than types 1 and 2. If a cable run includes any of these types of cable, its "equivalent length" must be calculated. (See "Configuration Limits" on page 2-20 for an explanation of equivalent length.)

  Equivalent length (of a run) = A + 2B + 1.5C
  Where: A is the actual length of type 1 or type 2 cable
  B is the actual length of type 8 cable
  C is the actual length of type 6 or 9 cable

- If the total equivalent-length run is less than or equal to 600 meters (1968 feet) and is within the same building, use either type 1 cable or coaxial cable from the distribution panel to the control unit. (See Figure 2-1 and Figure 2-2.)

- If the total equivalent-length run is greater than 600 meters (1968 feet), or for cable runs between buildings, use coaxial cable from the coaxial patch panel (on the equipment rack) to the control unit. (See Figure 2-2.)

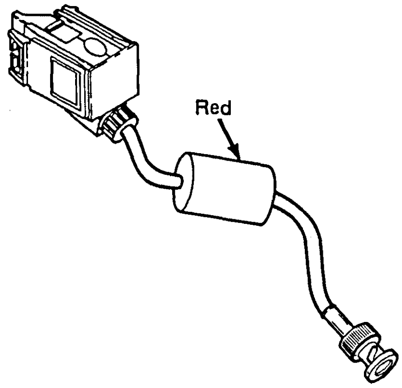
- If a 3299-2 is used, and the run is all indoors, type 1 or type 9 cable can be used, provided the equivalent cable length does not exceed 1000 meters (3280 feet).

  Note: For future migration to the IBM Token-Ring Network, equivalent-length runs indoors should be less than 710 meters (2329 feet).

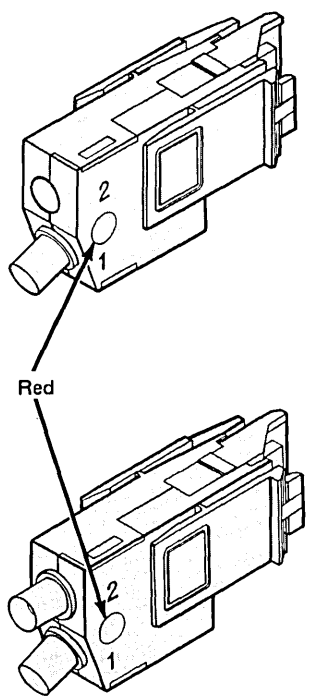
Outdoor Cable Runs

If outdoor cable runs are required for coaxial cable applications, use outdoor coaxial cable and coaxial surge suppressors. Refer to the appropriate physical planning manual for information on outdoor coaxial cable and surge suppressors.

Red Coaxial Balun Assembly and Cableless Coaxial Baluns



- Used to attach 3278-like (Category A) terminals, the corresponding control units, and printers to the cabling system
- Color-coded red
- Red coaxial balun assembly
  - Used to connect *bal*anced twisted-pair cable and *un*balanced coaxial cable together
  - Approximate length is 2.4 meters (8 feet)
  - Part number 8642546.

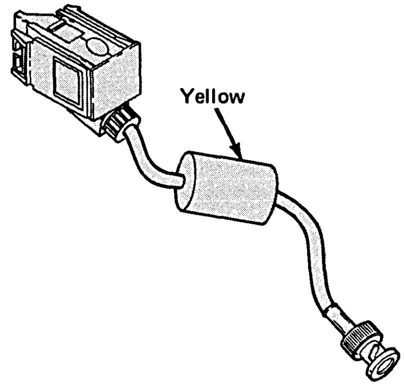


- Cableless coaxial baluns
  - Must be connected to device with coaxial jumper cable (not supplied with balun)
  - Part number 6339082 (single cableless balun)
  - Part number 6339083 (double cableless balun).

When the double balun is used to operate two devices, remove both coaxial cables from the balun at the distribution panel or at the control unit *before* disconnecting any balun or data connector in the data path. If the cables are not disconnected in this manner, the operation of the system could be disrupted.

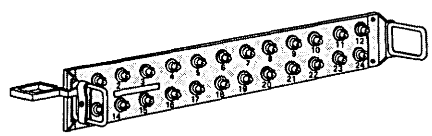
Note: Do not connect a display and a control unit to the same double coaxial cableless balun.

Yellow Coaxial Balun Assembly



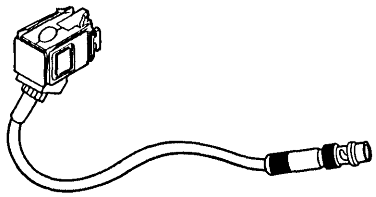
- Used to attach 3277-like (Category B) and 3730-like terminals, the corresponding control units, and printers to the cabling system
- Color-coded yellow
- Approximate length 2.4 meters (8 feet)
- Part number 8642544.

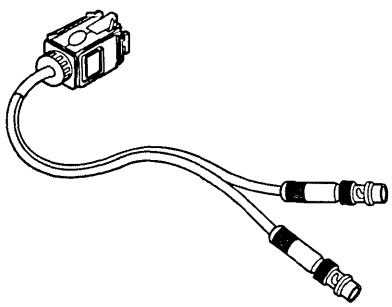
Coaxial Patch Panel



- Contains 24 BNC bulkhead connectors for terminating coaxial cables from control units or IBM 3299 Terminal Multiplexers.
- Mounts in an equipment rack.
- A maximum of four coaxial patch panels are recommended for each equipment rack.
- Part number 4716801.

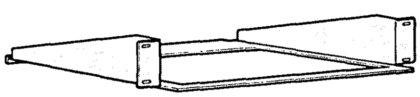
Dual Purpose Connector (DPC) Attachment Cable





- Used at the distribution panel to connect Category A terminals and printers to an IBM 3299-2 Terminal Multiplexer
- Part number 6339073 (single, 2.4 meters [8 feet])
- Part number 6339074 (single, 9 meters [30 feet])
- Part number 6339075 (double, 2.4 meters [8 feet]).

3299 Mounting Shelf



- Used to mount a 3299-1 or 3299-2 Terminal Multiplexer in an equipment rack.
- Screws for mounting are not supplied. (See Appendix C for installation instructions.)
- Part number 6217036.

Cable Schedule

Building 421
Floor 2

Wiring Closet Location C201
Date of Last Update

Cable Number	Cable Routing Information: Cable Runs From	Cable Routing Information: Cable Runs To	Cable Length	Distribution Panel Jumpers	Additional Information
2001	E204	C201-21-A8	130 ft.	A8 To E2	
2002	C205	C201-21-B8	150 ft.	B8 To F2	
2003	A201	C201-21-C8	120 ft.	C8 To G2	

System Configuration Worksheet

System 3270 Service Contact John Doe Telephone 555-3264

Attachment Description	Accessories in Work Area	Cable Runs from (Wall)	Cable & Cable Length	Cable Runs to (Panel)	Accessories on Equipment Rack
W501 3279 555-4044	RCB	A201	2003 L=120'	C201-21-C8	P-G2-2507 To Control Unit
W503-3262 555-4111	RCB	C205	2002 L=150'	C201-21-B8	P-F2-2506 To Control Unit
W503 3279 555-3004	RCB	E204	2001 L=130'	C201-21-A8	P-E2-2505 To Control Unit

Figure 2-1 (Part 1 of 2). Example Showing Category A Coaxial Cable Applications with Type 1 Cable to Control Unit

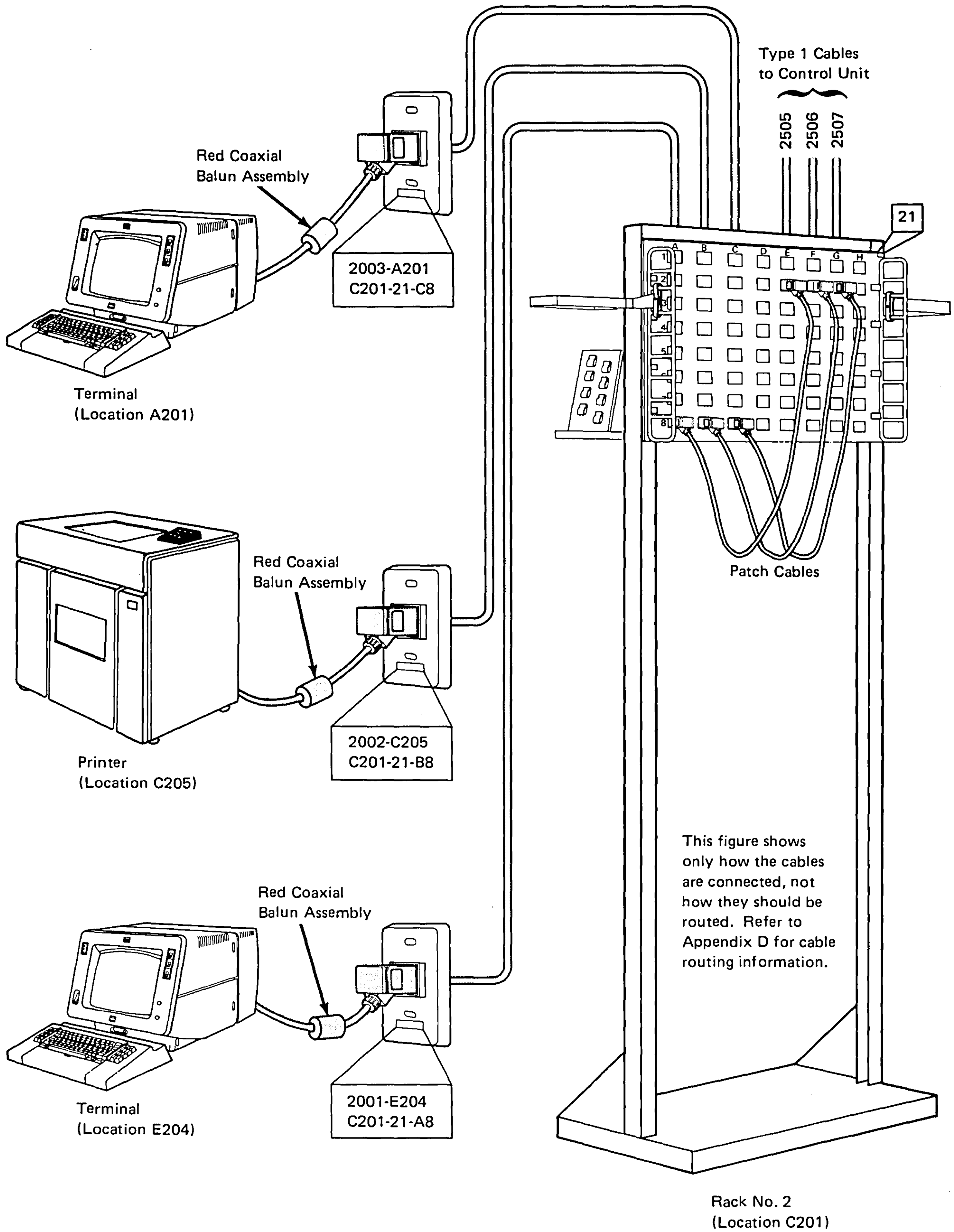


Figure 2-1 (Part 2 of 2). Example Showing Category A Coaxial Cable Applications with Type 1 Cable to Control Unit

Building 601 Floor 1	Cable Schedule			Wiring Closet Location C101 Date of Last Update	
Cable Number	Cable Routing Information: Cable Runs From	Cable Routing Information: Cable Runs To	Cable Length	Distribution Panel Jumpers	Additional Information
1002	B110	C101-11-B8	120 ft.	To Coax Patch Panel 14-15	
1004	F104	C101-11-D8	150 ft.	To Coax Patch Panel 14-17	
1006	A101	C101-11-F8	130 ft.	To Coax Patch Panel 14-21	

System Configuration Worksheet

System 3270 Service Contact John Doe Telephone 555-3264

Attachment Description	Accessories in Work Area	Cable Runs from (Wall)	Cable & Cable Length	Cable Runs to (Panel)	Accessories on Equipment Rack
WS01 3277 555-4044	YCB	B110	1002 L=120'	C101-11-B8	YCB-CPP #0014-15 To Control Unit
WS02 3262 555-4111	SCB	F104	1004 L=150'	C101-11-D8	SCB-CPP #0014-17 To Control Unit
WS03 3279 555-3004	SCB	A101	1006 L=130'	C101-11-F8	SCB-CPP #0014-21 To Control Unit

Figure 2-2 (Part 1 of 2). Example Showing Category A and B Coaxial Cable Applications with Coaxial Cable to Control Unit

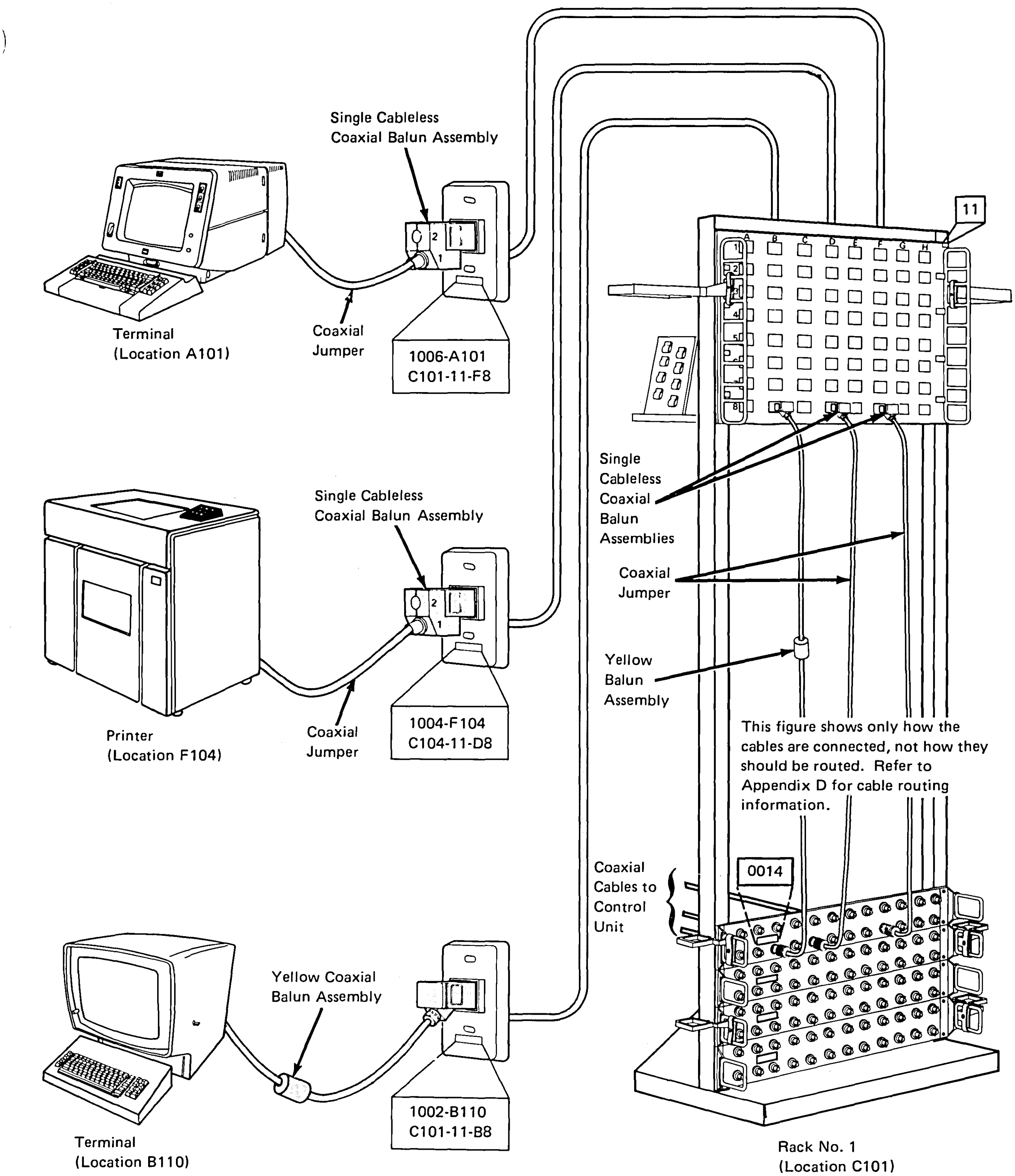


Figure 2-2 (Part 2 of 2). Example Showing Category A and B Coaxial Cable Applications with Coaxial Cable to Control Unit

Using the 3299-1 and 3299-2 Terminal Multiplexers

Using the 3299 Terminal Multiplexer can significantly reduce the number of cables required between control units and wiring closets. The 3299-2 has the added advantage of reducing the need to use balun assemblies at the distribution panel. (The dual purpose connector attachment cables are used instead of baluns.) For 3299 physical planning information, refer to *IBM 3270 Information Display System Installation— Physical Planning*, GA27-2787.

The 3299s can be installed in equipment racks that have multiple mounting positions. The 3299 Mounting Shelf is designed for this purpose. See Appendix C for information on how to install the 3299 Mounting Shelf.

Wiring between Control Units and 3299s

Follow these rules for a cable run between a 3274 Control Unit and a 3299 Terminal Multiplexer:

3299-1

- If the cable run is less than 400 meters (1312 feet) and is within the same building, use either coax, type 1, or type 9 cable from the 3299-1 to the 3274 Control Unit.
- If the cable run is between 400 meters (1312 feet) and 600 meters (1968 feet) and is within the same building, use either coax or type 1 cable from the 3299-1 to the 3274 Control Unit.
- If the cable run is greater than 600 meters (1968 feet) or for cable runs between buildings, use coax cable from the 3299-1 to the 3274 Control Unit.

3299-2

- If the cable run is less than 667 meters (2188 feet) and is within the same building, use either coax, type 1, or type 9 cable from the 3299-2 to the 3274 Control Unit.
- If the cable run is between 667 meters (2188 feet) and 1000 meters (3280 feet) and is within the same building, use either coax or type 1 cable from the 3299-2 to the 3274 Control Unit.

  Note: For future migration to the IBM Token-Ring Network, cable runs must be less than 710 meters (2329 feet).
- If the cable run is greater than 1000 meters (3280 feet) or for cable runs between buildings, use coax cable from the 3299-2 to the 3274 Control Unit.

3299 Terminal Multiplexer Labeling

Label each 3299 with a unique four-digit unit identification number. All of the 3299s in your installation should be labeled with consecutive numbers, starting with "0001" for the first 3299. Place the unit identification number in the space provided on the front of the 3299. For example, in Figure 2-4, the 3299 is labeled "0001."

Record this information on the Cable Schedule described in "Keeping Records of Cables" in Chapter 3 of the *IBM Cabling System Planning and Installation Guide.*

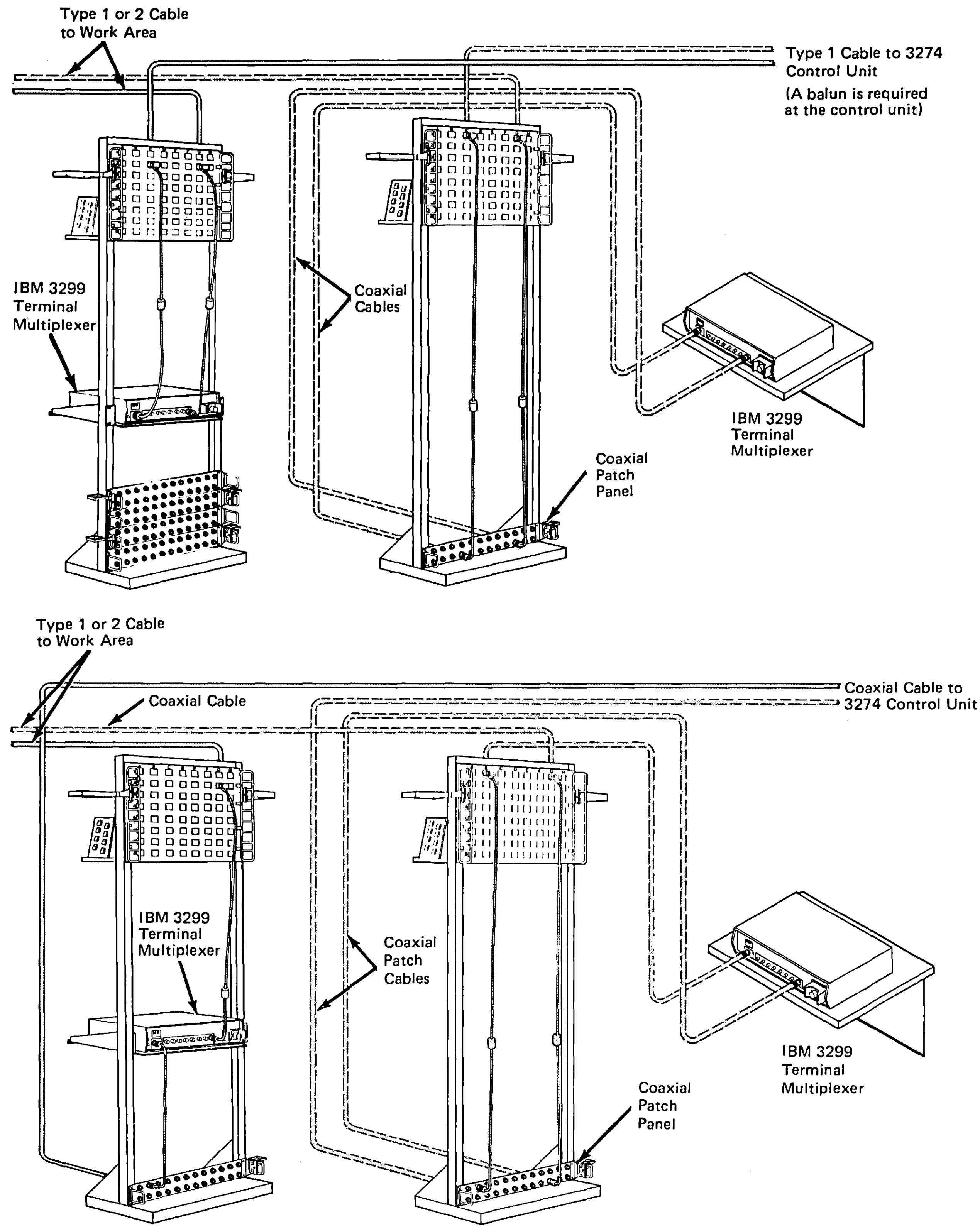


Figure 2-3. Examples of Wiring between Control Units and 3299s

Building 504 Floor 2		Cable Schedule			Wiring Closet Location D202 Date of Last Update
Cable Number	Cable Routing Information: Cable Runs From	Cable Routing Information: Cable Runs To	Cable Length	Distribution Panel Jumpers	Additional Information
2002	H201	D202-11-D8	120 ft.	3299 #0001 Port 2	
2004	K202	D202-11-B8	130 ft.	3299 #0001 Port 0 and Port 1	

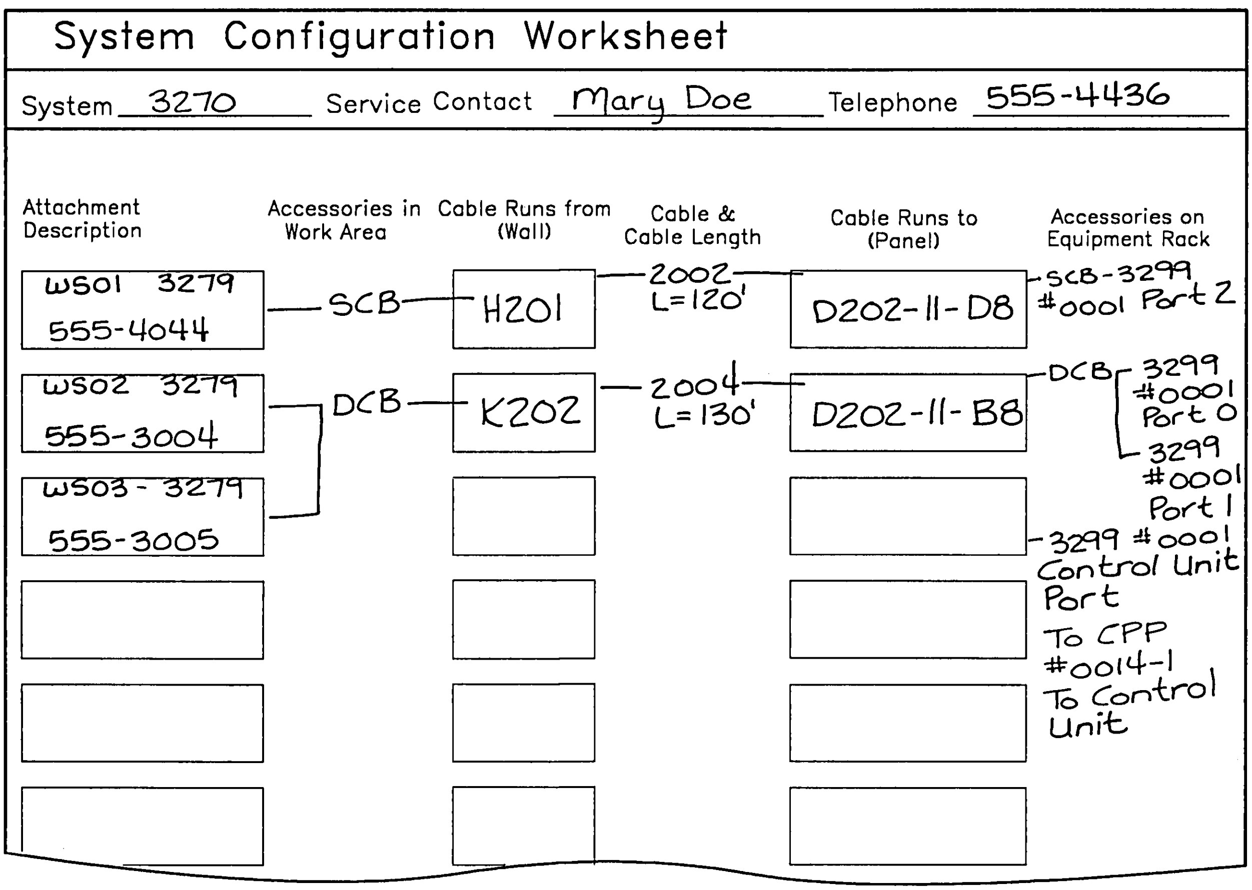


Figure 2-4 (Part 1 of 2). **Example of How the Cabling System Is Used with 3299-1 Terminal Multiplexer**

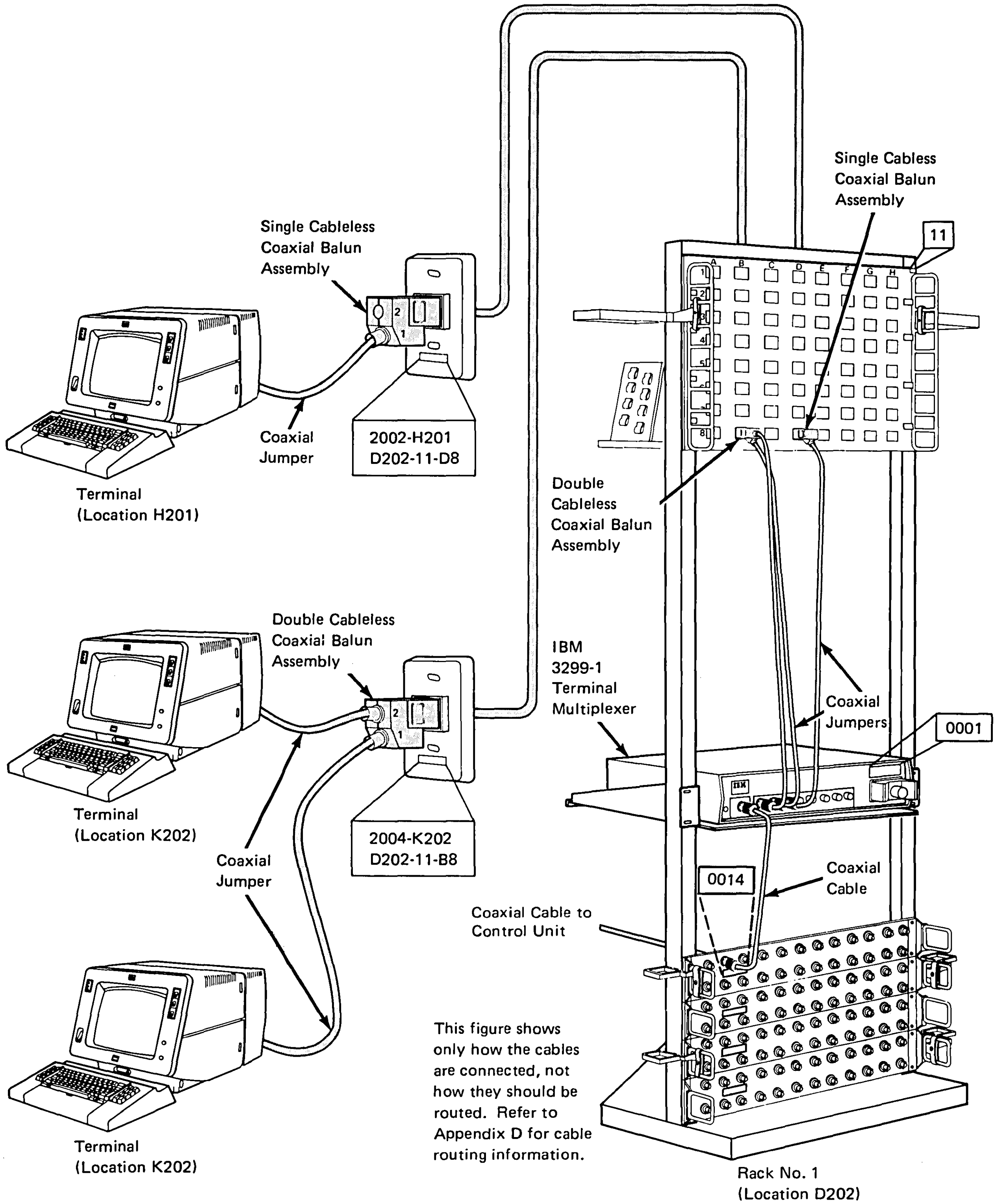


Figure 2-4 (Part 2 of 2). Example of How the Cabling System Is Used with 3299-1 Terminal Multiplexer

Cable Schedule

Building 504
Floor 2

Wiring Closet Location D202
Date of Last Update

Cable Number	Cable Routing Information: Cable Runs From	Cable Routing Information: Cable Runs To	Cable Length	Distribution Panel Jumpers	Additional Information
2002	H201	D202-11-D8	120 ft.	3299 #0001 Port 2	
2004	K202	D202-11-B8	130 ft.	3299 #0001 Port 0	

System Configuration Worksheet

System 3270 Service Contact Mary Doe Telephone 555-4436

Attachment Description	Accessories in Work Area	Cable Runs from (Wall)	Cable & Cable Length	Cable Runs to (Panel)	Accessories on Equipment Rack
WS01 3279 555-4044	SCB	H201	2002 L=120'	D202-11-D8	SDPC 3299 #0001 Port 2
WS02 3279 555-3004	SCB	K202	2004 L=130'	D202-11-B8	SDPC 3299 #0001 Port 0
					3299 #0001 Control Unit Port To CCP #0014-1 To Control Unit

Figure 2-5 (Part 1 of 2). Example of How the Cabling System is Used with 3299-2 Terminal Multiplexer

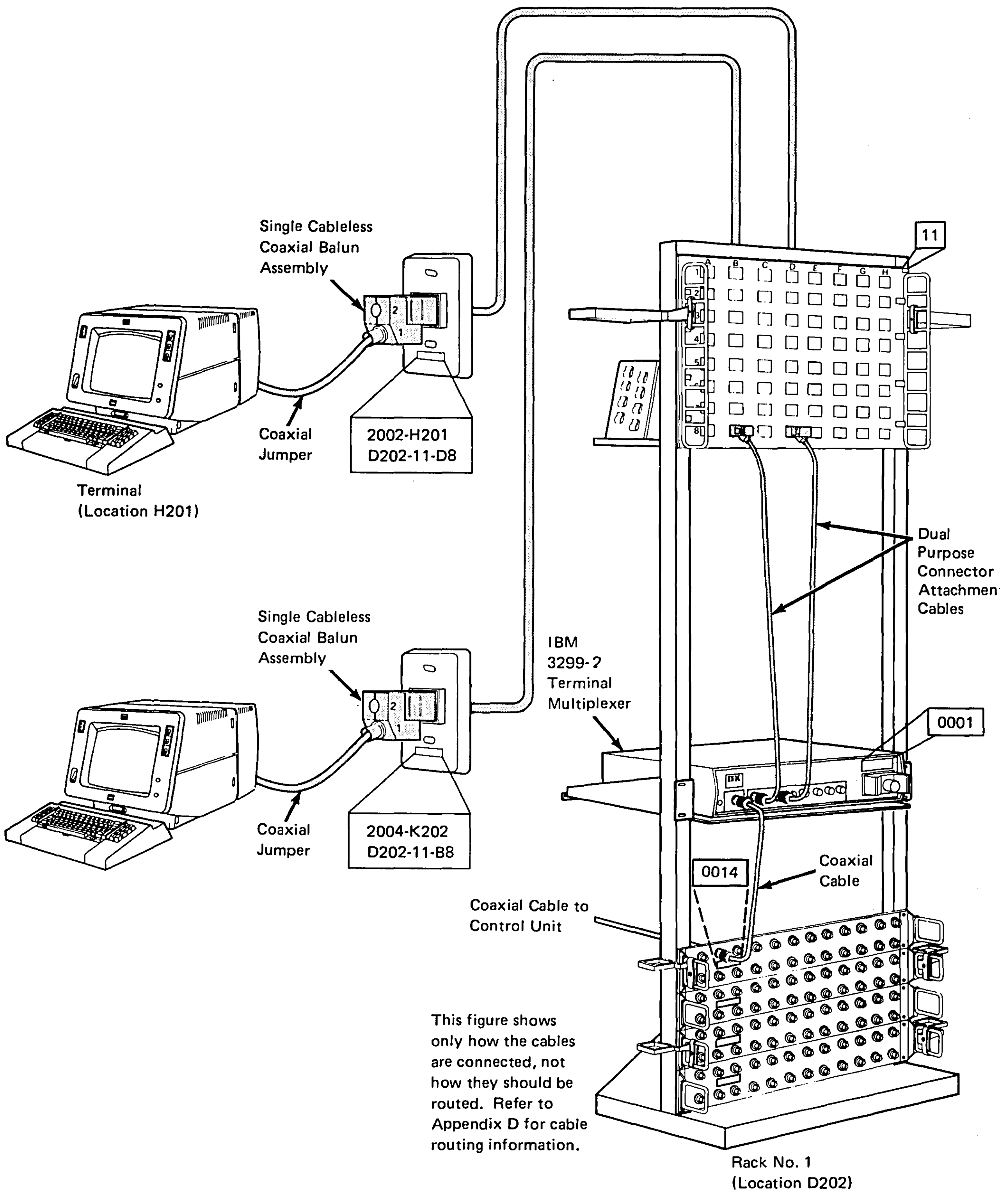


Figure 2-5 (Part 2 of 2). Example of How the Cabling System is Used with 3299-2 Terminal Multiplexer

Planning and Ordering Procedure for Coaxial Accessories

1. Remove the Attaching Products Worksheet from Appendix A and make several photocopies.

   Note: The worksheet is used for ordering accessories for all attaching systems. Use only the section for coaxial applications.

2. Determine your coaxial accessory requirements as follows:

   a. Enter the number of red coaxial baluns and single cableless coaxial baluns on lines Coax-1 and Coax-2, respectively. Order two red coaxial balun assemblies or two *single* cableless coaxial baluns for each Category A terminal and printer. One of the two baluns is used to connect the device to a work area faceplate; the second is used at the distribution panel or control unit.

      If a 3299-2 is used, only one balun is required for each Category A device. Use a DPC attachment cable at the 3299-2.

   b. Enter the number of *double* cableless coaxial baluns on line Coax-3. Order two double cableless coaxial baluns for each group of two terminals or printers connected to the same cabling system faceplate. One of the two baluns is used to connect the devices to a work area faceplate; the second is used at the distribution panel or control unit.

      If a 3299-2 is used, only one double cableless balun is required for each pair of Category A devices. Use a double DPC attachment cable at the 3299-2.

   c. Enter the number of yellow coaxial balun assemblies on line Coax-4. Order two yellow coaxial balun assemblies for each Category B terminal and 3730-like terminal and printer. One of the two baluns is used to connect the device to a work area; the second is used at the distribution panel.

   d. Enter the number of dual purpose connector (DPC) attachment cables on lines Coax-5, Coax-6, and Coax-7. Use DPC attachment cables only with the 3299-2 Terminal Multiplexer.

      Order one *double* DPC attachment cable for each *double* cableless coaxial balun used at a work area faceplate to connect Category A devices to the cabling system.

   e. If you plan to use rack-mounted 3299s, enter the number of 3299 mounting shelves on line Coax-8.

f. If coaxial patch panels are used, enter the total number on line Coax-9. One coaxial patch panel is required for each group of 24 coaxial cable drops (or fraction thereof).

g. For maintenance purposes, order two spare BNC bulkhead connectors for each coaxial patch panel. Enter the number of spare connectors on line Coax-10.

3. Go to Chapter 11 to see if it is applicable.

4. Fill out the Complete Order Summary Worksheet:

   a. Remove the Complete Order Summary Worksheet from Appendix A and make one photocopy of each page.

   b. Copy the information from the Order Summary Worksheet you filled out in the *IBM Cabling System Planning and Installation Guide* to Part 1 and Part 2 of the Complete Order Summary Worksheet. Be careful to copy the information accurately.

   c. Complete Part 3 and Part 4 using information from *all* of the Attaching Products Worksheets that have been completed. For each accessory, find the total number you will need. Add 10% to that number and enter the result under "Quantity."

Configuration Limits

In some configurations, type 6, 8, or 9 cable is combined with type 1 or type 2 cable. When computing configuration limits, the higher attenuation of types 6, 8 and 9 cable must be accounted for. This is accomplished by using "equivalent length" rather than actual cable length when calculating the drive distance. The equivalent length of a combined section of cable is the length of type 1 or type 2 cable that would have the same attenuation. For 3270 Coaxial Cable Applications, the formula for computing the equivalent length is:

Equivalent length = A + 2B + 1.5C
Where: A is the actual length of type 1 or type 2 cable
B is the actual length of type 8 cable
C is the actual length of type 6 or 9 cable

Example: For 1000 feet of type 9 cable and 100 feet of type 8 cable,

equivalent length = 0 + 2(100) + 1.5(1000) = 1700 feet

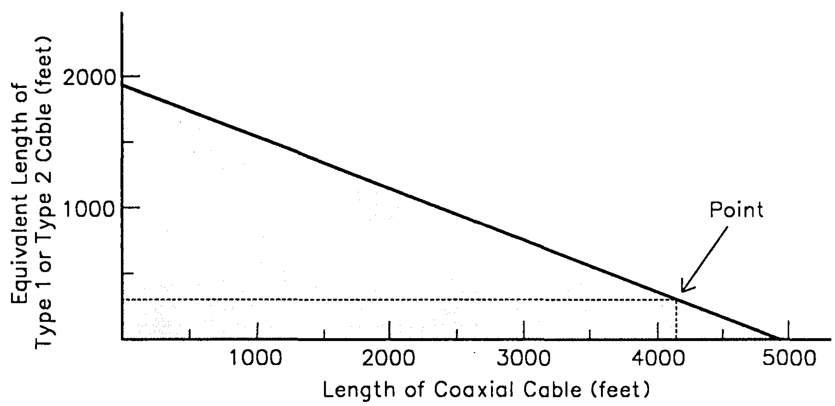
Limits for Category A

A Category A device is connected to a control unit or an IBM 3299 Terminal Multiplexer through either type 1 (or type 2) cable or *both* type 1 and coaxial cable. Do not install more than 4.9 meters (16 feet) of coaxial cable between a coaxial balun assembly and a Category A device.

Calculate the drive distance for your system configuration using either the following formula, graph, or the tables on the following page:

Drive distance = x + 2.5y
Where: x is the length of coaxial cable
y is the equivalent length of type 1 or type 2 cable
The drive distance must be less than or equal to 4920 feet.

Equivalent length = A + 2B + 1.5C
Where: A is the actual length of type 1 or type 2 cable
B is the actual length of type 8 cable
C is the actual length of type 6 or 9 cable



Find the length of coaxial cable on the horizontal axis and the equivalent length on the vertical axis. The point at which they intersect must fall in the shaded area in the graph.

Example: For 4100 feet of coaxial cable and an equivalent length of 300 feet:

- Satisfies the formula (4100 + (2.5 x 300) = 4850, which is less than 4920 feet) and is therefore acceptable.
- The point falls in the shaded area and is therefore acceptable.

When using 3299 Multiplexers, find the maximum drive distance in the tables below.

3299-1 Multiplexer	
Maximum Equivalent Length from 3299 to device	610 meters (2000 ft)
Maximum Cable Length from 3299 to control unit	Type 1 - 610 meters (2000 ft) Type 9 - 406 meters (1333 ft) Coax -1524 meters (5000 ft)

3299-2 Multiplexer	
Maximum Equivalent Length from 3299 to device	1000 meters (3280 ft)
Maximum Cable Length from 3299 to control unit	Type 1 -1000 meters (3280 ft) Type 9 - 667 meters (2188 ft) Coax -1524 meters (5000 ft)

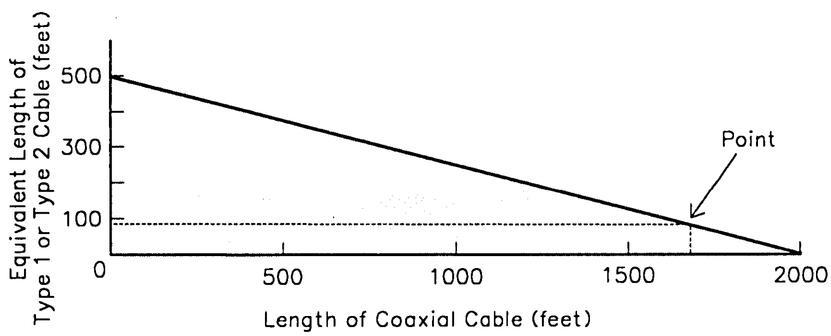
Limits for Category B

A Category B device is connected to a control unit through either type 1 cable (or type 2) or *both* type 1 and coaxial cable.

Calculate the drive distance for your system configuration using either the following formula or the graph below it:

Drive distance = x + 4y
Where: x is the length of coaxial cable
y is the equivalent length of type 1 or type 2 cable
The drive distance must be less than or equal to 2000 feet.

Equivalent length = A + 2B + 1.5C
Where: A is the actual length of type 1 or type 2 cable
B is the actual length of type 8 cable
C is the actual length of type 6 or 9 cable



Find the length of coaxial cable on the horizontal axis and the equivalent length on the vertical axis. The point at which they intersect must fall in the shaded area in the graph.

Example: For 1600 feet of coaxial cable and an equivalent length of 90 feet:

- Satisfies the formula (1600 + (4 x 90) = 1960, which is less than 2000 feet) and is therefore acceptable.
- The point falls in the shaded area and is therefore acceptable.

3

How to Use the Cabling System for Twinaxial Cable Applications

This chapter describes how to use the cabling system to wire IBM systems that use twinaxial connectors and cables to attach system devices.

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General Planning Considerations

The cabling system can be used to wire the following *twinaxial* systems:

- IBM 5250 Information Display System
- IBM 5520 Administrative System
- IBM System/34
- IBM System/36
- IBM System/38.

Note: For information on the IBM Series/1 Local Communication Controller feature #1400 (which also uses twinaxial cable), see Chapter 7.

This chapter supplements the wiring information contained in the following IBM publications:

- *IBM 5250 Information Display System Planning and Site Preparation Guide*, GA21-9337

- *IBM 5520 Administrative System Installation Manual Physical Planning*, GA23-1011

- *IBM System/36 Planning Packet-5360*, SBOF-4773

- *IBM System/36 Planning Packet-5362*, SBOF-4778

- *IBM System/38 Installation Manual— Physical Planning*, GA21-9293.

Note: When planning for twinaxial applications, you should order the *IBM Cabling System Problem Determination Guide for Twinaxial Applications*, GA21-9491. A set of IBM Cabling System labels are shipped with this manual. Please install these on all twinaxial accessories at the system and input/output (I/O) devices. If you need additional labels, you can order them separately under form number GA21-9502.

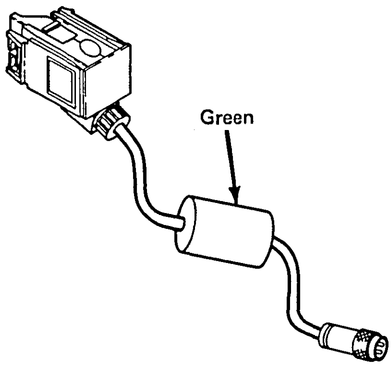
For information on how to get the above publications, see "How to Order IBM Publications" in the Preface of this manual.

Before using this chapter you must complete:

- The planning for your twinaxial system (using one of the IBM publications listed above)

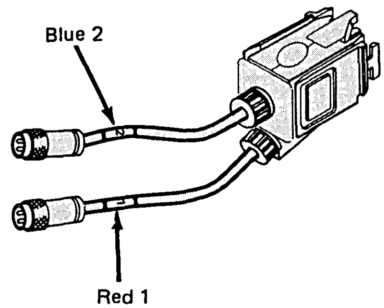
- The general planning and ordering procedure in "How to Plan for and Order Cables and Accessories" in the *IBM Cabling System Planning and Installation Guide*, GA27-3361.

Twinaxial Impedance Matching Device



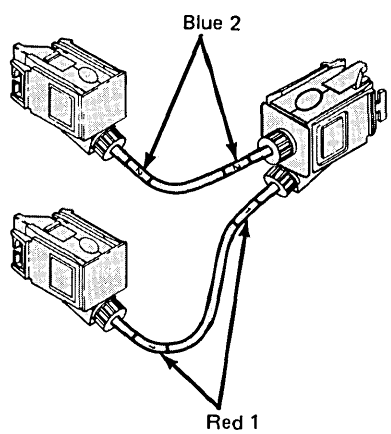
- Used for the following:
  - To connect a port on a 5250 Host System or 5250 controller to a cabling system receptacle
  - To connect a 5250 work station without cable-thru
  - To connect a display line on a 5520 System Unit to a cabling system receptacle
  - To connect the last IBM 5253 on a display line to a cabling system receptacle
- Color-coded green
- Approximate length 2.4 meters (8 feet)
- Part number 6091070.

Twinaxial Y Assembly



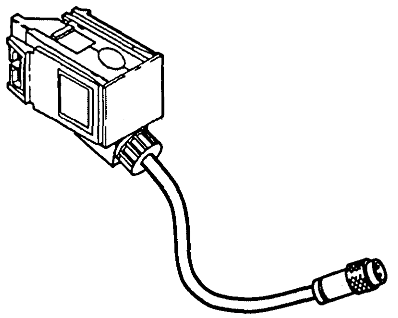
- Used to connect printers and work stations or display stations with cable-thru to a cabling system receptacle.
- Each leg of the twinaxial Y assembly is color-coded and numbered. The leg marked with *red* "1" is always connected to twinaxial connector socket "1." The leg marked with *blue* "2" is always connected to twinaxial connector socket "2."
- Approximate length (each leg) 2.7 meters (9 feet).
- Part number 8642550.

Y Assembly



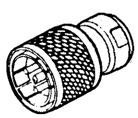
- Used at the distribution panel when connecting more than one work station, display station, or printer to the same port or line. Work stations and display stations must have cable-thru.
- Y assemblies are not needed at the distribution panel if a loop wiring concentrator is being used.
- Each leg of the Y assembly is color-coded and numbered. For the proper way to connect the connectors, see the Y assemblies in Figure 3-1, Figure 3-2, or Figure 3-3.
- Approximate length (each leg) 1.2 meters (4 feet).
- Part number 8642549.

Twinaxial Direct Connect Cable



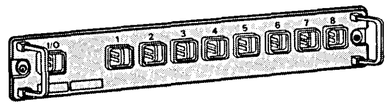
- Used to connect the last (or only) work station, display station, or printer to a cabling system receptacle (except for displays on a 5520 system)
- Used to connect a printer line on a 5520 system unit to a cabling system receptacle
- Used to connect the last printer on a 5520 system LDC line to a cabling system receptacle
- Approximate length 2.4 meters (8 feet)
- Part number 6091075.

Twinaxial Terminator (150 ohms)



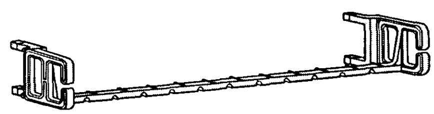
- Used to terminate the last (or only) work station, display station, or printer on a port or line (not used for 5520 or 5250 work stations without cable-thru)
- Color-coded green
- Part number 6091068.

Loop Wiring Concentrator (LWC)



- Used in wiring closets in place of Y assemblies to connect the cabling system drops so that they form a bus configuration.
- Used in place of Y assemblies to reduce cable congestion on the distribution panel and make reconfiguration and problem determination easier.
- Install LWCs in the equipment rack and connect them to the distribution panel with a 2.4-meter (8-foot) patch cables.
- Part number 6091077.

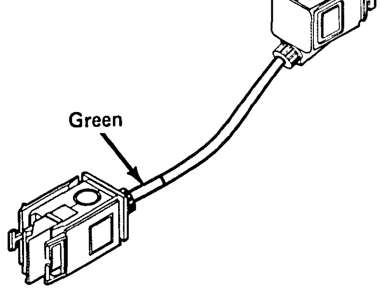
Cable Bracket



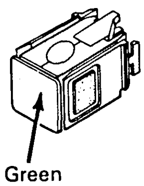
- Used for cable management at the equipment rack
- Attaches to the handles of the LWC
- Part number 6091042.

Twinaxial Test Accessories Kit

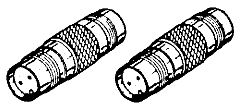
Twinaxial Test Adapter



Twinaxial Test Terminator



Twinaxial Straight Adapters



- Used in combination with the IBM Cabling System Tester when testing twinaxial accessories.
- Used in the *IBM Cabling System Problem Determination Guide for Twinaxial Applications*, GA21-9491, to test a data path.
- Kit includes the twinaxial test adapter, the twinaxial test terminator, and two twinaxial straight adapters.
- Twinaxial test adapter and twinaxial test terminator color-coded green.
- Part number 6339087.

Building 1223 Floor 3		Cable Schedule			Wiring Closet Location H301 Date of Last Update
Cable Number	Cable Routing Information: Cable Runs From	Cable Routing Information: Cable Runs To	Cable Length	Distribution Panel Jumpers	Additional Information
3002	A301	H301-31-H8	100 ft.	H8 To F8 Red	System Unit
3004	B306	H301-31-F8	120 ft.	F8 Blue To D8 Red	Y Assembly
3006	C311	H301-31-D8	150 ft.	D8 Blue To B8	Y Assembly
3008	D303	H301-31-B8	200 ft.	B8 To D8 Blue	Last Work Station

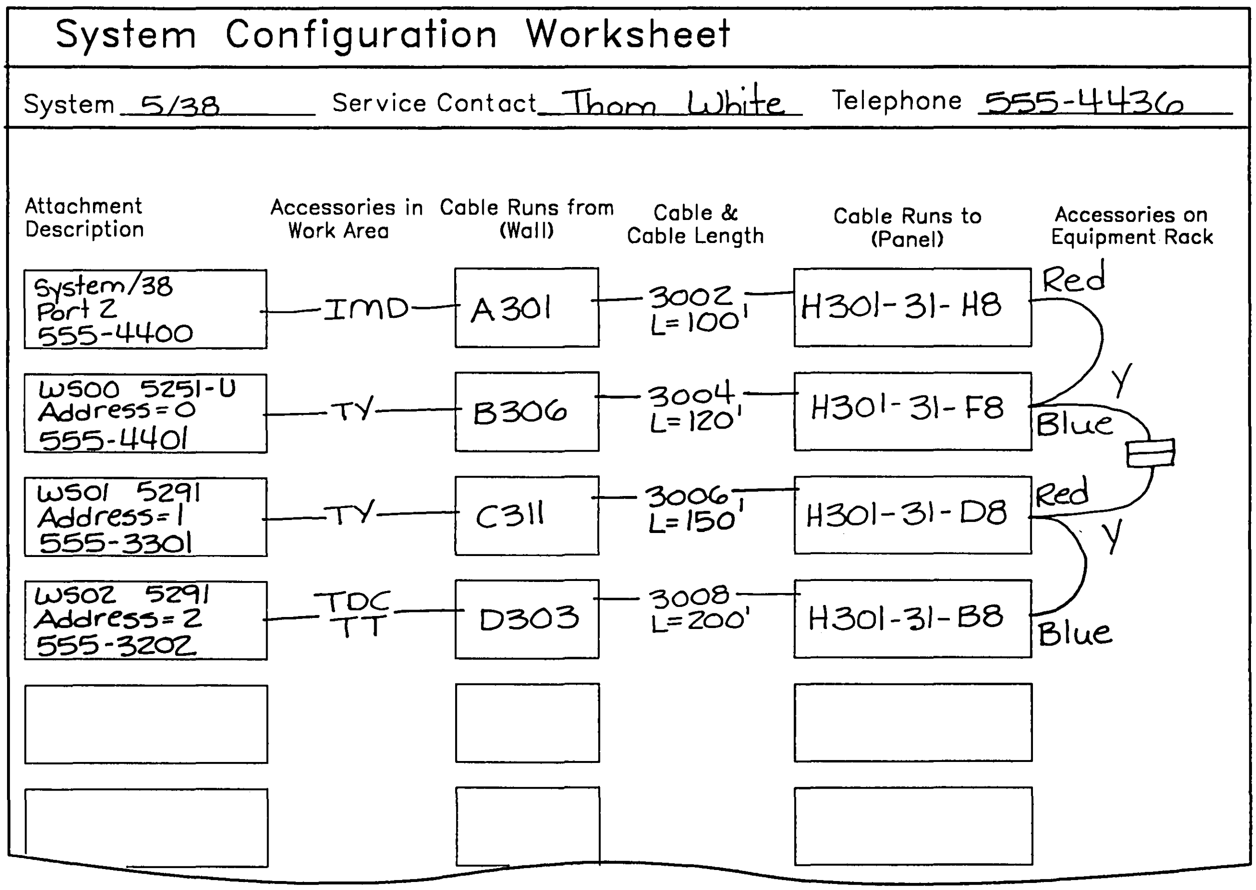
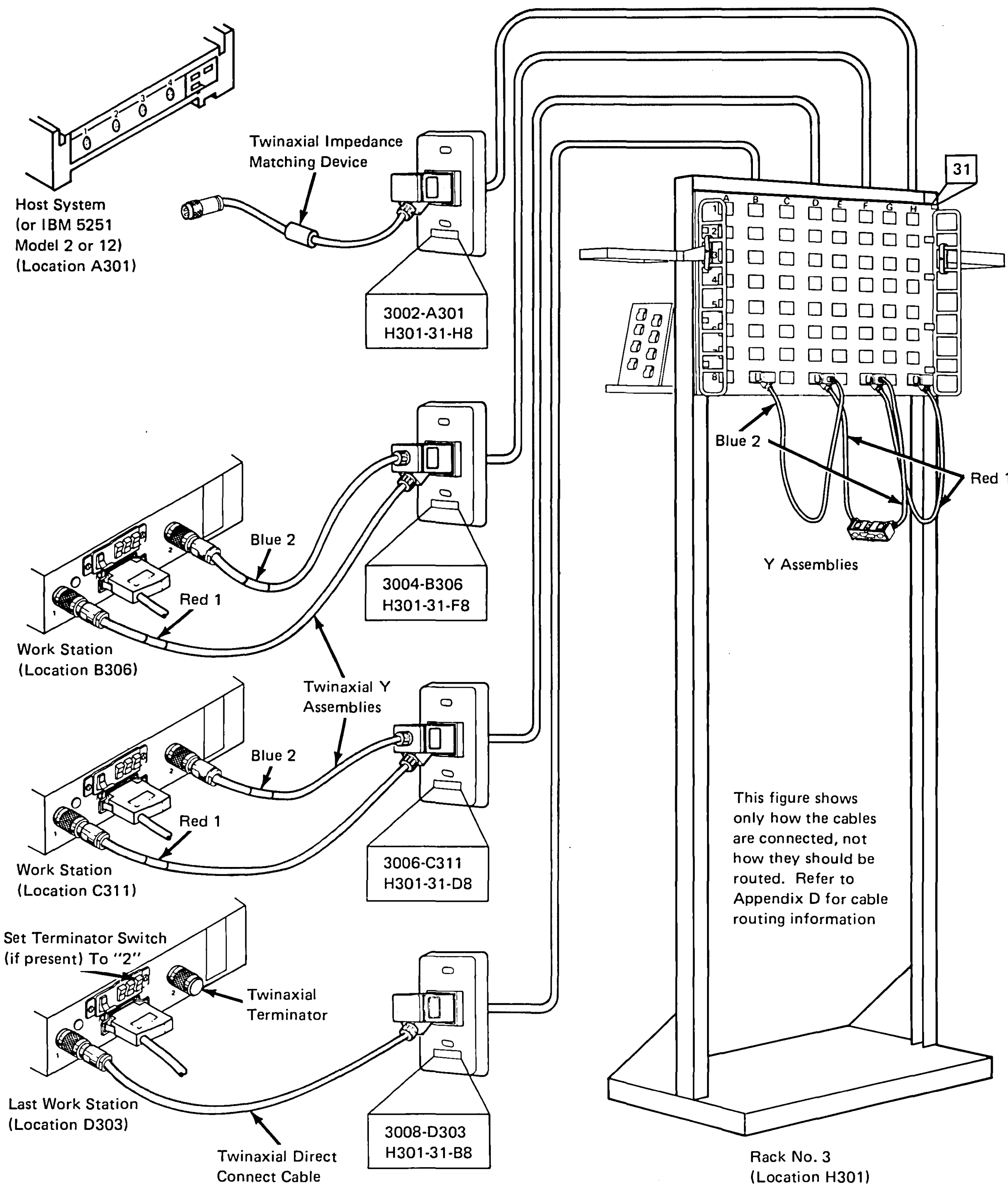


Figure 3-1 (Part 1 of 2). Example of How the Cabling System Is Used with 5250 Information Display System



Note:
For the 5251-11 and all printers without cable-thru, use a twinaxial impedance matching device instead of a twinaxial direct connect cable.

The twinaxial terminator is not required when the impedance matching device is used at the last device.

Figure 3-1 (Part 2 of 2). Example of How the Cabling System Is Used with 5250 Information Display System

Cable Schedule

Building 1223
Floor 3

Wiring Closet Location H301
Date of Last Update

Cable Number	Cable Routing Information: Cable Runs From	Cable Routing Information: Cable Runs To	Cable Length	Distribution Panel Jumpers	Additional Information
3002	A301	H301-31-H8	100 ft.	H8 To F8 Red	Display Line
3004	B306	H301-31-F8	75 ft.	F8 Blue To D8 Red	Y Assembly
3006	C311	H301-31-D8	80 ft.	D8 Blue To B8	Y Assembly
3008	D303	H301-31-B8	90 ft.	B8 To D8 Blue	Last Display

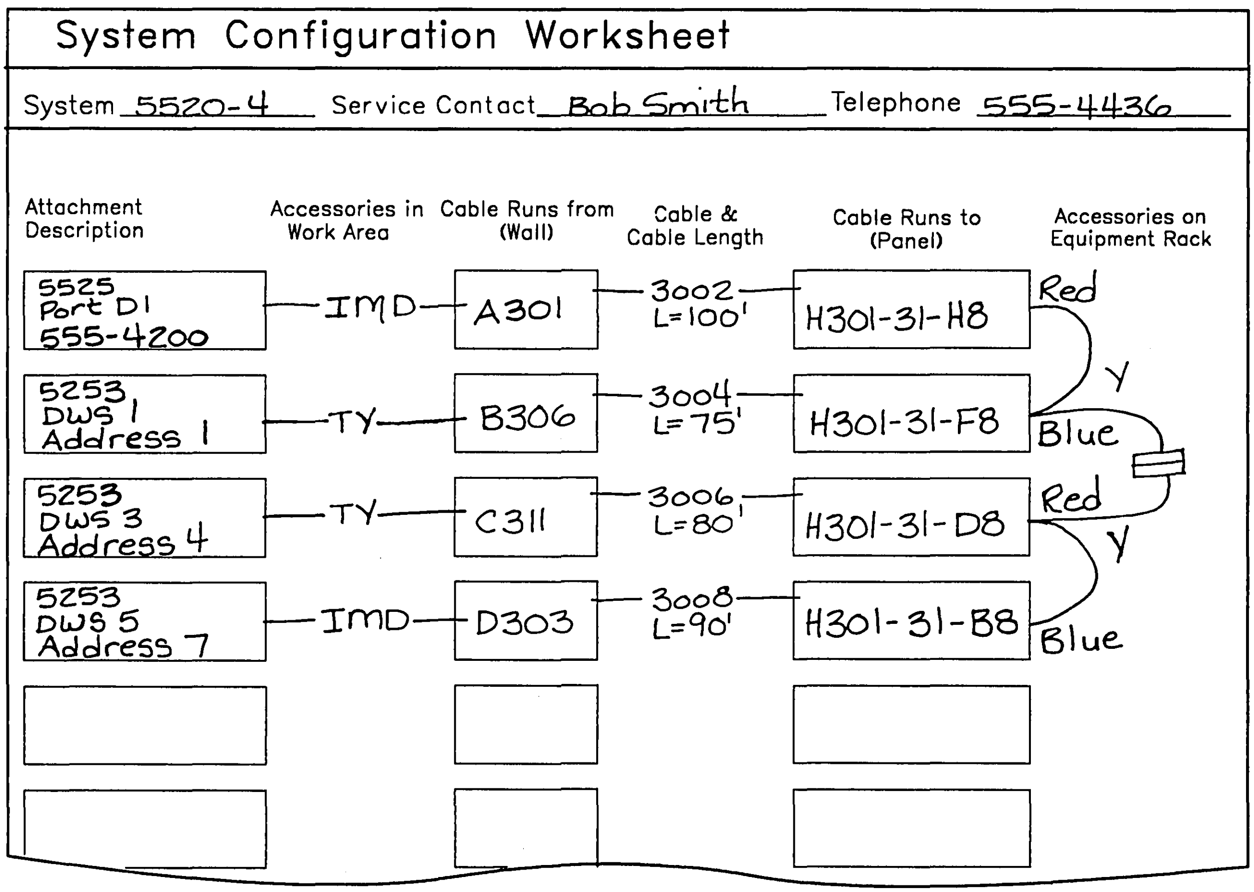


Figure 3-2 (Part 1 of 2). Example of How the Cabling System Is Used with 5520 Display Stations

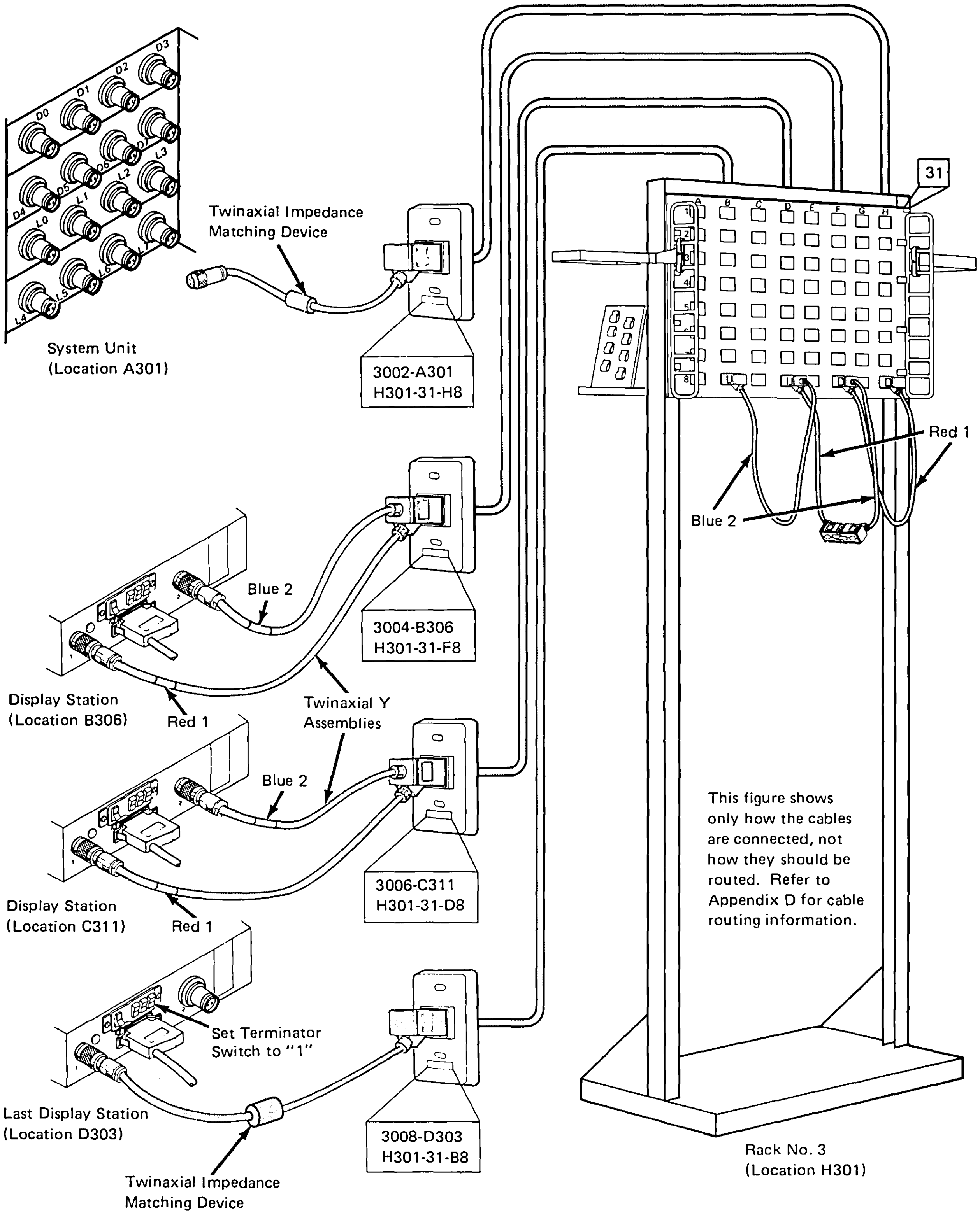


Figure 3-2 (Part 2 of 2). Example of How the Cabling System Is Used with 5520 Display Stations

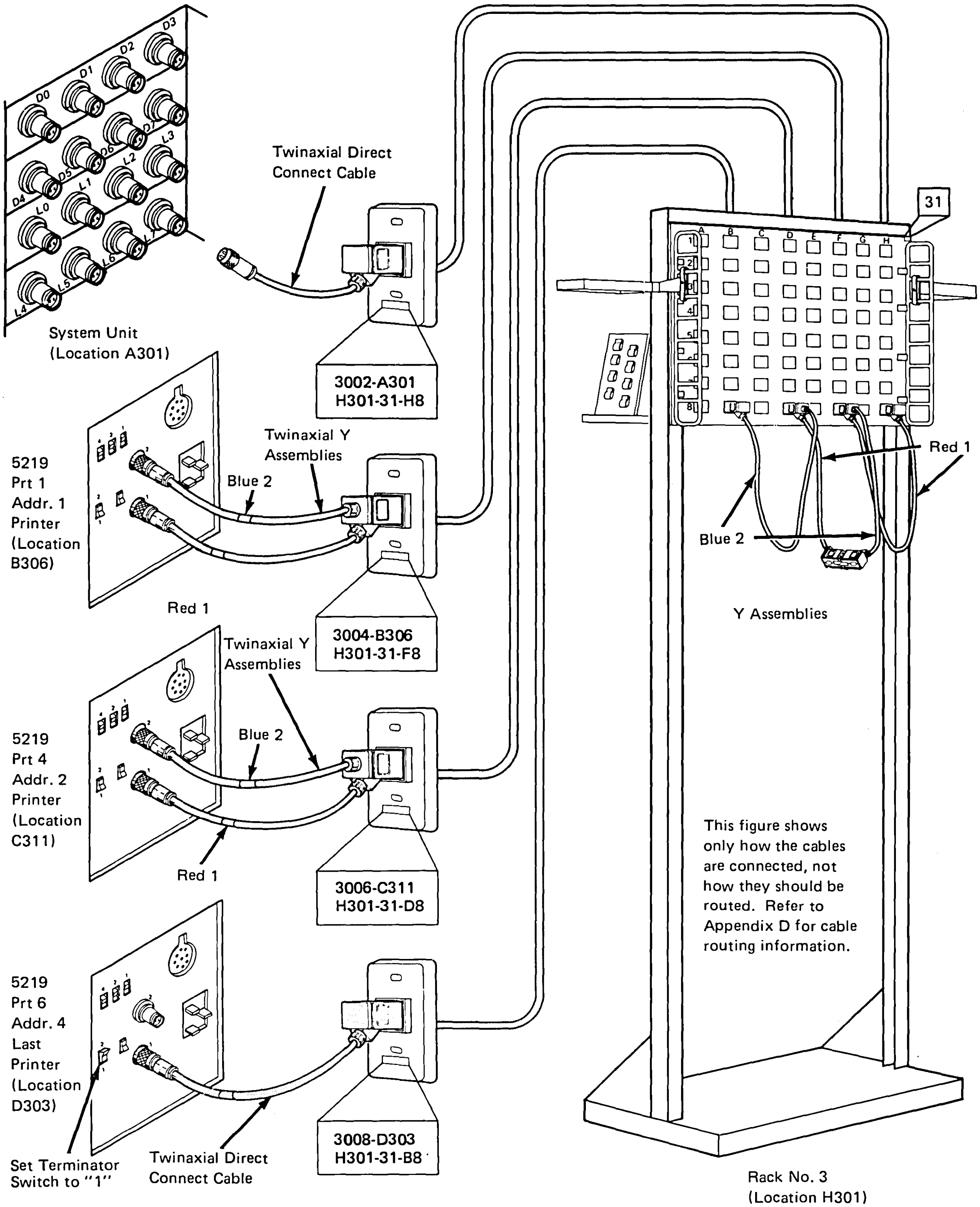
Building 1225 Floor 3	Cable Schedule				Wiring Closet Location H301 Date of Last Update
Cable Number	Cable Routing Information: Cable Runs From	Cable Routing Information: Cable Runs To	Cable Length	Distribution Panel Jumpers	Additional Information
3002	A301	H301-31-H8	100 ft.	H8 Red To F8 Red	System Unit (LDC)
3004	B306	H301-31-F8	75 ft.	F8 Blue To D8 Red	Y Assembly
3006	C311	H301-31-D8	80 ft.	D8 Blue To B8	Y Assembly
3008	D303	H301-31-B8	90 ft.	B8 To D8 Blue	Last Printer

System Configuration Worksheet

System 5520-4 Service Contact Ann White Telephone 555-4436

Attachment Description	Accessories in Work Area	Cable Runs from (Wall)	Cable & Cable Length	Cable Runs to (Panel)	Accessories on Equipment Rack
5525 Port L1 555-4200	TDC	A301	3002 L=100'	H301-31-H8	Red
5219 Prt 1 Address 1	TY	B306	3004 L=75'	H301-31-F8	Blue
5219 Prt 4 Address 2	TY	C311	3006 L=80'	H301-31-D8	Red
5219 Prt 6 Address 4	TDC	D303	3008 L=90'	H301-31-B8	Blue

Figure 3-3 (Part 1 of 2). Example of How the Cabling System Is Used with 5520 Printer Local Device Controller (LDC) Lines



Note: The 5520 Display Stations and Local Device Controller printers cannot share the same cable.

Figure 3-3 (Part 2 of 2). Example of How the Cabling System Is Used with 5520 Printer Local Device Controller (LDC) Lines

Building 1223 Floor 3	Cable Schedule			Wiring Closet Location H301 Date of Last Update	
Cable Number	Cable Routing Information: Cable Runs From	Cable Routing Information: Cable Runs To	Cable Length	Distribution Panel Jumpers	Additional Information
3002	A301	H301-31-B8	100 ft.	To LWC 0011 Port I/O	
3004	B306	H301-31-D8	120 ft.	To LWC 0011 Port 4	
3006	C311	H301-31-F8	150 ft.	To LWC 0011 Port 6	
3008	D303	H301-31-H8	200 ft.	To LWC 0011 Port 8	

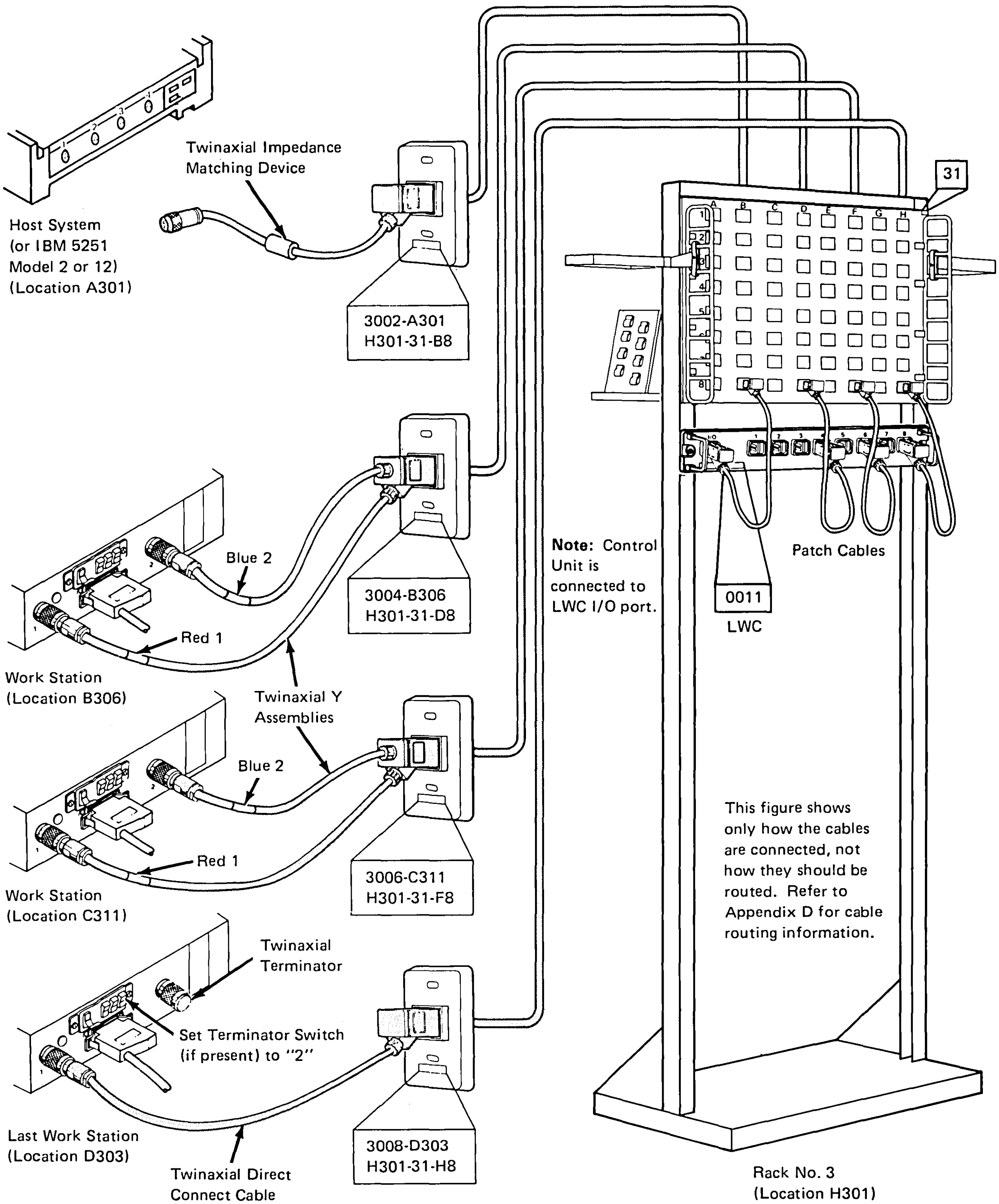
System Configuration Worksheet

System S/38 Service Contact Thom White Telephone 555-4436

Attachment Description	Accessories in Work Area	Cable Runs from (Wall)	Cable & Cable Length	Cable Runs to (Panel)	Accessories on Equipment Rack
System/38 Port 2 555-4400	IMD	A301	3002 L=100'	H301-31-B8	P-LWC #0011 Port I/O
WS00 5251-U Address=0 555-4401	TY	B306	3004 L=120'	H301-31-D8	P-LWC #0011 Port 4
WS01 5291 Address=1 555-3301	TY	C311	3006 L=150'	H301-31-F8	P-LWC #0011 Port 6
WS02 5291 Address=2 555-3202	TDC TT	D303	3008 L=200'	H301-31-H8	P-LWC #0011 Port 8

Note:
The LWC may be represented by a drawing on the System Configuration Worksheet.
Refer to the *IBM Cabling System Problem Determination Guide for Twinaxial Applications.*

Figure 3-4 (Part 1 of 2). Example of How the LWC Is Used with Twinaxial Applications



Note: A maximum of seven work stations can be connected to an LWC. Be sure to connect the last (terminated) work station to a radial port on the LWC that has a higher number than the radial ports to which the other work stations on the data path are connected.

Figure 3-4 (Part 2 of 2). Example of How the LWC Is Used with Twinaxial Applications

Multiple Devices Supported from a Single Faceplate

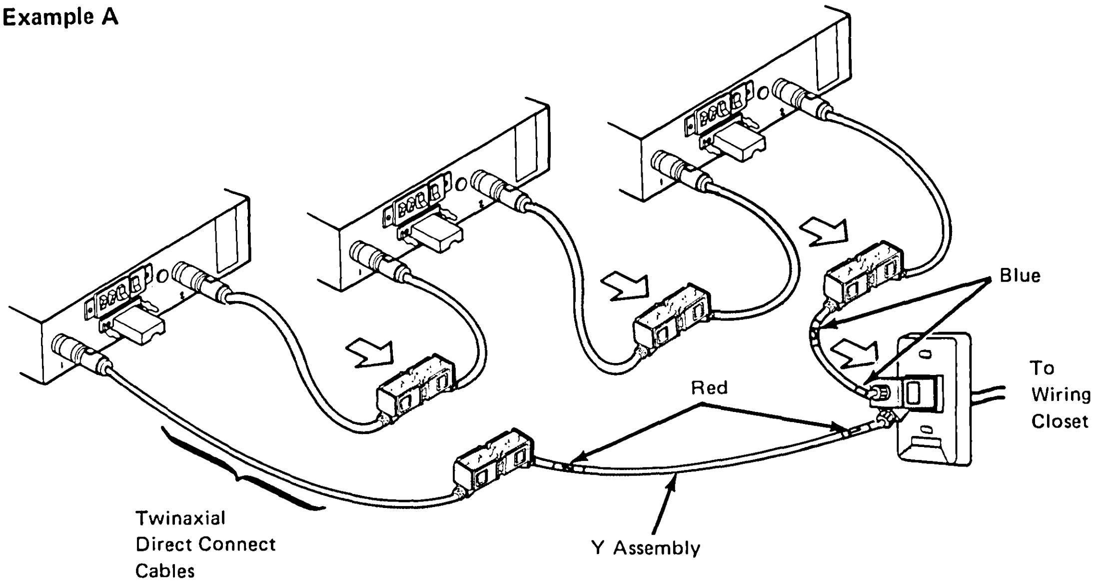
Typically, only one twinaxial device is attached to each cabling system faceplate. If there are not enough faceplates in a work area to permit one device per faceplate, the installation can be cabled so that multiple devices are supported from a single faceplate. The configuration limits specified at the end of this chapter still apply in such cases. The maximum signal path length must not be exceeded.

Figure 3-5 shows two examples of how multiple devices can be attached to a single faceplate. In Example A, three devices are attached between the red and blue legs of a Y assembly that is connected to a cabling system faceplate. The devices are connected together with twinaxial direct connect cables.

In Example B, a twinaxial Y assembly is used to attach each device to a Y assembly. The three Y assemblies are attached between the red and blue legs of a Y assembly that is connected to a cabling system faceplate. This configuration has the advantage that each device can be removed from the system without disrupting the data path. A device is removed by disconnecting its twinaxial Y assembly from the Y assembly.

In both examples, patch cables can be used to extend the length of the accessories so that the device can be placed farther from the faceplate. The arrows in Figure 3-5 indicate the points where patch cables can be connected. Again, the maximum signal path length must not be exceeded.

Example A



Example B

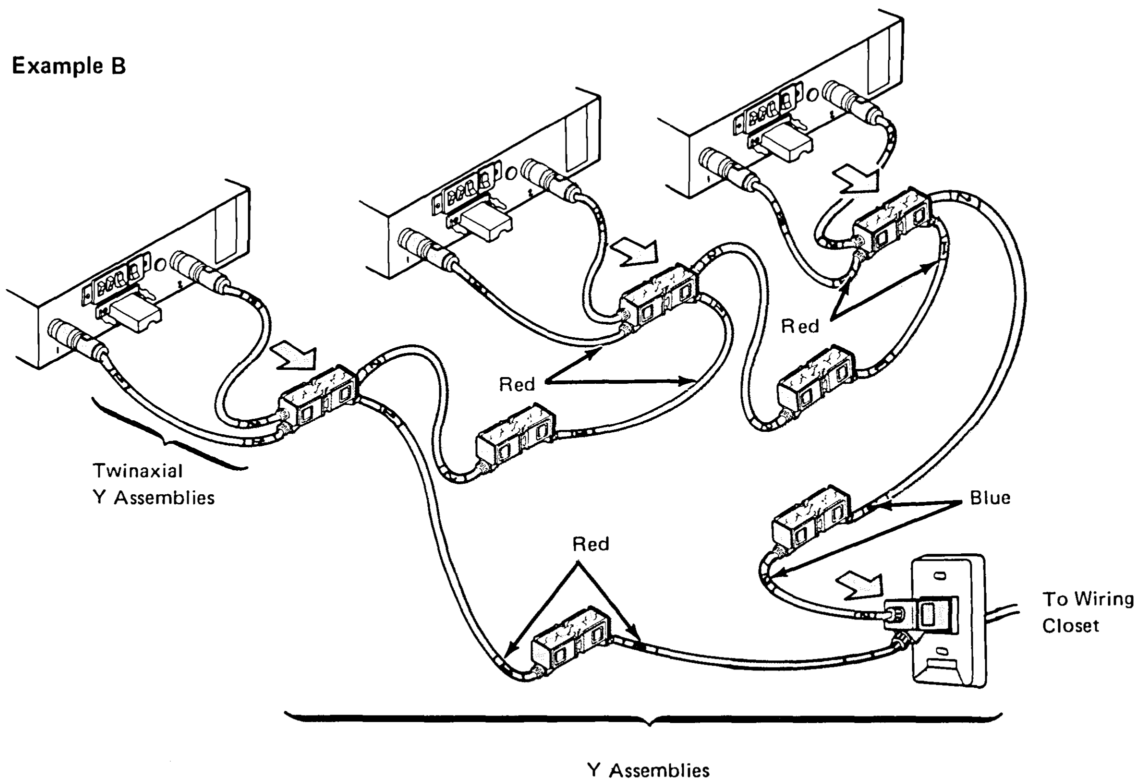


Figure 3-5. Examples of Multiple Devices Supported from a Single Faceplate

Loop Wiring Concentrator (LWC) Labeling

Label each LWC with a unique four-digit unit identification number. All of the LWCs in your installation should be labeled with consecutive numbers, starting with "0001" for the first LWC. Place the label in the designated area on the front of the LWC. For example, in Figure 3-4, the LWC is labeled "0011."

Record this information on the Cable Schedule described in "Keeping Records of Cables" in Chapter 3 of the *IBM Cabling System Planning and Installation Guide.*

Hierarchical Configuration of Loop Wiring Concentrators

You may use one or more LWCs to connect cabling system drops. It is recommended that you arrange the LWCs in a hierarchical configuration. The hierarchy may consist of one or two levels. Each level is described below.

One-level Configuration

When there is only one level to the hierarchy:

- Only one LWC is used.
- The control unit must be connected to the I/O port of the LWC.
- The last (or terminated) work station must be connected to a radial port that has a higher number than the radial ports to which the other work stations on the data path are connected.
- For the 5520 Administrative System, up to seven terminals or eight printers may be connected to the radial ports of the LWC.
- For the 5250 Information Display System, up to seven work stations may be connected to the radial ports of the LWC.

See Figure 3-6 for an example of a one-level configuration.

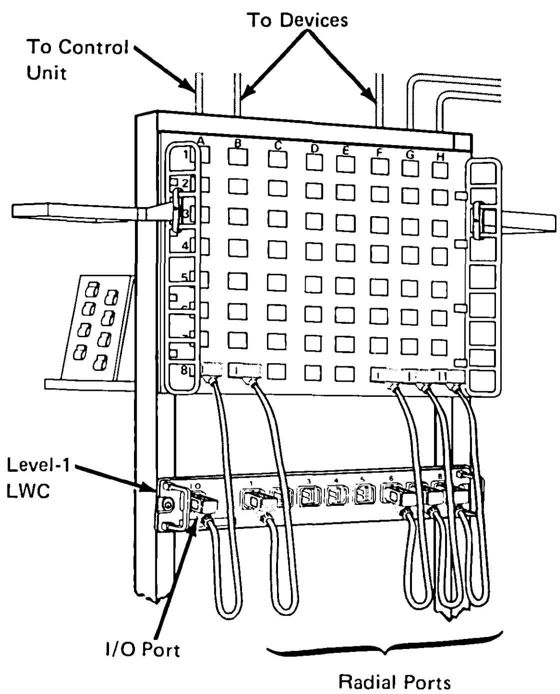


Figure 3-6. One-level Configuration of LWCs in a Twinaxial Application

Two-level Configuration

When there are two levels to the hierarchy:

- Connections between levels are made from the level-1 LWC radial ports to the level-2 LWC I/O ports.
- The control unit must be connected to the I/O port of the level-1 LWC.
- The last (or terminated) work station must be connected to a radial port on a level-2 LWC that has a higher number than the radial ports to which the other work stations on the data path are connected.
- For the 5520 Administrative System, up to seven terminals or eight printers may be connected to the radial ports of the level-1 LWC or level-2 LWCs.
- For the 5250 Information Display System, up to seven work stations may be connected to the radial ports of either level-1 LWC or level-2 LWCs.

See Figure 3-7 for an example of a two-level configuration.

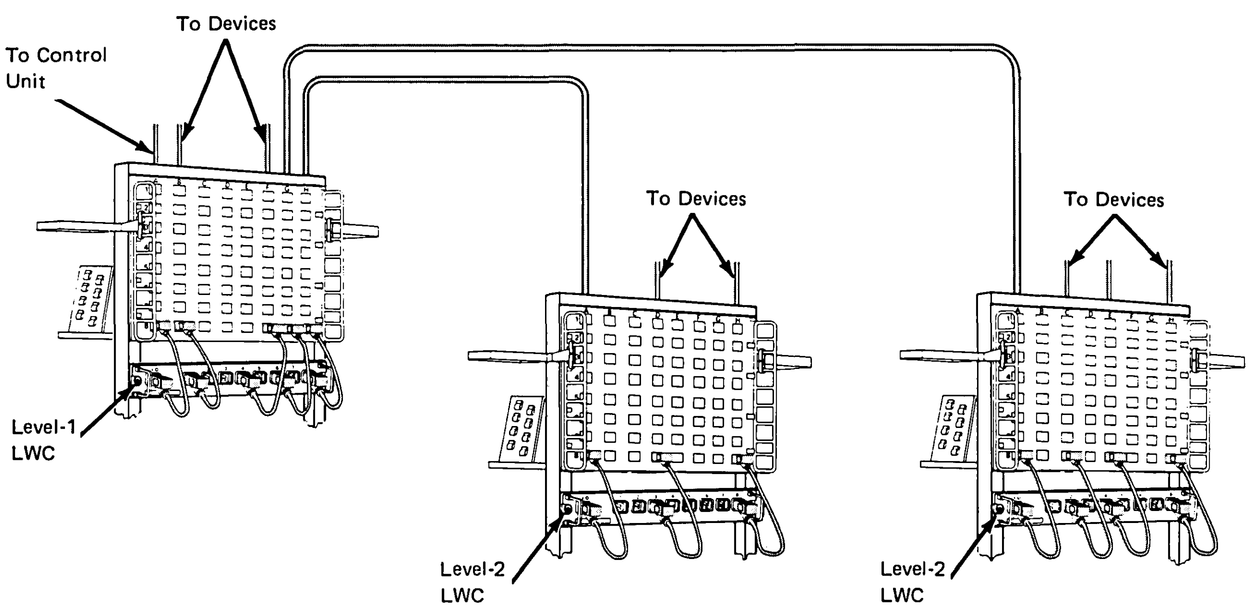


Figure 3-7. A Two-level Configuration of LWCs in a Twinaxial Application

Cable End Labels (5520 Administrative System Only)

For information on how to label the cable ends, refer to *IBM 5520 Administrative System Installation Manual Physical Planning.*

Planning and Ordering Procedure for Twinaxial Accessories

1. Remove the Attaching Products Worksheet from Appendix A and make several photocopies.

   Note: The worksheet is used for ordering accessories for all attaching systems. Use only the section for twinaxial applications.

2. Determine your twinaxial accessory requirements as follows:

   a. Enter the total number of impedance matching devices on line Twinax-1.

      - For the 5520, two are required for each display line.
      - For the 5250, one for each port used on the host and one for each device without cable-thru are required.

   b. Enter the number of Y assemblies and twinaxial Y assemblies on lines Twinax-2 and Twinax-3, respectively. Order one of *each* for each work station, display station, or printer with cable-thru installed, except for the last device on each line. Y assemblies are not needed if an LWC is used at the distribution panel.

   c. Enter the number of twinaxial direct connect cables on line Twinax-4.

      - For the 5520, two are required for each printer line.
      - For the 5250, one is required for each port, except when the last device does not have cable-thru; then none is required.

d. Enter the number of twinaxial terminators required on line Twinax-5. One terminator is required for the last or only 5250 work station, display station, or printer on each port, except when the last display does not have cable-thru; then no terminator is required. The 5520 system does not use the terminator.

e. Enter the number of LWCs on line Twinax-6. LWCs are not needed when Y assemblies are used at the distribution panel.

- For the 5520, one LWC is required for each group of seven terminals or eight printers (or fraction thereof).

- For the 5250, one LWC is required for each group of seven work stations (or fraction thereof).

f. Enter the number of cable brackets on line Twinax-7. One is required for each rack-mounted LWC.

g. Enter the number of patch cables on lines Twinax-8 and Twinax-9. Use a patch cable:

- To connect a cable drop to an LWC port. One 2.4-meter (8-foot) patch cable is required for each LWC port used.

- As an extension cable for twinaxial Y assemblies. Order one patch cable for each twinaxial Y you want to extend.

3. Go to Chapter 11 to see if it is applicable.

4. Fill out the Complete Order Summary Worksheet:

a. Remove the Complete Order Summary Worksheet from Appendix A and make one photocopy of each page.

b. Copy the information from the Order Summary Worksheet you filled out in the *IBM Cabling System Planning and Installation Guide* to Part 1 and Part 2 of the Complete Order Summary Worksheet. Be careful to copy the information accurately.

c. Complete Part 3 and Part 4 using information from *all* of the Attaching Products Worksheets that have been completed. For each accessory, find the total number you will need. Add 10% to that number and enter the result under "Quantity."

Configuration Limits

Strict adherence to the recommended maximum cable lengths is required.

In some configurations, type 6, 8, or 9 cable is combined with type 1 or type 2 cable. When computing configuration limits, the higher attenuation of types 6, 8, and 9 cable must be accounted for. This is accomplished by using "equivalent length" rather than actual cable length when calculating the signal path length. The equivalent length of a combined section of cable is the length of type 1 or type 2 cable that would have the same attenuation. For Twinaxial Cable applications, the formulas for computing the equivalent length are:

Equivalent length = A + 2B + 2.5C (5520 printers only)
A + 2B + 1.5C (except 5520 printers)

Where: A is the actual length of type 1 or type 2 cable
B is the actual length of type 8 cable
C is the actual length of type 6 or 9 cable

Example: For 1000 feet of type 1 cable and 100 feet of type 8 cable:

equivalent length = 1000 + 2(100) = 1200 feet

Signal Path Length

The *maximum* signal path length allowed is 1525 meters (5000 feet).

Note: In the United Kingdom, the maximum signal path length allowed for LDC lines is 1067 meters (3500 feet).

The signal path length is the *sum* of:

- The equivalent length of cable from the system port or line to the wiring closet.
- The equivalent length of cable between wiring closets.
- Two times (2x) the equivalent length of cable between the wiring closet and each work station, display station, or printer *except* the last unit.
- The equivalent length of cable between the wiring closet and the last or only work station, display station, or printer.
- 112 meters (368 feet) for each pair of surge suppressors after the first pair. (The 5520 display and printer lines are limited to only one pair of surge suppressors.)

For the twinaxial systems operating on the IBM Cabling System, the maximum of 11 connectors specified in the twinaxial systems documentation can be ignored.

For information on the maximum cable drop lengths, see "Maximum Cable Drop-Lengths" in Chapter 4 of the *IBM Cabling System Planning and Installation Guide.*

4

How to Use the Cabling System for Finance Communication System Loop Applications

This chapter describes how to use the cabling system to wire IBM 4700 or 3600 Finance Communication System Loops. (For information on 4700 and 3600 device cluster adapter [DCA] printers and displays, see Chapter 2.)

Contents Chapter 4

General Planning Considerations 4-2
Plug and Jack Y Assembly 4-2
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Cable Bracket 4-5
Loop Wiring Concentrator (LWC) Labeling 4-10
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Planning and Ordering Procedure for Finance Communication Loop Accessories 4-11
Configuration Limits 4-12

General Planning Considerations

This chapter supplements the wiring information contained in the following IBM publications:

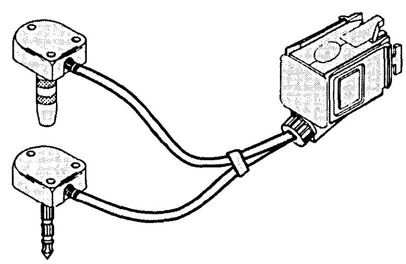
- *IBM 4700 Finance Communication System Installation Planning Manual,* GC31-2018
- *IBM 3600 Finance Communication System Installation Manual—Physical Planning,* GA27-2766
- *IBM Cabling System Installation Planning Introduction for 4700 and 3600 Systems,* GC31-2524.

(For information on how to get the above publications, see "How to Order IBM Publications" in the Preface of this manual.)

Before using this chapter, you must complete:

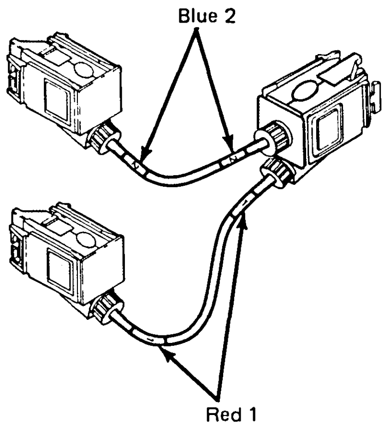
- The planning for your finance communication system loop (using one of the above IBM publications)
- The general planning and ordering procedure in Chapter 4, "How to Plan for and Order Cables and Accessories" in the *IBM Cabling System Planning and Installation Guide.*

Plug and Jack Y Assembly



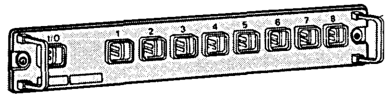
- Used in work areas to connect 4700 and 3600 loop work stations to a cabling system receptacle
- Approximate length (each leg) 0.5 meter (1.5 feet)
- Part number 8310552.

Y Assembly



- Used at the distribution panel when connecting 4700 and 3600 loop work stations to a cabling system receptacle.
- Y assemblies are not needed when loop wiring concentrators are used at the equipment rack.
- Each leg of the Y assembly is color-coded and numbered. For the proper way to connect the connectors, see Figure 4-1.
- Approximate length (each leg) 1.2 meters (4 feet).
- Part number 8642549.

Loop Wiring Concentrator (LWC)

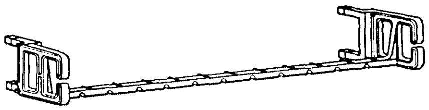


- Used in wiring closets in place of Y assemblies to connect the cabling system drops so that they form a loop configuration.

- Used in place of Y assemblies to reduce cable congestion on the distribution panel and make reconfiguration and problem determination easier.

- Install LWCs in the equipment rack and connect them to the distribution panel with 2.4-meter (8-foot) patch cables.

- Part number 6091077.



Cable Bracket

- Used for cable management at the equipment rack
- Attaches to the handles of the LWC
- Part number 6091042.

Cable Schedule

Building 421
Floor 1

Wiring Closet Location L101
Date of Last Update

Cable Number	Cable Routing Information: Cable Runs From	Cable Routing Information: Cable Runs To	Cable Length	Distribution Panel Jumpers	Additional Information
1002	K101	L101-11-G8	100 ft.	G8 Red To B8 Blue	Y Assembly
1007	H103	L101-11-B8	200 ft.	B8 Red To D8 Blue	Y Assembly
1004	G104	L101-11-D8	150 ft.	D8 Red To G8 Blue	Y Assembly

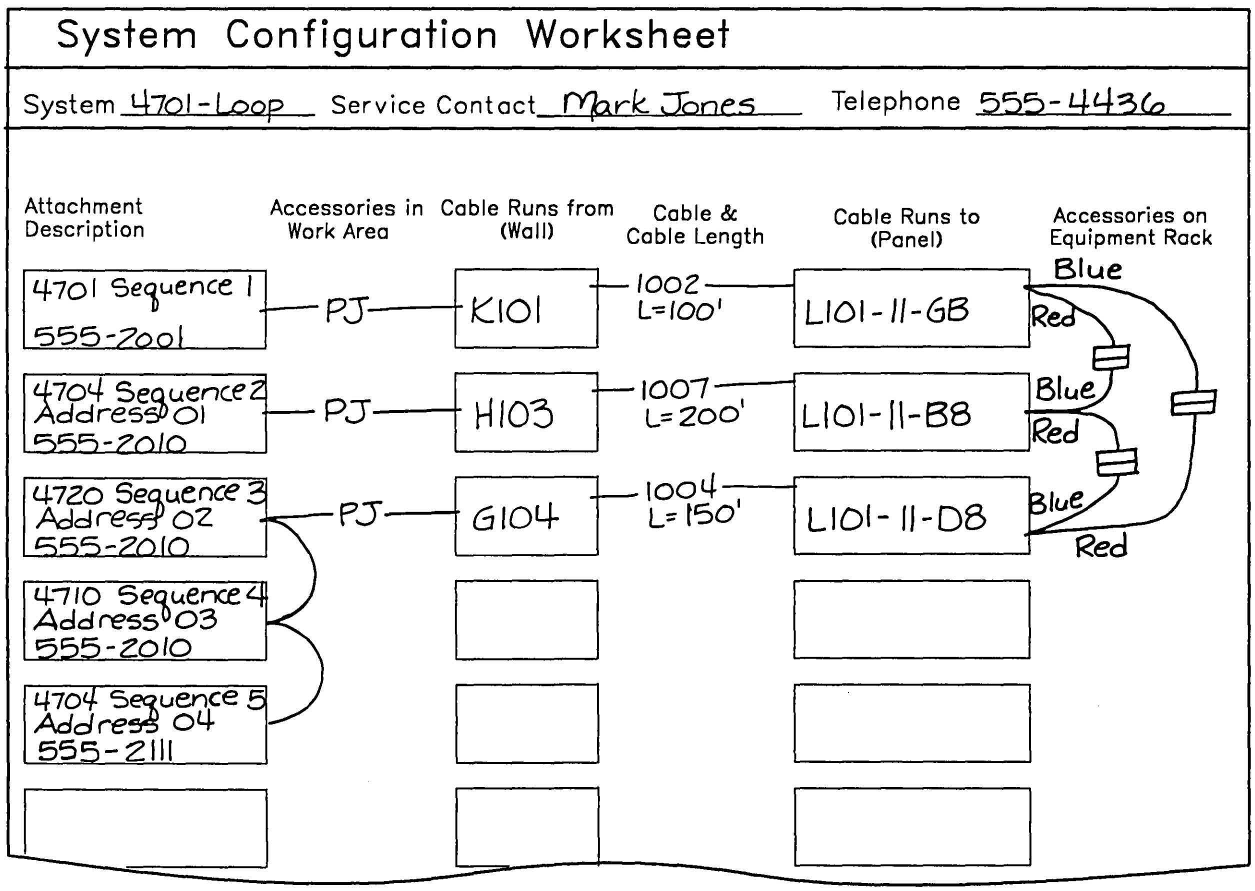


Figure 4-1 (Part 1 of 2). Example of How the Cabling System Is Used with 4700 and 3600 Systems

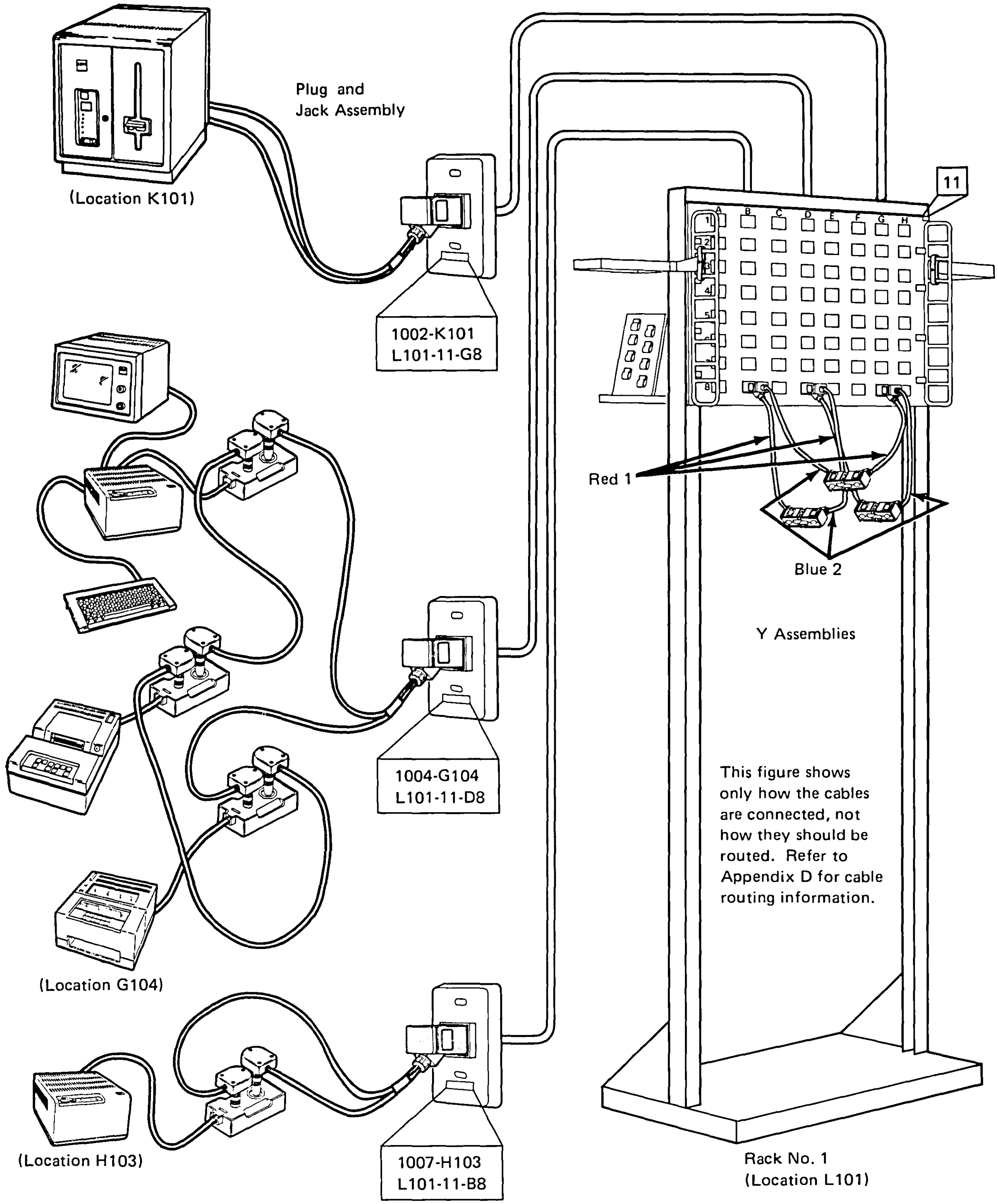


Figure 4-1 (Part 2 of 2). Example of How the Cabling System Is Used with 4700 and 3600 Systems

Cable Schedule

Building 421 | Floor 1 | Wiring Closet Location L101 | Date of Last Update

Cable Number	Cable Routing Information: Cable Runs From	Cable Routing Information: Cable Runs To	Cable Length	Distribution Panel Jumpers	Additional Information
1002	K101	L101-11-G8	100 ft.	To LWC #0001 Port 8	
1007	H103	L101-11-B8	200 ft.	To LWC #0001 Port 2	
1004	G104	L101-11-D8	150 ft.	To LWC #0001 Port 4	

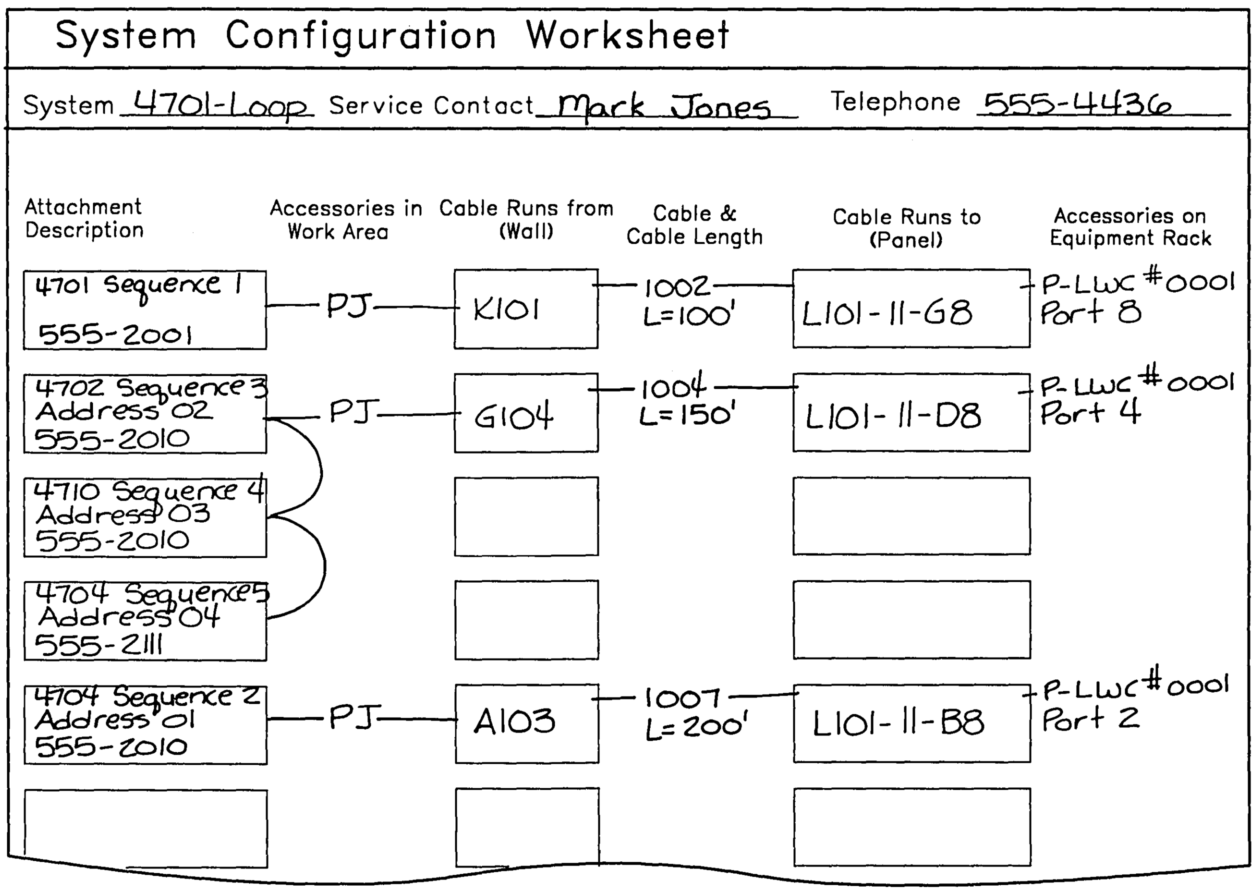


Figure 4-2 (Part 1 of 2). Example of How the LWC Is Used with Finance Communication Loop Applications

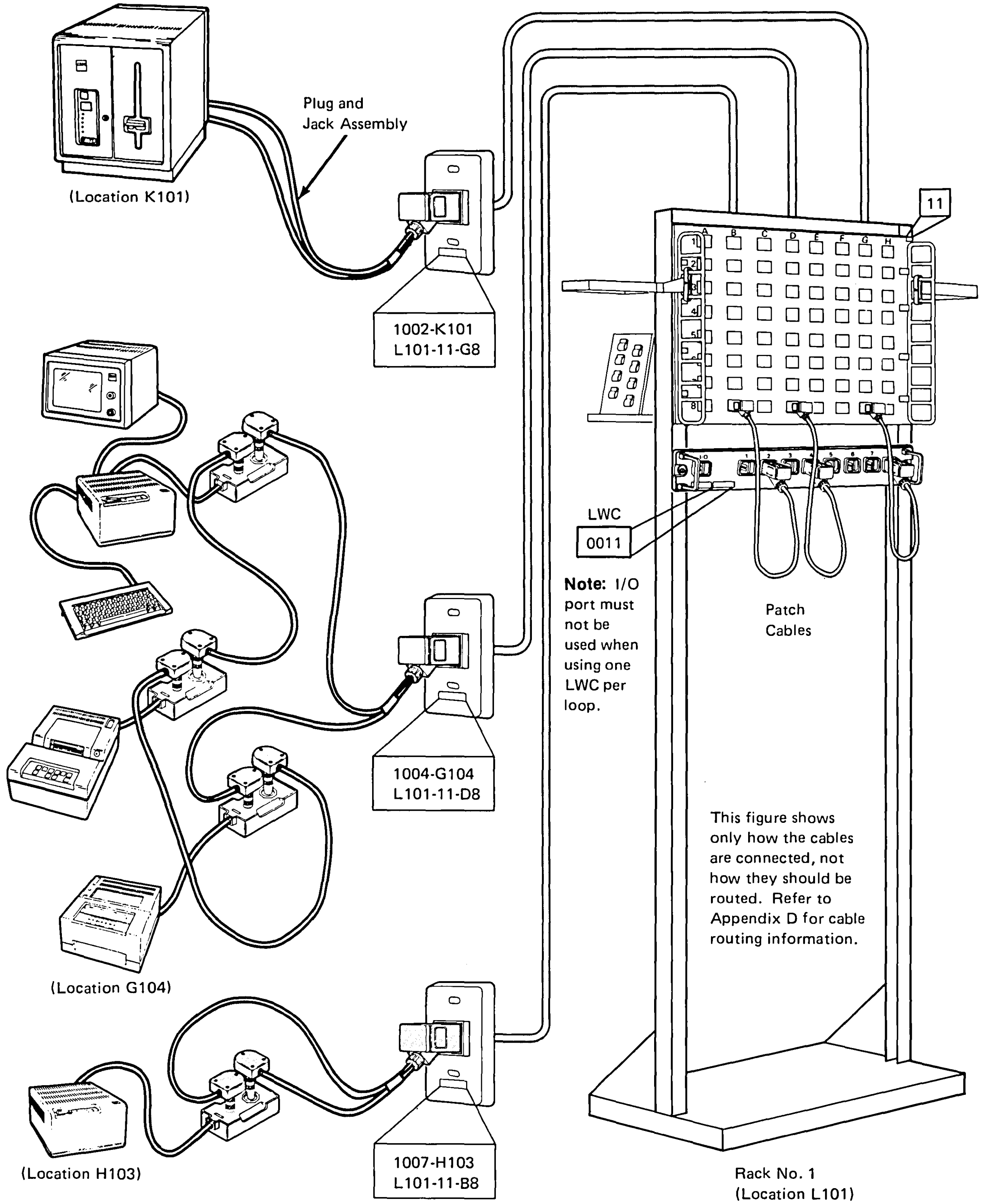


Figure 4-2 (Part 2 of 2). Example of How the LWC Is Used with Finance Communication Loop Applications

Loop Wiring Concentrator (LWC) Labeling

Label each LWC with a unique four-digit number unit identification number. All of the LWCs in your installation should be labeled with consecutive numbers, starting with "0001" for the first LWC. Place the label in the designated area on the front of the LWC. For example, in Figure 4-2, the LWC is labeled "0011."

Record this information on the Cable Schedule described in "Keeping Records of Cables" in Chapter 3 of the *IBM Cabling System Planning and Installation Guide.*

How to Configure LWCs

You may need to use one or more LWCs with your loop system. Go to Appendix B for information on the type of configuration you should use.

Planning and Ordering Procedure for Finance Communication Loop Accessories

1. Remove the Attaching Products Worksheet from Appendix A and make several photocopies.

   Note: The worksheet is used for ordering accessories for all attaching systems. Use only the section for 4700 and 3600 Finance Communication System loop applications.

2. Determine your accessory requirements as follows:

   a. Enter the total number of plug and jack Y assemblies on line 4700-1. One plug and jack assembly is required for each type 1, 1S, 1W, 2, and 2S faceplate.

   b. Enter the number of Y assemblies on line 4700-2. Y assemblies are not needed when LWCs are used. One Y assembly is required for each type 1, 1S, 1W, 2, and 2S faceplate.

   c. Enter the number of LWCs on line 4700-3. LWCs are not needed when Y assemblies are used at the distribution panel. One LWC is required for each group of eight faceplates (or fraction thereof).

      Note: An LWC can be used to form only one loop.

   d. Enter the number of cable brackets on line 4700-4. Order one bracket for each rack-mounted LWC.

   e. Enter the number of patch cables on lines 4700-5 and 4700-6. Use a patch cable:

      - To connect a cable drop to an LWC port. One 2.4-meter (8-foot) patch cable is required for each LWC port used.
      - As an extension cable for twinaxial Y assemblies. Order one patch cable for each twinaxial Y you want to extend.

3. Go to Chapter 11 to see if it is applicable.

4. Fill out the Complete Order Summary Worksheet:

   a. Remove the Complete Order Summary Worksheet from Appendix A and make one photocopy of each page.
   b. Copy the information from the Order Summary Worksheet you filled out in the *IBM Cabling System Planning and Installation Guide* to Part 1 and Part 2 of the Complete Order Summary Worksheet. Be careful to copy the information accurately.
   c. Complete Part 3 and Part 4 using information from *all* of the Attaching Products Worksheets that have been completed. For each accessory, find the total number you will need. Add 10% to that number and enter the result under "Quantity."

Configuration Limits

In some configurations, type 6, 8, or 9 cable is combined with type 1 or type 2 cable. When computing configuration limits, the higher attenuation of types 6,8, and 9 cable must be accounted for. This is accomplished by using "equivalent length" rather than actual cable length when calculating the signal path length. The equivalent length of a combined section of cable is the length of type 1 or type 2 cable that would have the same attenuation. For Finance Communication System Loop applications, the formula for computing the equivalent length is:

Equivalent length = A + 2B + 3.3C
Where: A is the actual length of type 1 or type 2 cable
B is the actual length of type 8 cable
C is the actual length of type 6 or 9 cable

Example: For 300 feet of type 1 cable, 100 feet of type 8 cable, and 150 feet of type 9 cable:

equivalent length = 300 + 2(100) + 3.3(150) = 995 feet

Signal Path Length

The *maximum* signal path length allowed is 610 meters (2000 feet). The signal path is the *sum* of the following:

- Two times (2x) the equivalent length of the cable between the wiring closet and the work area faceplate
- Two times (2x) the equivalent length of cable between wiring closets when the return loop path is in the same cable
- The equivalent length of cable between the terminals in the work area
- 112 meters (368 feet) for each pair of surge suppressors after the first pair.

For information on the maximum cable drop lengths, see "Maximum Cable Drop Lengths" in Chapter 4 of the *IBM Cabling System Planning and Installation Guide.*

5

How to Use the Cabling System for Programmable Store System Applications

This chapter describes how to use the cabling system for wiring IBM 3680 and 3650 Programmable Store System devices.

Contents
Chapter 5

General Planning Considerations 5-2
General Purpose Attachment Cable 5-2
WE Type-404B Receptacle (or Equivalent) 5-3
Loop Wiring Concentrator (LWC) 5-3
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Loop Wiring Concentrator (LWC) Labeling 5-6
How to Configure LWCs 5-6
Planning and Ordering Procedure for
Programmable Store System Accessories 5-7
Configuration Limits 5-8

General Planning Considerations

This chapter supplements the wiring information contained in the following IBM publications:

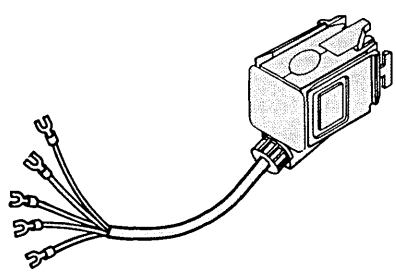
- *IBM 3680 Programmable Store System Planning and Site Preparation Guide*, GA27-3213
- *IBM 3650 Programmable Store System Installation Manual—Physical Planning*, GA27-3167.

(For information on how to get the above publications, see "How to Order IBM Publications" in the Preface of this manual.)

Before using this chapter, you must complete:

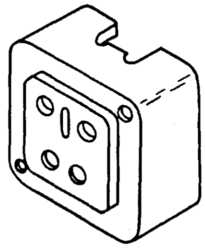
- The planning for your store system (using the above IBM publications)
- The general planning and ordering procedure in Chapter 4, "How to Plan for and Order Cables and Accessories" in the *IBM Cabling System Planning and Installation Guide*.

General Purpose Attachment Cable



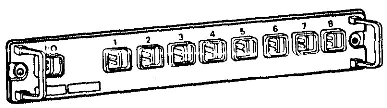
- Used to attach Western Electric (WE) type-404B receptacle (or equivalent) to a cabling system receptacle. (See "Making Store Loop Attachment Cables" in Appendix E.)
- Approximate length 2.4 meters (8 feet).
- Part number 8310554.

WE Type 404-B Receptacle (or Equivalent)



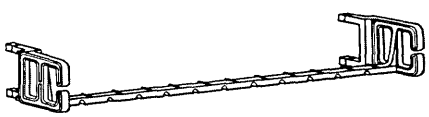
- Attaches to general purpose attachment cable
- Not available from IBM.

Loop Wiring Concentrator (LWC)



- Used in wiring closets to connect the cabling system drops so that they form a loop configuration.
- Install LWCs in the equipment rack and connect them to the distribution panel with 2.4-meter (8-foot) patch cables.
- Part number 6091077.

Cable Bracket



- Used for cable management at the equipment rack
- Attaches to the handles of the LWC
- Part number 6091042.

Building 118 Floor 2	Cable Schedule	Wiring Closet Location K201 Date of Last Update

Cable Number	Cable Routing Information		Cable Length	Distribution Panel Jumpers	Additional Information
	Cable Runs From	Cable Runs To			
2001	H220	K201-12-A8	300 ft.	To LWC #0001 Port 1	
2002	G210-1	K201-12-D8	150 ft.	To LWC #0001 Port 4	
2003	G210-2	K201-12-C8	150 ft.	To LWC #0001 Port 3	
2004	G210-3	K201-12-B8	150 ft.	To LWC #0001 Port 2	

System Configuration Worksheet

System 3680 Service Contact Barbara Hart Telephone 555-4436

Attachment Description	Accessories in Work Area	Cable Runs from (Wall)	Cable & Cable Length	Cable Runs to (Panel)	Accessories on Equipment Rack
3683 Address F7 555-3428	GPA/4048	G210-1	2002 L=150'	K201-12-D8	P-LWC #0011 Port 4
3683 Address F6 555-3600	GPA/4048	G210-2	2003 L=150'	K201-12-C8	P-LWC #0011 Port 3
3683 Address F5 555-3627	GPA/4048	G210-3	2004 L=150'	K201-12-B8	P-LWC #0011 Port 2
3684 Address FF 555-4444	GPA/4048	H220	2001 L=150'	K201-12-A8	P-LWC #0011 Port 1

Figure 5-1 (Part 1 of 2). Example of How the Cabling System Is Used with Store Systems

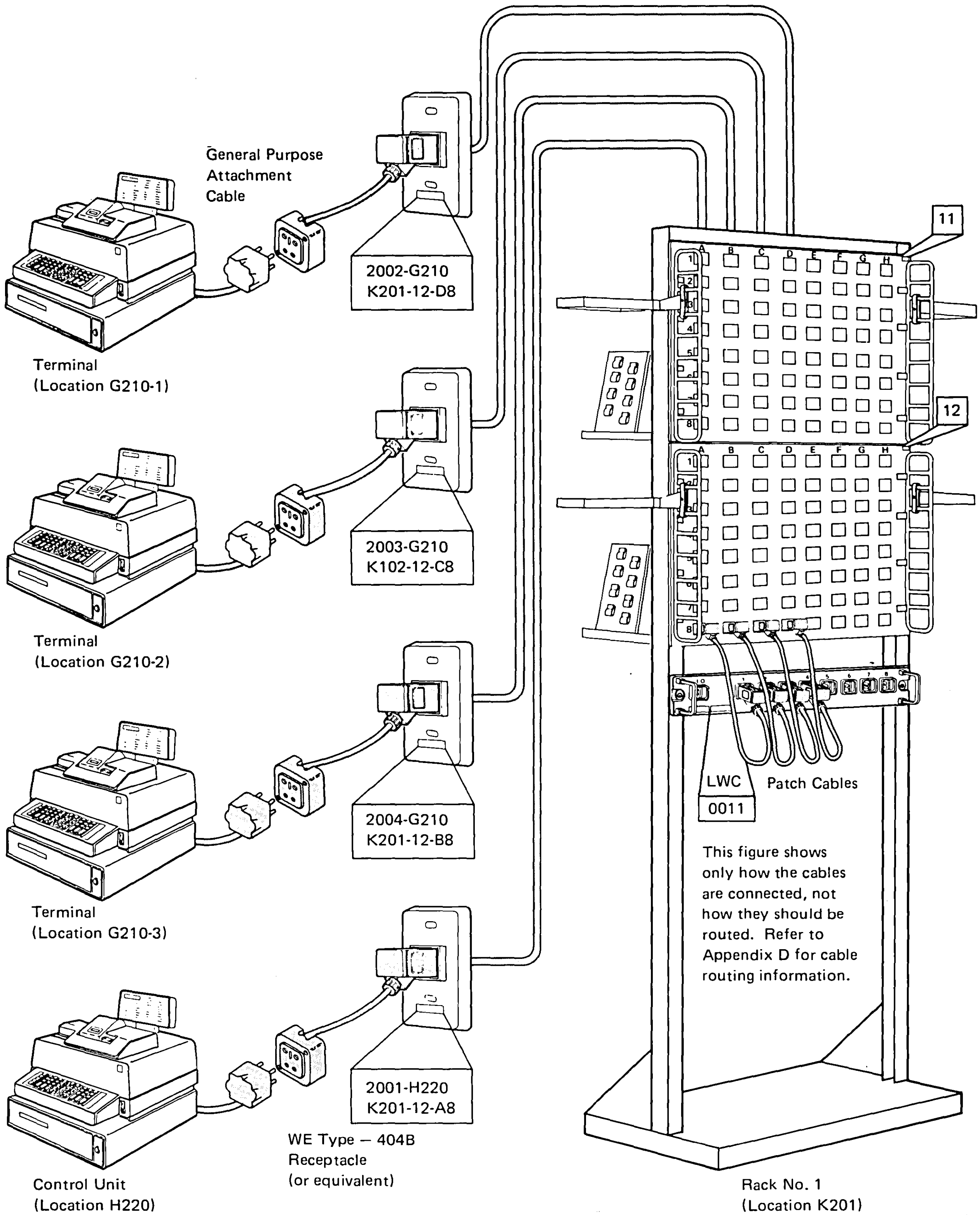


Figure 5-1 (Part 2 of 2). Example of How the Cabling System Is Used with Store Systems

Loop Wiring Concentrator (LWC) Labeling

Label each LWC with a unique four-digit number unit identification number. All of the LWCs in your installation should be labeled with consecutive numbers, starting with "0001" for the first LWC. Place the label in the designated area on the front of the LWC. For example, in Figure 5-1, the LWC is labeled "0011."

Record this information on the Cable Schedule described in "Keeping Records of Cables" in Chapter 3 of the *IBM Cabling System Planning and Installation Guide.*

How to Configure LWCs

You many need to use one or more LWCs with your loop system. Go to Appendix B for information on the type of configuration you should use.

Planning and Ordering Procedure for Programmable Store System Accessories

1. Remove the Attaching Products Worksheet in Appendix A, and make several photocopies of the worksheet.

   Note: The worksheet is used for ordering accessories for all attaching systems. Use only the section for store loop systems.

2. Determine your store loop accessory requirements as follows:

   a. Enter the number of general purpose attachment cables and the number of WE type-404B (or equivalent) receptacles on lines SLoop-1 and SLoop-2, respectively.

      - One general purpose attachment cable is required for each type 1 or 2 faceplate.

      - One WE type-404B (or equivalent) receptacle is required for each type 1 or 2 faceplate.

   b. Enter the number of LWCs on line SLoop-3. One LWC is required for each group of eight general purpose attachment cables with WE type-404B receptacles attached (or fraction thereof).

      Note: An LWC can be used to form only one loop.

   c. Enter the number of cable brackets on line SLoop-4. Order one bracket for each rack-mounted LWC.

   d. Enter the number of patch cables on line SLoop-5. One 2.4-meter (8-foot) patch cable is required for each LWC port used, including the I/O port.

3. Go to Chapter 11 to see if it is applicable.

4. Fill out the Complete Order Summary Worksheet:

   a. Remove the Complete Order Summary Worksheet from Appendix A and make one photocopy of each page.

   b. Copy the information from the Order Summary Worksheet you filled out in the *IBM Cabling System Planning and Installation Guide* to Part 1 and Part 2 of the Complete Order Summary Worksheet. Be careful to copy the information accurately.

   c. Complete Part 3 and Part 4 using information from *all* of the Attaching Products Worksheets that have been completed. For each accessory, find the total number you will need. Add 10% to that number and enter the result under "Quantity."

Configuration Limits

In some configurations, type 6, 8, or 9 cable is combined with type 1 or type 2 cable. When computing configuration limits, the higher attenuation of types 6, 8 and 9 cable must be accounted for. This is accomplished by using "equivalent length" rather than actual cable length when calculating the cable length between devices. The equivalent length of a combined section of cable is the length of type 1 or type 2 cable that would have the same attenuation. For Programmable Store System applications, the formula for computing the equivalent length is:

Equivalent length = A + 2B + 2.5C
Where: A is the actual length of type 1 or type 2 cable
B is the actual length of type 8 cable
C is the actual length of type 6 or 9 cable

Example: For 1000 feet of type 1 cable and 100 feet of type 8 cable:

equivalent length = 1000 + 2(100) = 1200 feet

Cable Length between Devices

For 3650 and 3680 systems, the *maximum* signal path length allowed between units that have the power on is 1220 meters (4000 feet).

The signal path length between two devices is the *sum* of the following:

- The equivalent length of cable from the first device to the wiring closet
- The equivalent length of cable between LWCs
- The equivalent length of cable from the wiring closet to the next device.

Note: For configuring loops that do not require power on specific devices, the complete signal path loop must be less than 1220 meters (4000 feet). (This loop is equal to two times the equivalent length of all the cable in the loop.)

All cable runs between devices must come through the distribution panel in the wiring closet.

Outdoor cable runs and surge suppressors must not be used for store systems.

For more information on the maximum cable drop lengths, see "Maximum Cable Drop Lengths" in Chapter 4 of the *IBM Cabling System Planning and Installation Guide.*

6

How to Use the Cabling System for Multiuse Communication Loop (MCL) Applications

This chapter describes how to use the cabling system to wire an IBM Multiuse Communication Loop (MCL). The cabling system can be used to wire the IBM 8100 Information System.

Contents Chapter 6

General Planning Considerations 6-2
Loop Station Connector (LSC) Surface Mount Device (Type 1LS) 6-2
Loop Wiring Concentrator (LWC) 6-3
Cable Bracket 6-3
Component Housing 6-3
Loop Wiring Concentrator (LWC) Labeling 6-10
How to Configure LWCs 6-10
Planning and Ordering Procedure for MCL Accessories 6-10
Configuration Limits 6-11
Exact Method of Determining Configuration Limits 6-12

General Planning Considerations

This chapter supplements the wiring information contained in the following IBM publications:

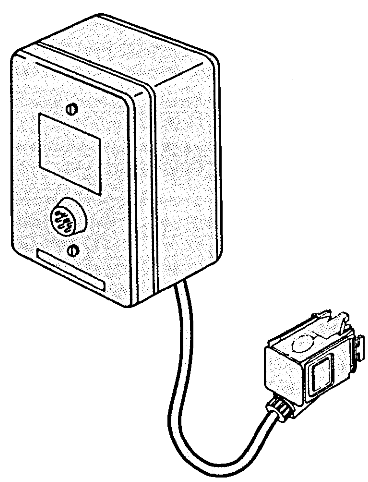
- *IBM Multiuse Communication Loop Planning and Installation Guide*, GA27-3341
- *Guide to Multiuse Communication Loop with IBM Cabling System*, GA27-3606.

(For information on how to get the above publications, see "How to Order IBM Publications" in the Preface of this manual.)

Before using this section, you must complete:

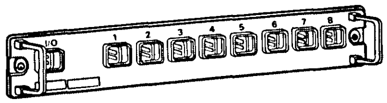
- The planning for your MCL system (using the above IBM publications)
- The general planning and ordering procedure in Chapter 4, "How to Plan for and Order Cables and Accessories" in the *IBM Cabling System Planning and Installation Guide.*

Loop Station Connector (LSC) Surface Mount Device (Type 1LS)



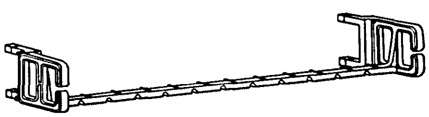
- Used to connect loop devices to cabling system receptacles.
- A *free-standing* device housing with a magnetic backing that attaches to metal furniture or walls. Can also be attached with screws (not provided).
- Approximate length of connecting cable 0.5 meter (1.5 feet).
- Part number 4760511.

Loop Wiring Concentrator (LWC)



- Used in wiring closets to connect the cabling system drops so that they form a loop configuration.
- Install LWCs in the equipment rack and connect them to the distribution panel with 2.4-meter (8-foot) patch cables. LWCs can also be mounted in a special component housing. See "Component Housing" below.
- Part number 6091077.

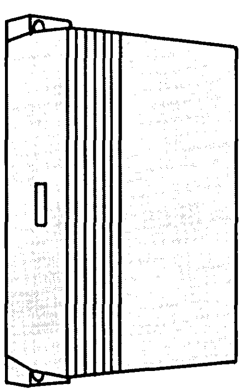
Cable Bracket



- Used for cable management at the equipment rack
- Attaches to the handles of the rack-mounted LWC
- Part number 6091042.

Component Housing

Warning: The component housing should be used only with the Multiuse Communication Loop and the IBM Token-Ring Network.



- Used to mount an LWC on the wall or on top of a desk or table. (See Appendix C for installation instructions.)
- Designed for use with a small system that is located in a single room. Used when it is not practical to wire the system to a wiring closet.
- Screws for mounting the housing on the wall are not provided.
- LWC must be ordered separately.
- Part number 6091078.

Building 118 Floor 2	Cable Schedule			Wiring Closet Location K201 Date of Last Update	
Cable Number	Cable Routing Information: Cable Runs From	Cable Routing Information: Cable Runs To	Cable Length	Distribution Panel Jumpers	Additional Information
2001	H220	K201-12-A8	300 ft.	To LWC #0011 Port 1	
2002	G210-1	K201-12-D8	150 ft.	To LWC #0011 Port 4	
2003	G210-2	K201-12-C8	150 ft.	To LWC #0011 Port 3	
2004	G210-3	K201-12-B8	150 ft.	To LWC #0011 Port 2	

System Configuration Worksheet

System 8100 Service Contact Jim Smith Telephone 555-4436

Attachment Description	Accessories in Work Area	Cable Runs from (Wall)	Cable & Cable Length	Cable Runs to (Panel)	Accessories on Equipment Rack
8775 Address F1	LSC	G210-1	2002 L=150'	K201-12-D8	P-LWC #0011 Port 4
8775 Address F2	LSC	G210-2	2003 L=150'	K201-12-C8	P-LWC #0011 Port 3
8775 Address F3	LSC	G210-3	2004 L=150'	K201-12-B8	P-LWC #0011 Port 2
8100 Port 4 555-3248	LSC	H220	2001 L=300'	K201-12-A8	P-LWC #0011 Port 1

Figure 6-1 (Part 1 of 2). Example of How the Cabling System Is Used with MCL

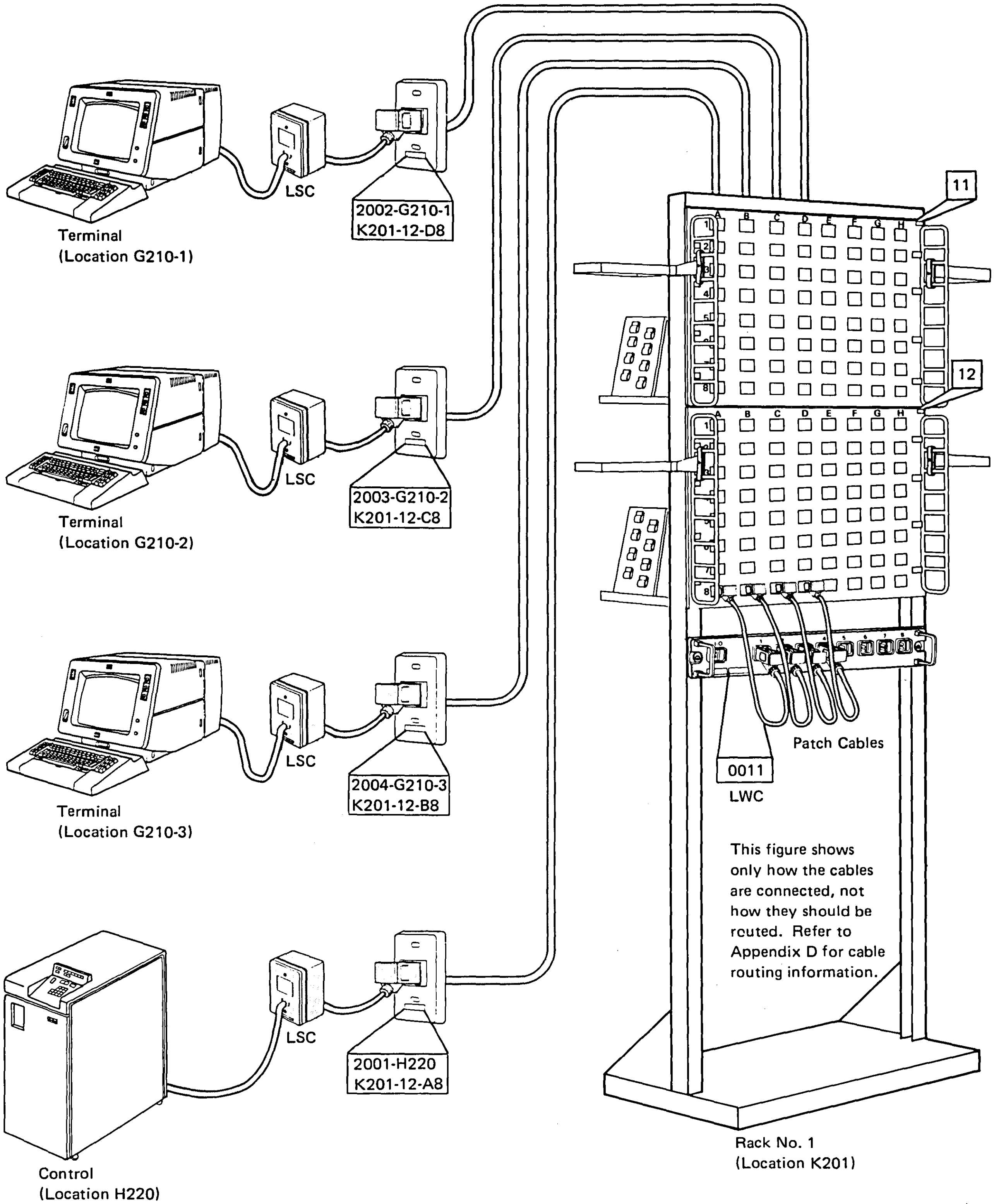
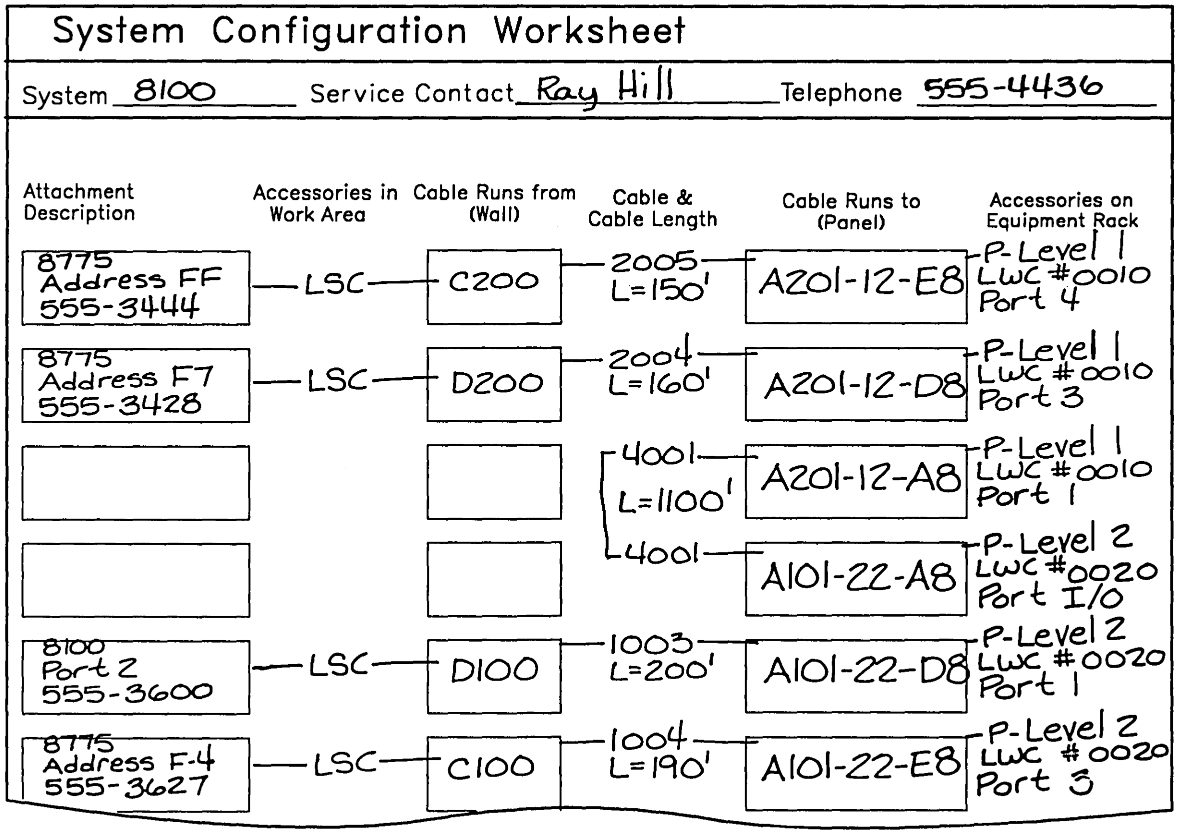


Figure 6-1 (Part 2 of 2). Example of How the Cabling System Is Used with MCL

Building 618 Floor 2		Cable Schedule		Wiring Closet Location A201 Date of Last Update	
Cable Number	Cable Routing Information: Cable Runs From	Cable Routing Information: Cable Runs To	Cable Length	Distribution Panel Jumpers	Additional Information
2004	D200	A201-22-D8	160 ft.	To LWC #0010	Port 3
2005	C200	A201-22-E8	150 ft.	To LWC #0010	Port 4
4001	A201-12-A8	A101-22-A8	1100 ft	To Level 1 LWC	#0010 Port 1



Building 618 Floor 1		Cable Schedule		Wiring Closet Location A101 Date of Last Update	
Cable Number	Cable Routing Information: Cable Runs From	Cable Routing Information: Cable Runs To	Cable Length	Distribution Panel Jumpers	Additional Information
1003	D100	A101-12-D8	200 ft.	To LWC #0020	Port 1
1004	C100	A101-12-E8	190 ft.	To LWC #0020	Port 3
4001	A101-22-A8	A101-12-A8	1100 ft	Level 2 LWC #0	020 Port I/O

Figure 6-2 (Part 1 of 2). Example of How Multiple LWCs are Connected

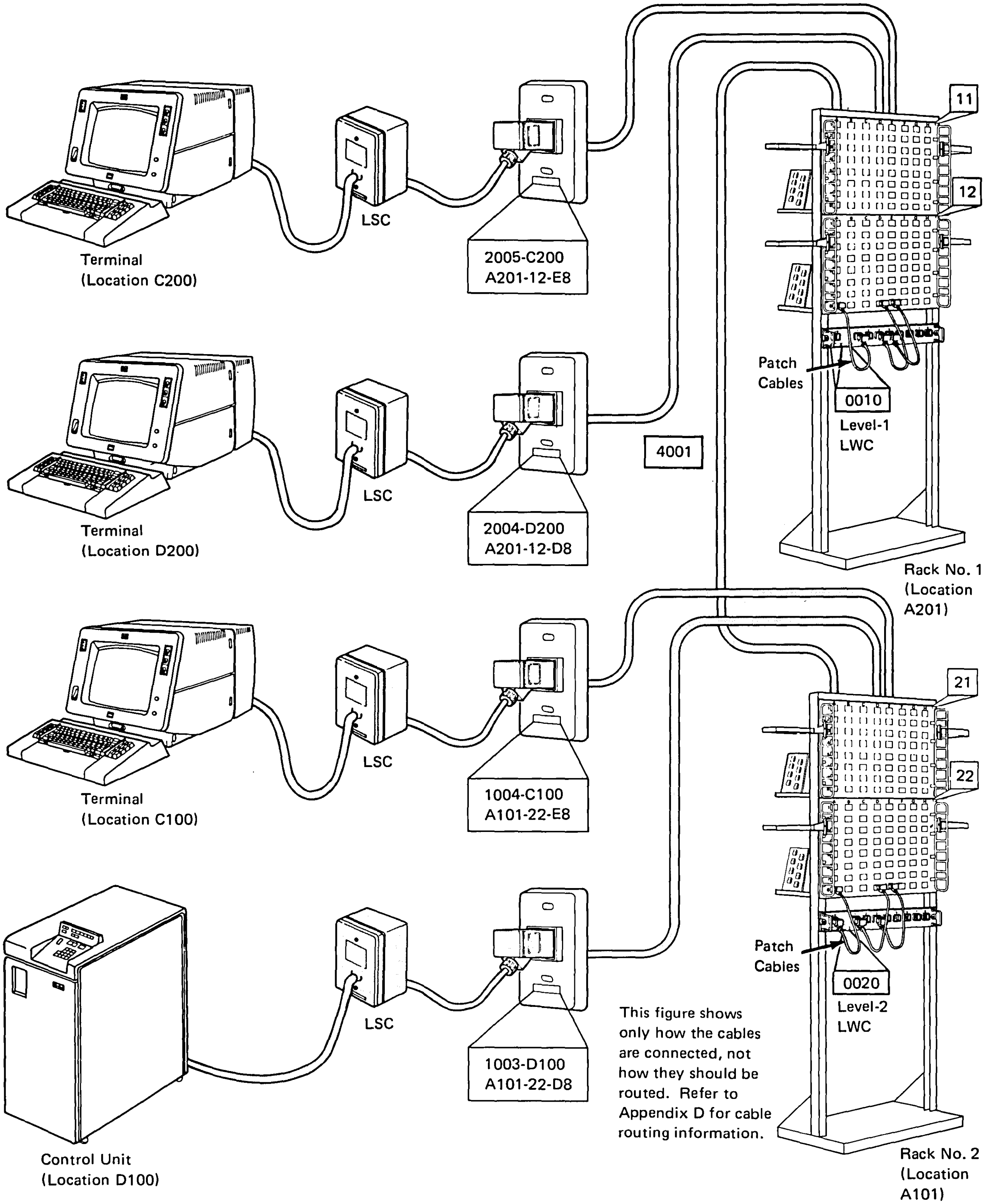


Figure 6-2 (Part 2 of 2). Example of How Multiple LWCs are Connected

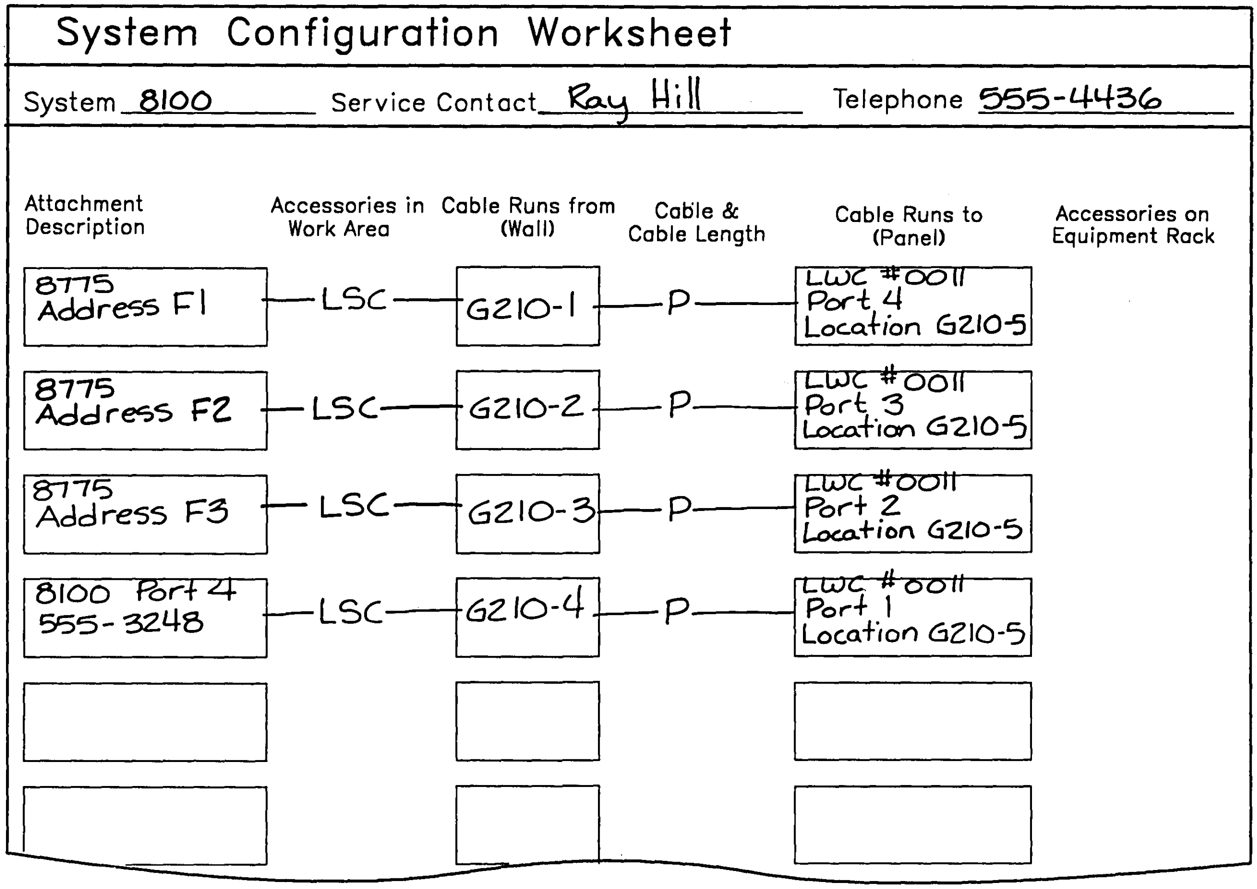


Figure 6-3 (Part 1 of 2). Example of How the Component Housing for the LWC Is Used

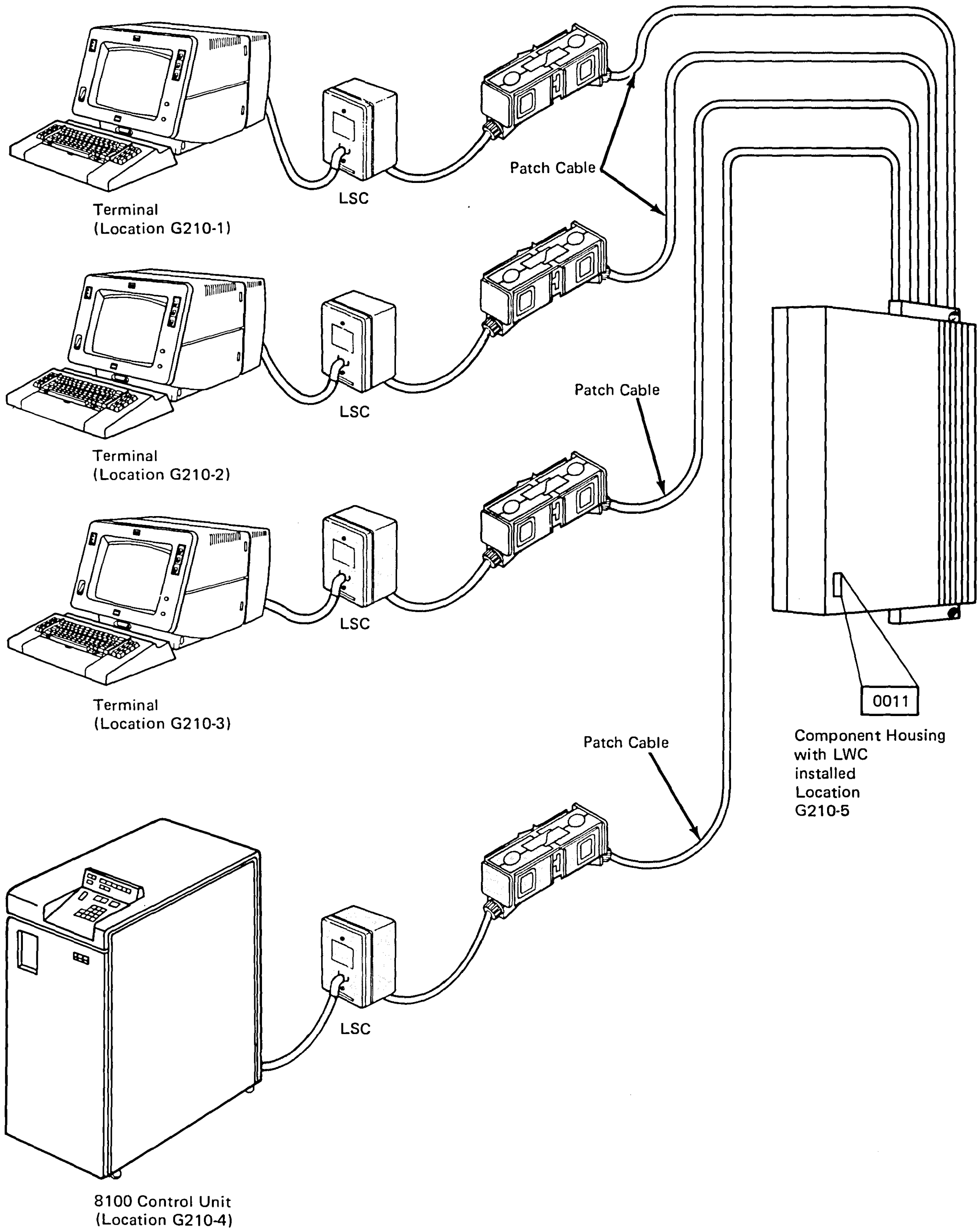


Figure 6-3 (Part 2 of 2). Example of How the Component Housing for the LWC Is Used

Loop Wiring Concentrator (LWC) Labeling

Label each LWC with a unique four-digit number unit identification number. All of the LWCs in your installation should be labeled with consecutive numbers, starting with "0001" for the first LWC. Place the label in the designated area on the front of the LWC. For example, in Figure 6-2, the labels for the LWCs are: "0010" and "0020."

Record this information on the Cable Schedule described in "Keeping Records of Cables" in Chapter 3 of the *IBM Cabling System Planning and Installation Guide.*

How to Configure LWCs

You may need one or more LWCs with your loop system. Go to Appendix B for information on the type of configuration you should use.

Planning and Ordering Procedure for MCL Accessories

1. Remove the Attaching Products Worksheet from Appendix A and make several photocopies.

   Note: The worksheet is used for ordering accessories for all attaching systems. Use only the section for MCL systems.

2. Determine your accessory requirements for each wiring closet as follows:

   a. Enter the total number of type 1LS surface mount LSCs on line MCL-1. One type 1LS LSC is required for each type 1, 1S, 1W, 2, or 2S faceplate.

   b. Enter the total number of loop wiring concentrators (LWCs) on line MCL-2. One LWC is required for each group of eight loop station connectors (LSCs) (or fraction thereof).

      Note: An LWC can be used to form only one loop.

   c. LWCs may be mounted in an equipment rack or in a special component housing. If any of the LWCs will be mounted in component housings, enter the number of housings on MCL-3.

   d. Enter the number of cable brackets on line MCL-4. Order one for each *rack-mounted* LWC.

   e. Enter the number of patch cables required on line MCL-5. One 2.4-meter (8-foot) patch cable is required for each LWC port used, including the I/O port.

3. Go to Chapter 11 to see if it is applicable.

4. Fill out the Complete Order Summary Worksheet:

   a. Remove the Complete Order Summary Worksheet from Appendix A and make one photocopy of each page.

   b. Copy the information from the Order Summary Worksheet you filled out in the *IBM Cabling System Planning and Installation Guide* to Part 1 and Part 2 of the Complete Order Summary Worksheet. Be careful to copy the information accurately.

   c. Complete Part 3 and Part 4 using information from *all* of the Attaching Products Worksheets that have been completed. For each accessory, find the total number you will need. Add 10% to that number and enter the result under "Quantity."

Configuration Limits

In some configurations, type 6, 8, and 9 cable is combined with type 1 or type 2 cable. When computing configuration limits, the higher attenuation of types 6, 8, and 9 cable must be accounted for. This is accomplished by using "equivalent length" rather than actual cable length when calculating the cable length for a lobe. The equivalent length of a combined section of cable is the length of type 1 or type 2 cable that would have the same attenuation. For Multiuse Communication Loop applications, the formula for computing the equivalent length is:

Equivalent length = A + 2B + 2.5C
Where: A is the actual length of type 1 or type 2 cable
B is the actual length of type 8 cable
C is the actual length of type 6 and 9 cable

Example: For 1000 feet of type 1 cable and 100 feet of type 8 cable:

equivalent length = 1000 + 2(100) = 1200 feet

Cable Length for a Lobe

The *maximum* cable length allowed for a lobe is as follows:

- 3355 meters (11,000 feet) for 9.6 kbps
- 3050 meters (10,000 feet) for 19.2 kbps
- 2135 meters (7000 feet) for 38.4 kbps.

The cable length for a lobe is the sum of the following:

- The equivalent length of cable between wiring closets (LWC to LWC)
- The equivalent length of cable between wiring closets (LWCs) and each LSC on the lobe
- 183 meters (600 feet) for each surge suppressor used to terminate an outdoor cable
- 12 meters (40 feet) for each loop station connector (LSC)
- 30 meters (100 feet) for each loop wiring concentrator (LWC).

The figures given above are approximations. If your calculations are within 305 meters (1000 feet) of the maximum allowable cable length, it is recommended that you follow the instructions in "Exact Method of Determining Configuration Limits." This will considerably reduce the possibility that you will have to make changes to the lobe after installation verification.

For information on maximum cable drop lengths, see "Maximum Cable Drop Lengths" in Chapter 4 of the *IBM Cabling System Planning and Installation Guide.*

Exact Method of Determining Configuration Limits

For an exact method of determining configuration limits, refer to *Guide to Multiuse Communication Loop with IBM Cabling System*, GA27-3606.

7

How to Use the Cabling System for IBM Series/1 Applications

This chapter describes how to use the cabling system to attach devices to an IBM Series/1.

Contents
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General Planning Considerations

The cabling system can be used to wire the following:

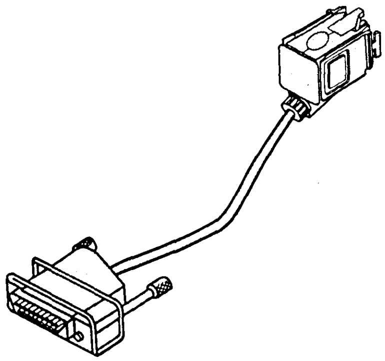
- IBM 3101 Display Terminals, Model 23 (Series/1 feature #1310)
- IBM 4975 Printers, Models 01L and 02L (Series/1 feature #1310)
- Series/1 Local Communication Controller (LCC Series/1 feature #1400)
- IBM 4980 Display Station (Series/1 Multidrop Workstation Attachment feature #1250).

This chapter supplements the wiring information contained in *IBM Series/1 Customer Site Preparation Manual*, GA34-0050. (For information on how to get this publication, see "How to Order IBM Publications" in the Preface of this manual.)

Before using this chapter you must complete:

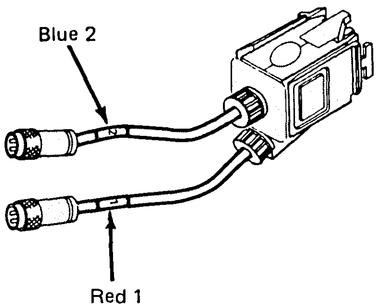
- The planning for your Series/1 system (using the above IBM publication)
- The general planning and ordering procedure in Chapter 4, "How to Plan for and Order Cables and Accessories" in the *IBM Cabling System Planning and Installation Guide*, GA27-3361.

For the Series/1 Multidrop Work Station Attachment feature #1250, order *IBM Cabling System Problem Determination Guide for Twinaxial Applications*, GA21-9491.



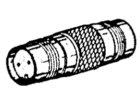
MFA/422 Attachment Cable

- Multi-function attachment (MFA) cable is used to attach IBM 3101 Display Terminals (Model 23) and IBM 4975 Printers (Models 01L and 02L) to a cabling system receptacle.
- Approximate length 2.4 meters (8 feet).
- Part number 8310553.



Twinaxial Y Assembly

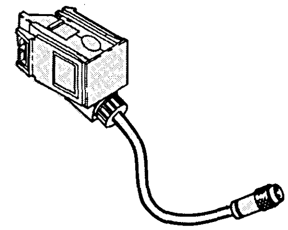
- Used to attach the following to a cabling system receptacle:
  - Local Communication Controller (LCC)
  - 4980 Display Stations.
- Each leg is color-coded and numbered.
- Approximate length (each leg) 2.7 meters (9 feet).
- Part number 8642550.



Twinaxial Straight Adapter

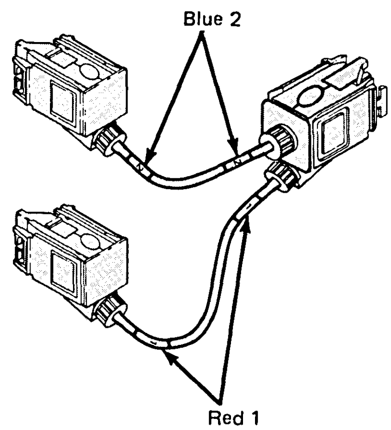
- Used to connect twinaxial accessories to Local Communication Controller feature #1400 and Multidrop Workstation Attachment feature #1250
- Part number 7362230.

Twinaxial Direct Connect Cable



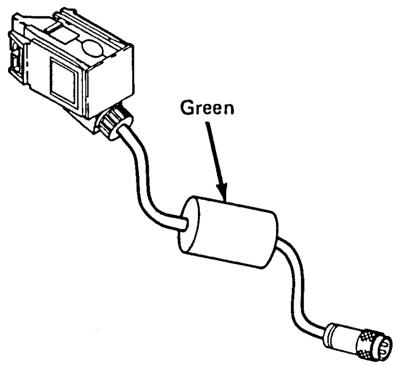
- Used to connect 4980 Display Station to a cabling system receptacle
- Approximate length 2.4 meters (8 feet)
- Part number 6091075.

Y Assembly



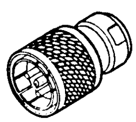
- Used at distribution panel when the Series/1 Local Communication Controller (LCC) feature #1400 or Series/1 Multidrop Workstation Attachment feature #1250 is used.
- Each leg of the Y assembly is color-coded and numbered. See Figure 7-2 for the proper way to connect the connectors.
- Approximate length (each leg) 1.2 meters (4 feet).
- Part number 8642549.

Twinaxial Impedance Matching Device



- Used to connect a port on the Series/1 Multidrop Workstation Attachment feature #1250 to a cabling system receptacle
- Color-coded green
- Approximate length 2.4 meters (8 feet)
- Part number 6091070.

Twinaxial Terminator (150 ohms)



- Used to terminate the last (or only) work station, display station, or printer on a port or line
- Color-coded green
- Part number 6091068.

Building 421 Floor 1	Cable Schedule			Wiring Closet Location B123 Date of Last Update	
Cable Number	Cable Routing Information: Cable Runs From	Cable Routing Information: Cable Runs To	Cable Length	Distribution Panel Jumpers	Additional Information
1005	A504	B223-11-E8	100 ft.	Jumpered To C8	
1003	M118	B223-11-C8	75 ft.	Jumpered To E8	

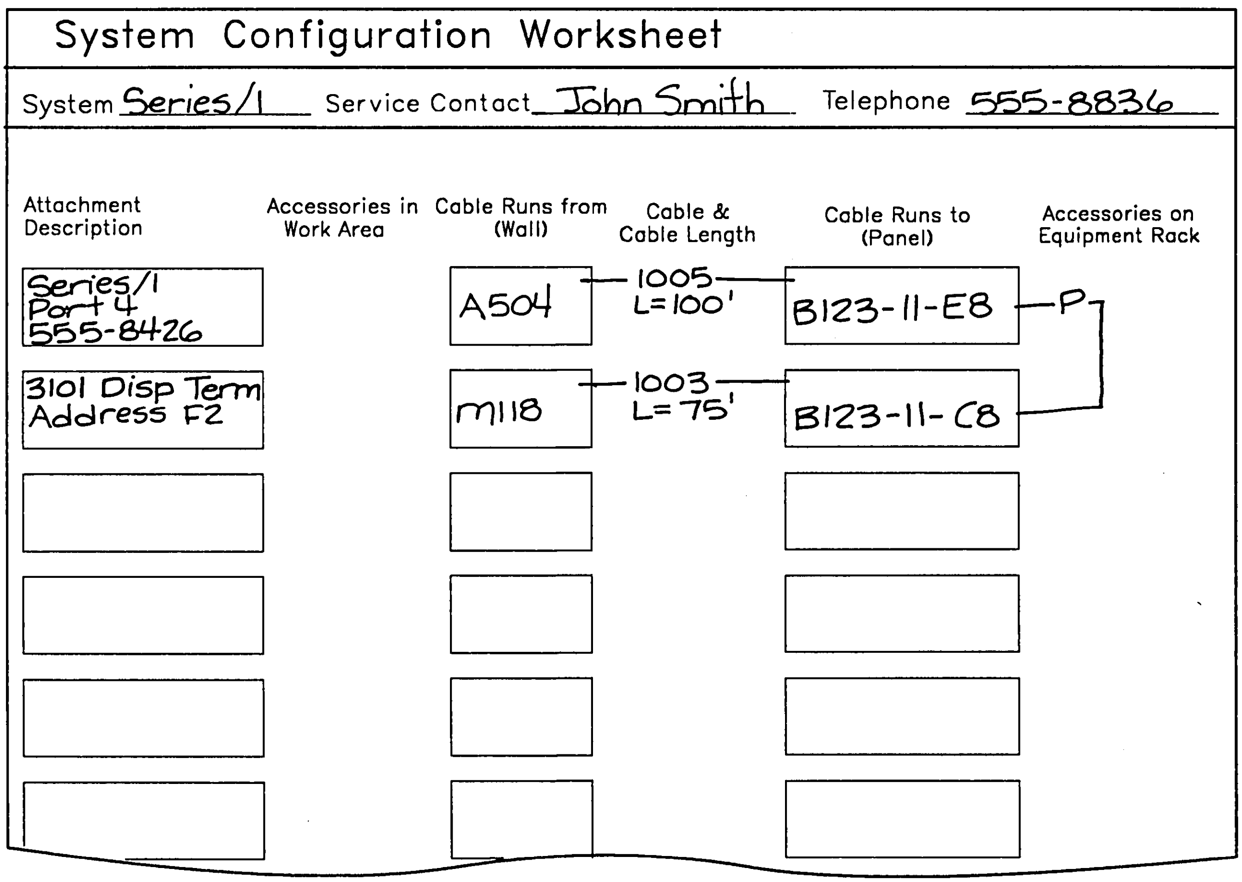


Figure 7-1 (Part 1 of 2). Example of How the Cabling System Is Used to Attach 3101 and 4975 to Series/1

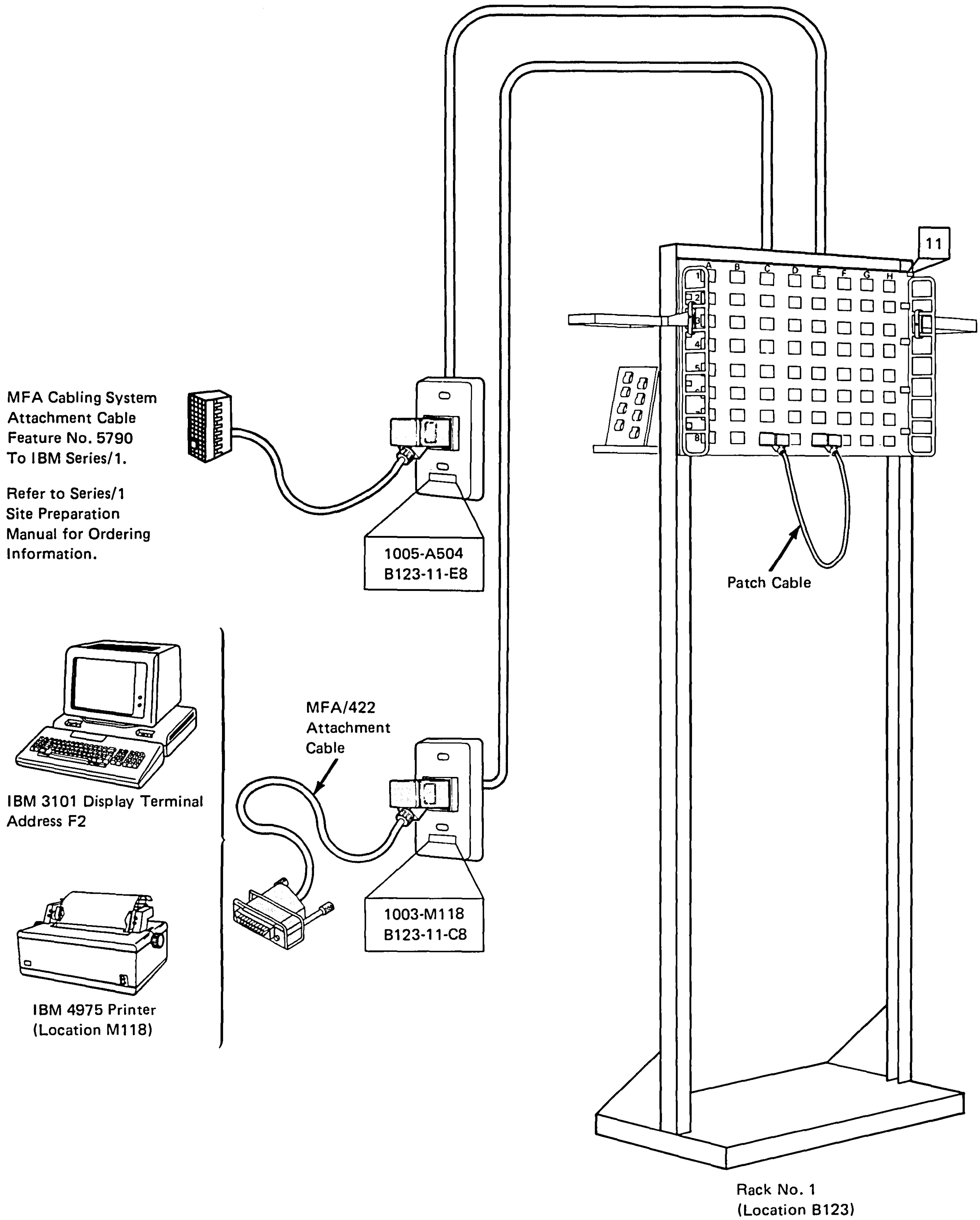


Figure 7-1 (Part 2 of 2). Example of How the Cabling System Is Used to Attach 3101 and 4975 to Series/1

Building 601 Floor 3		Cable Schedule			Wiring Closet Location L301 Date of Last Update
Cable Number	Cable Routing Information		Cable Length	Distribution Panel Jumpers	Additional Information
	Cable Runs From	Cable Runs To			
1007	C300	L301-21-B8	150 ft.	B8 Red To H8 Blue	Y Assembly
1002	K301	L301-21-H8	160 ft.	H8 Red To F8 Blue	Y Assembly
1004	G301	L301-21-F8	170 ft.	F8 Red To D8 Blue	Y Assembly
1006	H303	L301-21-D8	180 ft.	D8 Red To B8 Blue	Y Assembly

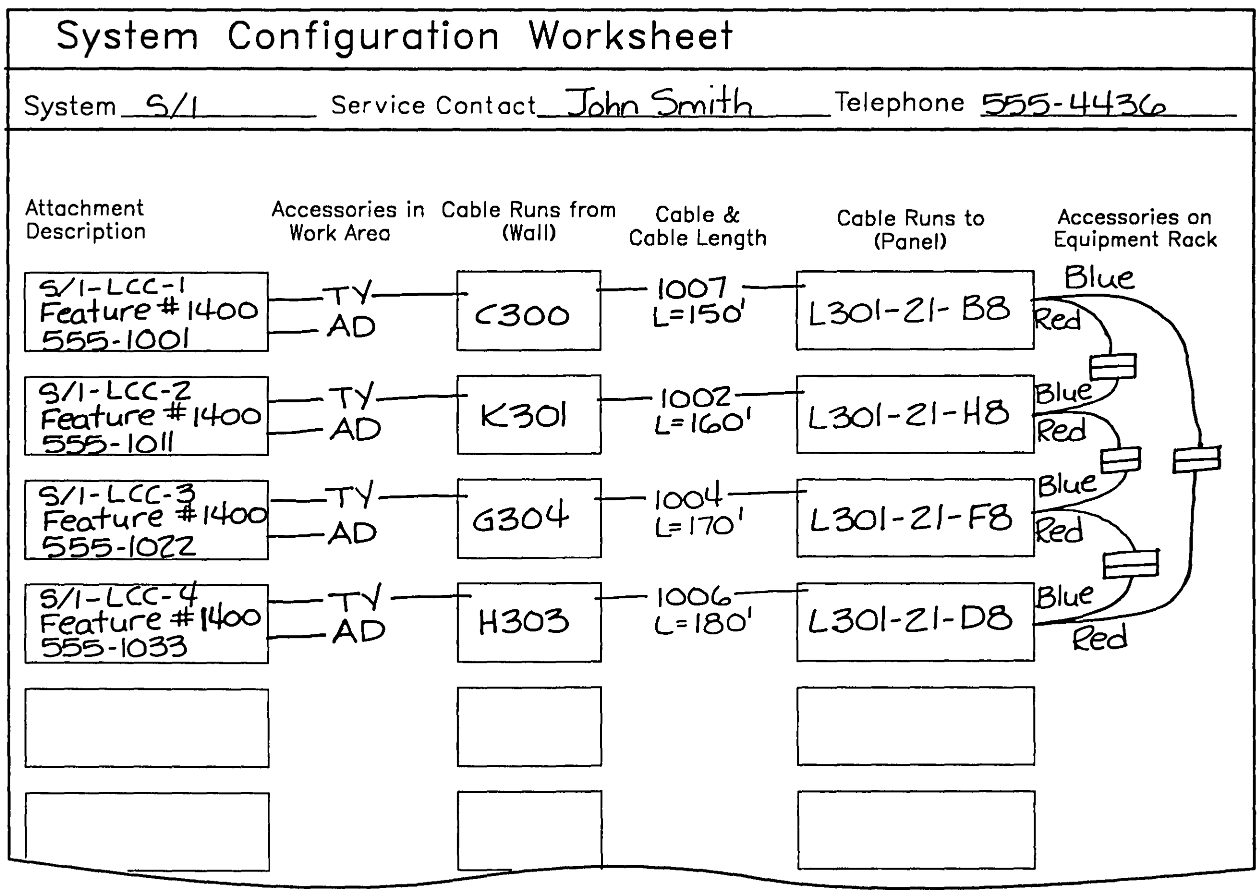


Figure 7-2 (Part 1 of 2). Example of How the Cabling System Is Used with Series/1 Local Communication Controller Feature

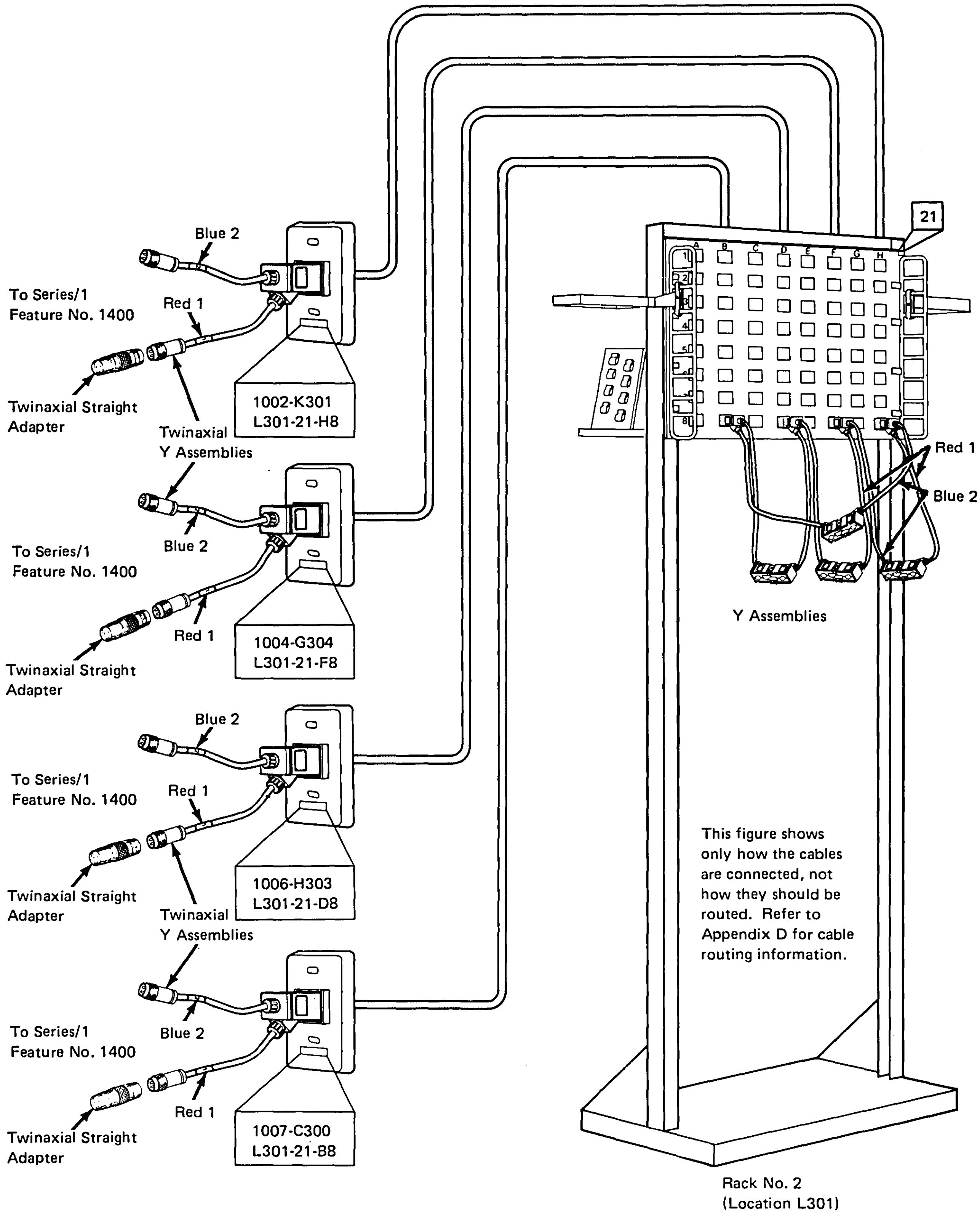


Figure 7-2 (Part 2 of 2). Example of How the Cabling System Is Used with Series/1 Local Communication Controller Feature

Cable Schedule

Building 300
Floor 2

Wiring Closet Location P201
Date of Last Update

Cable Number	Cable Routing Information: Cable Runs From	Cable Routing Information: Cable Runs To	Cable Length	Distribution Panel Jumpers	Additional Information
1102	A201	P201-11-F8	200 ft.	F8 To E8 Red	
1103	K222-1	P201-11-E8	190 ft.	E8 Blue To C8 Red	Y Assembly
1105	L205	P201-11-C8	160 ft.	C8 Blue To B8	Y Assembly
1106	M214	P201-11-B8	170 ft.	B8 To C8 Blue	

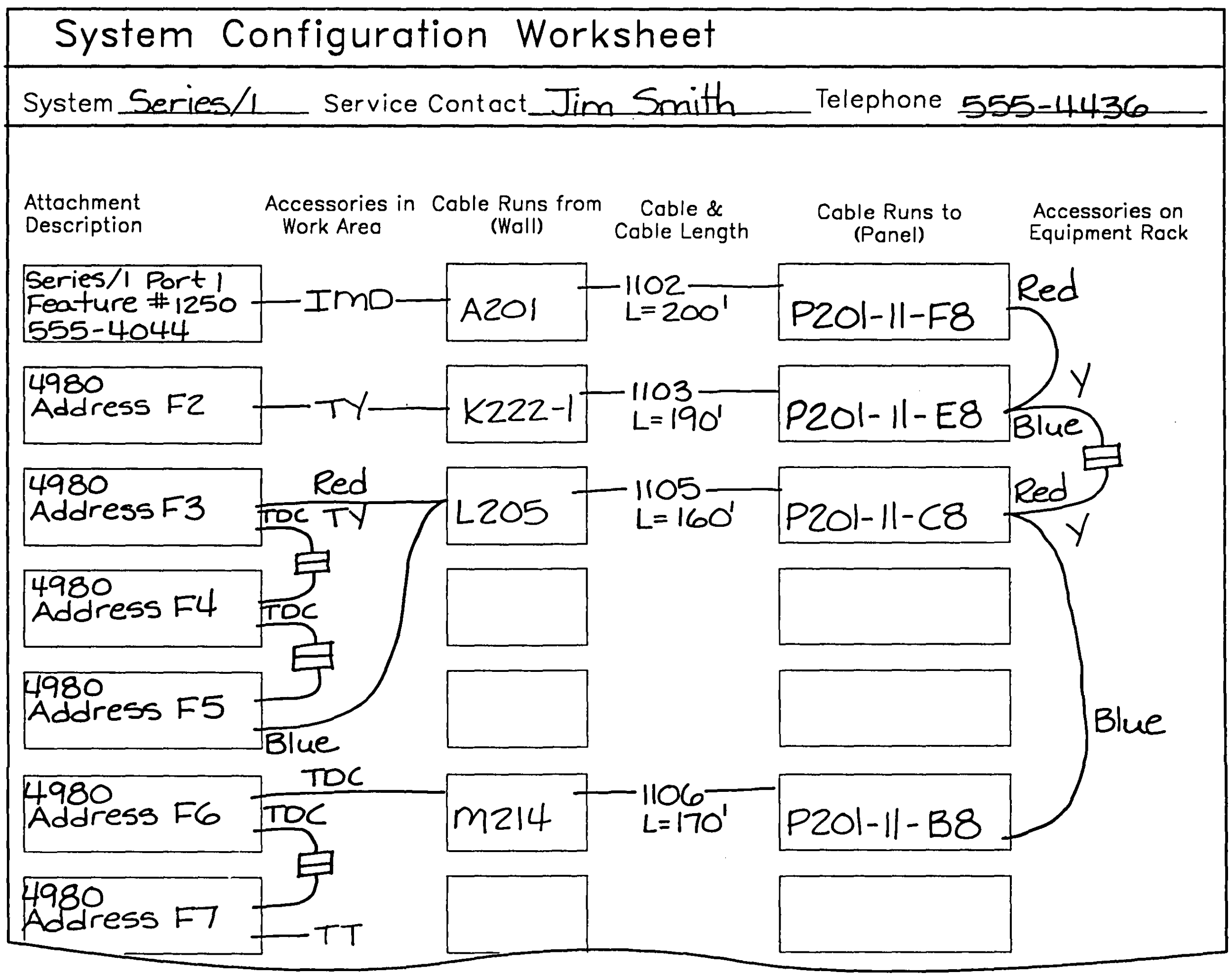
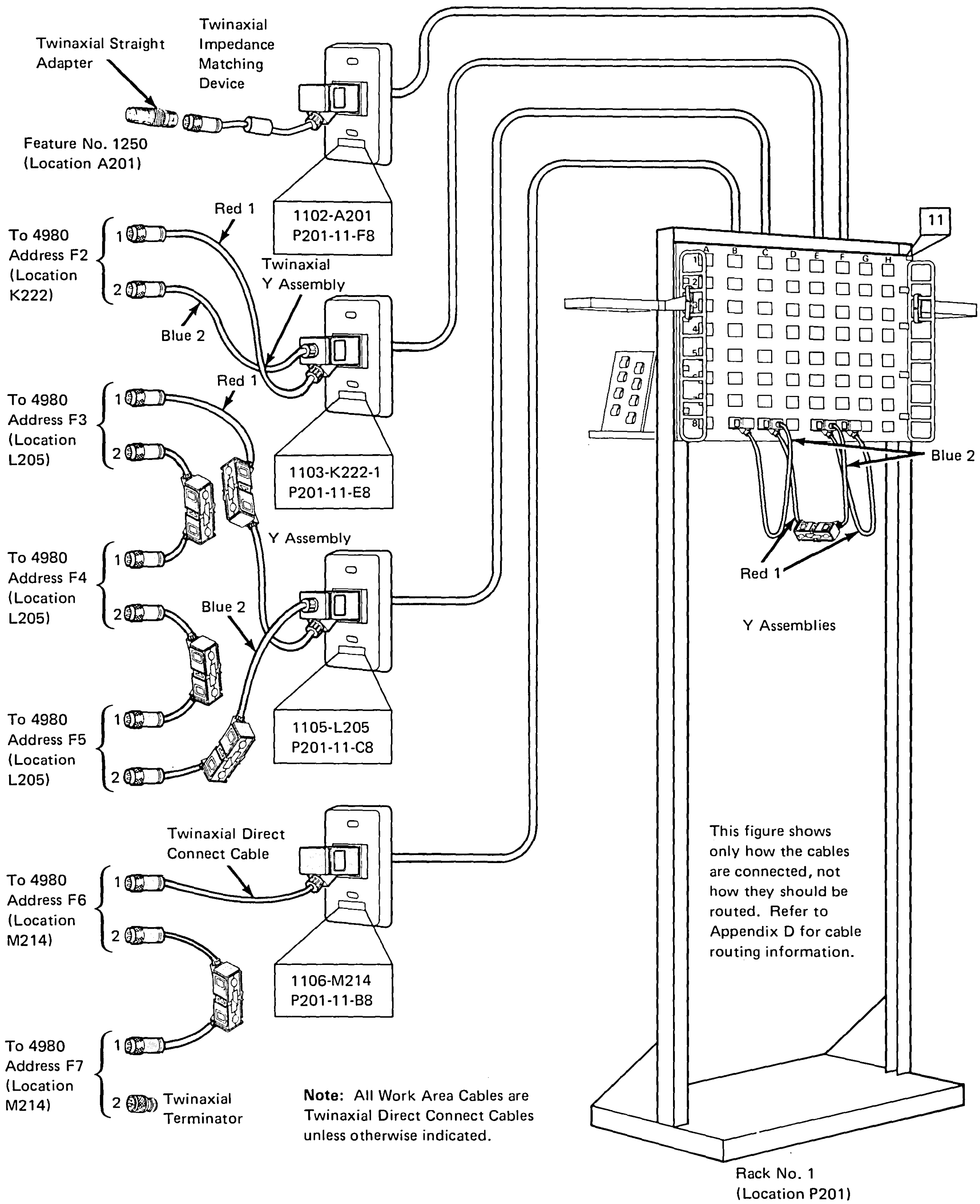


Figure 7-3 (Part 1 of 2). Example of How the Cabling System Is Used to Attach 4980s to Series/1



Note: All Work Area Cables are Twinaxial Direct Connect Cables unless otherwise indicated.

Figure 7-3 (Part 2 of 2). Example of How the Cabling System Is Used to Attach 4980s to Series/1

Planning and Ordering Procedure for Series/1 Accessories

1. Remove the Attaching Products Worksheet from Appendix A and make several photocopies.

   Note: The worksheet is used for ordering accessories for all attaching systems. Use only the section for Series/1 applications.

2. Determine your accessory requirements for the 3101 or 4975 as follows:

   a. Enter the total number of MFA/422 attachment cables on line S/1-1. One cable is required for each 3101 and 4975.

   b. Enter the number of 2.4-meter (8-foot) patch cables on line S/1-5. One patch cable is required at the distribution panel for each 3101 and 4975.

   c. Enter the number of feature #5790 on line S/1-7. One is required for each 3101 and 4975.

3. Determine your accessory requirements for the Local Communication Controller feature as follows:

   a. Enter the number of Y assemblies, twinaxial Y assemblies, and twinaxial straight adapters on lines S/1-2, S/1-3, and S/1-4, respectively. One of each is required for each Series/1 Local Communication Controller (feature #1400).

   b. The length of each leg of the twinaxial Y assembly is approximately 2.7 meters (9 feet). The assembly can be extended by attaching a patch cable to the data connector end. If you want to extend the assemblies, you will probably need one patch cable for each Series/1 Local Communication Controller feature. Depending on the length of the extension needed, enter the number of patch cables required on line S/1-5 or S/1-6.

4. Determine your accessory requirements for the 4980 Display Station as follows:

   a. Determine the total number of ports used for each Series/1 feature #1250. One Series/1 feature #1250 has four ports and a maximum of eight terminals can be connected for each feature. For each port, one twinaxial straight adapter, one impedance matching device and one twinaxial terminator (S/1-4, S/1-8 and S/1-9, respectively) are required.

   b. Determine the total number of display stations to be attached. Each terminal requires two twinaxial direct connect cables. If the terminal is the last terminal on the port, one direct connect cable is required. Enter the number of direct connect cables on line S/1-10.

   c. For each Y assembly used at a work area faceplate, a Y assembly is required at the distribution panel. Y assemblies are required when multiple terminals are connected to a single cabling system receptacle. Add the number of Y assemblies needed to the total on line S/1-2.

5. Go to Chapter 11 to see if it is applicable.

6. Fill out the Complete Order Summary Worksheet:

   a. Remove the Complete Order Summary Worksheet from Appendix A and make one photocopy of each page.

   b. Copy the information from the Order Summary Worksheet you filled out in the *IBM Cabling System Planning and Installation Guide* to Part 1 and Part 2 of the Complete Order Summary Worksheet. Be careful to copy the information accurately.

   c. Complete Part 3 and Part 4 using information from *all* of the Attaching Products Worksheets that have been completed. For each accessory, find the total number you will need. Add 10% to that number and enter the result under "Quantity."

Configuration Limits

In some configurations, type 6, 8, and 9 cable is combined with type 1 or type 2 cable. When computing configuration limits, the higher attenuation of types 6, 8, and 9 cable must be accounted for. This is accomplished by using "equivalent length" rather than actual cable length when calculating the signal path length. The equivalent length of a combined section of cable is the length of type 1 or type 2 cable that would have the same attenuation. For IBM Series/1 applications, the formula for computing the equivalent length is:

Equivalent length = A + 2B + 1.5C (LCC only)
A + 2B + 2.5C (except LCC)

Where: A is the actual length of type 1 or type 2 cable
B is the actual length of type 8 cable
C is the actual length of type 6 or 9 cable

Example: For 1000 feet of type 1 cable and 100 feet of type 8 cable:

equivalent length = 1000 + 2(100) = 1200 feet

Limits for 3101/4975

The *maximum* signal path length allowed is 1220 meters (4000 feet). The signal path for a device is the *sum* of the following:

- The equivalent length of the cable between distribution panels
- The length of the cable from the Series/1 to the distribution panel
- The equivalent length of the cable from the 3101 or 4975 to the distribution panel.

Note: For 3101/4975 (feature #1310), outdoor cable runs are not allowed.

For information on the maximum cable drop lengths, see "Maximum Cable Drop Lengths" in Chapter 4 of the *IBM Cabling System Planning and Installation Guide.*

Limits for LCC

The *maximum* signal path allowed is 762 meters (2500 feet). The signal path length for Series/1 LCC is the *sum* of the following:

- Two times (2x) the equivalent length of cable between wiring closets
- Two times (2x) the equivalent length of cable from each Series/1 processor to the wiring closet
- 112 meters (368 feet) for each pair of surge suppressors after the first pair.

For information on the maximum cable drop lengths, see "Maximum Cable Drop Lengths" in Chapter 4 of the *IBM Cabling System Planning and Installation Guide.*

Limits for 4980

The *maximum* signal path length allowed varies with speed as follows:

Data Rate	Maximum Signal Path Length
100 kbps	1220 meters (4000 feet)
250 kbps	488 meters (1600 feet)
500 kbps	244 meters (800 feet)

The signal path length for a 4980 display station is the sum of the following:

- The equivalent length of the cable between wiring closets
- The equivalent length of the cable from the Series/1 to the wiring closets
- Two times (2X) the equivalent cable length from each 4980 (except the last one in the chain) to the wiring closets
- The equivalent cable length from the wiring closet to the last 4980 in the chain.

Note: For 4980 (feature #1250), outdoor cable runs are not allowed.

8

How to Use the Cabling System for IBM 5080 Graphics System Applications

This chapter describes how to use the cabling system with the IBM Graphics System.

Contents
Chapter 8

General Planning Considerations 8-2
Red Coaxial Balun Assembly and Cableless Coaxial Baluns 8-3
Y Assembly 8-4
Using 3250 System Components 8-7
Planning and Ordering Procedure for 5080 Graphics System Accessories 8-7
Configuration Limits 8-8

General Planning Considerations

This chapter supplements the wiring information contained in the following IBM publications:

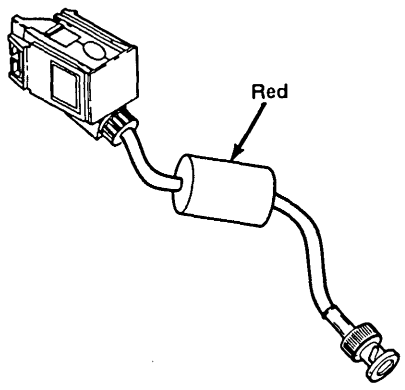
- *IBM 5080 Graphics System: System Planning and Installation*, GA23-0135
- *IBM 5080 Graphics System: Site Planning*, GA23-0129.

(For information on how to get these publications, see "How to Order IBM Publications" in the Preface of this manual.)

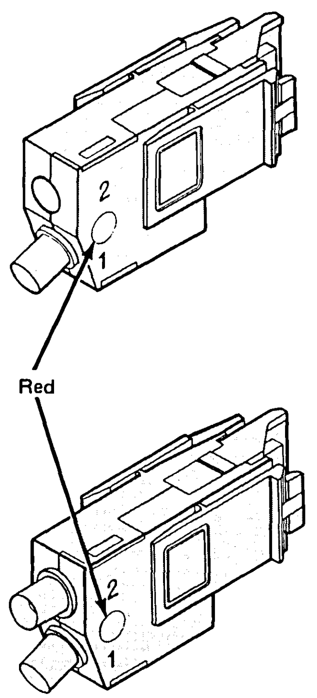
Before using this chapter you must complete:

- The planning for your 5080 Graphics System (using one of the above publications)
- The general planning and ordering procedure in Chapter 4, "How to Plan for and Order Cables and Accessories" in the *IBM Cabling System Planning and Installation Guide.*

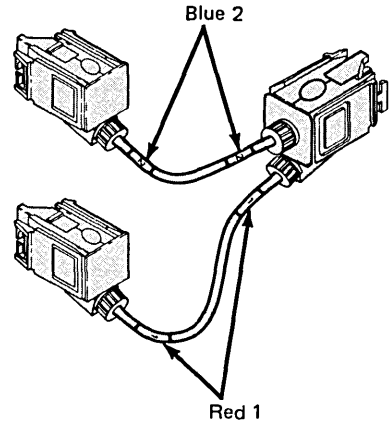
Red Coaxial Balun Assembly and Cableless Coaxial Baluns



- Used to attach the 5088 Channel Controller and 5085 Graphics Processor to the cabling system
- Color-coded red
- Red coaxial balun assembly
  - Used to connect *bal*anced twisted-pair cable and *un*balanced coaxial cable together
  - Approximate length is 2.4 meters (8 feet)
  - Part number 8642546.
- Cableless coaxial baluns.
  - Must be connected to device by using coaxial jumper cable with male BNC connectors (not supplied with balun)
  - Part number 6339082 (single cableless balun)
  - Part number 6339083 (double cableless balun).



Y Assembly



- Used at the distribution panel when connecting more than one graphics processor to the same line.
- Each leg of the Y assembly is color-coded and numbered. See Figure 8-1 for the correct way to connect the connectors.
- Approximate length (each leg) 1.2 meters (4 feet).
- Part number 8642549.

Cable Schedule

Building 806 | Floor 1 | Wiring Closet Location B101 | Date of Last Update

Cable Number	Cable Routing Information: Cable Runs From	Cable Routing Information: Cable Runs To	Cable Length	Distribution Panel Jumpers	Additional Information
2001	E102	B101-11-H8	110 ft.	H8 To F8 Red	Controller
2002	E103	B101-11-F8	120 ft.	F8 Blue To D8 Red	Y Assembly
2003	E104	B101-11-D8	130 ft.	D8 Blue To B8	Y Assembly
2004	E105	B101-11-B8	140 ft.	B8 To D8 Blue	Last Control Unit

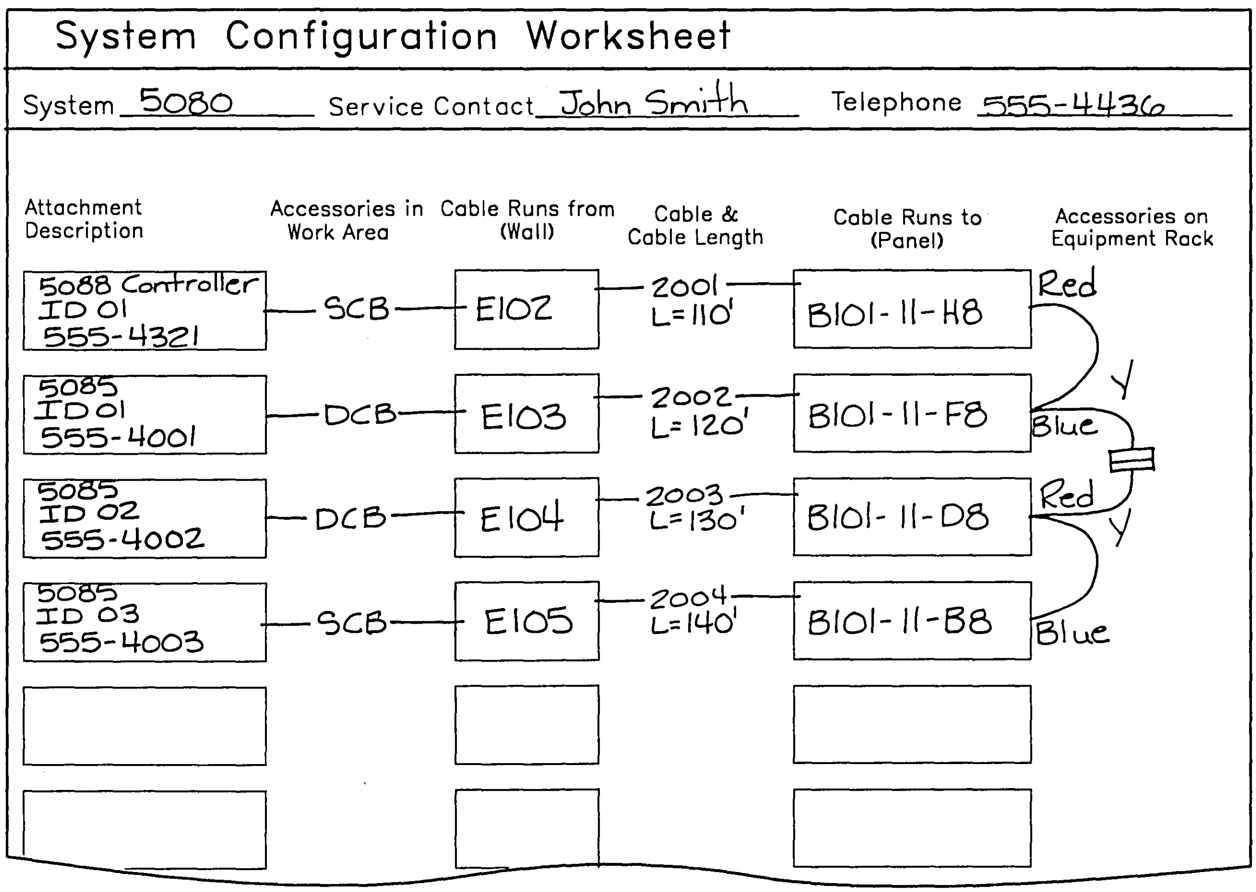
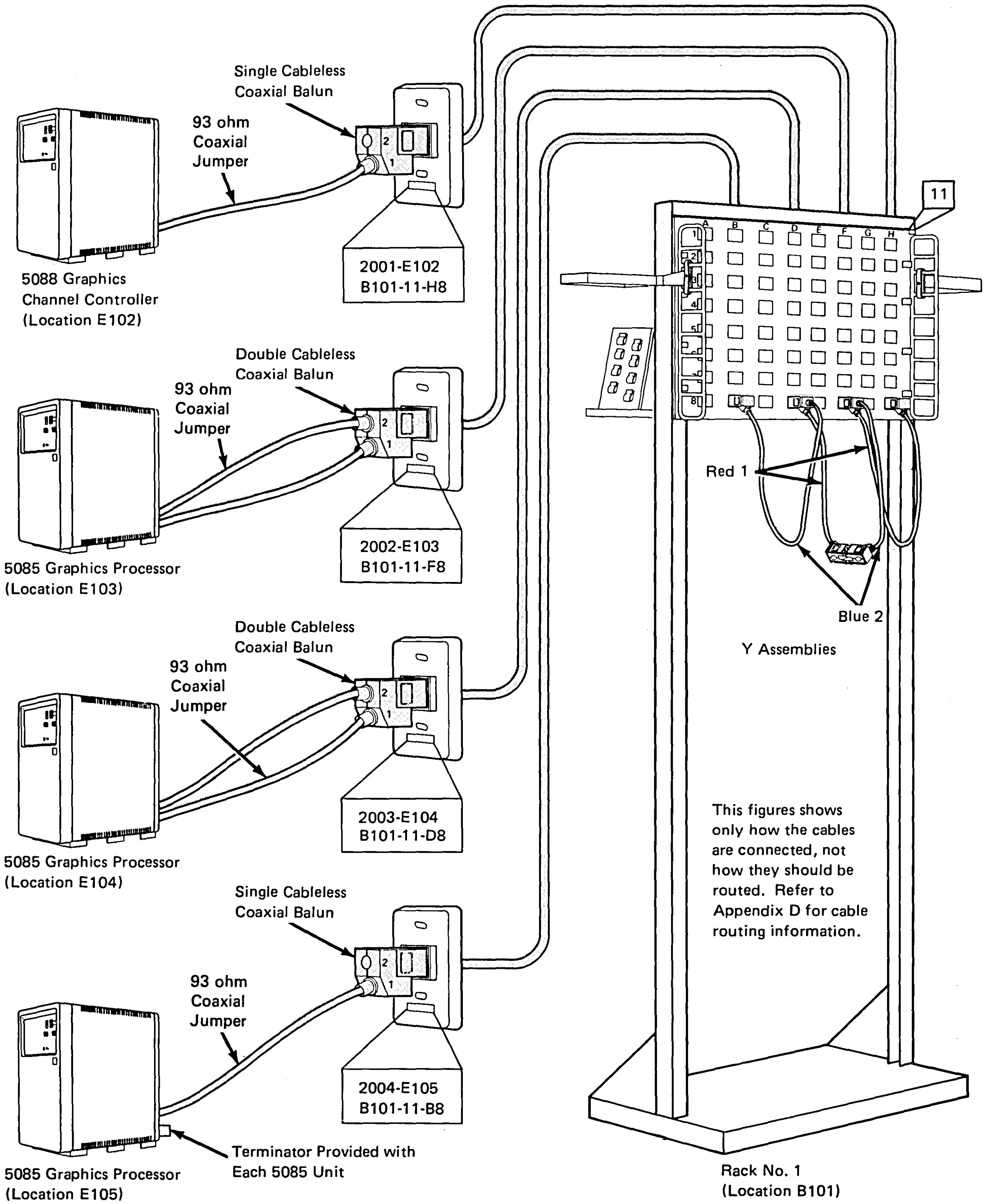


Figure 8-1 (Part 1 of 2). Example of How the Cabling System Is Used to Configure 5080 Graphics System



Note:
A 3258 Channel Control Unit may be used in place of the 5088, and a 3255 Display Control Unit may be used in place of the 5085. See "Using 3250 System Components" for additional information.

Figure 8-1 (Part 2 of 2). Example of How the Cabling System Is Used to Configure 5080 Graphics System

Using 3250 System Components

A 3258 Channel Control Unit may be used in place of the 5088 Graphics Channel Controller. A 3255 Display Control Unit may be used in place of the 5085 Graphics Processor.

In both cases, you will need F male to BNC female connectors for the 3250s. Use one connector for each 3258 Control Unit. Use two for each 3255 Display Unit.

The F-to-BNC connector is not available from IBM. Use AVA Electronics Corporation part number 261501, Tektronix, Inc. part number 103-0158-00, or the equivalent.

Planning and Ordering Procedure for 5080 Graphics System Accessories

1. Remove the Attaching Products Worksheet from Appendix A and make several photocopies.

   Note: The worksheet is used for ordering accessories for all attaching systems. Use only the section for the 5080 Graphics System.

2. Determine your 5080 Graphics requirements as follows:

   a. Order one red coaxial balun assembly or one *single* cableless coaxial balun for each 5088 Channel Controller and for the last or only 5085 Graphics Processor on a line. Enter the number of red coaxial baluns and single cableless baluns on lines 5080-1 and 5080-2, respectively.

   b. Order one *double* cableless coaxial balun for each 5085 Graphics Processor, except for the last device on each line. Enter the number of double cableless coaxial baluns on line 5080-3.

   c. Enter the number of Y assemblies on line 5080-4. Order one for each 5085 processor, except for the last device on each line.

3. Go to Chapter 11 to see if it is applicable.

4. Fill out the Complete Order Summary Worksheet:

   a. Remove the Complete Order Summary Worksheet from Appendix A and make one photocopy of each page.

   b. Copy the information from the Order Summary Worksheet you filled out in the *IBM Cabling System Planning and Installation Guide* to Part 1 and Part 2 of the Complete Order Summary Worksheet. Be careful to copy the information accurately.

   c. Complete Part 3 and Part 4 using information from *all* of the Attaching Products Worksheets that have been completed. For each accessory, find the total number you will need. Add 10% to that number and enter the result under "Quantity."

Configuration Limits

In some configurations, type 6, 8, or 9 cable is combined with type 1 or type 2 cable. When computing configuration limits, the higher attenuation of types 6, 8, and 9 cable must be accounted for. This is accomplished by using "equivalent length" rather than actual cable length when calculating the signal path length. The equivalent length of a combined section of cable is the length of type 1 or type 2 cable that would have the same attenuation. For IBM 5080 Graphics System applications, the formula for computing the equivalent length is:

Equivalent length = A + 2B + 1.5C
Where: A is the actual length of type 1 or type 2 cable
B is the actual length of type 8 cable
C is the actual length of type 6 or 9 cable

Example: For 1000 feet of type 1 cable and 100 feet of type 8 cable:

equivalent length = 1000 + 2(100) = 1200 feet

Signal Path Length

The *maximum* signal path allowed is 915 meters (3000 feet). The signal path length is the *sum* of the following:

- The equivalent length of cable from the channel controller to the wiring closet
- The equivalent length of cable between wiring closets
- 62 meters (200 feet) for each double balun used
- 31 meters (100 feet) for each single balun used
- Two times (2x) the equivalent length of cable between the wiring closet and each graphics processor, except the last one on the line
- The equivalent length of cable between the wiring closet and the last or only graphics processor.

For additional information on how to determine configuration limits, refer to the following publications:

- *IBM 5080 Graphics System: System Planning and Installation*
- *IBM 5080 Graphics System: Site Planning.*

For information on the maximum cable drop lengths, see "Maximum Cable Drop Lengths" in Chapter 4 of the *IBM Cabling System Planning and Installation Guide.*

9

How to Use the Cabling System for General Purpose Applications

This chapter describes how to use the cabling system for attaching other devices that would normally use in-house telephone wire, such as limited-distance modems. For this purpose, a general purpose attachment cable is available.

Contents
Chapter 9

General Planning Considerations 9-2
General Purpose Attachment Cable 9-2
Planning and Ordering Procedure for General Purpose Attachment Accessories 9-5

General Planning Considerations

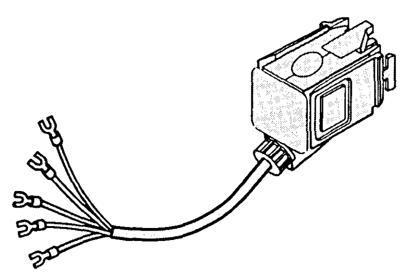
Before using this chapter, you must complete the general planning and ordering procedure in Chapter 4, "How to Plan for and Order Cables and Accessories" in the *IBM Cabling System Planning and Installation Guide.* For information on how to get the manual, see "How to Order IBM Publications" in the Preface of this manual.

At low frequencies, the cabling system data wires have approximately the same characteristic impedance as most existing *in-house* telephone lines. Consult your equipment manufacturer for specific requirements.

Note: When the cabling system is used for general purpose applications, signal levels should not exceed 0 dBm and should be within the frequency range of 50 hertz to 1.5 megahertz.

No specific devices are supported for attachment by the cabling system. The user is responsible for the correct functioning of attached devices. In addition, the user is responsible for ensuring that no attached device interferes with other devices attached to the cabling system.

General Purpose Attachment Cable



- Used to attach devices, such as a limited-distance modem, to a cabling system receptacle
- Approximate length 2.4 meters (8 feet)
- Can be used as a data wire test cable
- Part number 8310554.

Building 806 Floor 2	Cable Schedule			Wiring Closet Location F201 Date of Last Update	
Cable Number	Cable Routing Information		Cable Length	Distribution Panel Jumpers	Additional Information
	Cable Runs From	Cable Runs To			
2003	G202	F201-11-E8	75 ft.	Jumpered to C8	
2005	G205	F201-11-C8	100 ft.	Jumpered to E8	

Figure 9-1 (Part 1 of 2). Example of How General Purpose Attachment Cable Is Used

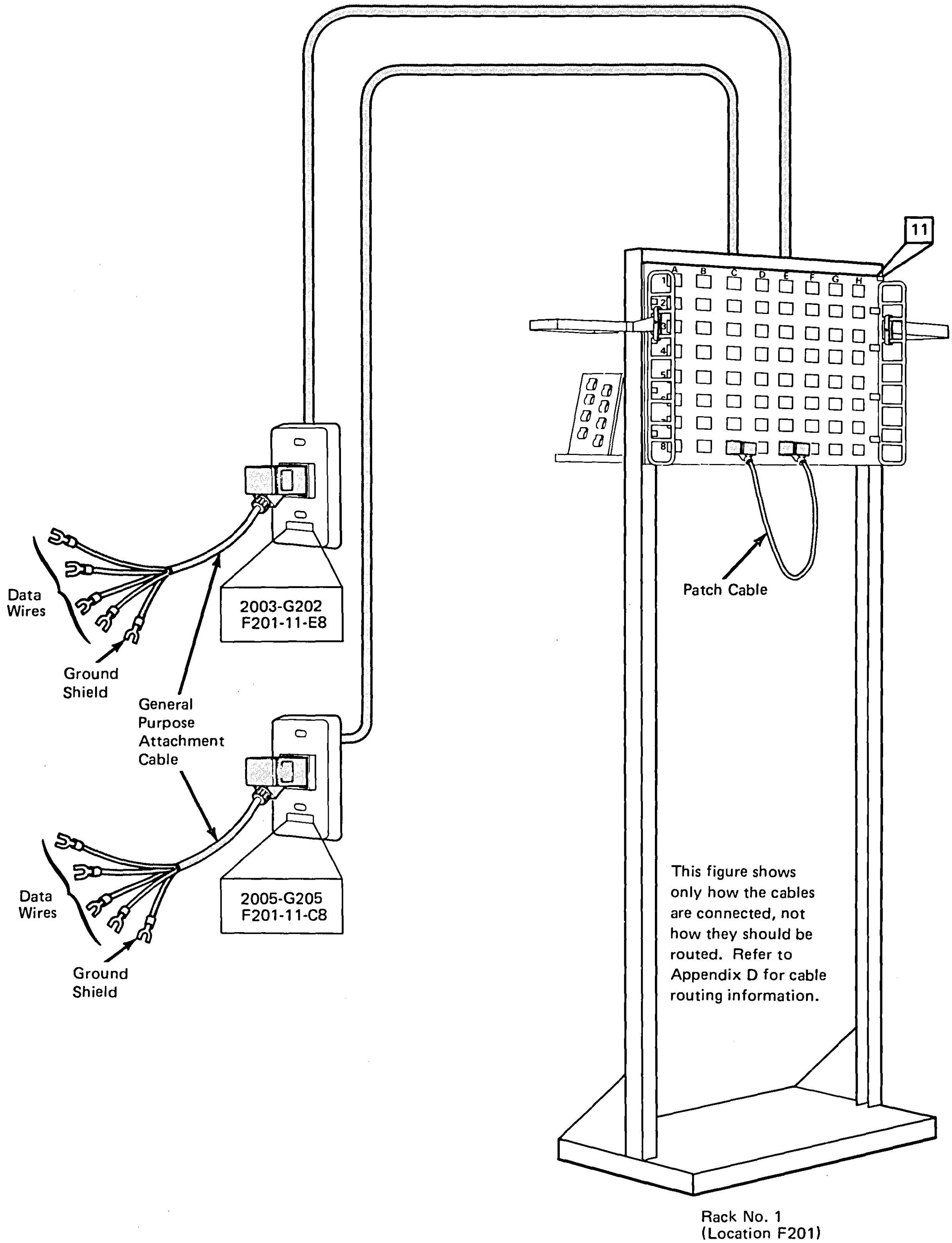


Figure 9-1 (Part 2 of 2). Example of How General Purpose Attachment Cable Is Used

Planning and Ordering Procedure for General Purpose Attachment Accessories

1. Remove the Attaching Products Worksheet from Appendix A and make several photocopies.

   Note: The worksheet is used for ordering accessories for all attaching systems. Use only the section for the general purpose attachment cable.

2. Order one general purpose attachment cable for each device that is to be attached to the cabling system. Enter the number of cables on Gen-1.

3. Order one patch cable for each device that is to be attached to the cabling system. Patch cables are available in 2.4-meter (8-foot) and 9-meter (30-foot) lengths. Enter the number of patch cables on lines Gen-2 or Gen-3.

4. Go to Chapter 11 to see if it is applicable.

5. Fill out the Complete Order Summary Worksheet:

   a. Remove the Complete Order Summary Worksheet from Appendix A and make one photocopy of each page.

   b. Copy the information from the Order Summary Worksheet you filled out in the *IBM Cabling System Planning and Installation Guide* to Part 1 and Part 2 of the Complete Order Summary Worksheet. Be careful to copy the information accurately.

   c. Complete Part 3 and Part 4 using information from *all* of the Attaching Products Worksheets that have been completed. For each accessory, find the total number you will need. Add 10% to that number and enter the result under "Quantity."

10

Use of the Cabling System with an IBM Token-Ring Network

This chapter describes the components and accessories used to connect an IBM Token-Ring Network to the IBM Cabling System.

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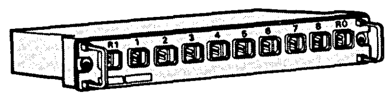
General Planning Considerations

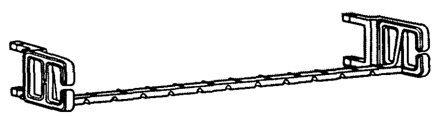
This chapter supplements the wiring information contained in IBM Token-Ring Network documentation. Follow the instructions in the *IBM Token-Ring Network Introduction and Planning Guide*, GA27-3677, to complete the planning for your token-ring network. For information on how to get this publication, see "How to Order IBM Publications" in the Preface of this manual.

IBM 8228 Multistation Access Unit



- A wiring concentrator used to form a star-wired ring configuration
- Installed in the equipment rack or in a special component housing
- Part number 6091014.

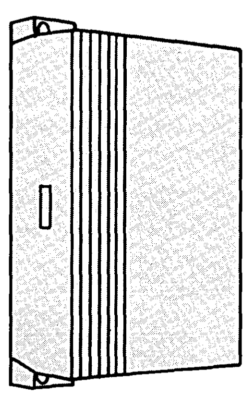
Cable Bracket



- Used for cable management at the equipment rack
- Attaches to the handles of the rack-mounted Multistation Access Unit
- Comes with the Multistation Access Unit

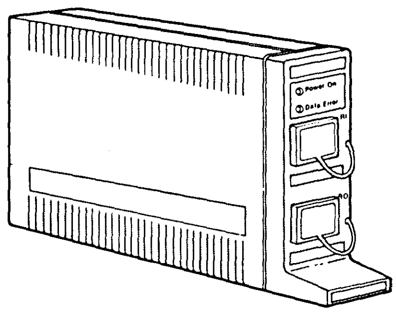
Component Housing

Warning: The component housing should be used only with the IBM Token-Ring Network and the Multiuse Communication Loop.



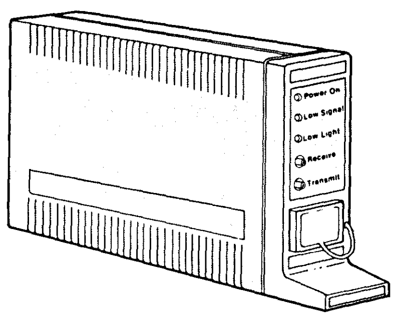
- Used to mount a Multistation Access Unit on the wall.
- Screws for attaching the housing to the wall are not provided.
- Multistation Access Unit must be ordered separately.
- Part number 6091078.

IBM Token-Ring Network 8218 Copper Repeater



- Used to extend the drive distance between 8228 Multistation Access Units (up to 750 meters [2460 feet])
- Provides redrive on the backup path when a second 8218 is installed on a segment of the Token-Ring Network
- Installs in a standard 19-inch rack or to a flat surface with appropriate accessory hardware.

IBM Token-Ring Network 8219 Optical Fiber Repeater



- Allows the use of optical fiber cable between 8228 Multistation Access Units
- A pair of 8219 Optical Fiber Repeaters can transmit and receive a Token-Ring Network signal up to 2.0 kilometers (1.24 miles) on IBM Cabling System type 5 optical fiber cable
- Increases security of data transmission since optical fiber signals do not radiate electrical energy
- Can be used to avoid ground potential difference problems.

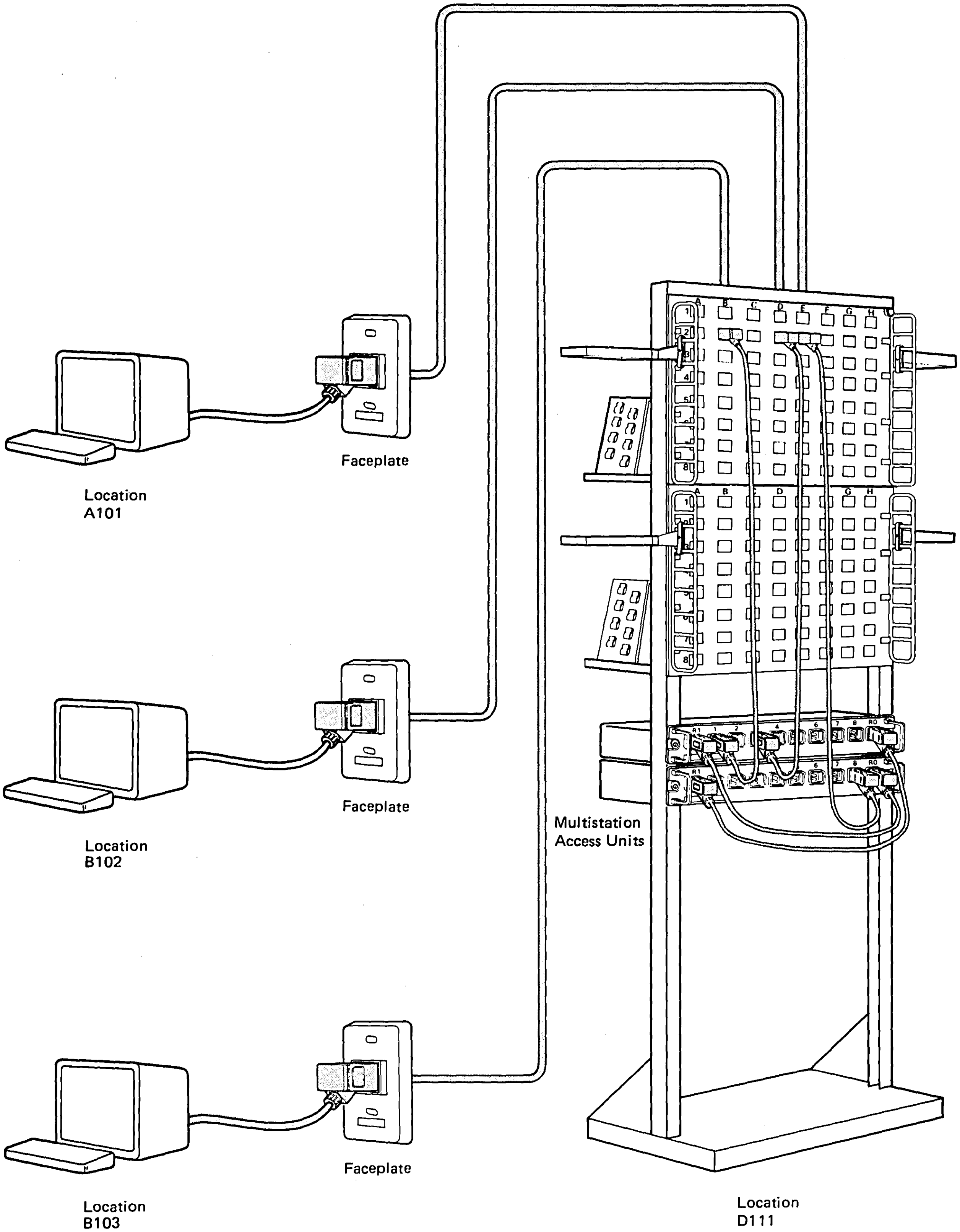


Figure 10-1. Example of a Network with Multistation Access Units

Planning and Ordering Procedure for IBM Token-Ring Network Components

See the *IBM Token-Ring Network Introduction and Planning Guide* for information on how to plan for and order components and accessories for your token-ring network.

11

Planning and Ordering Procedure for Cable between Wiring Closets

This chapter describes the procedure to follow when you must route cables between wiring closets or from a wiring closet to a controller room.

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Preparing the Wiring Closet/Controller Room Worksheet

When cables must be routed between wiring closets or between a wiring closet and a controller room, follow the instructions below. This procedure tells you how to determine the amount of cable, equipment racks, and other supplies you will need. Figure 11-1 shows an example of a completed Wiring Closet/Controller Room Worksheet.

1. Remove the Wiring Closet/Controller Room Worksheet from Appendix A and make photocopies.

2. Enter the building number next to "Building." You should complete a separate worksheet for each building. If you use a separate worksheet for each floor, enter the floor number.

3. Enter a worksheet number.

4. Determine the cable requirements for each cable or group of cables with the same route.

   a. If the cable will be routed between two locations in the same building, continue with step 5.

   b. If the cable will be routed between this building and another, go to step 6.

5. For each cable or group of cables with the same route in the same building, enter the following information in the section "Cable Routes within a Single Building":

   a. Enter the location and the floor number of the first wiring closet.

   b. Enter the location and the floor number of the second wiring closet or controller room.

   c. Enter the number of cables to be routed between the wiring closets or between the wiring closet and the controller room.

   d. Enter the cable length.

   e. For each cable type that is required:

      1) Enter the number of cables needed.

      2) Multiply the number of cables required by the cable length. Enter the result under "Total Feet."

         Note: Remember, record the cable requirements for a given cable route only once.

   f. If faceplates are to be used in a controller room, enter the number of faceplates required under the appropriate column.

      If the total number of cables being routed to a controller room is greater than eight, it is recommended that distribution panels and racks be used to terminate the cables rather than faceplates.

   g. Go to step 7.

6. For each cable or group of cables that is routed between this building and another building, enter the following information in the section "Cable Routes between Buildings":

   a. Enter the location and the floor number of the wiring closet.

   b. Enter the location and the floor number of the surge suppressor in this building.

   c. Enter the location, the floor, and the building number of the wiring closet or controller room in the second building where the outdoor cable is terminated.

   d. Enter the length of the indoor cable to be routed between the wiring closet and the surge suppressor in this building.

   e. Enter the length of the outdoor cable to be routed between the buildings.

   f. For each cable type that is required:

      1) Enter the number of cables needed.

      2) Multiply the number of cables required by the appropriate cable length. Enter the result under "Total Feet."

      3) Enter the number of surge suppressors needed. You will need a surge suppressor to terminate the end of the outdoor cable at this building.

         Note: You will need to calculate and record the cable requirements for the surge suppressor and indoor cable in the building at the other end of the cable route. Record that information on the worksheet for the floor or building where the cable route terminates. Remember to record the outdoor cable between two surge suppressors only once.

   g. Continue with step 7.

7. Enter the total number of data connectors required for this worksheet next to "Data Connectors." You will need one data connector for each indoor cable that is connected to a surge suppressor. Two connectors are required for all other applications of type 1, type 1 plenum, and type 8 cable.

8. If distribution panels are needed for controller rooms, do the following:

   a. Enter the number required next to "Distribution Panels." One distribution panel is required for each 48 cable drops (or fraction thereof) in each controller room.

   b. Enter the number of equipment racks. One or two distribution panels can be mounted in each rack.

   c. Enter the number of equipment rack grounding kits. One grounding kit is required for each equipment rack.

   d. Enter the number of cable label packages. Order one package of cable labels for each distribution panel.

9. Return to the chapter that brought you here.

Wiring Closet/Controller Room Worksheet

Building 610
Floor 1
Worksheet 1

Cable Routes Within a Single Building

	Wiring Closet Location/ Floor	Wiring Closet or Controller Room Location/ Floor	Number of Cables	Cable Length	Cable Requirements: Type 1		Type 1 P		Type 5		Faceplate Devices 1	1S	1W
1	C118	L142	8	260	6	1560			2	520			
2	C118	A104	6	140	6	560						6	
3	C118	C218	8	50	6	300			2	100			
4	L142	L242	8	40	6	240			2	80			
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													
Totals						2660				700		6	

Cable Routes Between Buildings

	Wiring Closet Location/ Floor	Surge Suppressor Location/ Floor	Wiring Closet or Controller Room Location/ Floor/ Building	Length of Indoor Cable in this Building	Type 1 No.	Type 1 Total Feet	Type 1 P No.	Type 1 P Total Feet	Length of Outdoor Cable	Type 1 Outdoor No.	Type 1 Outdoor Total Feet	Surge Sup- pressors
1	C118	F101	G116/609	75	6	450			300	6	1800	3
2												
3												
4												
Totals					6	450				6	1800	3

Data Connectors 66	Distribution Panels ______	Rack Grounding Kit ______
	Distribution Racks ______	Cable Label Packages ______

Figure 11-1. Example of a Completed Wiring Closet/Controller Room Worksheet

12

Testing the Data Path

This chapter tells you how to test the cable and cabling system accessories in a failing data path.

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How to Use the Data Path Problem Determination Procedure with a System Problem Determination Procedure

Follow the procedure in the section "The Data Path Problem Determination Procedure" when your *system problem determination procedure* indicates a problem in the cabling system data path. The system problem determination procedure can be found in the appropriate documentation for your IBM communication products.

Notes:

1. When testing a Multiuse Communication Loop system, follow the system problem determination procedure in the *Guide to Multiuse Communication Loop with IBM Cabling System*, GA27-3606. If necessary, return here and follow "The Data Path Problem Determination Procedure."

2. When testing twinaxial systems, follow the system problem determination procedure in the *IBM Cabling System Problem Determination Guide for Twinaxial Applications*, GA21-9491. If necessary, return here and follow "The Data Path Problem Determination Procedure."

Terms Used in this Chapter

Continuity Describes an uninterrupted data wire, telephone wire, or shield with resistance of less than 500 ohms.

Open Describes a data wire, telephone wire, or shield that is normally not connected and has a resistance greater than 10,000 ohms.

Short circuit or short Describes a connection of two normally unconnected wires or shield with a resistance of less than 1000 ohms.

The Data Path Problem Determination Procedure

Follow the instructions in this section only if the *system problem determination procedure* you performed has identified a problem in a cable or cabling system accessory. The following steps direct you in testing the cable and cabling system accessories associated with the failing data path.

1. Use the completed Cable Schedule and System Configuration Worksheets to determine if the data path is correctly cabled, connected and configured.

   a. If you do not find any errors, continue with step 2.

   b. If you find any errors, correct the errors. Go to step 10.

Warning: Before disconnecting any devices or control units, be sure you have the records showing how everything should be reconnected. Follow the instructions in step 3 when disconnecting double baluns.

2. Locate any coaxial patch panels in the failing data path.

   a. If there is no coaxial patch panel, continue with step 3.

   b. If there is a coaxial patch panel, move both coaxial cable connections to another coaxial bulkhead connector on the coaxial patch panel. Operate the system to see if the problem is corrected.

      1) If the problem is corrected, the coaxial bulkhead connector is defective. Replace it. Go to step 10.

      2) If the problem still exists, reconnect the cables to the original bulkhead connector. Continue with step 3.

3. Locate any baluns in the failing data path.
   When the double cableless balun is used to operate a device, remove both coaxial jumper cables from the balun at the distribution panel or at the control unit ***before*** *disconnecting any balun or data connector in the data path. If the cables are not disconnected in this manner, the operation of the system could be disrupted.*

   a. If there are no baluns, continue with step 4.
   b. If there are baluns, swap them one at a time with a balun that is new or already tested defect free.
      1) If the problem is corrected, go to step 10.
      2) If the problem still exists, continue with step 4.

4. Disconnect each device and control unit from the failing data path by disconnecting the data connector from the faceplate or patch cable.

5. Use the list of cabling system accessories in Figure 12-1 to identify the accessories involved with the failing data path.

   a. If no accessories are found, go to step 7.
   b. If any of the accessories are found:
      1) Make a list of the accessories.
      2) Disconnect the accessories from the data path.
      3) Continue with step 6.

Cabling System Accessories	Procedure Used IBM Tester	Procedure Used Ohmmeter
Y Assembly PN 8642549	A	AA
Twinaxial Y Assembly PN 8642550	B	BB
Twinaxial Direct Connect Cable PN 6091075	C	CC
Twinaxial Impedance Matching Device PN 6091070	D	DD
Twinaxial Terminator PN 6091068		EE
Red Coaxial Balun Assembly PN 8642546		FF
Single Cableless Coaxial Balun PN 6339082		FF
Double Cableless Coaxial Balun PN 6339083		GG
Yellow Coaxial Balun Assembly PN 8642544		HH
Dual Purpose Connector (DPC) Attachment Cable PN 6339073 (2.4 meters [8 feet]) PN 6339074 (9 meters [30 feet])		JJ
Double Dual Purpose Connector (DPC) Attachment Cable PN 6339075		KK
Plug and Jack Y Assembly PN 8310552	L	LL
MFA/422 Attachment Cable PN 8310553		MM
General Purpose Attachment Cable PN 8310554	N	NN
Loop Wiring Concentrator (LWC) PN 6091077	P	PP
Store Loop Attachment Assembly	Q	QQ
Patch Cable PN 8642551 (2.4 meters [8 feet]) PN 8642552 (9 meters [30 feet])	R	RR
Indoor and Outdoor Surge Suppressor PN 4760469 (Indoor) PN 6091063 (Outdoor)	S	SS

Figure 12-1. Cabling System Accessories and Test Procedures

6. Test the accessories in the failing data path by using the appropriate test procedure in "Test Procedures for Cabling System Accessories." The test procedures are listed in Figure 12-1.

   You will need the IBM Cabling System Tester (part number 4760500), an ohmmeter (which is not available from IBM), or both to complete the test procedures. It is recommended that you use the IBM Cabling System Tester whenever possible.

   Test each of the accessories in the failing data path until the defective item is found or until all the accessories have been tested defect free.

   a. If all the cabling system accessories are defect free, continue with step 7.

   b. If you find a defective accessory, replace it. Go to step 10.

7. Using the Cable Schedule and System Configuration Worksheets, you will now test the data path with patch cables and surge suppressors (if any) still connected.

   Figure 12-2 and Figure 12-3 illustrate several examples of data paths that may consist of:

   - A single patch cable

   - A single in-the-wall cable (or undercarpet cable) between a distribution panel and a faceplate

   - A combination of in-the-wall cabling and patch cables connected to one another

   - A combination of patch cables, surge suppressors, outdoor cable, indoor cables, and in-the-wall cables in a data path that is routed between buildings.

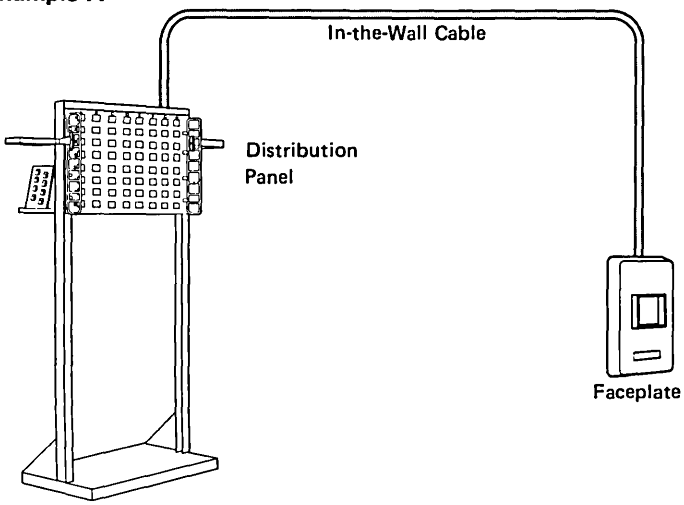
   Test the data path using either "Testing Data Cable with the IBM Cabling System Tester" or "Testing Data Cable with an Ohmmeter" in Appendix G.

   a. If the data path is defect free, go to step 10.

   b. If the data path is defective and consists of a single data cable as shown in Figure 12-2, go to step 9.

   c. If the data path is defective and consists of more than one data cable or a data cable with surge suppressors as shown in Figure 12-3, continue with step 8 to identify the defective item.

Example A



Example B

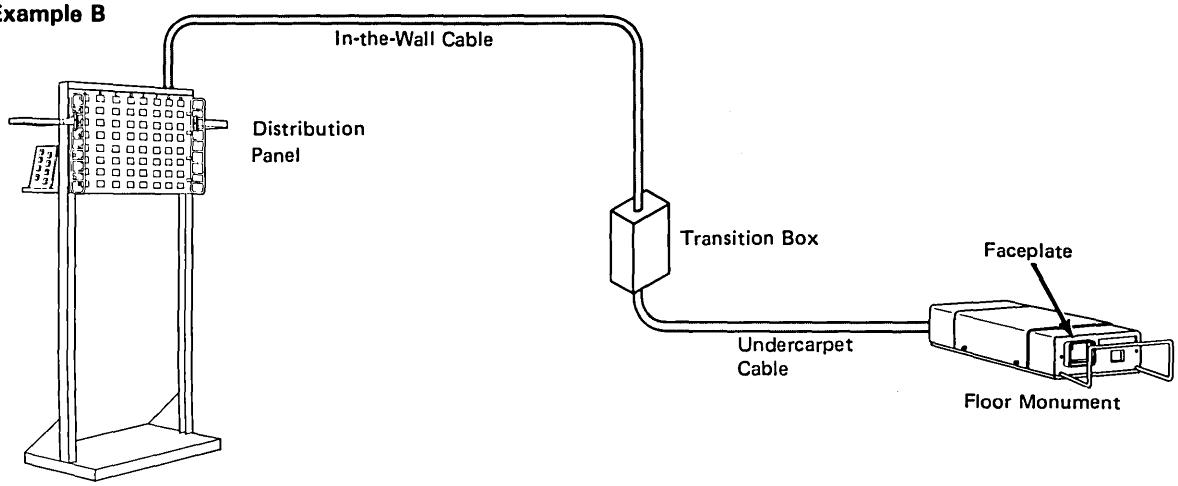


Figure 12-2. Examples of Data Paths Consisting of a Single Data Cable

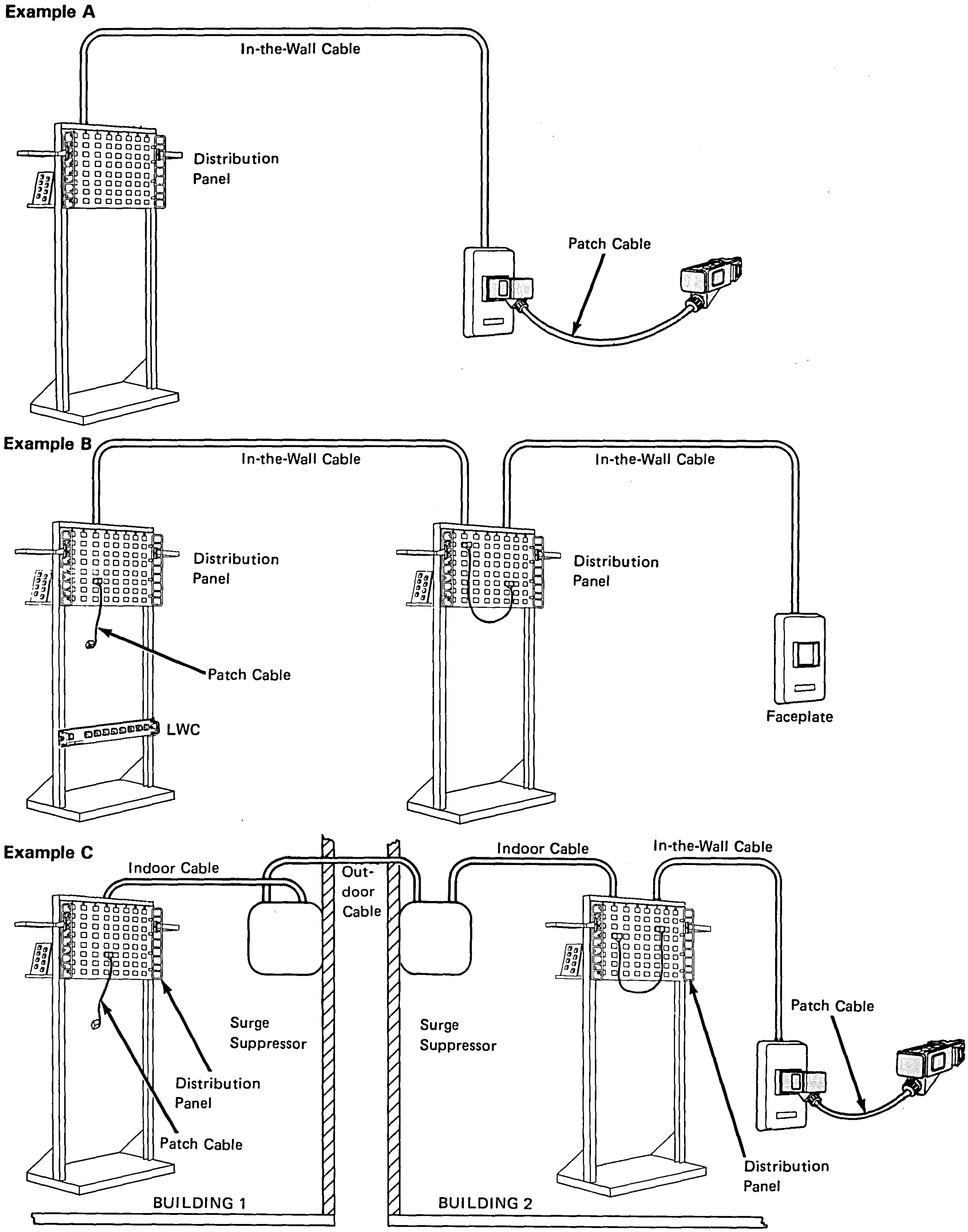


Figure 12-3. Examples of Data Paths Consisting of More than One Data Cable or a Data Cable with Surge Suppressors

8. You will now test the data path in segments. A "segment" is any data cable with or without surge suppressors between IBM Cabling System data connectors, including the data connectors themselves. Example "C" in Figure 12-3 shows a data path that consists of five segments (from left to right):

   - Patch cable
   - Surge suppressors with outdoor cable and indoor cable between distribution panels in two buildings
   - Patch cable
   - In-the-wall cable
   - Patch cable.

   Figure 12-4 illustrates how to test the data path in segments.

   Starting at one end of the data path, disconnect a segment of cable and test it using "Testing Data Cable with the IBM Cabling System Tester" or "Testing Data Cable with an Ohmmeter" in Appendix G.

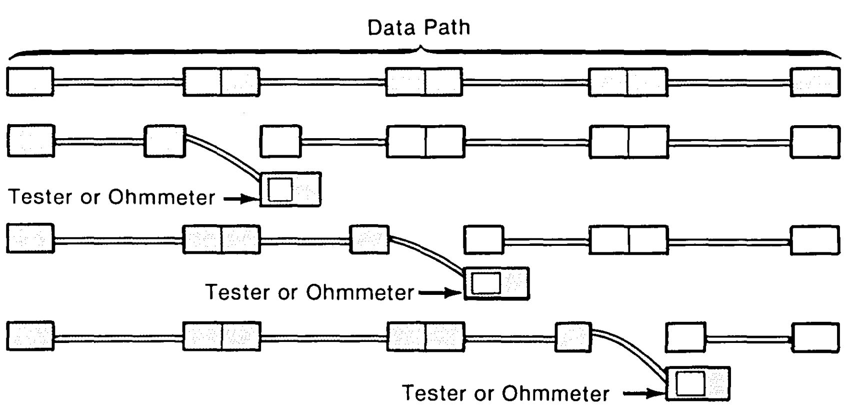
   a. If the cabling does not test defective and you have not tested all of the segments:

      1) Reconnect the segment, go to the next data connector, and disconnect it.

      2) Repeat the test on the connected segments.

   b. If the cabling does not test defective and you have tested all of the segments, go to step 10.

   c. If the cabling tests defective, the segment of the data path just added to the test group is defective. Continue with step 9.



Note:
If the group of cable segments tests defective, the cable segment just added is defective.

Figure 12-4. Testing the Data Path in Segments

9. Correct the defective cable segment:

   a. If the defective segment is a patch cable, replace it. Continue with step 10.

   b. If the defective segment contains surge suppressors and outdoor cable, test the surge suppressor data paths. Use either "Procedure S: Indoor and Outdoor Surge Suppressor – IBM Cabling System Tester" or "Procedure SS: Indoor and Outdoor Surge Suppressor - Ohmmeter" in this chapter. Continue with step 10.

   c. If the defective segment is in-the-wall (or undercarpet) cable, replace the data connectors at each end and retest the cable.

      1) If the cable with new connectors is not defective, continue with step 10.

      2) If the cable is defective, replace the cable. Continue with step 10.

10. Reconnect all cabling system accessories, devices, and control units that you have disconnected while performing this test procedure and take the appropriate action:

    a. Return to the system problem determination procedure to determine if there are any additional steps you should follow. For example, the problem may have disappeared or been changed by disconnecting or reconnecting accessories and cables.

    b. Follow the recommendations found in the section "Finding Difficult Problems" later in this chapter if the problem still exists.

    c. Return to the system problem determination procedure to verify that the system is operating properly. For example, run diagnostic or application programs.

(

Test Procedures for Cabling System Accessories

The following test procedures tell you how to test cabling system accessories, such as the twinaxial impedance matching device, Y assembly, and the loop wiring concentrator (LWC). You will need either the IBM Cabling System Tester (part number 4760500), an ohmmeter (which is not available from IBM), or both to complete the test. It is recommended that you use the IBM Cabling System Tester whenever possible.

This section is divided into two parts. The first part includes procedures that permit the use of the IBM tester. If you have the tester, you should use these procedures. The second part includes procedures for testing all of the accessories with an ohmmeter. See the table of contents for this chapter for a list of the test procedures.

Notes:

1. In all of these test procedures, the reference to the color of a wire indicates the color of the wire itself, or of the tracer or band on a white wire. For example, a "red" wire is either a red wire, a white wire with a red tracer, or a white wire with a red band.
2. "Replace" means to substitute a part that is *new* or *known to be good* for the defective part.
3. See Appendix E for information on using the IBM Cabling System Tester.
4. For an explanation of red light indicators on the IBM Cabling System Tester, see "Red Light Descriptions" in Appendix E.

IBM Cabling System Tester Procedures

Procedure A: Y Assembly – IBM Cabling System Tester

This procedure requires the Twinaxial Test Accessories Kit (part number 6339087) used with the IBM Cabling System Tester.

1. See Figure 12-5 and connect the tester data cable to connector 3 of the Y assembly.

2. Connect connectors 1 and 2 together.

3. Set the tester mode switch to position 1.

4. Press the test button:

   a. If the green light comes on, continue with step 5.

   b. If any red lights come on, the Y assembly is defective. Replace it. Go to step 16.

5. Disconnect the tester data cable from connector 3 and disconnect connectors 1 and 2.

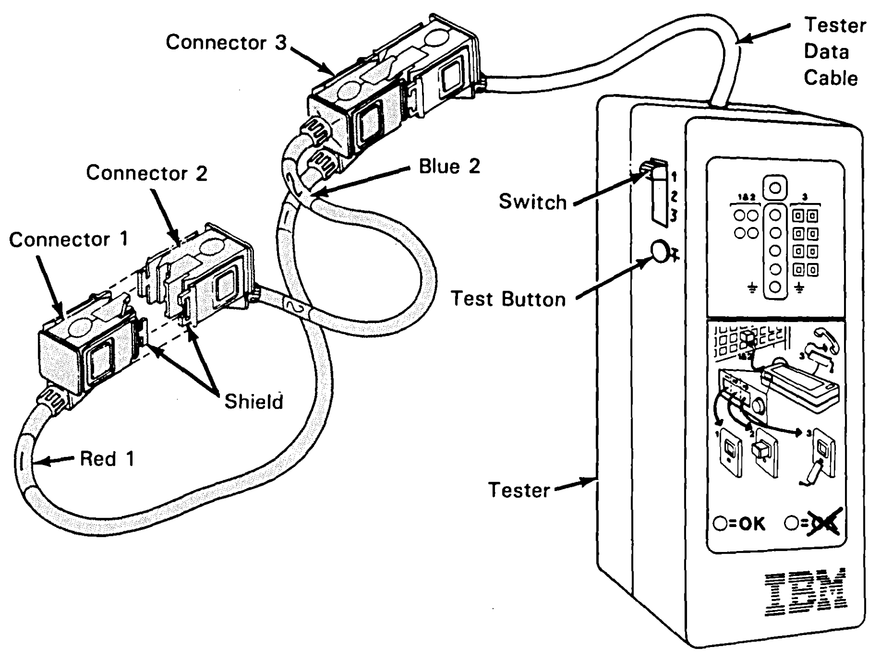


Figure 12-5. Testing for Continuity of All Signal Paths in Y Assembly

6. See Figure 12-6 and connect the twinaxial test adapter to the tester data cable.

7. Connect the other end of the twinaxial test adapter to connector 1 of the Y assembly.

8. Connect Y assembly connector 2 to the twinaxial test terminator.

9. Set the tester mode switch to position 2.

10. Press the test button:

    a. If a green light comes on, continue with step 11.

    b. If any red lights come on, the Y assembly is defective. Replace it. Go to step 16.

11. Disconnect the twinaxial test terminator from connector 2 of the Y assembly.

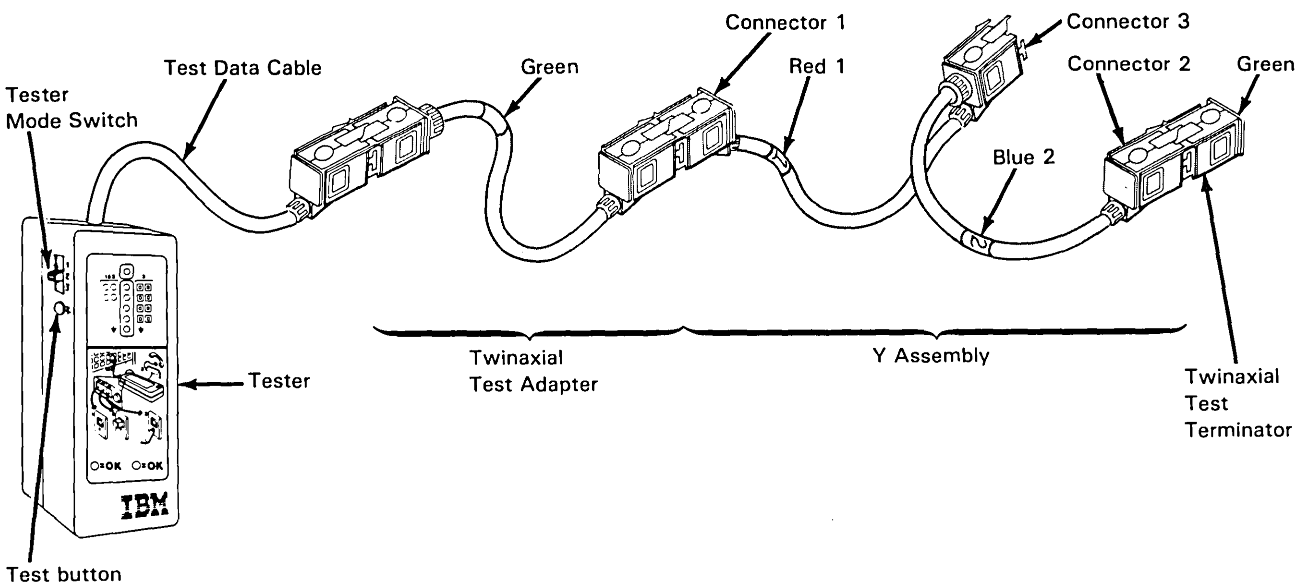


Figure 12-6. Testing for Continuity of the Shield between Connectors 1 and 2 in the Y Assembly

12. See Figure 12-7 and connect the twinaxial test terminator to connector 3 of the Y assembly.

13. Set the tester mode switch to position 2.

14. Press the test button:

    a. If the green light comes on, the Y assembly is not defective. Continue with step 15.

    b. If any red lights come on, the Y assembly is defective. Replace it. Go to step 16.

15. Disconnect the twinaxial test terminator and the twinaxial test adapter from the Y assembly. Disconnect the test adapter from the tester data cable.

16. Return to step 6 in "The Data Path Problem Determination Procedure" or to the procedure that brought you here.

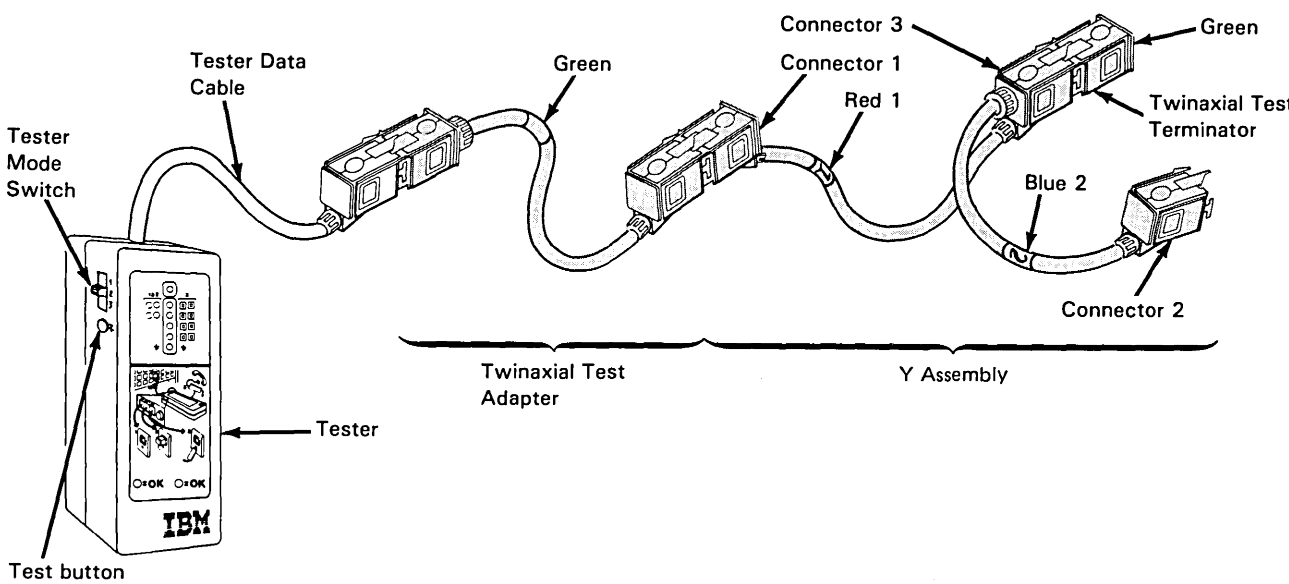


Figure 12-7. Testing for Continuity of the Shield between Connectors 1 and 3 in the Y Assembly

Procedure B: Twinaxial Y Assembly – IBM Cabling System Tester

This procedure requires the Twinaxial Test Accessories Kit (part number 6339087) used with the IBM Cabling System Tester and two twinaxial direct connect cables. The direct connect cables must be new or already tested defect free.

1. See Figure 12-8 and connect the tester data cable to connector 3 of the twinaxial Y assembly.

2. Using a twinaxial straight adapter, connect connectors 1 and 2 of the twinaxial Y assembly together.

3. Set the tester mode switch to position 1.

4. Press the test button:

   a. If the green light comes on, continue with step 5.

   b. If any red lights come on, the twinaxial Y assembly is defective. Replace it. Go to step 17.

5. Disconnect the tester data cable and the twinaxial straight adapter from the twinaxial Y assembly.

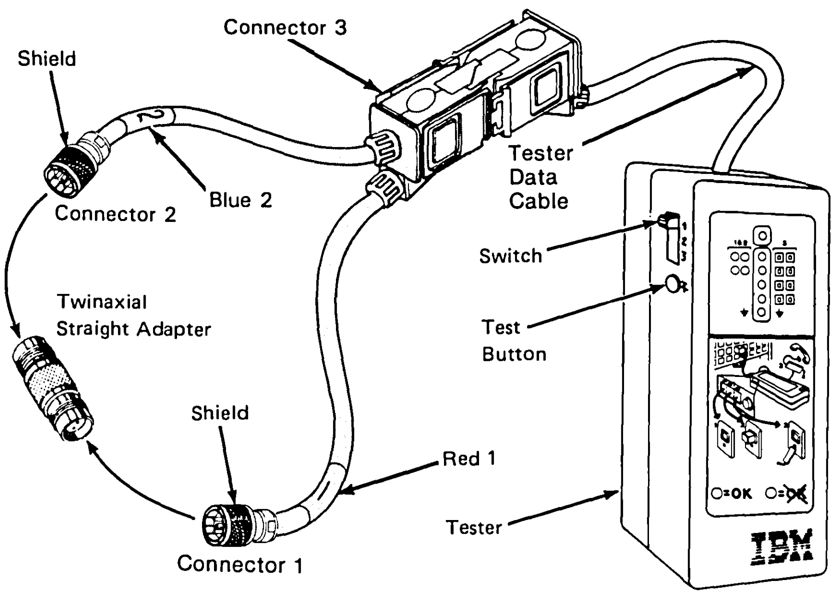


Figure 12-8. Testing for Continuity of All Signal Paths in the Twinaxial Y Assembly

6. See Figure 12-9 and connect the tester data cable to the twinaxial test adapter.

7. Using the twinaxial straight adapters, connect a twinaxial direct connect cable to each leg of the twinaxial Y assembly.

8. Connect the twinaxial test adapter to the twinaxial direct connect cable that is attached to *connector 1* of the twinaxial Y assembly.

9. Connect the twinaxial test terminator to the twinaxial direct connect cable that is attached to *connector 2* of the twinaxial Y assembly.

10. Set the tester mode switch to position 2.

11. Push the test button:

    a. If a green light comes on, continue with step 12.

    b. If any red lights come on, the twinaxial Y assembly is defective. Replace it. Go to step 17.

12. Disconnect the twinaxial straight adapter from connector 2 of the Y assembly and disconnect the twinaxial test terminator from the direct connect cable.

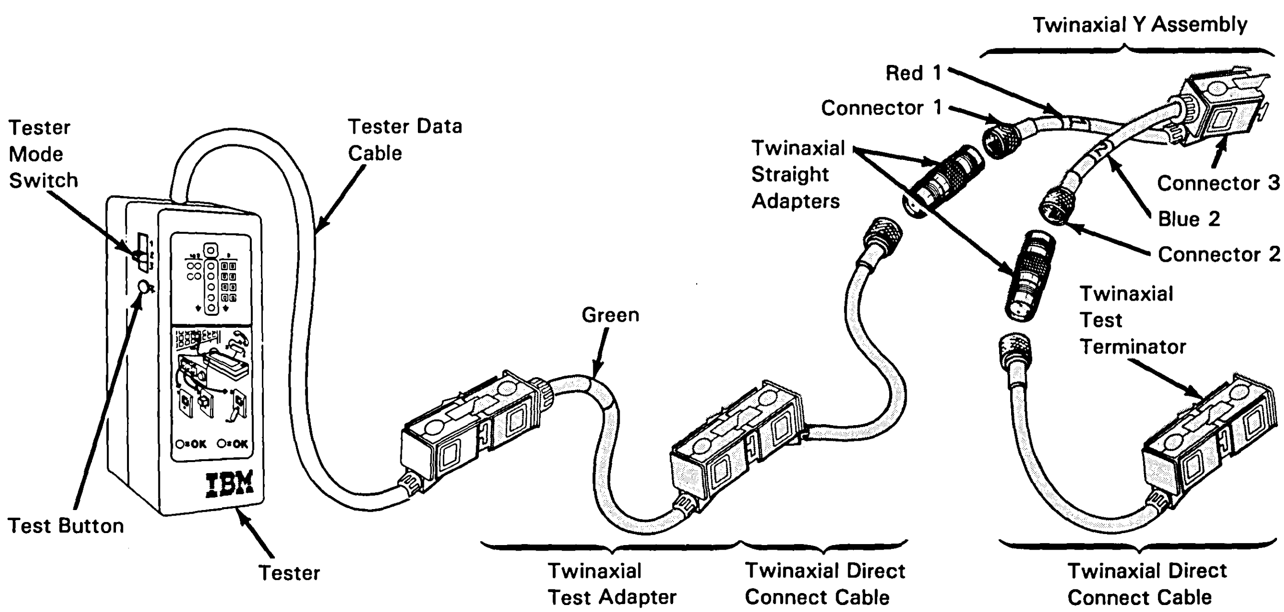


Figure 12-9. Testing for Continuity of the Shield between Connectors 1 and 2 in the Twinaxial Y Assembly

13. See Figure 12-10 and connect the twinaxial test terminator to twinaxial Y assembly connector 3.

14. Set the tester mode switch to position 2.

15. Push the test button:

    a. If the green light comes on, the twinaxial Y assembly is not defective. Continue with step 16.

    b. If any red lights come on, the twinaxial Y assembly is defective. Replace it. Go to step 17.

16. Disconnect the twinaxial test terminator and the twinaxial test adapter from the twinaxial Y assembly. Disconnect the test adapter from the tester data cable.

17. Return to step 6 in "The Data Path Problem Determination Procedure" or to the procedure that brought you here.

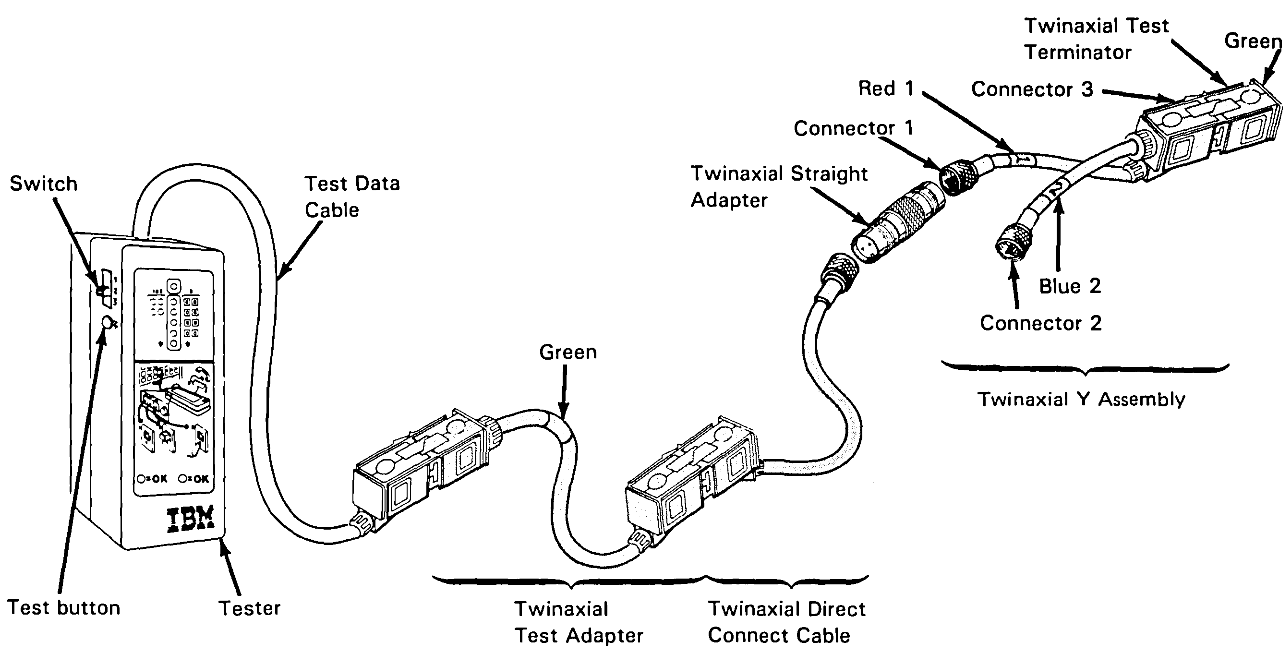


Figure 12-10. Testing for Continuity of the Shield between Connectors 1 and 3 of the Twinaxial Y Assembly

Procedure C: Twinaxial Direct Connect Cable - IBM Cabling System Tester

This procedure requires the Twinaxial Test Accessories Kit (part number 6339087) used with the IBM Cabling System Tester. You will also need a twinaxial direct connect cable that is new or already tested defect free.

1. See Figure 12-11 and connect the twinaxial test adapter to the tester data cable.

2. Using a twinaxial straight adapter, connect the good twinaxial direct connect cable to the direct connect cable that is being tested.

3. Connect the good direct connect cable to the twinaxial test adapter.

4. Connect the twinaxial test terminator to the twinaxial direct connect cable that is being tested.

5. Set the tester mode switch to position 2.

6. Push the test button:

   a. If the green light comes on, the twinaxial direct connect cable is not defective. Continue with step 7.

   b. If any red lights come on, the twinaxial direct connect cable is defective. Replace it. Go to step 8.

7. Disconnect the twinaxial direct connect cables and the twinaxial test accessories.

8. Return to step 6 in "The Data Path Problem Determination Procedure" or to the procedure that brought you here.

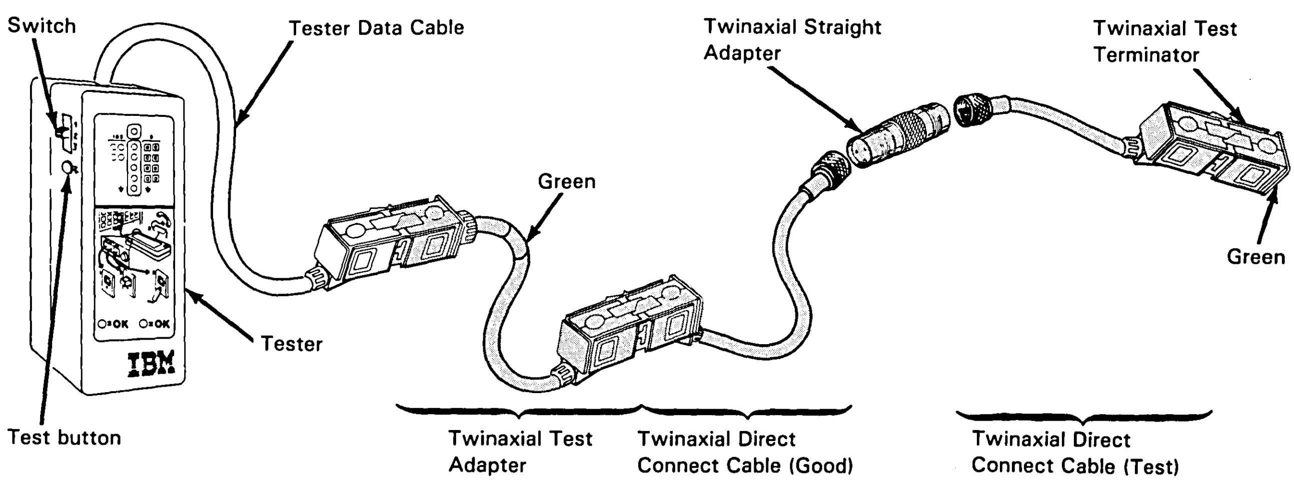


Figure 12-11. Testing the Twinaxial Direct Connect Cable

Procedure D: Twinaxial Impedance Matching Device – IBM Cabling System Tester

This procedure requires the Twinaxial Test Accessories Kit (part number 6339087) used with the IBM Cabling System Tester. You will also need a twinaxial direct connect cable that is new or already tested defect free.

1. See Figure 12-12 and connect the twinaxial test adapter to the tester data cable.
2. Using a twinaxial straight adapter, connect the twinaxial direct connect cable to the twinaxial impedance matching device that is being tested.
3. Connect the twinaxial test adapter to the twinaxial direct connect cable.
4. Connect the twinaxial test terminator to the twinaxial impedance matching device.
5. Set the tester mode switch to position 2.
6. Push the test button:
   a. If a green light comes on, continue with step 7.
   b. If any red lights come on, the twinaxial impedance matching device is defective. Replace it. Go to step 9.
7. Disconnect the direct connect cable from the twinaxial impedance matching device and disconnect the twinaxial test accessories.
8. Continue testing by going to "Procedure DD: Twinaxial Impedance Matching Device - Ohmmeter" in this chapter.
9. Return to step 6 in "The Data Path Problem Determination Procedure" or to the procedure that brought you here.

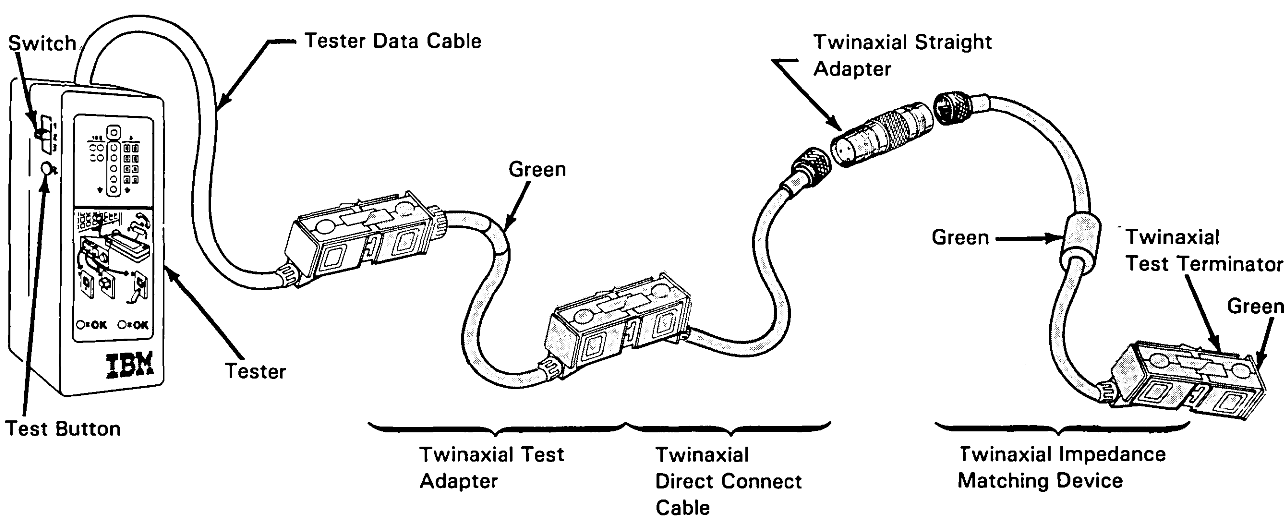


Figure 12-12. Testing the Twinaxial Impedance Matching Device

Procedure L: Plug and Jack Y Assembly - IBM Cabling System Tester

This procedure requires an ohmmeter and a data wire test cable. Use a General Purpose Attachment Cable (part number 8310554) or see "Making a Data Wire Test Cable" in Appendix F.

1. See Figure 12-13 and connect the tester data cable to connector 3 of the plug and jack Y assembly.

2. Connect connectors 1 and 2 together.

3. Set the tester mode switch to position 1.

4. Press the test button:

   a. If the green light comes on, continue with step 5.

   b. If any red lights come on, the plug and jack Y assembly is defective. Replace it and go to step 10.

5. Disconnect the tester data cable from connector 3 and disconnect connectors 1 and 2.

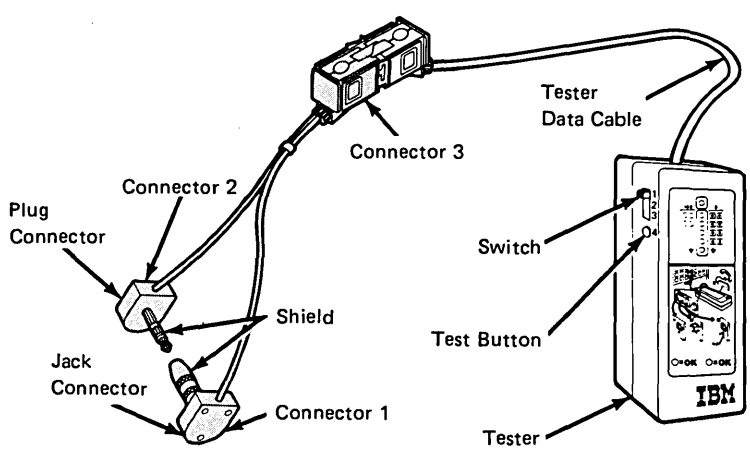


Figure 12-13. Testing the Plug and Jack Y Assembly Using the IBM Cabling System Tester

6. See Figure 12-14 and connect a data wire test cable to connector 3 of the plug and jack Y assembly.

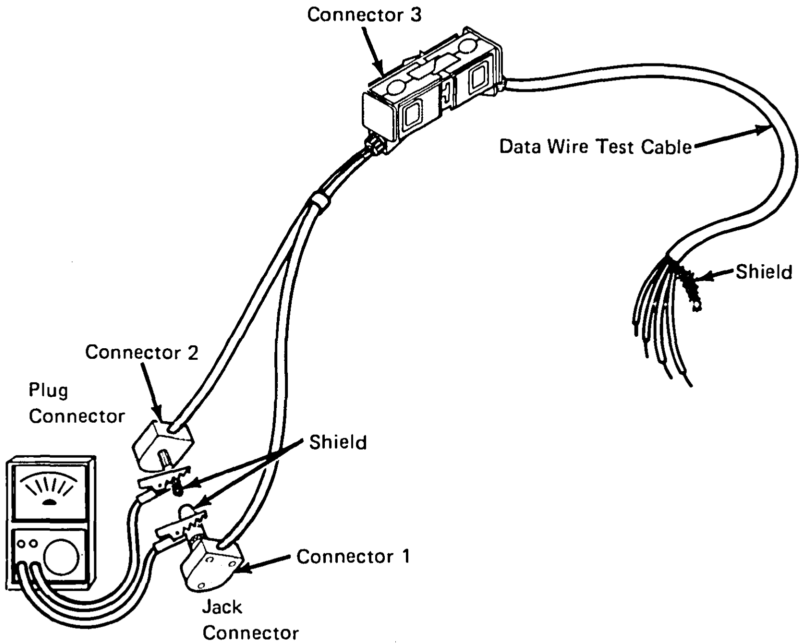


Figure 12-14. Testing the Plug and Jack Y Assembly Using an Ohmmeter

7. Using an ohmmeter, check for *continuity* of the shield of connector 1 and the shield of connector 2.

   a. If there is continuity, continue with step 8.

   b. If there is no continuity, the plug and jack Y assembly is defective. Replace it and go to step 10.

8. Using an ohmmeter, check for an *open* between the shield of connector 1 and the shield of connector 3.

   a. If there is an open, continue with step 9.

   b. If there is no open, the plug and jack Y assembly is defective. Replace it and continue with step 10.

9. Using an ohmmeter, check for an open between the following leads of the data wire test cable:

   - Red and orange
   - Red and green
   - Red and black
   - Orange and green
   - Orange and black
   - Green and black
   - Shield and red
   - Shield and orange
   - Shield and green
   - Shield and black.

   a. If you get an open in each case, the plug and jack Y assembly is not defective. Disconnect the data wire test cable and continue with step 10.

   b. If you do not get an open in each case, the plug and jack Y assembly is defective. Replace it and continue with step 10.

10. Return to step 6 in "The Data Path Problem Determination Procedure" or to the procedure that brought you here.

Procedure N: General Purpose Attachment Cable – IBM Cabling System Tester

This procedure requires a data wrap plug, an accessory to the IBM Cabling System Tester (part number 4760500). You will also need a data wire test cable. Use the General Purpose Attachment Cable (part number 8310554) or see "Making a Data Wire Test Cable" in Appendix F.

1. See Figure 12-15. Connect the leads of the data wire test cable to the general purpose attachment cable being tested. Be sure to connect leads of the same color together.

   If your data wire test cable is a general purpose attachment cable, connect the leads using tape. If you made the data wire test cable, twist the leads together.

2. Connect the data wire test cable to the tester data cable.
3. Set the tester mode switch to position 1.
4. Press the test button:
   a. If the green light comes on, continue with step 5.
   b. If any red lights come on, the general purpose attachment cable is defective. Go to step 8.

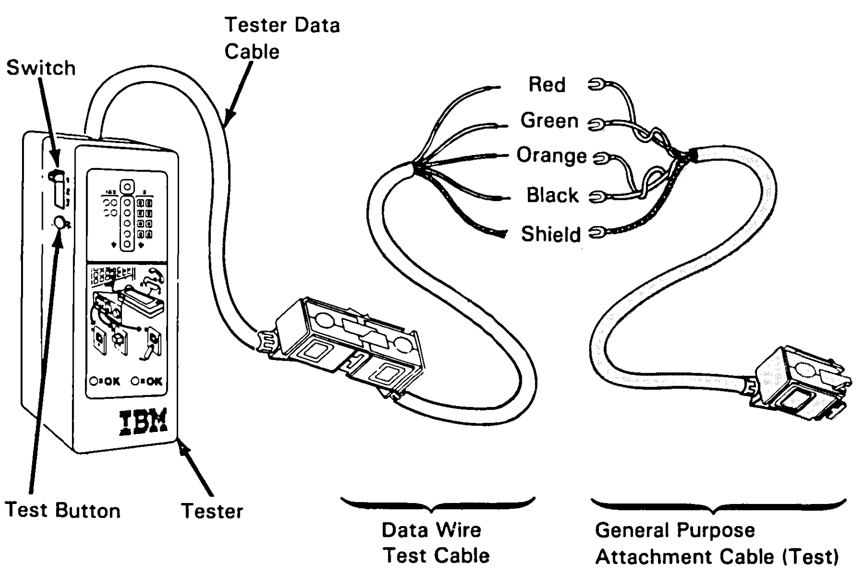


Figure 12-15. Testing the General Purpose Attachment Cable

5. See Figure 12-16 and connect the data wrap plug to the data connector of the general purpose attachment cable.

6. Set the tester mode switch to position 2.

7. Press the test button:

   a. If the green light comes on, the general purpose attachment cable is not defective. Continue with step 9.

   b. If any red lights come on, the general purpose attachment cable is defective. Go to step 8.

8. The general purpose attachment cable is defective. Replace the data connector at the end of the cable. Repeat this test procedure.

   a. If the test did not find any defects, the general purpose attachment cable is not defective. Continue with step 9.

   b. If the test found any defects, replace the cable. Continue with step 9.

9. Disconnect the data wrap plug, the tester and the data wire test cable, if they are connected.

10. Return to step 6 in "The Data Path Problem Determination Procedure" or to the procedure that brought you here.

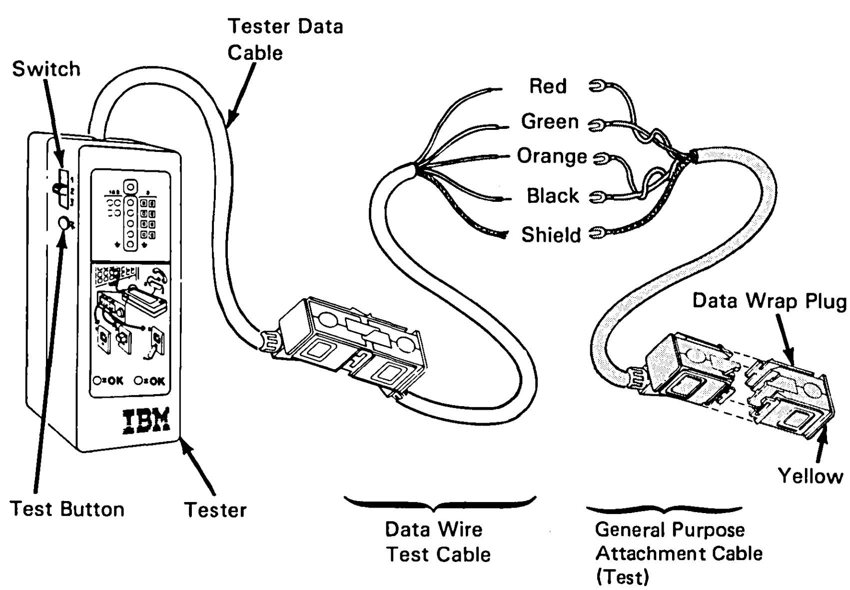


Figure 12-16. Testing the General Purpose Attachment Cable with Data Wrap Plug

Procedure P: Loop Wiring Concentrator (LWC) – IBM Cabling System Tester

This procedure requires a data wrap plug, an accessory to the IBM Cabling System Tester (part number 4760500).

1. Make sure that any patch cables currently connected to the LWC are labeled so that they can be reconnected properly.

2. If any patch cables are connected to the LWC, disconnect them from the LWC.

3. See Figure 12-17 and connect the tester data cable to the I/O port of the LWC. (See Figure 12-19 for a schematic of the LWC.)

4. Set the tester mode switch to position 1.

5. Press the test button:

   a. If the green light comes on, continue with step 6.

   b. If any red lights come on, the LWC is defective. Replace it and go to step 12.

6. Disconnect the tester data cable from the I/O port and connect it to one of the radial ports.

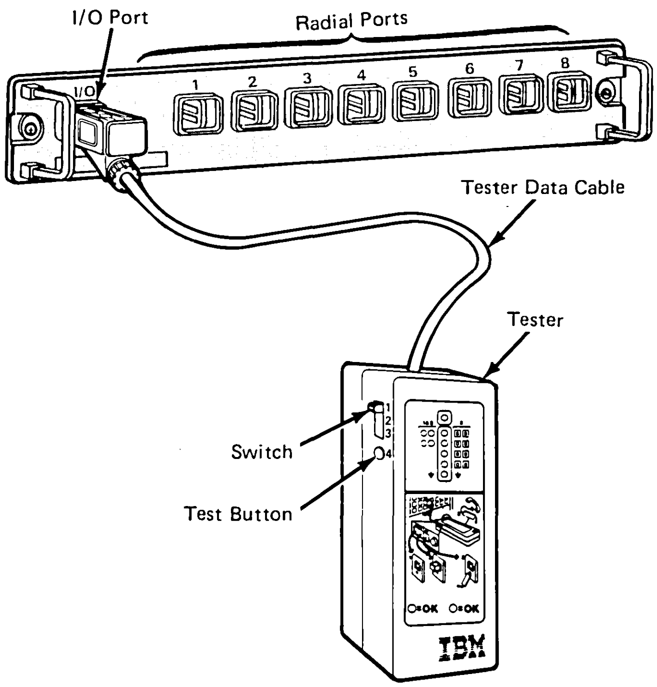


Figure 12-17. Testing the Loop Wiring Concentrator (LWC).

Note: This test is performed at one of the radial ports to check the shorting bars in the I/O port.

7. Press the test button:

   a. If the green light comes on, continue with step 8.

   b. If any red lights come on, the LWC is defective. Replace it and go to step 12.

8. Connect the data wrap plug to one of the other radial ports or the I/O port.

9. Set the tester mode switch to position 2.

10. Press the test button:

    a. If the green light comes on, the LWC is not defective. Continue with step 11.

    b. If any red lights come on, the LWC is defective. Replace it and go to step 12.

11. Disconnect the data wrap plug and the tester.

12. Return to step 6 in "The Data Path Problem Determination Procedure" or to the procedure that brought you here.

Procedure Q: Store Loop Attachment Assembly – IBM Cabling System Tester

This procedure requires a store loop shorting plug.

1. See Figure 12-18 and connect the tester data cable to the data connector of the store loop attachment assembly.

2. Connect the store loop shorting plug to the Western Electric (WE) type-404B receptacle.

3. Set the tester switch to position 1.

4. Press the test button:

   a. If the green light comes on, the store loop attachment assembly is not defective. Continue with step 5.

   b. If any red lights come on, the store loop attachment assembly is defective. Repair or replace it.

5. Disconnect the tester data cable and the store loop shorting plug.

6. Return to step 6 in "The Data Path Problem Determination Procedure" or to the procedure that brought you here.

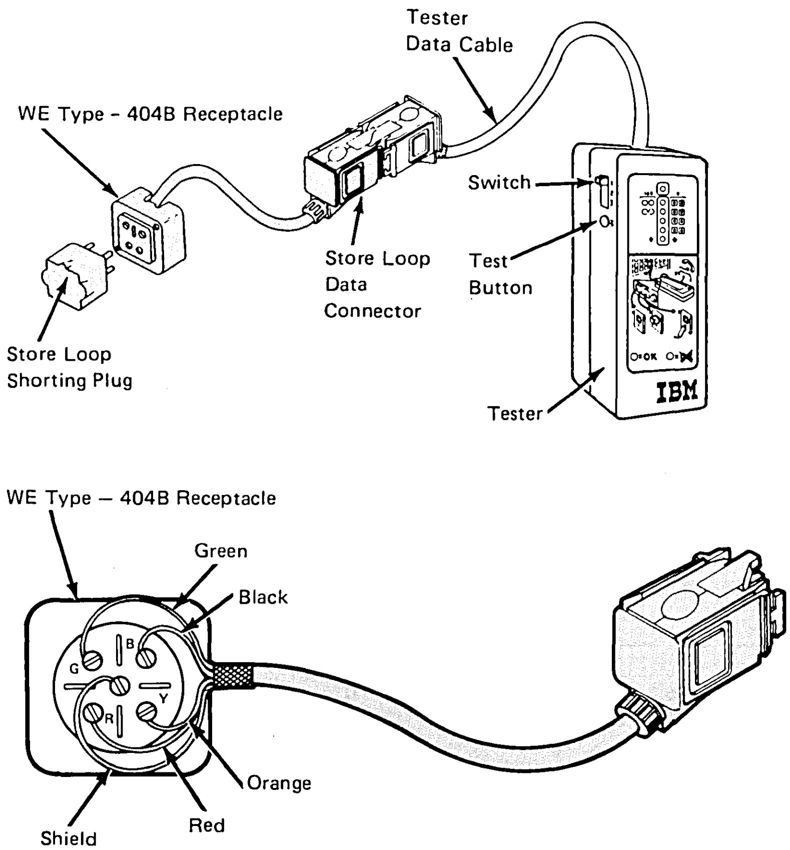


Figure 12-18. Testing the Store Loop Attachment Assembly

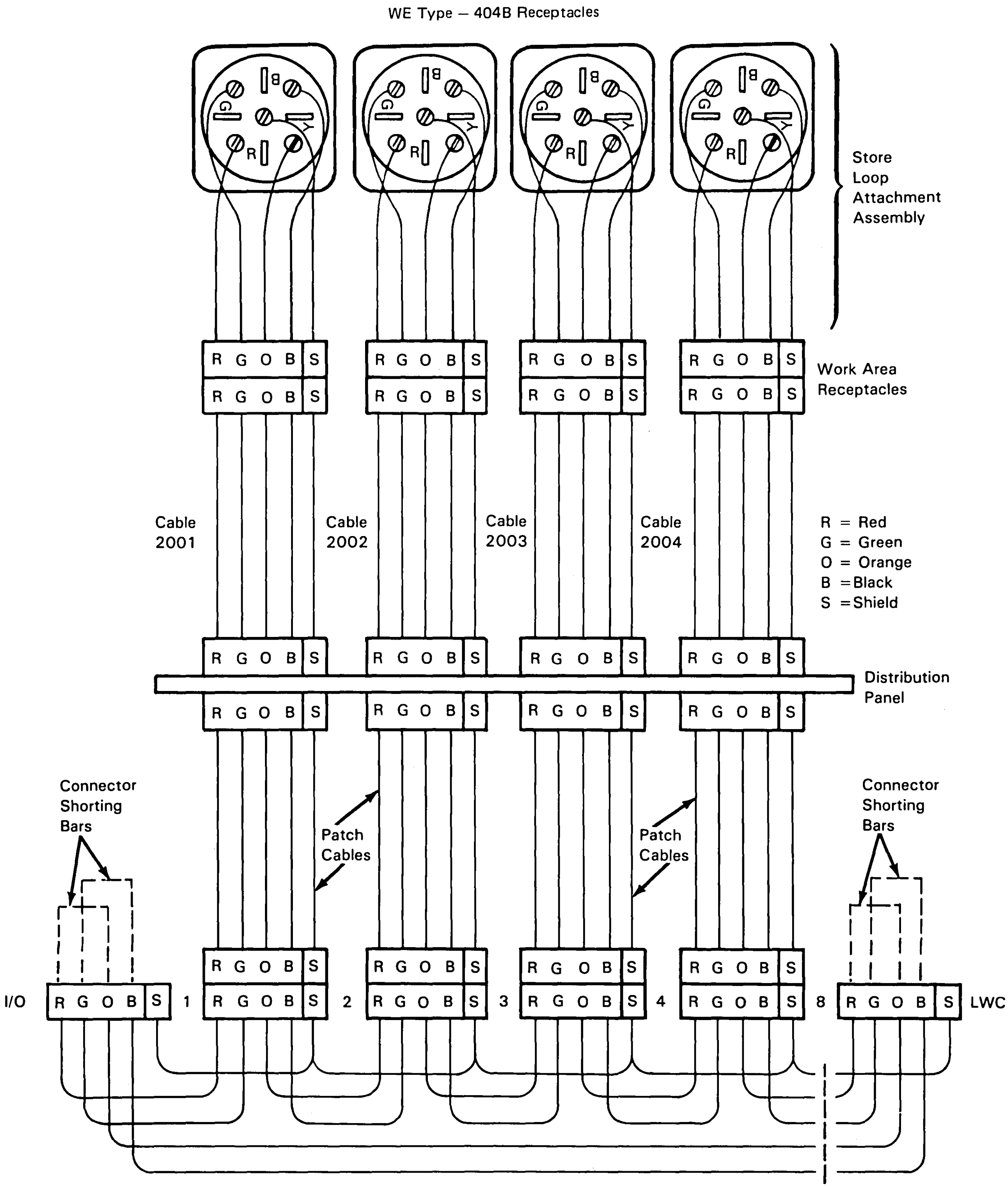


Figure 12-19. Schematic of an Installation Using Store Loop Attachment Assemblies

Procedure R: Patch Cable – IBM Cabling System Tester

This procedure requires a data wrap plug, an accessory to the IBM Cabling System Tester (part number 4760500).

1. See Figure 12-20 and connect the tester data cable to one end of the patch cable.

2. Make sure no devices are connected to the other end of the patch cable.

3. Set the tester mode switch to position 1.

4. Press the test button:

   a. If the green light comes on, continue with step 5.

   b. If any red lights come on, the patch cable is defective. Replace it and go to step 11.

5. Disconnect the tester data cable from the patch cable and connect it to the other end.

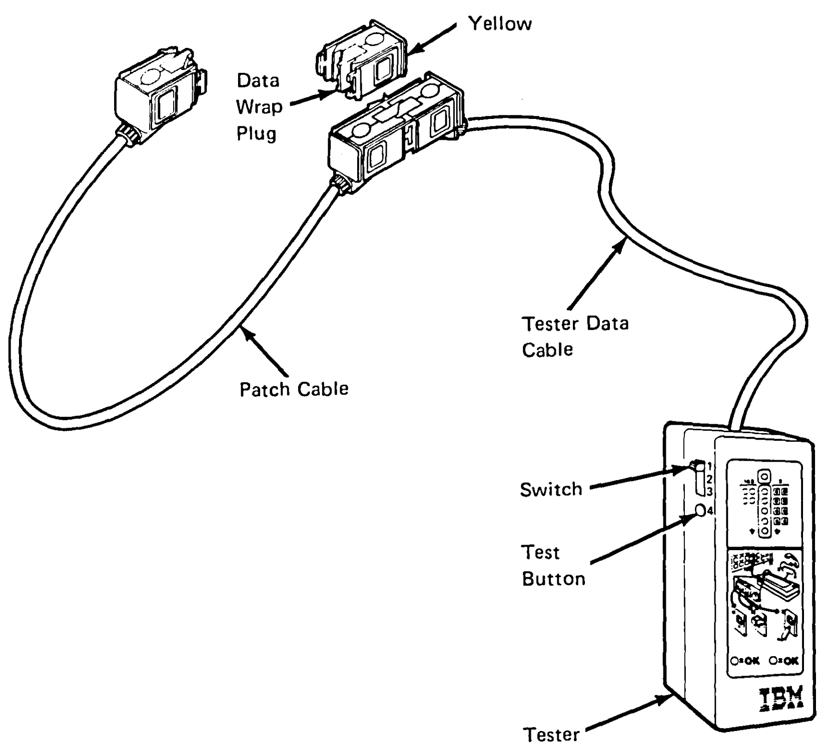


Figure 12-20. Testing Patch Cable

Note: This test is performed at both ends of the patch cable to check the shorting bars in both connectors.

6. Leave the tester mode switch in position 1.

7. Press the test button:

   a. If the green light comes on, continue with step 8.

   b. If any red lights come on, the patch cable is defective. Replace it and go to step 11.

8. Connect the data wrap plug to the other end of the patch cable.

9. Set the tester mode switch to position 2.

10. Press the test button:

    a. If the green light comes on, the patch cable is not defective. Continue with step 11.

    b. If any red lights come on, the patch cable is defective. Replace it and go to step 12.

11. Disconnect the data wrap plug (if connected) and the tester.

12. Return to step 6 in "The Data Path Problem Determination Procedure" or to the procedure that brought you here.

Procedure S: Indoor and Outdoor Surge Suppressor – IBM Cabling System Tester

DANGER
Only qualified persons should perform this test procedure. Do not perform this procedure during periods of lightning activity. Do not disconnect any ground or shield connectors during this procedure.

Warning: This test procedure tests only the data path through the surge suppressor. You cannot use it to verify the surge suppression capabilities of the surge suppressor.

This procedure can be performed more efficiently with two persons working together. This test procedure has five parts:

1. Visual Inspection
2. Testing the Surge Suppressor Data Path
3. Testing the Surge Suppressors
4. Testing the Outdoor Cable
5. Testing the Indoor Cable.

Each part tests different components of the cabling system. The parts are arranged so that those components most likely to be defective are tested first.

Figure 12-21 shows a diagram of the cabling system components that this procedure tests:

- The surge suppressor data path between the distribution panel in one building and the distribution panel in the next building
- The surge suppressors
- Outdoor cable
- Indoor cable.

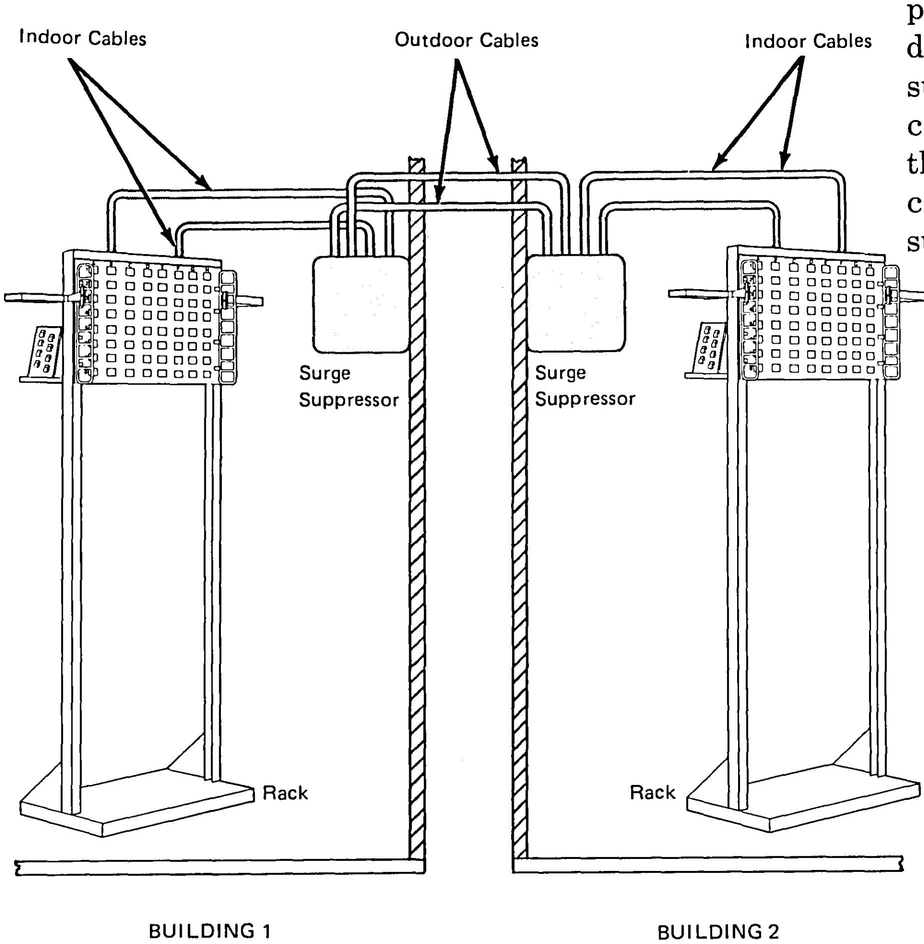


Figure 12-21. Example Showing Parts of Cabling System Tested in Procedure S

Visual Inspection

1. Visually inspect *both* surge suppressors, including the printed circuit boards, all components, and wire connections. Look for burned, broken, or otherwise damaged components. Even if the first surge suppressor is damaged, inspect the second one.

   a. If you do not find any damage, go to "Testing the Surge Suppressor Data Path," the next part of this test procedure.

   b. If you find damage, continue with step 2.

2. The surge suppressor is defective.

   Have a qualified person replace the surge suppressor by following the instructions in "Surge Suppressor Replacement" in Appendix C.

   Reconnect all of the cables to the surge suppressor and continue with step 3.

3. Verify the data path by going to "Testing the Surge Suppressor Data Path," the next part of this test procedure.

Testing the Surge Suppressor Data Path

Follow the instructions in this section to test each surge suppressor data path. There may be only one surge suppressor data path used in your installation. If two data paths are used, be sure to test *both*.

1. In Figure 12-22, *data path 1* and *data path 2* are two surge suppressor data paths. Data path 1 is being tested.

2. Before starting this test, disconnect any cables connected to the data connectors at either end of the surge suppressor data path you are testing.

3. Test each surge suppressor data path by following the instructions in "Testing Data Cable with the IBM Cabling System Tester" in Appendix G.

   a. If the test does not find defects in either data path, return to "The Data Path Problem Determination Procedure" or to the procedure that brought you here.

   b. If the test finds defects in either or both data paths, continue testing the defective data path by going to "Testing the Surge Suppressors," the next part of this test procedure.

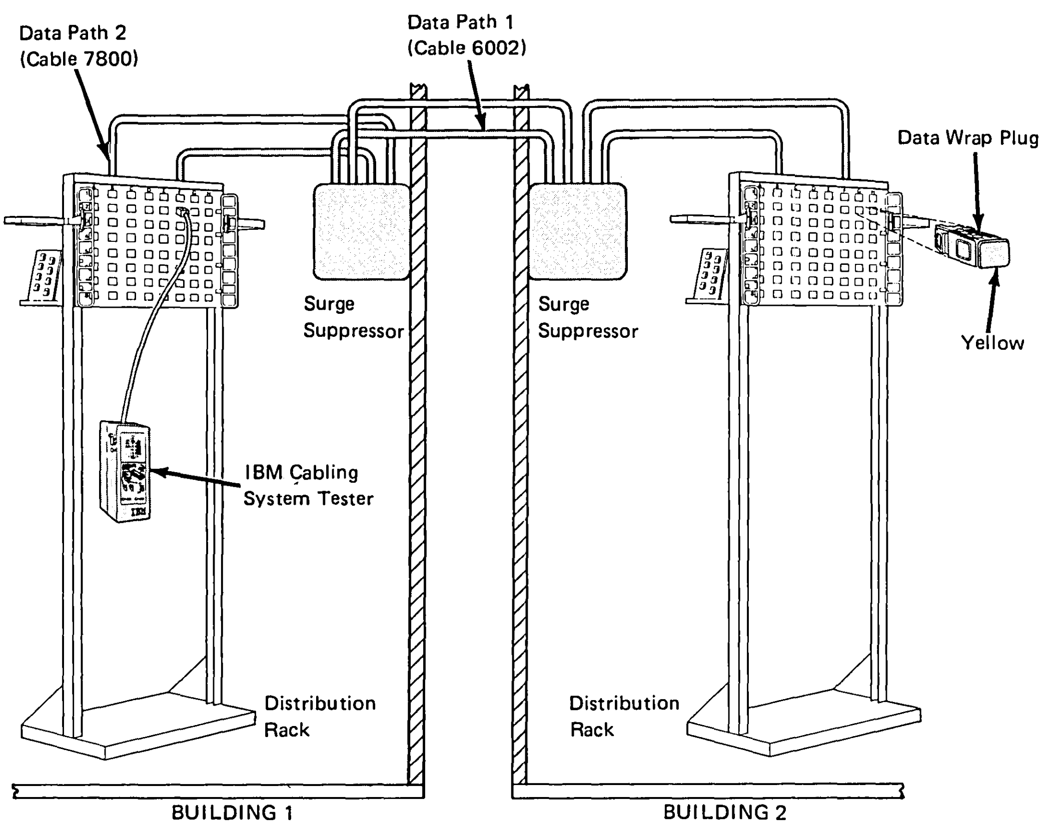


Figure 12-22. Testing the Surge Suppressor Data Path with the IBM Cabling System Tester

Testing the Surge Suppressors

Follow the instructions in this section to test both surge suppressors. When you are finished testing one, go to the second building and repeat this test at the other surge suppressor.

This test requires two data wire test cables. Use the General Purpose Attachment Cable (part number 8310554) or see "Making a Data Wire Test Cable" in Appendix F.

1. If you have not visually inspected the surge suppressor, inspect it now. Look for burned, broken, or otherwise damaged circuit boards, components, and wire connections.

   a. If you do not find any damage, continue with step 2.

   b. If you find damage, go to step 13.

2. Test the defective data path that you identified in the previous part of this test procedure. See Figure 12-23 for an illustration of the type of surge suppressor (indoor or outdoor) you are testing.

   a. If the defective data path is connected to outdoor terminal block/data path 1 A and indoor terminal block/data path 1 B, follow the illustration in Figure 12-24 that corresponds to the type of surge suppressor you are testing.

   b. If the defective data path is connected to outdoor terminal block/data path 2 C and indoor terminal block/data path 2 D, follow the illustration in Figure 12-25 that corresponds to the type of surge suppressor you are testing.

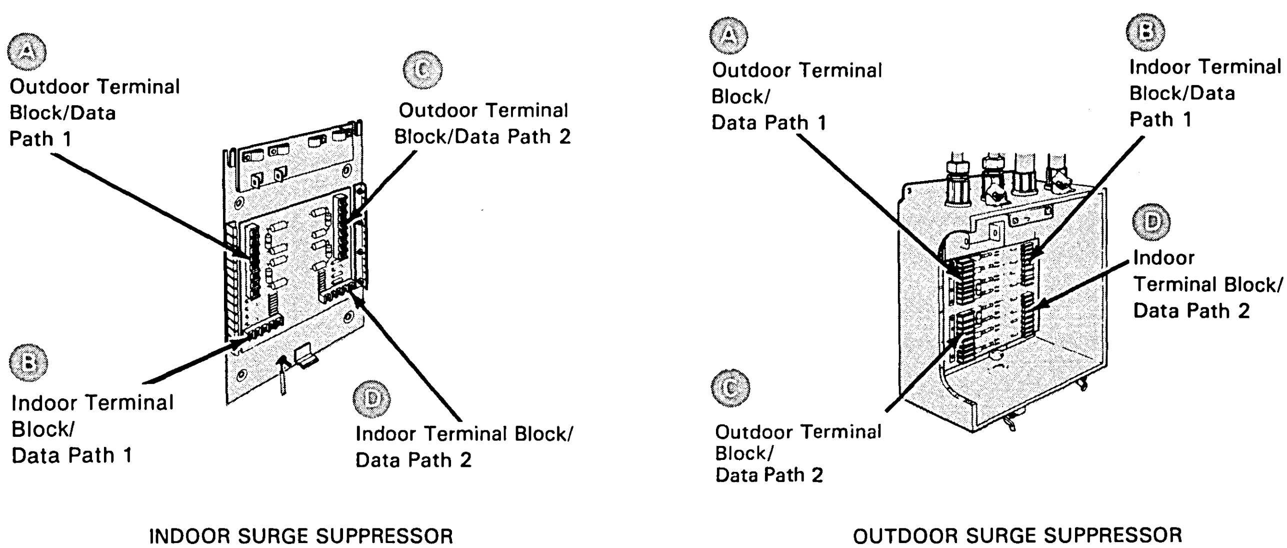


Figure 12-23. Indoor and Outdoor Surge Suppressor Terminal Blocks

3. Disconnect the data wires in the defective data path from the outdoor and the indoor terminal block in the surge suppressor. Follow the illustration that corresponds to the type of surge suppressor you are testing.

CAUTION
Make sure that any existing ground connections have not been disconnected.

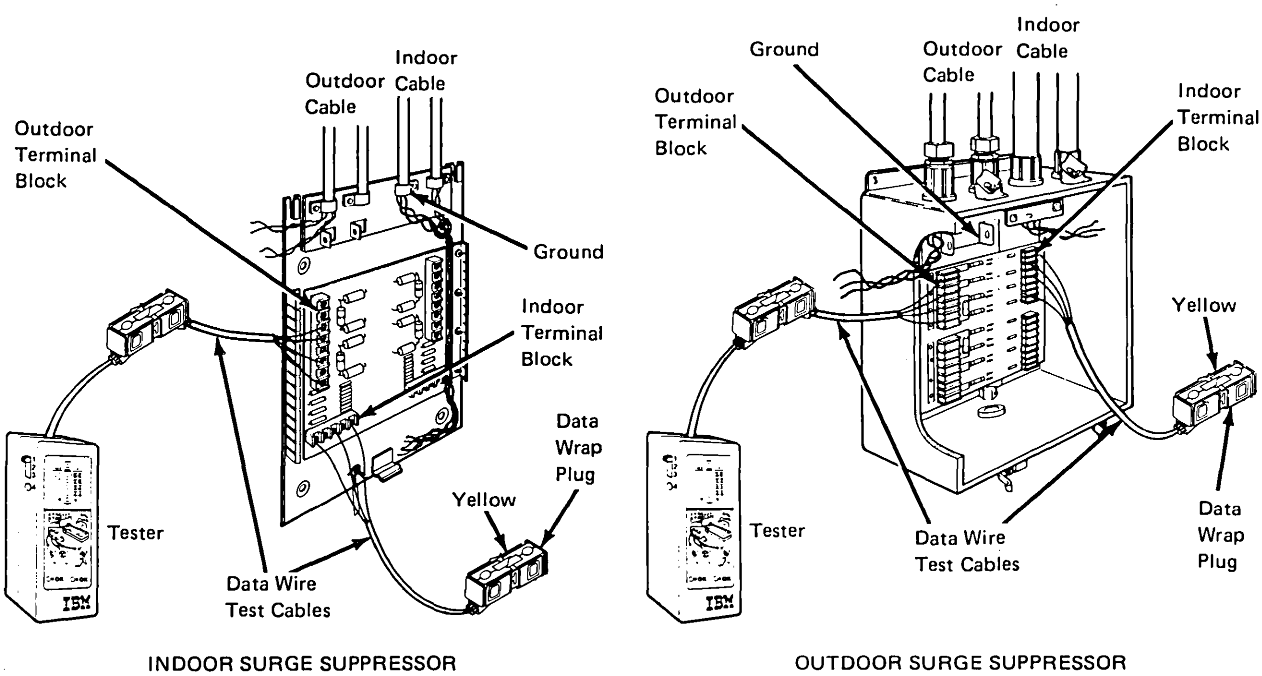


Figure 12-24. Testing the Data Path through Terminal Blocks A and B with the IBM Cabling System Tester

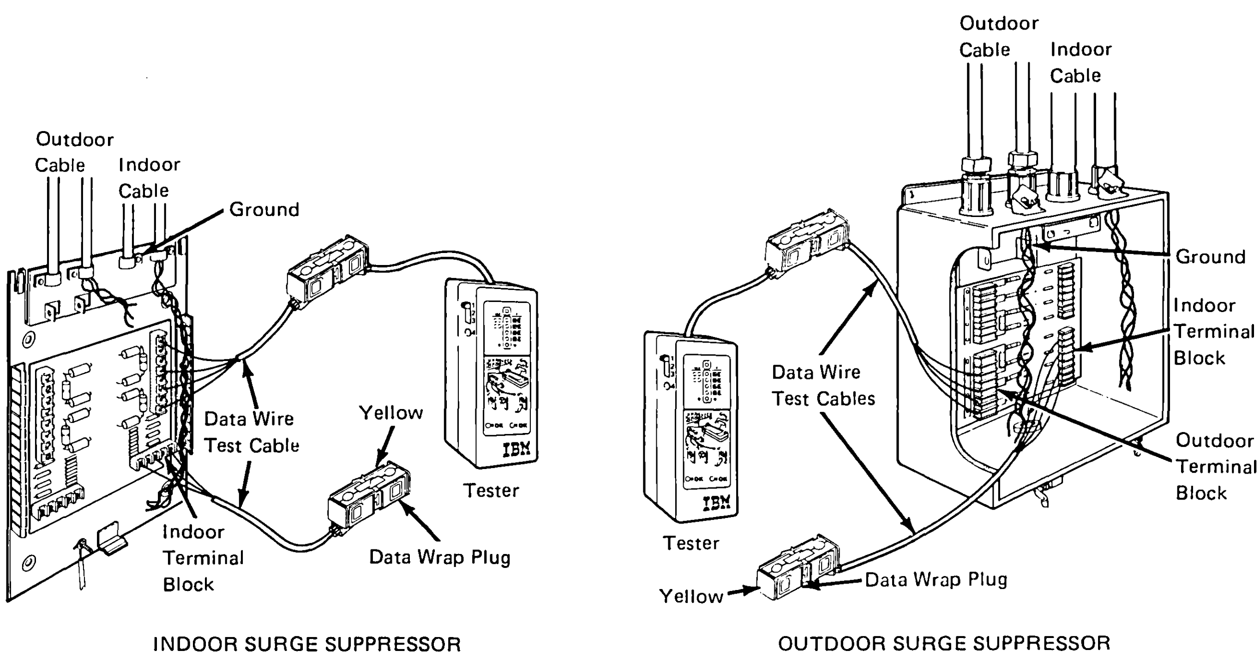


Figure 12-25. Testing the Data Path through Terminal Blocks C and D with the IBM Cabling System Tester

4. Connect the data wire test cables to the outdoor and the indoor terminal block in the defective data path. Connect each lead in the data wire test cable to the terminal block position of the same color.

5. Connect the IBM Cabling System Tester to one of the data wire test cables.

6. Set the tester mode switch to position 1.

7. Press the test button:

   a. If the green light comes on, continue with step 8.
   b. If any red lights come on, go to step 13.

8. Connect the data wrap plug to the other data wire test cable.

9. Set the tester mode switch to position 2.

10. Press the test button:

    a. If the green light comes on, go to step 11.
    b. If any red lights come on, go to step 13.

11. Disconnect the data wrap plug and disconnect both data wire test cables from the surge suppressor. Leave the outdoor and the indoor cable disconnected from the surge suppressor. Continue with step 12.

12. Have you tested the second surge suppressor in this data path?

    a. If you have, continue testing by going to "Testing Outdoor Cable."
    b. If you have not, test the second surge suppressor in the other building by repeating "Testing the Surge Suppressors" beginning at step 1.

13. The surge suppressor is defective.

    Have a qualified person replace the surge suppressor by following the instructions in "Surge Suppressor Replacement" in Appendix C.

    Reconnect all the cables to the surge suppressor and continue with step 14.

14. Verify that the surge suppressor has been correctly installed by repeating the test "Testing the Surge Suppressor Data Path."

    a. If the test does not find defects, return to "The Data Path Problem Determination Procedure" or to the procedure that brought you here.
    b. If the test finds defects, continue testing by going to "Testing Outdoor Cable," the next part of this procedure.

Testing Outdoor Cable

Follow these steps to test the outdoor cable in the defective data path you identified while performing "Testing the Surge Suppressor Data Path."

CAUTION
Make sure that any existing ground connections have not been disconnected.

This test requires two data wire test cables. Use the General Purpose Attachment Cable (part number 8310554) or see "Making a Data Wire Test Cable" in Appendix F.

1. Disconnect the outdoor cable from the terminal blocks of the surge suppressors in both buildings, if it is not already disconnected.

2. See Figure 12-26 and attach a data wire test cable to each end of the outdoor cable you are testing. Be sure to connect wires of the same color.

   If you are using general purpose attachment cables, *tape* the leads to the wires of the outdoor cable. If you are using data wire test cables that you made, *twist* the wires together.

Warning: Avoid breaking the cable wires when you twist them. The shield connector can be used only once, and no spare shield connectors are provided.

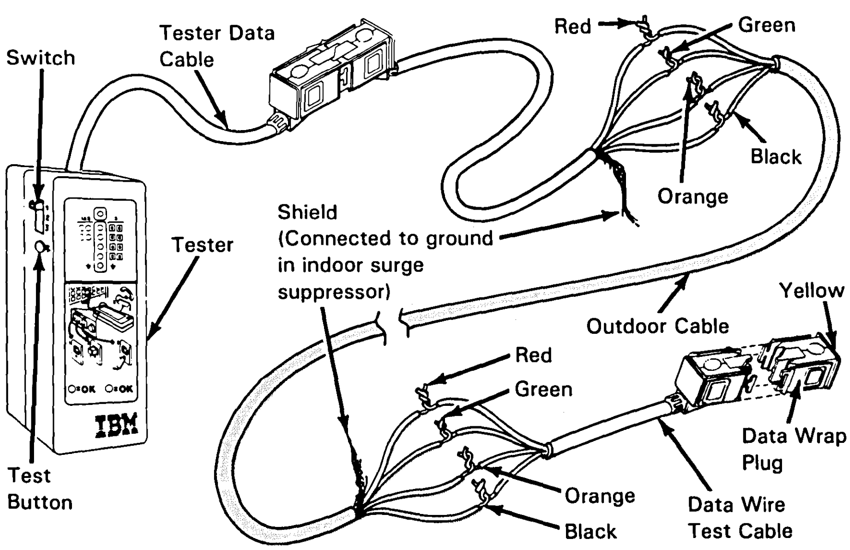


Figure 12-26. Testing the Outdoor Cable

3. Connect the IBM Cabling System Tester to one of the data wire test cables.

4. Set the tester mode switch to position 1.

5. Press the test button:

   a. If the green light comes on, continue with step 6.
   b. If any red lights come on, go to step 9.

6. Connect the data wrap plug to the other data wire test cable.

7. Set the tester mode switch to position 2.

8. Press the test button:

   a. If the green light comes on, go to step 11.
   b. If any red lights come on, continue with step 9.

9. The outdoor cable you are testing is defective. Replace the cable. Reconnect the outdoor cable.

10. Verify that the defect in the outdoor cable has been corrected by repeating the test "Testing the Surge Suppressor Data Path."

    a. If the test does not find defects, return to "The Data Path Problem Determination Procedure" or to the procedure that brought you here.
    b. If the test finds defects, continue with "Testing Indoor Cable," the next part of this test procedure.

11. Disconnect the data wrap plug and the tester. Disconnect the data wire test cables from the outdoor cable. Reconnect the outdoor cable to the terminal blocks. Continue testing by going to "Testing Indoor Cable," the next part of this procedure.

Testing Indoor Cable

As shown in Figure 12-21, there are two indoor cables in each surge suppressor data path. Follow these steps to test both indoor cables in the defective data path.

CAUTION
Make sure that any existing ground connections have not been disconnected.

1. Disconnect the indoor cables from the terminal blocks of the surge suppressors in both buildings, if they are not already disconnected.

2. Test both indoor cables using "Procedure N: General Purpose Attachment Cable – IBM Cabling System Tester" in this chapter. Perform any repair actions as described in that procedure. Continue with step 3.

3. Reconnect all cables to the surge suppressor. Verify the surge suppressor data path by repeating the test "Testing the Surge Suppressor Data Path."

   a. If the test does not find any defects, return to "The Data Path Problem Determination Procedure" or to the procedure that brought you here.

   b. If the test finds defects, go to "Finding Difficult Problems" in this chapter.

4. Return to step 6 in "The Data Path Problem Determination Procedure" or to the procedure that brought you here.

Ohmmeter Test Procedures

Procedure AA: Y Assembly - Ohmmeter

This procedure requires a data wire test cable. Use a General Purpose Attachment Cable (part number 8310554) or see "Making a Data Wire Test Cable" in Appendix F.

1. See Figure 12-27 and connect the data wire test cable to connector 3 of the Y assembly.

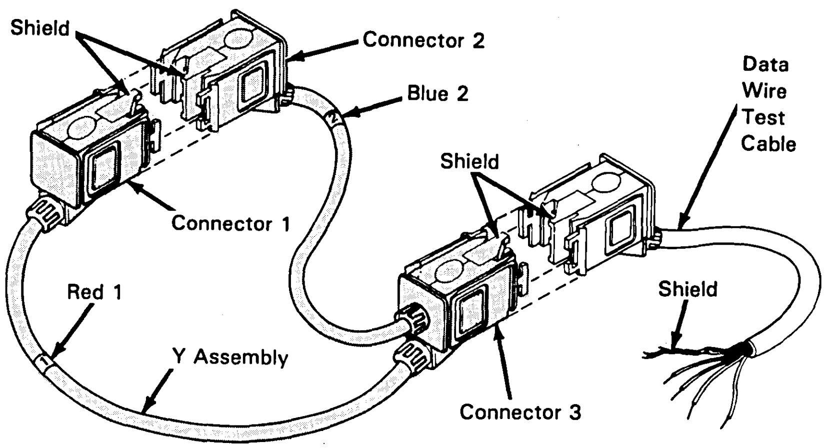


Figure 12-27. Y Assembly

2. Connect connector 1 of the Y assembly to connector 2.

3. Using an ohmmeter, check for continuity between the following wires of the data wire test cable:

   - Red and orange
   - Green and black.

   a. If you find continuity in each case, continue with step 4.

   b. If you do not, go to step 6.

4. Using an ohmmeter, check for an open between:

   - The red (or orange) wire and the green (or black) wire of the data wire test cable
   - Each of the data wires and the shield of the data wire test cable.

   a. If you find an open in each case, continue with step 5.

   b. If you do not, go to step 6.

5. Disconnect connectors 1 and 2 and check for continuity between:

   - The shields of connectors 1 and 2
   - The shield of connector 1 (or connector 2) and the shield of the data wire test cable.

   a. If you find continuity in each case, the Y assembly is not defective. Disconnect the data wire test cable. Go to step 7.

   b. If you do not, continue with step 6.

6. The Y assembly is defective. Replace it.

7. Return to step 6 in "The Data Path Problem Determination Procedure" or to the procedure that brought you here.

Procedure BB: Twinaxial Y Assembly - Ohmmeter

1. See Figure 12-28 and use an ohmmeter to check for continuity between:

   - The phase A pin of connector 1 and the phase A pin of connector 2
   - The phase B pin of connector 1 and the phase B pin of connector 2
   - The shield of connector 1 and the shield of connector 2.

   a. If you find continuity in each case, continue with step 2.

   b. If you do not, go to step 3.

2. Using an ohmmeter, check for an open between:

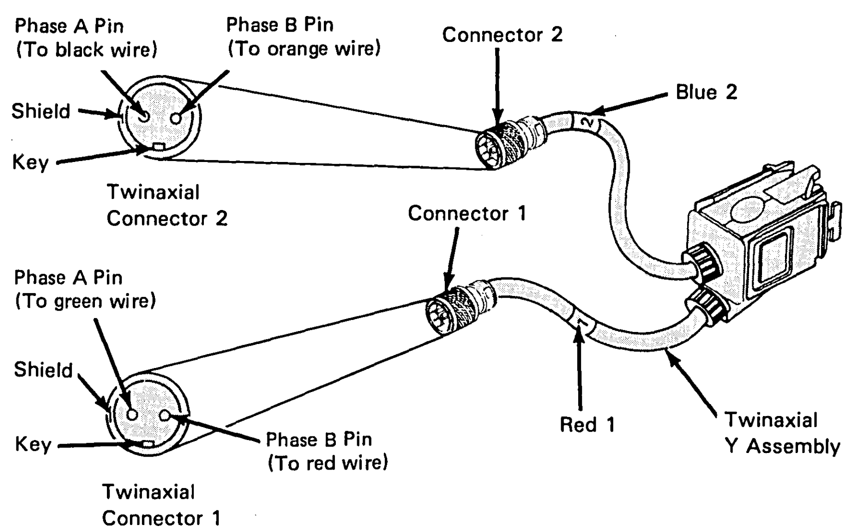
   - The phase A pin and the phase B pin
   - The shield and either pin.

   a. If you find an open in each case, the twinaxial Y assembly is not defective. Go to step 4.

   b. If you do not, continue with step 3.

3. The twinaxial Y assembly is defective. Replace it.

4. Return to step 6 in "The Data Path Problem Determination Procedure" or to the procedure that brought you here.



Note: When the data connector is disconnected, shorting bars inside the connector automatically connect:

- The red position to the orange position
- The green position to the black position.

Figure 12-28. Twinaxial Y Assembly

Procedure CC: Twinaxial Direct Connect Cable—Ohmmeter

This procedure requires a data wire test cable. Use a General Purpose Attachment Cable (part number 8310554) or see "Making a Data Wire Test Cable" in Appendix F.

1. See Figure 12-29 and connect the data wire test cable to the data connector of the twinaxial direct connect cable.

2. Using an ohmmeter, check for continuity between:

   - The phase A pin and the green wire of the data wire test cable
   - The phase B pin and the red wire of the data wire test cable
   - The shield of the twinaxial connector and the shield of the data wire test cable.

   a. If you find continuity in each case, continue with step 3.

   b. If you do not, go to step 4.

3. Using an ohmmeter, check for an open between:

   - The phase A and B pins
   - The phase A pin and the shield
   - The phase B pin and the shield.

   a. If you find an open in each case, the twinaxial direct connect cable is not defective. Disconnect the data wire test cable and go to step 5.

   b. If you do not, continue with step 4.

4. The twinaxial direct connect cable is defective. Replace it.

5. Return to step 6 in "The Data Path Problem Determination Procedure" or to the procedure that brought you here.

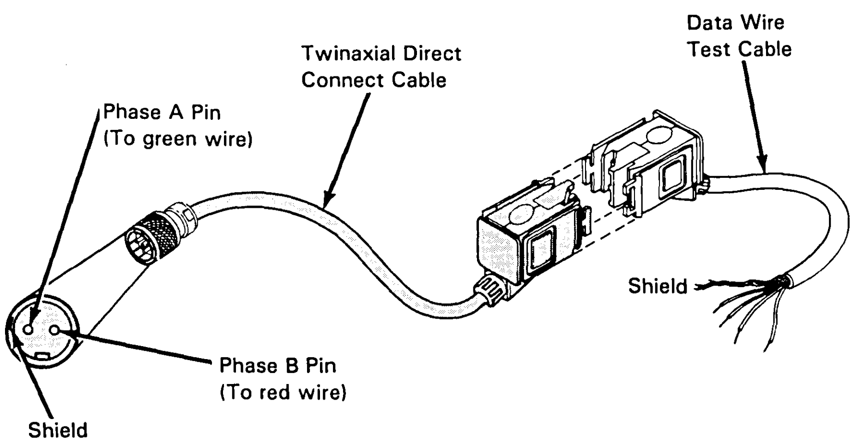


Figure 12-29. Twinaxial Direct Connect Cable

Procedure DD: Twinaxial Impedance Matching Device - Ohmmeter

This procedure requires a data wire test cable. Use a General Purpose Attachment Cable (part number 8310554) or see "Making a Data Wire Test Cable" in Appendix F.

1. See Figure 12-30 and connect the data wire test cable to the data connector of the twinaxial impedance matching device.

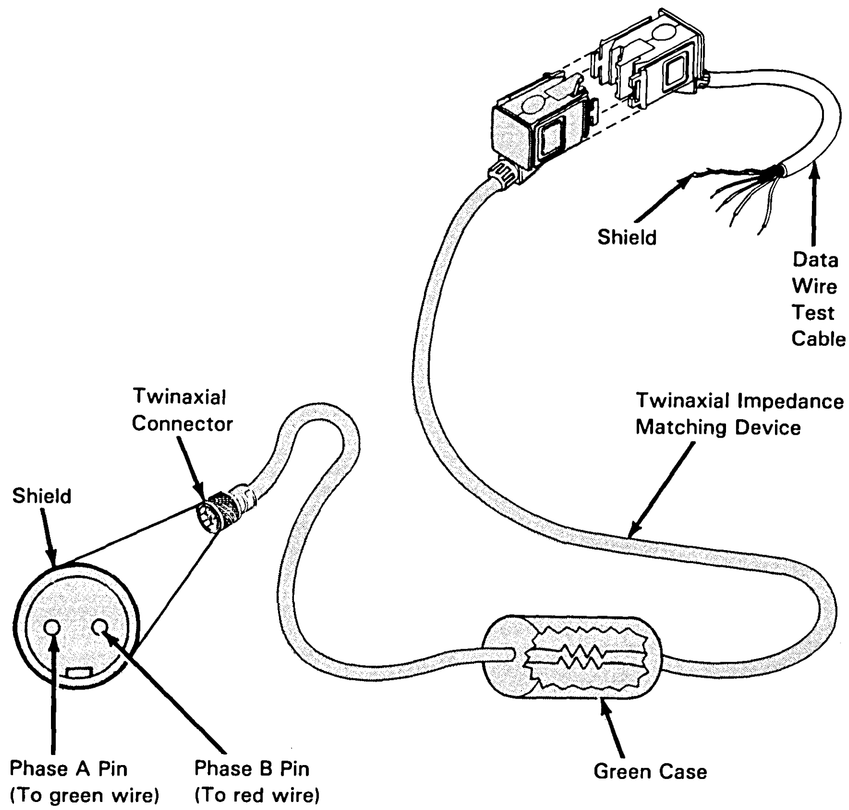


Figure 12-30. Twinaxial Impedance Matching Device

2. Using an ohmmeter, check for 15 to 25 ohms of resistance between:

   - The phase A pin and the green wire of the data wire test cable
   - The phase B pin and the red wire of the data wire test cable.

   a. If you find 15 to 25 ohms resistance in each case, continue with step 3.

   b. If you do not, go to step 5.

3. Using an ohmmeter, check for continuity between:

   - The shield of the twinaxial connector and the shield of the data wire test cable.

   a. If you find continuity, continue with step 4.

   b. If you do not, go to step 5.

4. Using an ohmmeter, check for an open between:

   - The phase A and B pins
   - The phase A pin and the shield
   - The phase B pin and the shield.

   a. If you find an open in each case, the twinaxial impedance matching device is not defective. Disconnect the data wire test cable and go to step 6.

   b. If you do not, continue with step 5.

5. The twinaxial impedance matching device is defective. Replace it.

6. Return to step 6 in "The Data Path Problem Determination Procedure" or to the procedure that brought you here.

Procedure EE: Twinaxial Terminator - Ohmmeter

1. See Figure 12-31 and use an ohmmeter to check for 70 to 80 ohms of resistance between:

   - The phase A pin and the shield
   - The phase B pin and the shield.

   a. If you find 70 to 80 ohms resistance in each case, continue with step 2.

   b. If you do not, go to step 3.

2. Using an ohmmeter, check for 145 to 155 ohms between pin A and pin B.

   a. If you get 145 to 155 ohms, the twinaxial terminator is not defective. Go to step 4.

   b. If you do not, continue with step 3.

3. The twinaxial terminator is defective. Replace it.

4. Return to step 6 in "The Data Path Problem Determination Procedure" or to the procedure that brought you here.

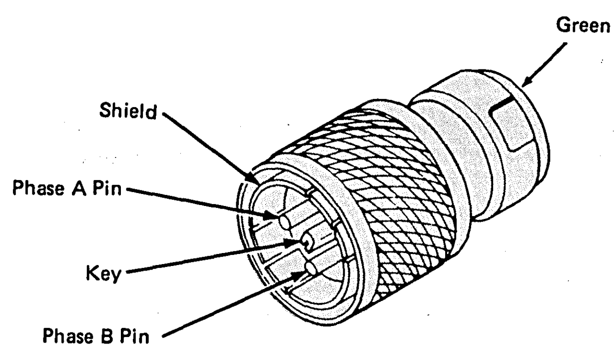


Figure 12-31. Twinaxial Terminator

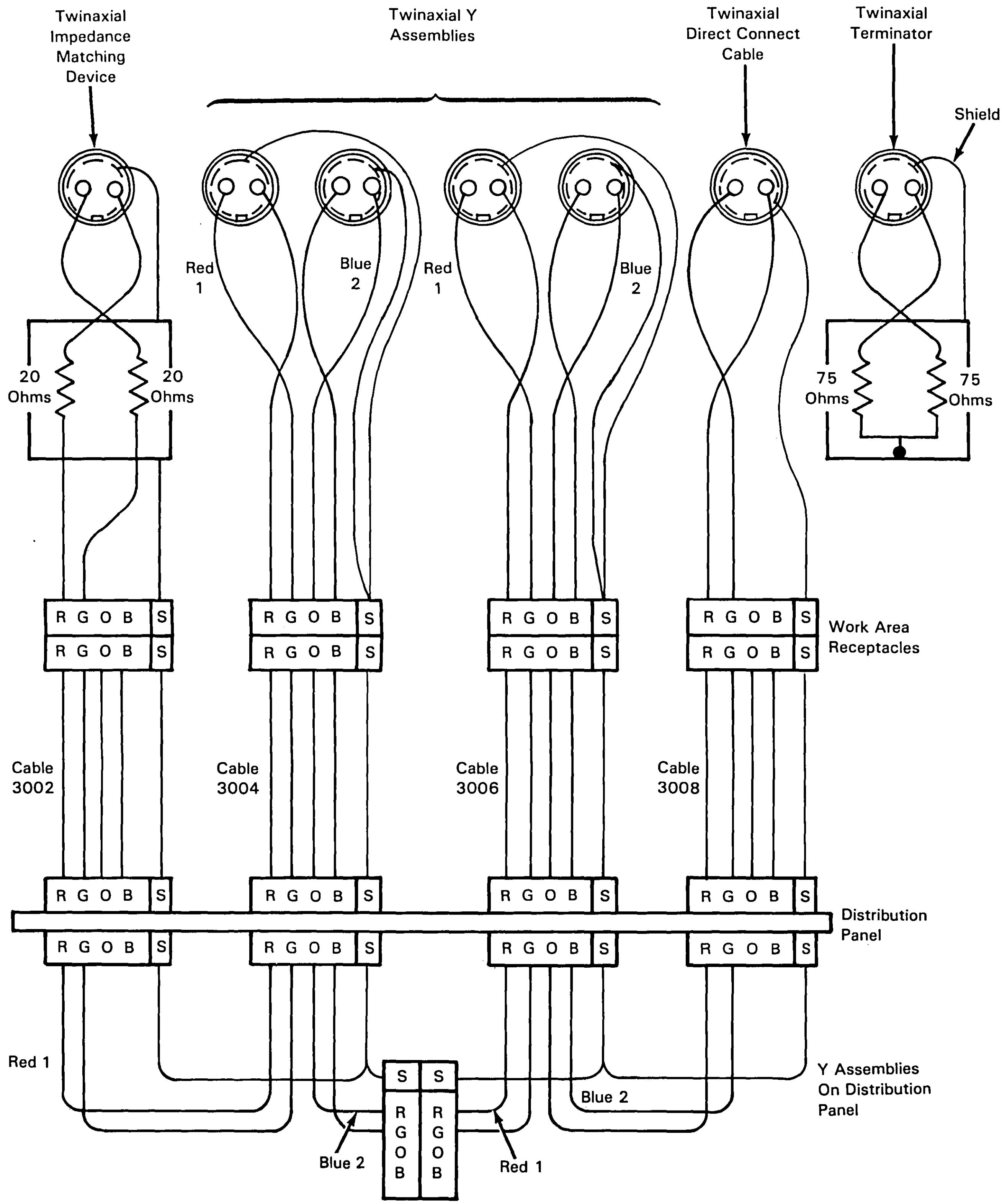


Figure 12-32. Schematic of an Installation Using Twinaxial Accessories

Procedure FF: Red Coaxial and Single Cableless Coaxial Balun Assemblies - Ohmmeter

This procedure requires a data wire test cable. Use a General Purpose Attachment Cable (part number 8310554) or see "Making a Data Wire Test Cable" in Appendix F.

1. See Figure 12-33, if you are testing a red coaxial balun. See Figure 12-34, if you are testing a single cableless coaxial balun. Connect the data wire test cable to the data connector of the balun assembly.

2. Using an ohmmeter, check for less than 10 ohms of resistance between:

   - The center conductor and the shield of the coaxial connector
   - The red and the green wires of the data wire test cable.

   a. If you find the proper resistance in each case, continue with step 3.

   b. If you do not, go to step 4.

3. Using an ohmmeter, check for an open between:

   - The center conductor of the coaxial connector and the red and green wires of the data wire test cable
   - The center conductor of the coaxial connector and the shield of the data wire test cable
   - The shield of the coaxial connector and the shield of the data wire test cable. (There may be a slight meter deflection.)

   a. If you find an open in each case, the coaxial balun assembly is not defective. Disconnect the data wire test cable and go to step 5.

   b. If you do not, continue with step 4.

4. The coaxial balun assembly is defective. Replace it.

5. Return to step 6 in "The Data Path Problem Determination Procedure" or to the procedure that brought you here.

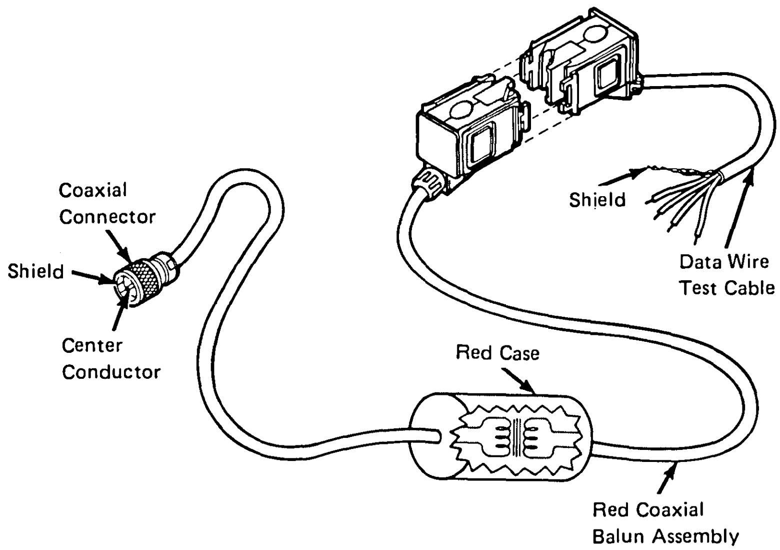


Figure 12-33. Red Coaxial Balun Assembly

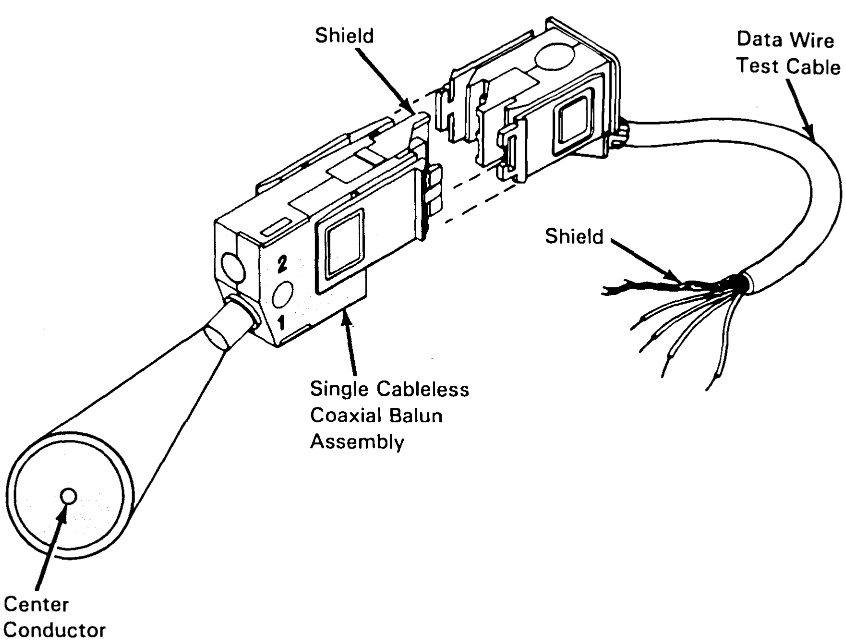


Figure 12-34. Single Cableless Coaxial Balun

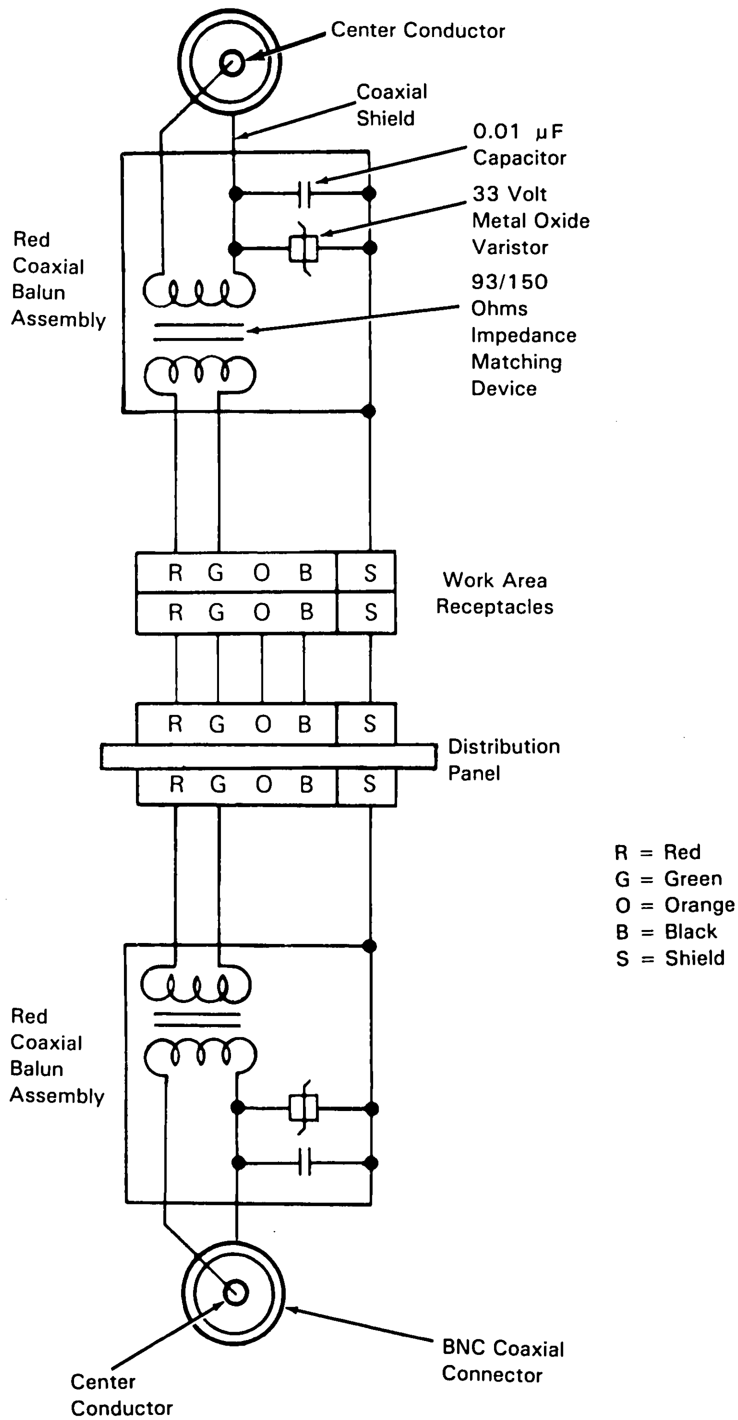


Figure 12-35. Schematic of an Installation Using Red Coaxial Balun Assemblies

Procedure GG: Double Cableless Coaxial Balun Assembly – Ohmmeter

This procedure requires a data wire test cable. Use a General Purpose Attachment Cable (part number 8310554) or see “Making a Data Wire Test Cable” in Appendix F.

1. Remove both coaxial jumper cables from the double balun at the distribution panel or at the control unit *before* disconnecting any balun or data connector in the data path.

2. See Figure 12-36 and connect the data wire test cable to the data connector of the balun assembly.

3. Using an ohmmeter, check for less than 10 ohms of resistance between:

   - The center conductor and the shield of coaxial connector 1
   - The center conductor and the shield of coaxial connector 2
   - The red and the green wires of the data wire test cable
   - The orange and black wires of the data wire test cable.

   a. If you get the proper resistance in each case, continue with step 4.

   b. If you do not, go to step 5.

4. Using an ohmmeter, check for an open between:

   - The center conductor of coaxial connector 1 and each of the wires of the data wire test cable

   - The center conductor of coaxial connector 2 and each of the wires of the data wire test cable

   - The center conductor of coaxial connector 1 and the shield of the data wire test cable

   - The center conductor of coaxial connector 2 and the shield of the data wire test cable

   - The shields of the coaxial connectors and the shield of the data wire test cable. (There may be a slight meter deflection.)

   a. If you find an open in each case, the coaxial balun assembly is not defective. Disconnect the data wire test cable and go to step 6.

   b. If you do not, continue with step 5.

5. The coaxial balun assembly is defective. Replace it.

6. Return to step 6 in “The Data Path Problem Determination Procedure” or to the procedure that brought you here.

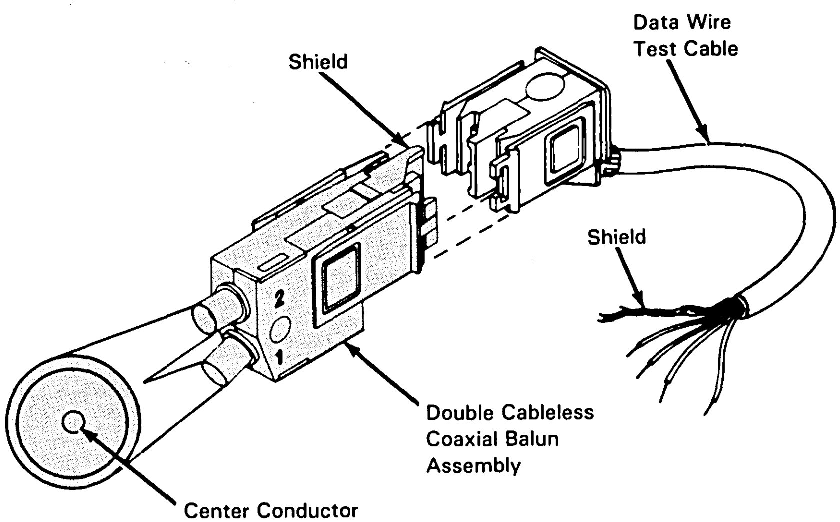


Figure 12-36. Double Cableless Coaxial Balun Assembly

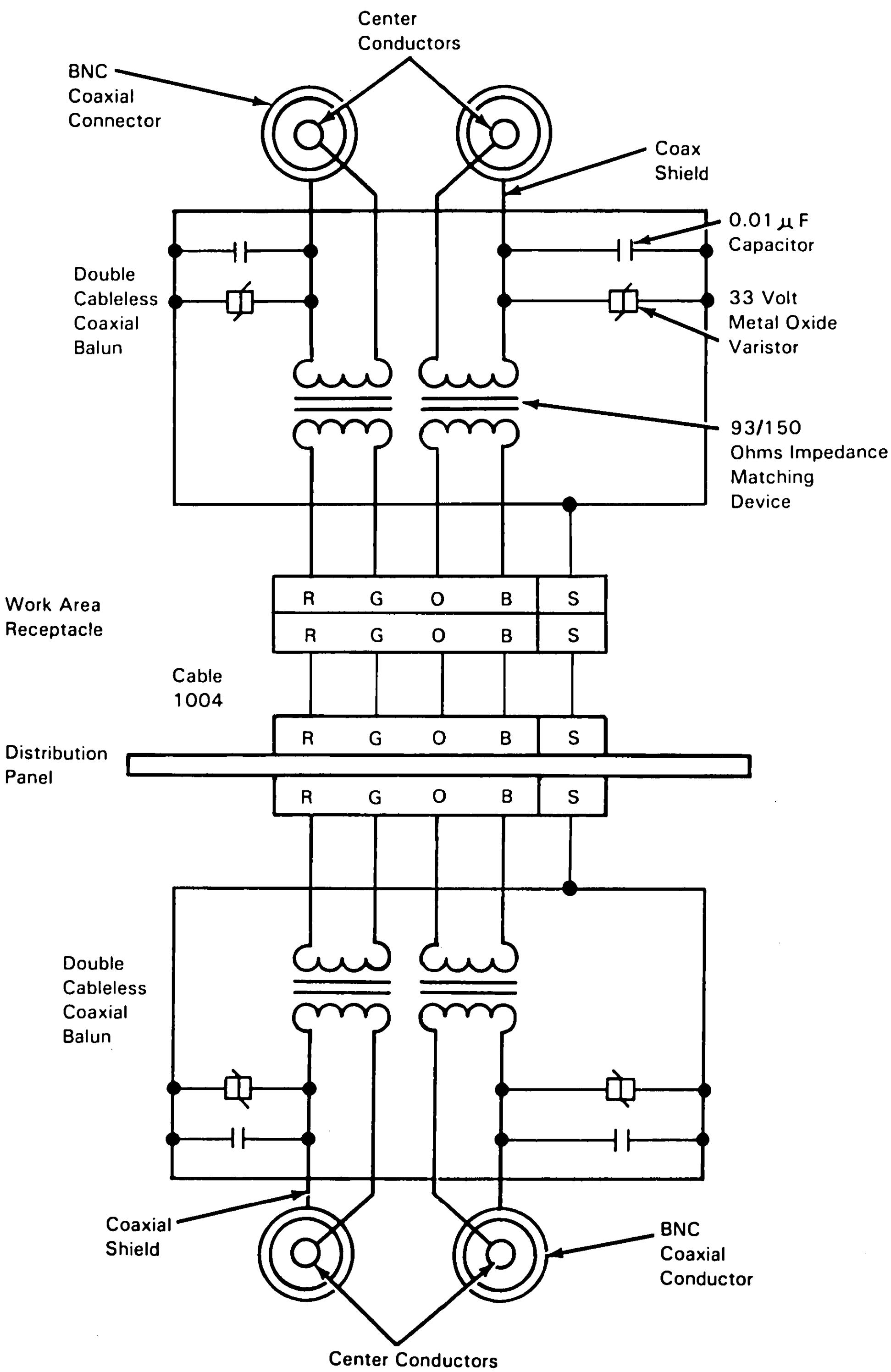


Figure 12-37. Schematic of an Installation Using Double Cableless Balun Assemblies

Procedure HH: Yellow Coaxial Balun Assembly - Ohmmeter

This procedure requires a data wire test cable. Use a General Purpose Attachment Cable (part number 8310554) or see "Making a Data Wire Test Cable" in Appendix F.

1. See Figure 12-38 and connect the data wire test cable to the connector of the yellow coaxial balun assembly.

2. Using an ohmmeter, check for less than 10 ohms of resistance between:

   - The center conductor of the coaxial connector and the red wire of the data wire test cable
   - The shield of the coaxial connector and the green wire of the data wire test cable
   - The red and orange wires of the data wire test cable
   - The green and black wires of the data wire test cable.

   a. If you find the proper resistance in each case, continue with step 3.
   b. If you do not, go to step 4.

3. Using an ohmmeter, check for an open between:

   - The center conductor and the shield of the coaxial connector. (There may be a slight meter deflection.)
   - The center conductor of the coaxial connector and the black and green wires of the data wire test cable.
   - The center conductor of the coaxial connector and the shield of the data wire test cable.
   - The shield of the coaxial connector and the shield of the data wire test cable. (There may be a slight meter deflection.)

   a. If you find an open in each case, the yellow coaxial balun assembly is not defective. Go to step 5.
   b. If you do not, continue with step 4.

4. The yellow coaxial balun assembly is defective. Replace it.

5. Return to step 6 in "The Data Path Problem Determination Procedure" or to the procedure that brought you here.

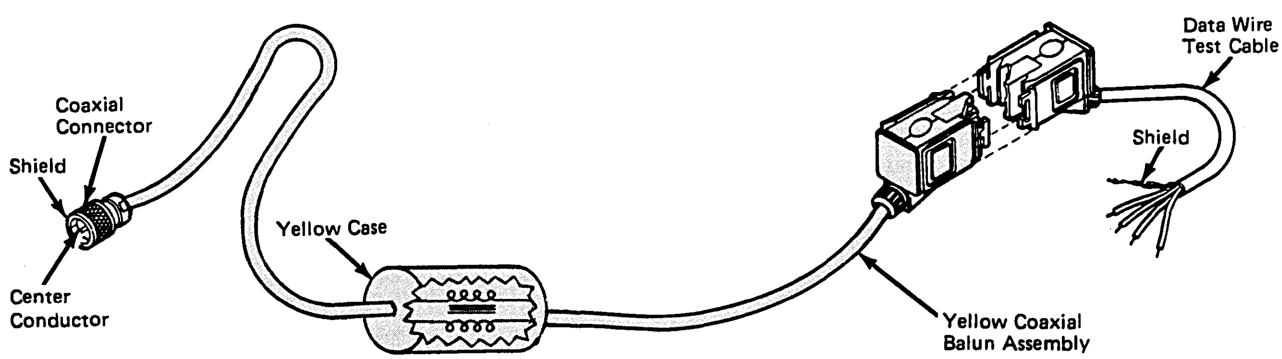


Figure 12-38. Yellow Coaxial Balun Assembly

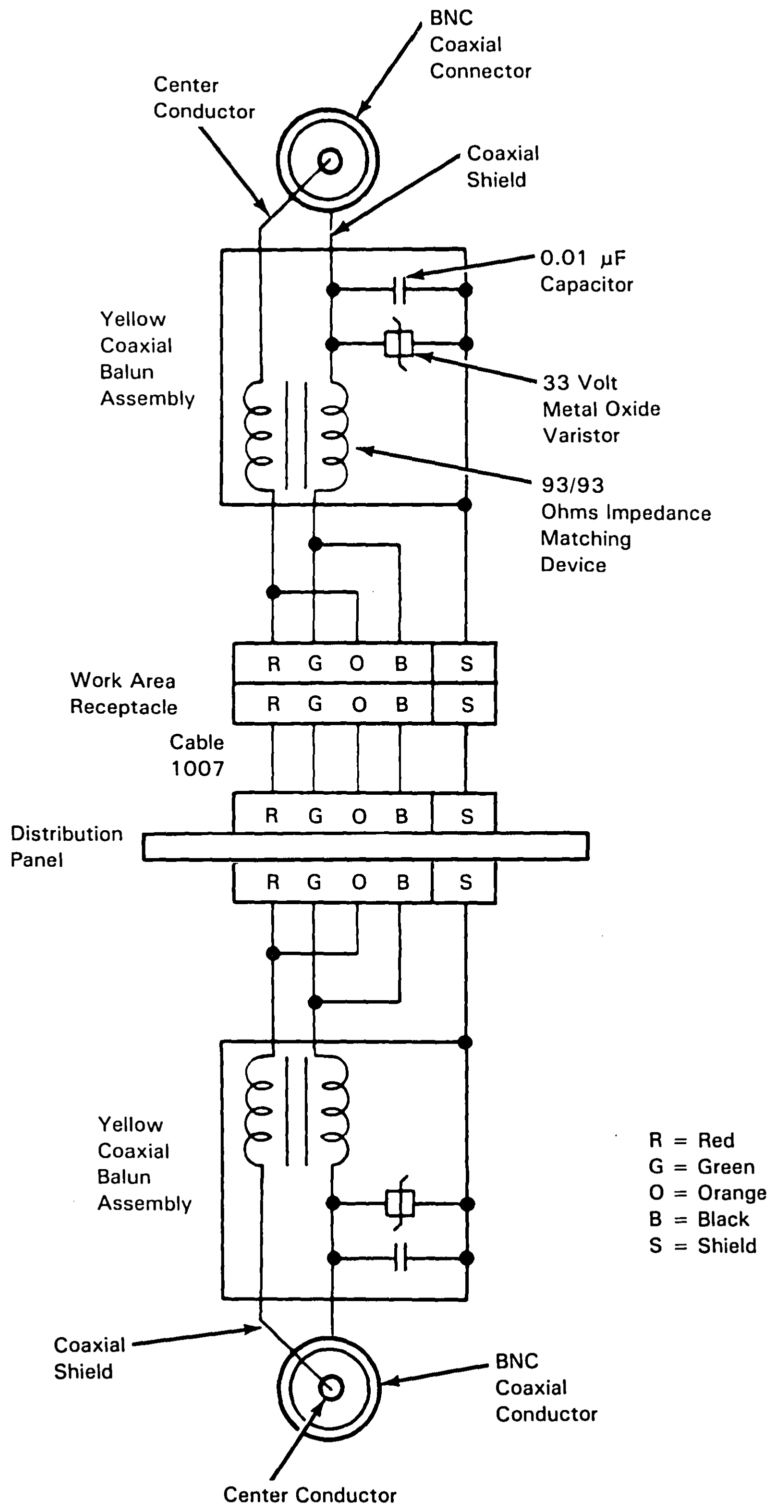


Figure 12-39. Schematic of an Installation Using Yellow Coaxial Balun Assemblies

Procedure JJ: Single Dual Purpose Connector (DPC) Attachment Cable - Ohmmeter

This procedure requires the use of a data wire test cable. Use a General Purpose Attachment Cable (part number 8310554) or see "Making a Data Wire Test Cable" in Appendix F.

1. See Figure 12-40 and connect the data wire test cable to connector 1 of the single DPC attachment cable.

2. Using an ohmmeter, check for continuity between:

   - The center conductor of connector 2 and the red wire of the data wire test cable
   - The side conductor of connector 2 and the green wire of the data wire test cable
   - The housing of connector 2 and the shield of the data wire test cable.

   a. If you find continuity in each case, continue with step 3.

   b. If you do not, go to step 4.

3. Using an ohmmeter, check for an open between the following leads of the data wire test cable:

   - Shield and green
   - Shield and red
   - Red and green
   - Red and orange
   - Red and black.

   a. If you find an open in each of these cases, the DPC attachment cable is not defective. Disconnect the data wire test cable and go to step 5.

   b. If you do not, continue with step 4.

4. The DPC attachment cable is defective. Replace it.

5. Return to step 6 in "The Data Path Problem Determination Procedure" or to the procedure that brought you here.

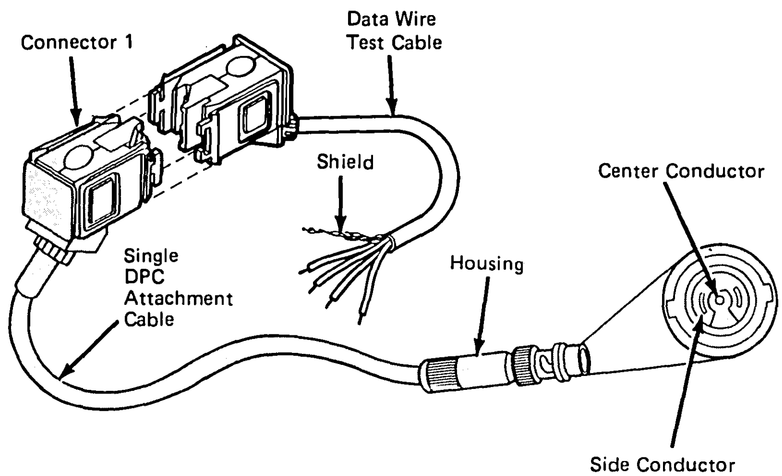


Figure 12-40. Single DPC Attachment Cable

Procedure KK: Double Dual Purpose Connector (DPC) Attachment Cable - Ohmmeter

This procedure requires the use of a data wire test cable. Use a General Purpose Attachment Cable (part number 8310554) see "Making a Data Wire Test Cable" in Appendix F.

1. See Figure 12-41 and connect the data wire test cable to connector 1 of the double DPC attachment cable.

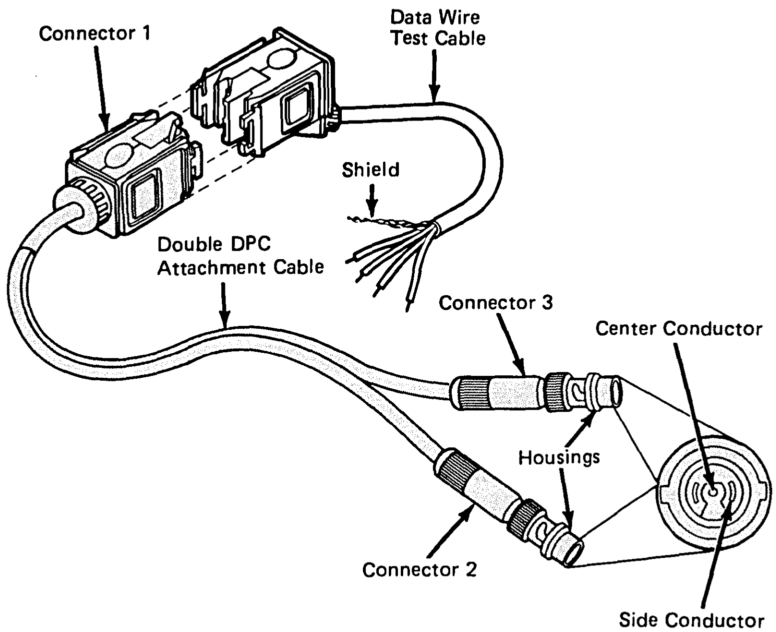


Figure 12-41. Double DPC Attachment Cable

2. Using an ohmmeter, check for continuity between:

   - The center conductor of connector 2 and the red wire of the data wire test cable
   - The side conductor of connector 2 and the green wire of the data wire test cable
   - The center conductor of connector 3 and the orange wire of the data wire test cable
   - The side conductor of connector 3 and the black wire of the data wire test cable
   - The housing of connector 2, the housing of connector 3, and the shield of the data wire test cable.

   a. If you find continuity in each case, continue with step 3.

   b. If you do not, go to step 4.

3. Using an ohmmeter, check for an open between the following leads of the data wire test cable:

   - Shield and green
   - Shield and orange
   - Shield and black
   - Shield and red
   - Red and green
   - Red and orange
   - Red and black
   - Green and orange
   - Green and black
   - Orange and black.

   a. If you find an open in each of these cases, the DPC attachment cable is not defective. Disconnect the data wire test cable and go to step 5.

   b. If you do not, continue with step 4.

4. The DPC attachment cable is defective. Replace it.

5. Return to step 6 in "The Data Path Problem Determination Procedure" or to the procedure that brought you here.

Procedure LL: Plug and Jack Y Assembly - Ohmmeter

This procedure requires a data wire test cable. Use a General Purpose Attachment Cable (part number 8310554) or see "Making a Data Wire Test Cable" in Appendix F.

1. See Figure 12-42 and connect the data wire test cable into connector 3 of the plug and jack Y assembly.

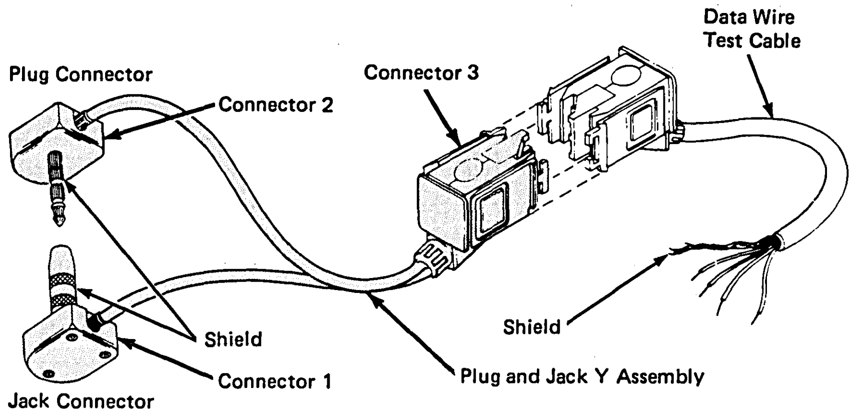


Figure 12-42. Plug and Jack Y Assembly

2. Connect connectors 1 and 2 together.

3. Using an ohmmeter, check for continuity between the following leads of the data wire test cable:

   - Red and orange
   - Green and black.

   a. If you find continuity in each case, continue with step 4.

   b. If you do not, go to step 7.

4. Using an ohmmeter, check for an open between:

   - The red and green wires of the data wire test cable
   - The shield of the plug and jack and the shield of the data wire test cable.

   a. If you find an open in each case, continue with step 5.

   b. If you do not, go to step 7.

5. Disconnect connectors 1 and 2 and check for continuity between:

   - The shield of connector 2 and the shield of connector 1.

   a. If you find continuity, continue with step 6.

   b. If you do not, go to step 7.

6. Using an ohmmeter, check for an open between the following wires of the data wire test cable:

   - Red and orange
   - Red and green
   - Red and black
   - Orange and green
   - Orange and black
   - Green and black
   - Shield and red
   - Shield and orange
   - Shield and green
   - Shield and black.

   a. If you find an open in each case, the plug and jack Y assembly is not defective. Disconnect the data wire test cable and go to step 8.

   b. If you do not, go to step 7.

7. The plug and jack Y assembly is defective. Replace it.

8. Return to step 6 in "The Data Path Problem Determination Procedure" or to the procedure that brought you here.

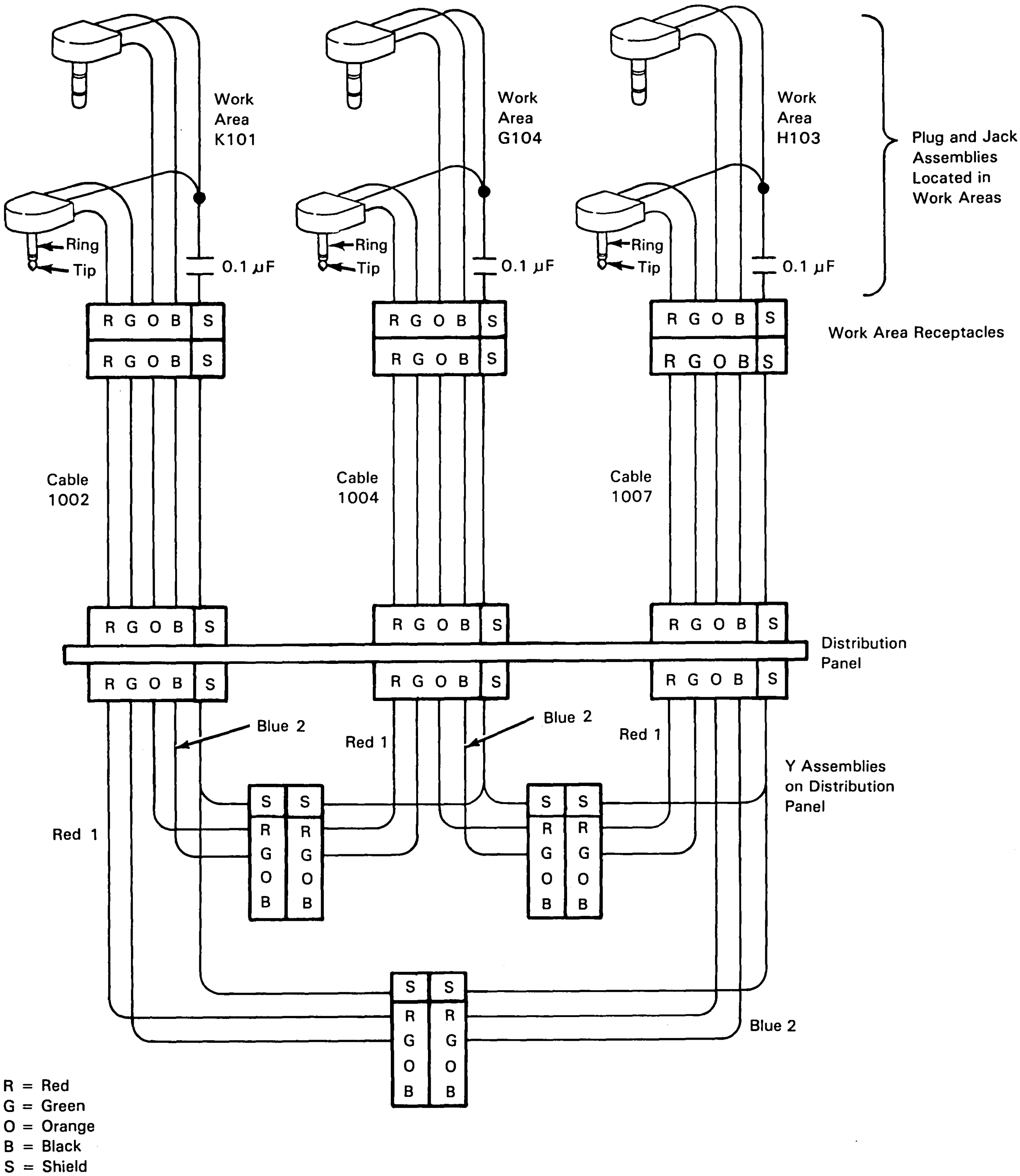


Figure 12-43. Schematic of an Installation Using Plug and Jack Y Assemblies

Procedure MM: MFA/422 Attachment Cable – Ohmmeter

1. See Figure 12-44 and check for continuity between:

   - Pins 15 and 19 of the MFA plug
   - Pins 17 and 25 of the MFA plug
   - Pin 1 of the MFA plug and the shield of the data connector.

   a. If you find continuity in each case, continue with step 2.

   b. If you do not, go to step 3.

2. Using an ohmmeter, check for an open between:

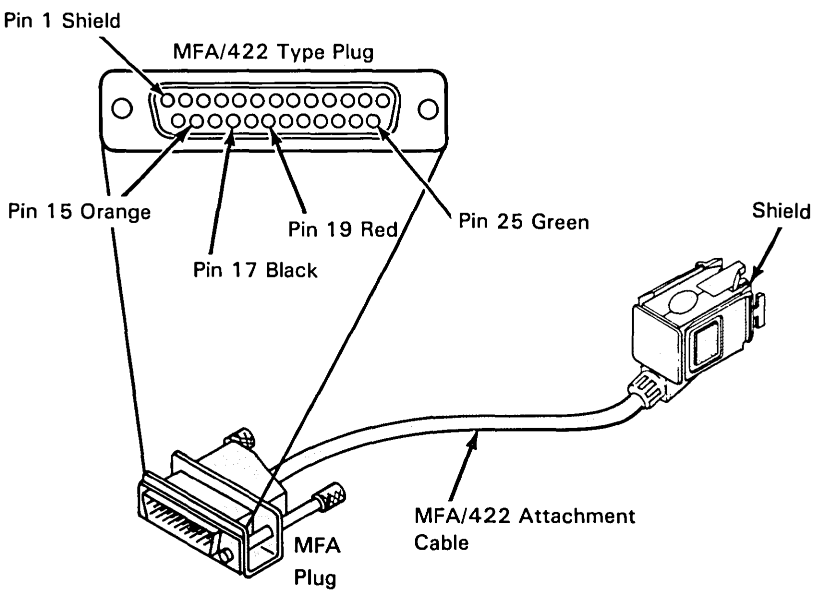
   - Pin 19 (or pin 15) to pin 25 (or pin 17)
   - Pin 1 and any of the other four pins.

   a. If you find an open in each case, the MFA/422 attachment cable is not defective. Go to step 4.

   b. If you do not, continue with step 3.

3. The MFA/422 attachment cable is defective. Replace it.

4. Return to step 6 in "The Data Path Problem Determination Procedure" or to the procedure that brought you here.



Note:
When the data connector is disconnected, shorting bars inside the connector automatically connect:

- The red position to the orange position
- The green position to the black position.

Figure 12-44. MFA/422 Attachment Cable

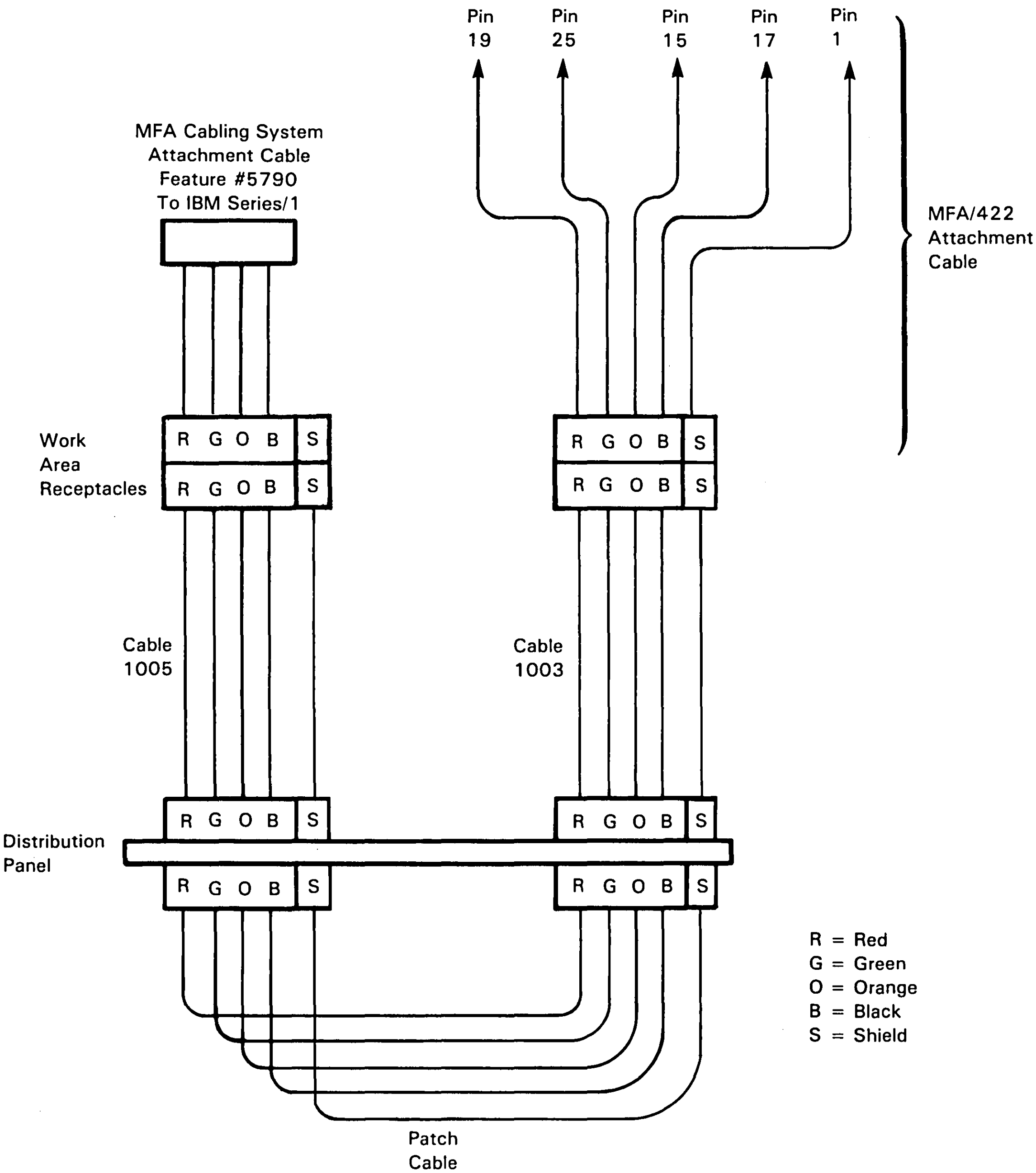


Figure 12-45. Schematic of an Installation Using MFA/422 Attachment Cable

Procedure NN: General Purpose Attachment Cable – Ohmmeter

1. See Figure 12-46 and check for continuity between the following wires in the general purpose attachment assembly:

   - Red and orange
   - Green and black
   - Cable shield wire and the shield contact of the data connector.

   a. If you find continuity in each case, continue with step 2.

   b. If you do not, go to step 3.

2. Using an ohmmeter, check for an open between:

   - The red (or orange) wire and the green (or black) wire
   - The shield wire and any of the other four data wires.

   a. If you find an open in each case, the general purpose attachment cable is not defective. Go to step 4.

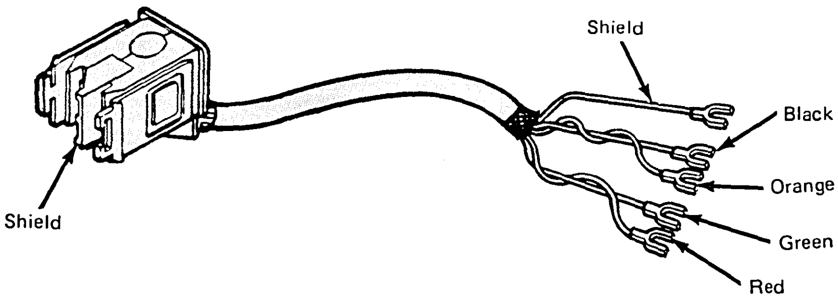
   b. If you do not, continue with step 3.

3. The general purpose attachment cable is defective. Replace the data connector at the end of the cable. Repeat this test procedure.

   a. If the test does not find any defects, the general purpose attachment cable is not defective. Continue with step 4.

   b. If the test finds defects, replace the cable. Continue with step 4.

4. Return to step 6 in "The Data Path Problem Determination Procedure" or to the procedure that brought you here.



Note:
When the data connector is disconnected, shorting bars inside the connector automatically connect:

- The red position to the orange position
- The green position to the black position.

Figure 12-46. General Purpose Attachment Cable

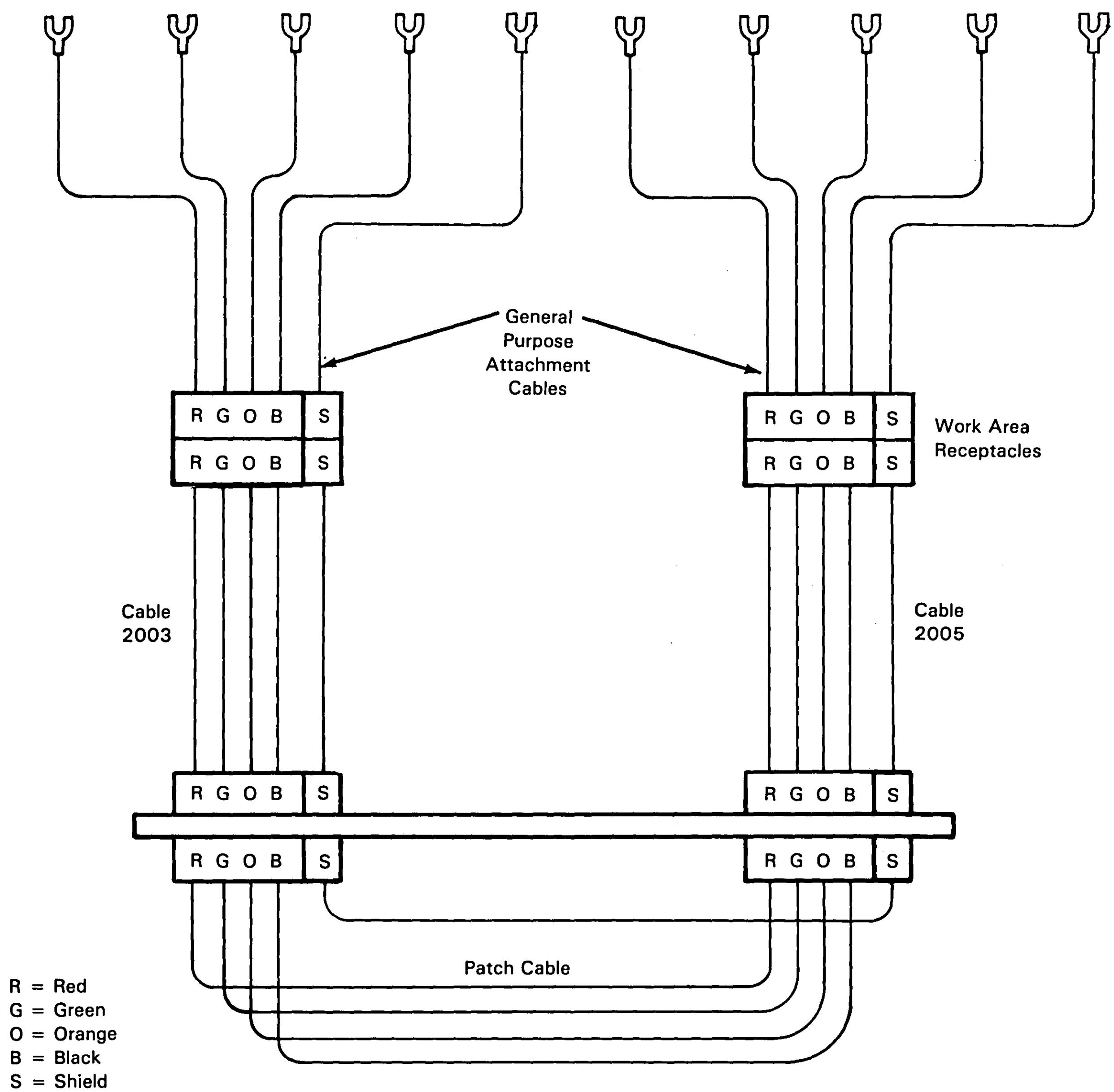


Figure 12-47. Schematic of an Installation Using General Purpose Attachment Cable

Procedure PP: Loop Wiring Concentrator (LWC) – Ohmmeter

This procedure requires a data wire test cable. Use a General Purpose Attachment Cable (part number 8310554) or see "Making a Data Wire Test Cable" in Appendix F.

1. Make sure that all cables currently connected to the LWC are labeled so that they can be reconnected properly.

2. If any patch cables are connected to the LWC, disconnect them from the LWC.

3. See Figure 12-48 and connect the data wire test cable to the I/O port of the LWC. (See Figure 12-50 for a schematic of the LWC.)

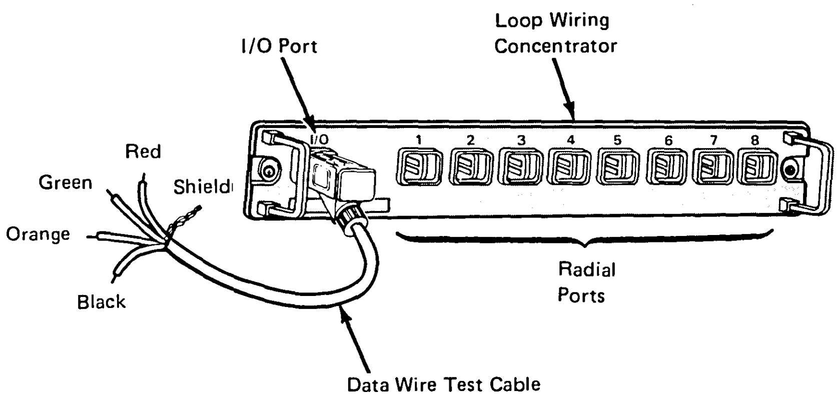


Figure 12-48. Loop Wiring Concentrator (LWC)

4. Using an ohmmeter, check for continuity between:

   - The red and orange wires of the data wire test cable
   - The green and black wires of the data wire test cable
   - The data wire test cable shield and the LWC shield contact in each of the radial ports.

   a. If you find continuity in each case, continue with step 5.

   b. If you do not, go to step 8.

5. Using an ohmmeter, check for an open between:

   - The red (or orange) wire and the green (or black) wire of the data wire test cable
   - Each of the data wires and the shield of the data wire test cable.

   a. If you find an open in each case, continue with step 6.

   b. If you do not, go to step 8.

6. Disconnect the data wire test cable and connect it to any radial port.

7. Using an ohmmeter, check for continuity between the following wires of the data wire test cable:

   - Red and orange
   - Green and black.

   a. If you find continuity in each case, the LWC is not defective. Disconnect the data wire test cable and go to step 9.

   b. If you do not, continue with step 8.

8. The LWC is defective. Replace it.

9. Do one of the following:

   a. If you are testing a failing data path using "The Data Path Problem Determination Procedure," leave the patch cables disconnected and return to step 6 in "The Data Path Problem Determination Procedure."

   b. If you came here from another procedure, reconnect the patch cables and return to that procedure.

Procedure QQ: Store Loop Attachment Assembly – Ohmmeter

This procedure requires a data wire test cable. Use a General Purpose Attachment Cable (part number 8310554) or see "Making a Data Wire Test Cable" in Appendix F.

1. See Figure 12-49 and connect the data wire test cable to the store loop attachment assembly data connector.

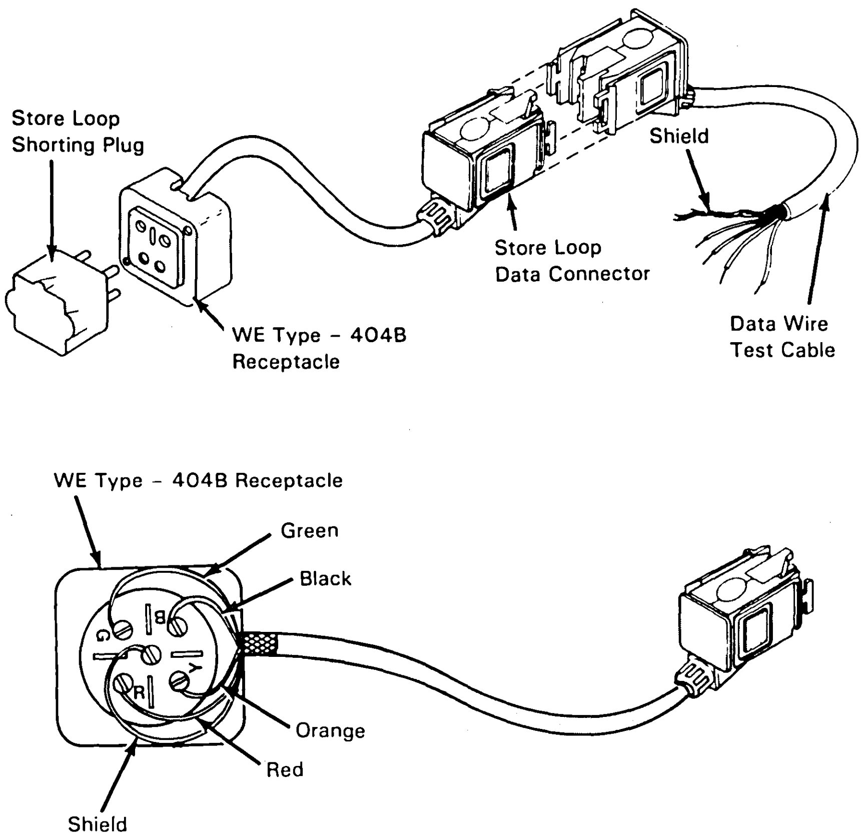


Figure 12-49. Testing the Store Loop Attachment Assembly with Ohmmeter

2. Connect the store loop shorting plug to the Western Electric (WE) type-404B receptacle.

3. Using an ohmmeter, check for continuity between the following wires of the data wire test cable:

   - Red and orange
   - Green and black.

   a. If you find continuity in each case, continue with step 4.

   b. If you do not, go to step 6.

4. Disconnect the store loop shorting plug from the WE type-404B receptacle.

5. Using an ohmmeter, check for an open between the following leads of the data wire test cable:

   - Shield and green
   - Shield and orange
   - Shield and black
   - Shield and red
   - Red and green
   - Red and orange
   - Red and black
   - Green and orange
   - Green and black
   - Orange and black.

   a. If you find an open in each case, the store loop attachment assembly is not defective. Disconnect the data wire test cable and go to step 7.

   b. If you do not, continue with step 6.

6. The store loop attachment assembly is defective. Replace it.

7. Return to step 6 in "The Data Path Problem Determination Procedure" or to the procedure that brought you here.

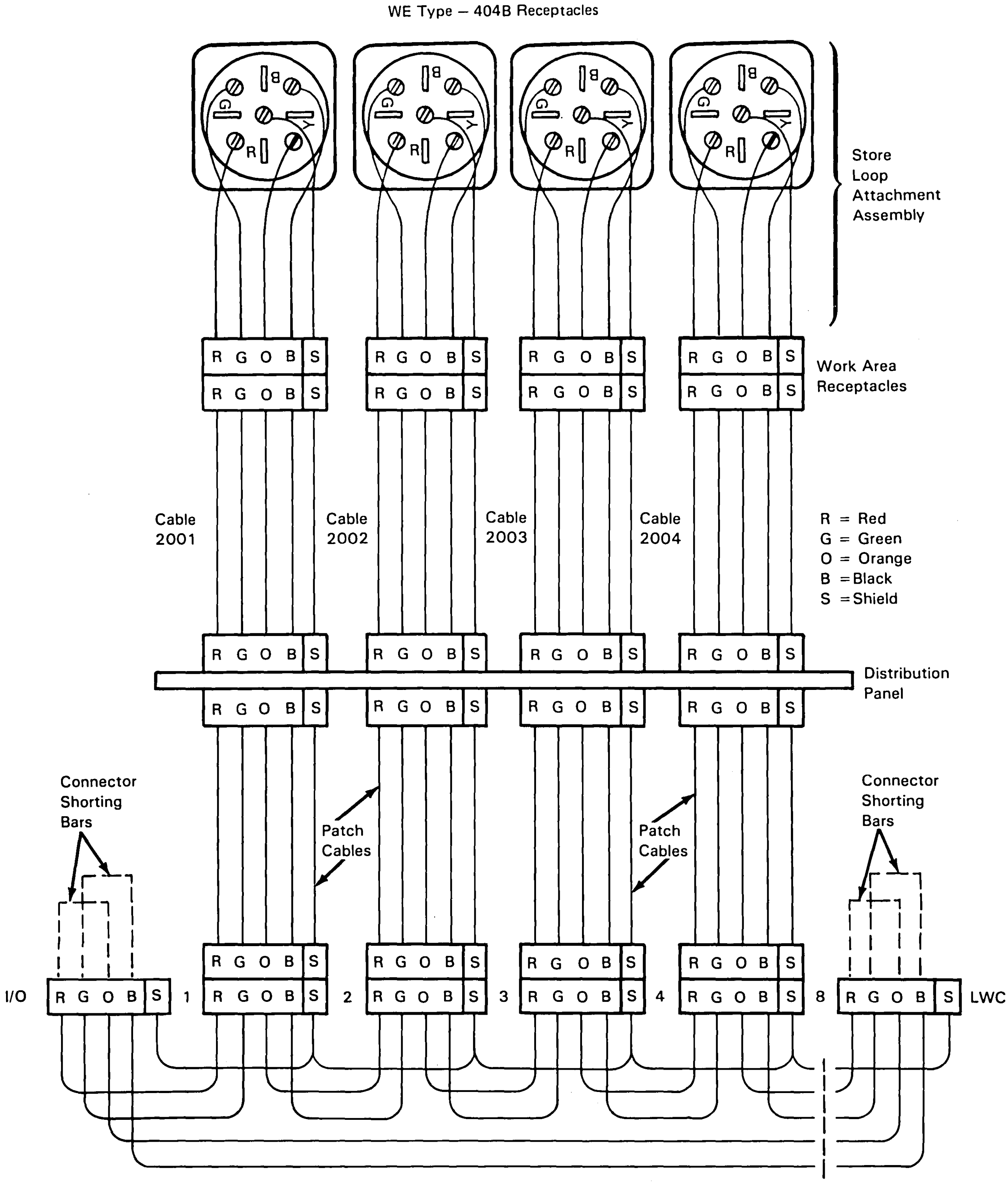


Figure 12-50. Schematic of an Installation Using Store Loop Attachment Assemblies

Procedure RR: Patch Cable - Ohmmeter

This procedure requires a data wire test cable. Use a General Purpose Attachment Cable (part number 8310554) or see "Making a Data Wire Test Cable" in Appendix F.

1. See Figure 12-51 and connect the data wire test cable to connector 1 of the patch cable.

2. Using an ohmmeter, check for continuity between:

   - The red and orange wires of the data wire test cable
   - The green and black wires of the data wire test cable
   - The data wire test cable shield and the patch cable shield contact in connector 2.

   a. If you find continuity in each case, continue with step 3.

   b. If you do not, go to step 6.

3. Using an ohmmeter, check for an open between the following wires of the data wire test cable:

   - Red (or orange) and green (or black)
   - Each of the data wires and the shield.

   a. If you find an open in each case, continue with step 4.

   b. If you do not, go to step 6.

4. Disconnect the data wire test cable and connect it to the other end of the patch cable.

5. Using an ohmmeter, check for continuity between the following wires of the data wire test cable:

   - Red and orange
   - Green and black.

   a. If you find continuity in each case, the patch cable is not defective. Disconnect the data wire test cable and go to step 7.

   b. If you do not, go to step 6.

6. The patch cable is defective. Replace it.

7. Return to step 6 in "The Data Path Problem Determination Procedure" or to the procedure that brought you here.

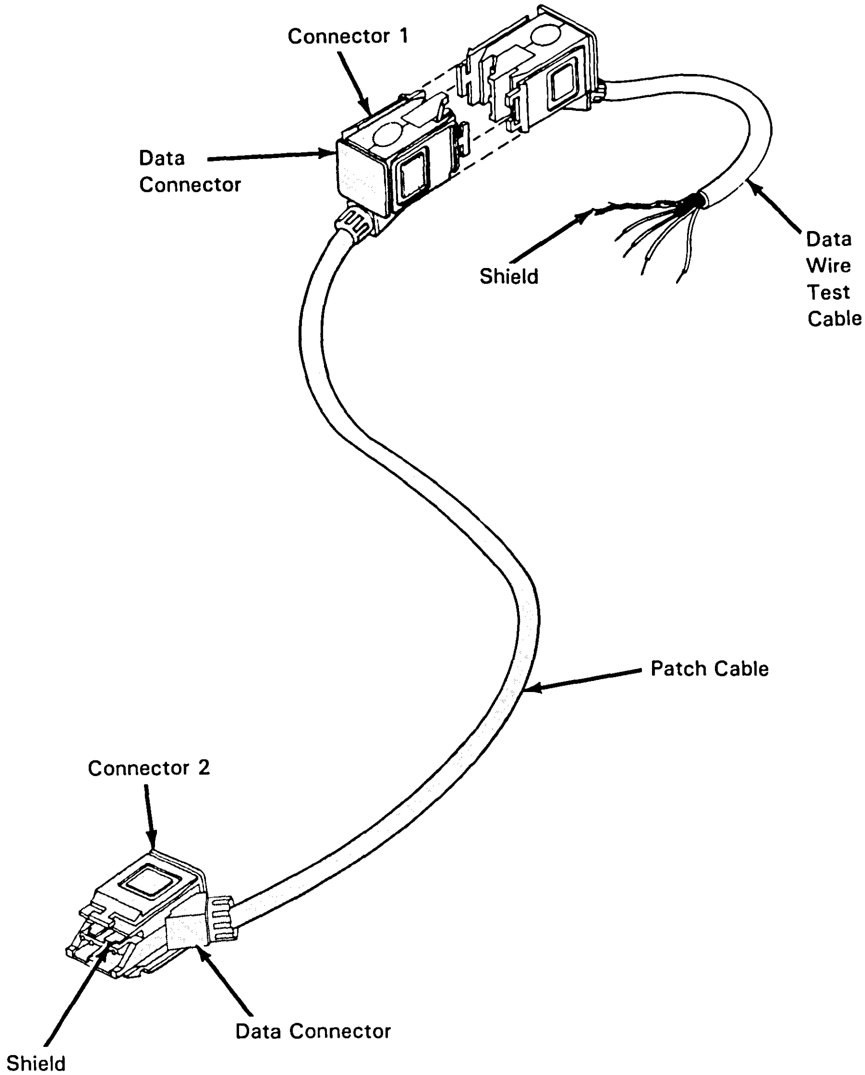


Figure 12-51. Patch Cable

Procedure SS: Indoor and Outdoor Surge Suppressor - Ohmmeter

DANGER
Only qualified persons should perform this test procedure. Do not perform this procedure during periods of of lightning activity. Do not disconnect any ground or shield connectors during this procedure.

Warning: This test procedure tests only the data path through the surge suppressor. You cannot use it to verify the surge suppression capabilities of the surge suppressor.

This procedure can be performed more efficiently with two persons working together. This test procedure has five parts:

1. Visual Inspection
2. Testing the Surge Suppressor Data Path
3. Testing the Surge Suppressors
4. Testing Outdoor Cable
5. Testing Indoor Cable

Each part tests different components of the cabling system. The parts are arranged so that those components most likely to be defective are tested first.

Figure 12-52 shows a diagram of the cabling system components that this procedure tests:

- The surge suppressor data path between the distribution panel in one building and the distribution panel in the next building
- The surge suppressors
- Outdoor cable
- Indoor cable.

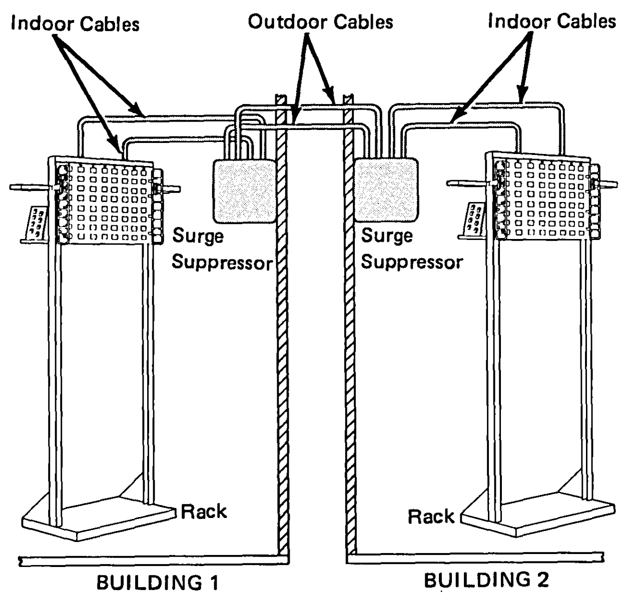


Figure 12-52. Example Showing Parts of Cabling System Tested in Procedure SS

Visual Inspection

1. Visually inspect *both* surge suppressors, including the printed circuit boards, all components, and wire connections. Look for burned, broken, or otherwise damaged components. Even if the first surge suppressor is damaged, inspect the second one.

   a. If you do not find any damage, go to "Testing the Surge Suppressor Data Path," the next part of this test procedure.

   b. If you find damage, continue with step 2.

2. The surge suppressor is defective.

   Have a qualified person replace the surge suppressor by following the instructions in "Surge Suppressor Replacement" in Appendix C.

   Reconnect all of the cables to the surge suppressor and continue with step 3.

3. Verify the data path by going to "Testing the Surge Suppressor Data Path," the next part of this test procedure.

Testing the Surge Suppressor Data Path

Follow the instructions in this section to test each surge suppressor data path. There may be only one surge suppressor data path used in your installation. If two data paths are used, be sure to test *both*.

1. In Figure 12-53, *data path 1* and *data path 2* are two surge suppressor data paths. Data path 1 is being tested.

2. Before starting this test, disconnect cables connected to the data connectors at either end end of the surge suppressor data path you are testing.

3. Test each surge suppressor data path by following the instructions in "Testing Data Cable with an Ohmmeter" in Appendix G.

    a. If the test does not find defects in either data path, return to "The Data Path Problem Determination Procedure" or to the procedure that brought you here.

    b. If the test finds defects in either or both data paths, continue testing the defective data path by going to "Testing the Surge Suppressor," the next part of this test procedure.

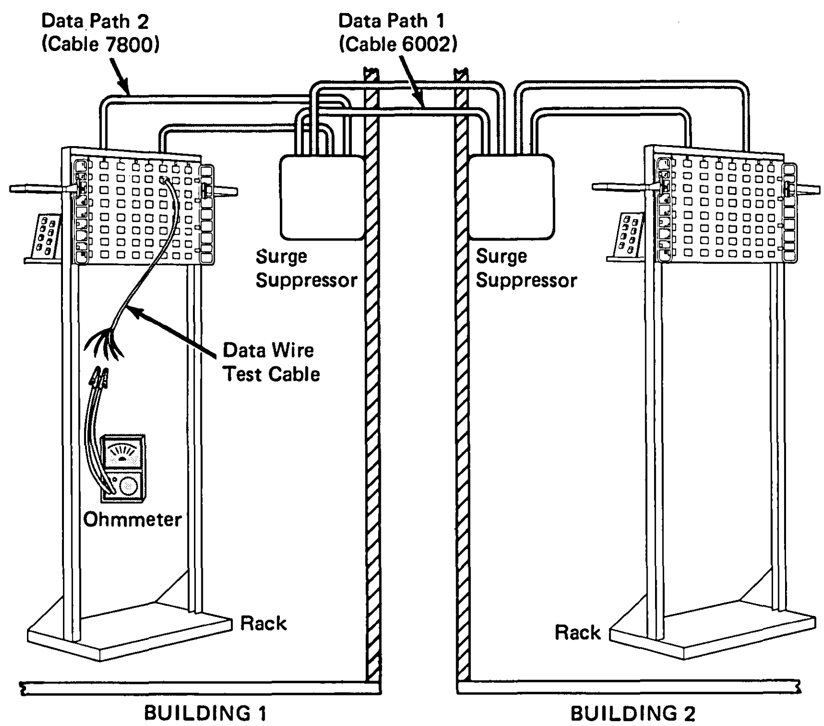


Figure 12-53. Testing the Surge Suppressor Data Path with an Ohmmeter

Testing the Surge Suppressor

Follow the instructions in this section to test both surge suppressors. When you are finished testing one, go to the second building and repeat this test at the other surge suppressor.

1. If you have not visually inspected the surge suppressor, inspect it now. Look for burned, broken, or otherwise damaged circuit boards, components, and wire connections.

   a. If you do not find any damage, continue with step 2.

   b. If you find damage, go to step 7.

2. Test the defective data path that you identified in the previous part of this test procedure. See Figure 12-54 for an illustration of the type of surge suppressor (indoor or outdoor) you are testing.

   a. If the defective data path is connected to outdoor terminal block/data path 1 (A) and indoor terminal block/data path 1 (B), follow the illustration in Figure 12-55 that corresponds to the type of surge suppressor you are testing.

   b. If the defective data path is connected to outdoor terminal block/data path 2 (C) and indoor terminal block/data path 2 (D), follow the illustration in Figure 12-56 that corresponds to the type of surge suppressor you are testing.

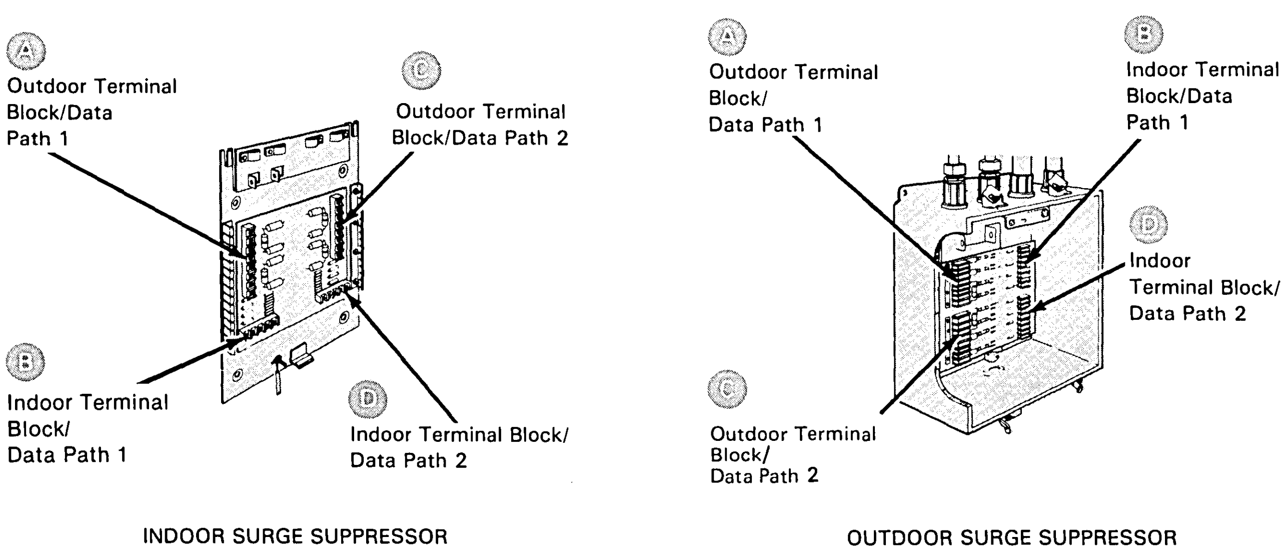


Figure 12-54. Indoor and Outdoor Surge Suppressor Terminal Blocks

CAUTION
Make sure that any existing ground connections have not been disconnected.

3. Disconnect the data wires in the defective data path from the outdoor and the indoor terminal block in the surge suppressor. Follow the illustration that corresponds to the type of surge suppressor you are testing have not been disconnected.

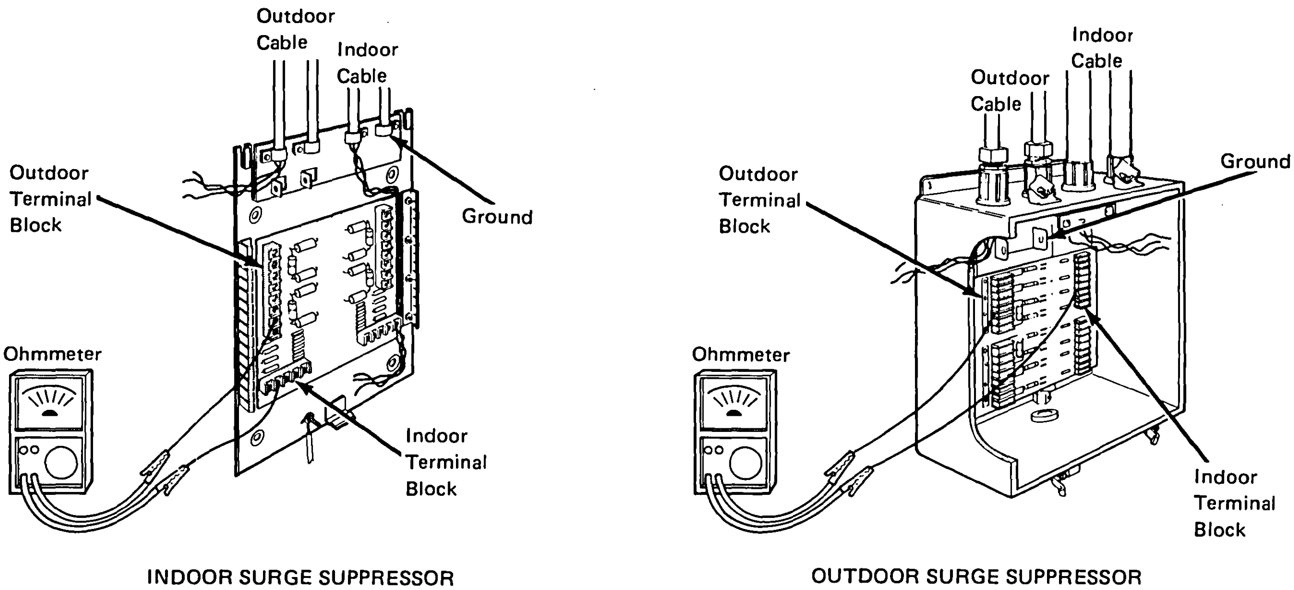


Figure 12-55. Testing the Data Path through Terminal Blocks A and B with an Ohmmeter

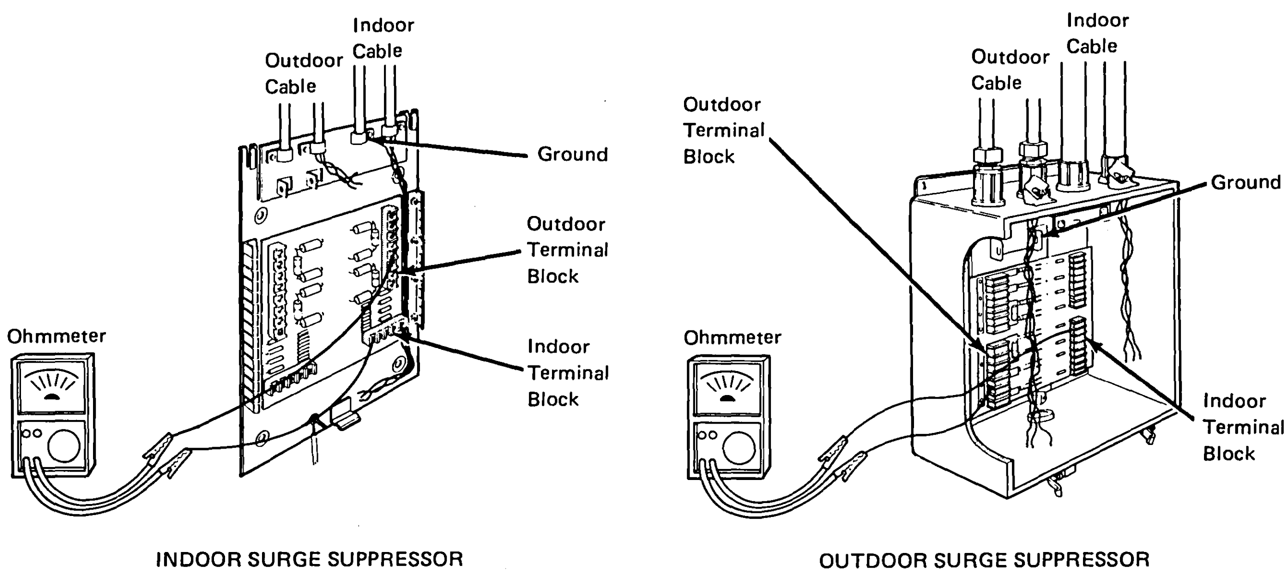


Figure 12-56. Testing the Data Path through Terminal Blocks C and D with an Ohmmeter

4. Using an ohmmeter, make the following measurements between the corresponding positions at the outdoor and the indoor terminal block in the defective data path:

Terminal Block		**Desired Result**
Outdoor	Indoor	
Red	Red	8 to 12 ohms
Green	Green	8 to 12 ohms
Orange	Orange	8 to 12 ohms
Black	Black	8 to 12 ohms.

   a. If you get the desired result for each measurement, continue with step 5.
   b. If you do not, go to step 7.

5. Using an ohmmeter, make the following measurements between the corresponding positions at the outdoor and the indoor terminal block in the defective data path:

Terminal Block		**Desired Result**
Outdoor	Indoor	
Red	Green	Open
Red	Orange	Open
Red	Black	Open
Green	Orange	Open
Green	Black	Open
Orange	Black	Open
Red	Ground	Open
Green	Ground	Open
Orange	Ground	Open
Black	Ground	Open.

   a. If you get the desired result for each measurement, continue with step 6.
   b. If you do not get the desired results, go to step 7.

6. Have you tested the second surge suppressor in this data path?

   a. If you have, continue testing by going to "Testing Outdoor Cable."
   b. If you have not, test the second surge suppressor in the other building by repeating "Testing the Surge Suppressors" beginning at step 1.

7. The surge suppressor is defective.

   Have a qualified person replace the surge suppressor by following the instructions in "Surge Suppressor Replacement" in Appendix C.

   Reconnect all the cables to the surge suppressor and continue with step 8.

8. Verify that the surge suppressor has been correctly installed by repeating "Testing the Surge Suppressor Data Path."

   a. If the test does not find any defects, return to "The Data Path Problem Determination Procedure" or to the procedure that brought you here.
   b. If the test finds defects, continue testing by going to "Testing Outdoor Cable," the next part of this procedure.

Testing Outdoor Cable

Follow these steps to test the outdoor cable in the defective data path you identified while performing "Testing the Surge Suppressor Data Path."

CAUTION
Make sure that any existing ground connections have not been disconnected.

1. Disconnect the outdoor cable from the terminal blocks of the surge suppressors in both buildings, if it is not already disconnected.

2. At one end of the outdoor cable, make the following measurements between the corresponding data wires of the outdoor cable:

Data Wires	Desired Result
Red and green	Open
Red and orange	Open
Red and black	Open
Green and orange	Open
Green and black	Open
Orange and black	Open
Red and ground	Open
Green and ground	Open
Orange and ground	Open
Black and ground	Open.

   a. If you get the desired result for each measurement, continue with step 3.
   b. If you do not get the desired results, go to step 5.

Warning: Avoid breaking the cable wires when you twist them. The shield connector can be used only once, and no spare shield connectors are provided.

3. At one end of the outdoor cable, twist or tape together the ends of the following data wires:

   - Red and orange
   - Green and black.

4. Go to the other end of the outdoor cable. Using an ohmmeter, check for continuity between these data wires:

   - Red to orange
   - Green to black.

   a. If you get the desired result for each measurement, go to step 7.
   b. If you do not get the desired results, continue with step 5.

5. The outdoor cable that you are testing is defective. Replace the cable. Reconnect all of the cables and continue with step 6.

6. Verify that the defect in the outdoor cable has been corrected by repeating the test in "Testing the Surge Suppressor Data Path."

   a. If the test does not find any defects, return to "The Data Path Problem Determination Procedure" or to the procedure that brought you here.
   b. If the test finds defects, continue testing by going to "Testing Indoor Cable," the next part of this test procedure.

7. Reconnect the outdoor cable to the terminal blocks. Continue testing by going to "Testing Indoor Cable," the next part of this test procedure.

Testing Indoor Cable

As shown in Figure 12-52, there are two indoor cables in each surge suppressor data path. Follow these steps to test *both* indoor cables in the defective data path.

CAUTION
Make sure that any existing ground connections have not been disconnected.

1. Disconnect the indoor cables from the terminal blocks of the surge suppressors in both buildings, if they are not already disconnected.

2. Test *both* indoor cables using "Procedure NN: General Purpose Attachment Cable – Ohmmeter" in this chapter. Perform any repair actions as described in that procedure. Continue with step 3.

3. Reconnect all cables to the surge suppressor. Verify the surge suppressor data path by repeating the test "Testing the Surge Suppressor Data Path."

   a. If the test does not find any defects, return to "The Data Path Problem Determination Procedure" or to the procedure that brought you here.
   b. If the test finds defects, go to "Finding Difficult Problems" in this chapter.

4. Return to step 6 in "The Data Path Problem Determination Procedure" or to the procedure that brought you here.

Finding Difficult Problems

Use this procedure if you are experiencing a difficult problem and all other procedures have failed to find the cause.

1. Verify (again) the system configuration and connections. Make sure they fall within the configuration limits described in this manual and in the portions of your system documentation concerning total length and the number of surge suppressors. Experience shows that many problems are caused by incorrectly configured wiring.

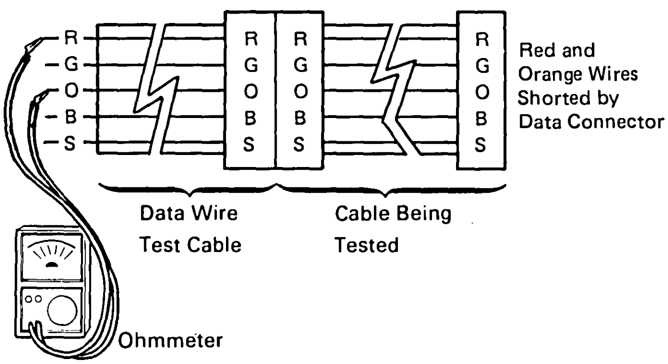
2. Verify that the allowable cable resistance has not been exceeded. The table in Figure 12-57 shows the expected resistance measurements at the maximum recommended temperature of 80°C for different lengths of cable, up to the maximum allowed, with and without surge suppressors. Your measurements may differ depending on the temperature and the accuracy of your ohmmeter. For 300 meters (1000 feet) of #22 AWG conductor, the resistance changes approximately 0.5 ohm for each 10°C (18°F) change in temperature.

   Note: For twinaxial applications, see also the system configuration limits in Chapter 3.

	Type 1 or 2 Indoor Cable				Outdoor Cable With Surge Suppressor				Type 6 or 9 Cable	Type 8 Cable
Cable Length	50m 165ft	100m 330ft	200m 660ft	700m 2300ft	50m 165ft	100m 330ft	200m 660ft	700m 2300ft	50m 165ft	50m 165ft
Loop Path Through Two Data Wires	7 ohms	14 ohms	28 ohms	98 ohms	55 ohms	62 ohms	76 ohms	147 ohms	15.3 ohms	13.5 ohms
Loop Path Through One Data Wire and Shield	4.2 ohms	8.3 ohms	16.6 ohms	58 ohms	28 ohms	32 ohms	39 ohms	77 ohms	8.2 ohms	7.5 ohms

Notes:

1. Loop path through two data wires:



2. Loop path through data wire and shield:

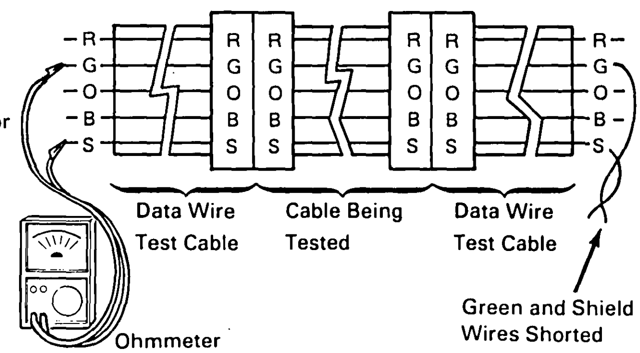


Figure 12-57. Table of Maximum Allowable Cable Resistance

Warning: Only a person qualified to adequately deal with separating the cables from electromagnetic and radio frequency sources should attempt to correct a cable separation problem.

Warning: Only a person qualified to deal with AC power grounding conductors and building grounding conductors should attempt to verify the integrity of the AC power grounding system for the building.

DANGER
Hazardous voltages may be encountered.

3. Verify that the cables are separated from sources of electromagnetic and radio frequency interference. (See "Cable Separation from Electromagnetic Sources" and "Radio Frequency Interference" in Appendix H.)

4. To verify that the building's AC power grounding system is properly grounded, *have a qualified person do the following:*

   a. Verify that the power distribution transformer is properly grounded (the secondary neutral should be connected to the power and building ground).

   b. Verify the correct wiring and grounding of the office AC power outlets serving the terminals or devices of the system.

5. Perform the ground potential and ground path resistance measurements for each segment of the data path by following the procedure in "Ground Potential Difference and Ground Path Resistance Measurement" in Appendix H. *If the readings exceed the specified values, contact the responsible party to make the necessary corrections.* Retest to verify that the ground potential difference is within the specified limits.

6. If any change to the cabling or grounding was made as a result of measurements in step 5, determine if the problem has been resolved before proceeding.

7. If the problem persists, there may be an operational ground potential difference problem.

   a. For IBM 5250-type systems, perform the "Operational Ground Potential Difference Test Procedure," the next section of this chapter.

      The operational ground potential difference measurement is a closed-loop measurement that measures the amount of potential existing at the port of the device. This measurement could be different from that measured open-circuit, as in step 5.

   b. For systems other than IBM 5250-type systems (Series/34, Series/36, Series/38, and 5525 work station lines, but not 5525 printer lines), continue with step 8.

8. If the problem still exists, the resolution is beyond the scope of this manual. The problem should be referred to a person qualified and experienced in dealing with unusual noise problems.

9. Return to the procedure that brought you here.

Operational Ground Potential Difference Test Procedure

This procedure is applicable only to IBM 5250-type devices (Series/34, Series/36, Series/38, 5525 work station lines, but not 5525 printer lines).

You will need:

- A voltmeter with a full-scale reading of 3.0 volts
- A spliced pair of data wire test cables.

1. Have the user stop system operation. Stop all polling activity from the controller.
2. Ensure that the continuity tests have been performed and that there are no opens, shorts, faults, or crossed pairs.
3. Make a spliced pair of data wire test cables by following these steps:

    a. Make two data wire test cables. See "Making a Data Wire Test Cable" in Appendix F.

    b. Splice together the shields and the matching wires in each of the two cables to form the assembly shown in Figure 12-58.

    c. Insulate the black, the orange, and the green wire splice points using either electrical wire nuts for #22 AWG conductor or some other insulator.

    d. While using the assembly, keep the red wire and the shield splice junctions from shorting to each other or to another conductive surface.

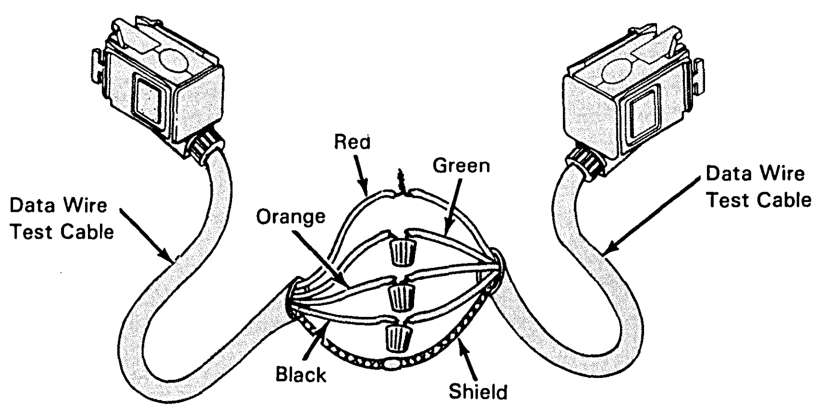


Figure 12-58. Spliced-pair Assembly of Data Wire Test Cables

4. Go to any device operating on the cabling system. Disconnect the device from the cabling system by unplugging the cabling system accessory for that device from the cabling system receptacle. The AC power cable for the device must be plugged into the AC power receptacle that normally supplies AC power and ground for that device. The device must be powered off. All other devices must be connected as they are during data operations except they should be powered off.

5. Connect one end of a spliced pair of data wire test cables to the cabling system receptacle where the accessory for the device was removed. Connect the cabling system accessory for the device to the other end of the spliced pair of the data wire test cables. See Figure 12-58.

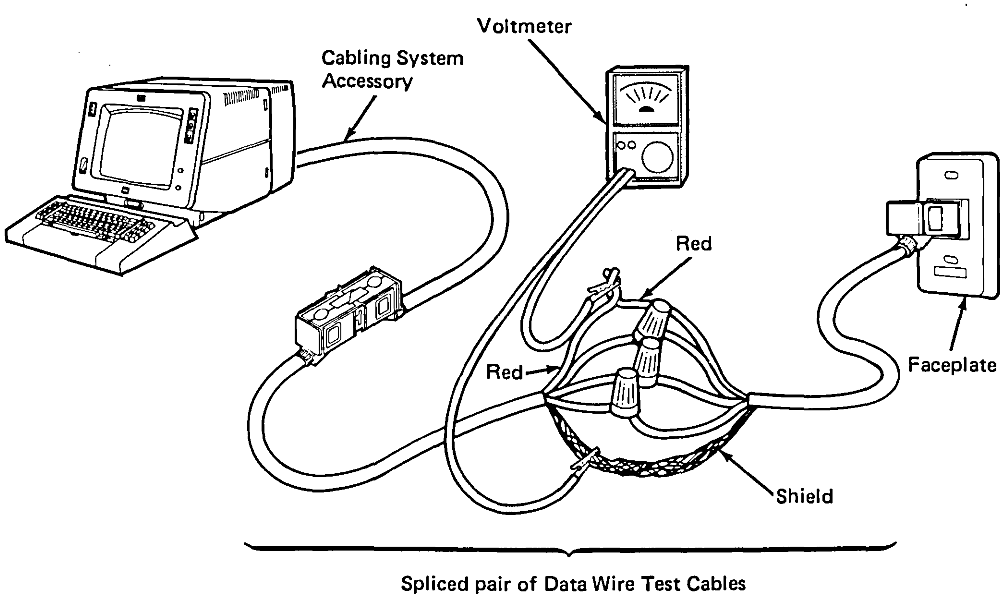


Figure 12-59. Example of the Operational Ground Potential Test Procedure

6. Set the voltmeter to an AC scale of approximately 10 to 15 volts.

7. Connect one voltmeter test lead to the junction of the test cable shields and connect the other voltmeter test lead to the junction of the red wires in the spliced pair of the data wire test cable assembly.

8. Adjust the voltmeter voltage scale to the lowest possible full-scale value (3.0 volts or lower unless the voltage present is too high). Read and record the voltage.

9. If there are two or more devices in the cabling system network, go to each device in sequence and repeat steps 3 through 7.

10. After you make the ground potential difference measurements for all the devices, review the readings.
To assure reliable system operation, the ground potential difference reading at any device must not exceed 1.0 volt AC.

    If the readings exceed the specified values, contact the responsible party to make the necessary corrections.

11. If corrections were made to any AC power or grounding circuits, have a *qualified person* repeat the operational ground potential difference test to verify acceptable readings after the corrections have been made. Record the measurements you get during retesting and verify that any corrections you made were successful.

12. If the operational potential ground difference measurement does not exceed 1.0 volt AC, there does not appear to be a problem with ground potential difference.

13. Return to the procedure that brought you here.

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Appendix A. Worksheets

This appendix contains the following worksheets:

- Attaching Products Worksheet
- Complete Order Summary Worksheet
- System Configuration Worksheet
- Wiring Closet/Controller Room Worksheet.

Make as many copies of these worksheets as you need. Save the blank originals for later copies.

You are hereby authorized to copy pages A-2 through A-10 only.

Attaching Products Worksheet

	Accessories	Part Number	Total Number	Comments
	Coaxial			
Coax-1	Red Coaxial Balun Assembly	8642546		
Coax-2	Single Cableless Balun Assembly	6339082		
Coax-3	Double Cableless Balun Assembly	6339083		
Coax-4	Yellow Coaxial Balun Assembly	8642544		
Coax-5	Single DPC Attachment Cable (8 feet)	6339073		
Coax-6	Single DPC Attachment Cable (30 ft)	6339074		
Coax-7	Double DPC Attachment Cable	6339075		
Coax-8	3299 Mounting Shelf	6217036		
Coax-9	Coaxial Patch Panel	4716801		
Coax-10	Spare BNC Bulkhead Connector	-------		note 1
	Twinaxial			
Twinax-1	Twinaxial Impedance Matching Device	6091070		
Twinax-2	Y Assembly	8642549		
Twinax-3	Twinaxial Y Assembly	8642550		
Twinax-4	Twinaxial Direct Connect Cable	6091075		
Twinax-5	Twinaxial Terminator	6091068		
Twinax-6	Loop Wiring Concentrator (LWC)	6091077		
Twinax-7	Cable Bracket	6091042		
Twinax-8	Patch Cable (8 feet)	8642551		
Twinax-9	Patch Cable (30 feet)	8642552		
Twinax-10	Twinaxial Test Accessories Kit	6339087		
	Finance Communication Loop			
4700-1	Plug and Jack Y Assembly	8310552		
4700-2	Y Assembly	8642549		
4700-3	Loop Wiring Concentrator (LWC)	6091077		
4700-4	Cable Bracket	6091042		
4700-5	Patch Cable (8 feet)	8642551		
4700-6	Patch Cable (30 feet)	8642552		
	Store System Loop			
SLoop-1	General Purpose Attachment Cable	8310554		
SLoop-2	WE Type-404B Receptacle	-------		note 2
SLoop-3	Loop Wiring Concentrator (LWC)	6091077		
SLoop-4	Cable Bracket	6091042		
SLoop-5	Patch Cable (8 feet)	8642551		
	Continued			

Notes:

1. Amphenol 31-2200 or equivalent
2. WE type 404-B receptacle or equivalent

Attaching Products Worksheet (Continued)

	Accessories	Part Number	Total Number	Comments
	Multiuse Communication Loop			
MCL-1	Type 1LS Loop Station Connector (LSC)	4760511		
MCL-2	Loop Wiring Concentrator (LWC)	6091077		
MCL-3	Component Housing	6091078		
MCL-4	Cable Bracket	6091042		
MCL-5	Patch Cable (8 feet)	8642551		
	Series/1			
S/1-1	MFA/422 Attachment Cable	8310553		
S/1-2	Y Assembly	8642549		
S/1-3	Twinaxial Y Assembly	8642550		
S/1-4	Twinaxial Straight Adapter	7362230		
S/1-5	Patch Cable (8 feet)	8642551		
S/1-6	Patch Cable (30 feet)	8642552		
S/1-7	Series/1 Feature #5790	-------		
S/1-8	Twinaxial Impedance Matching Device	6091070		
S/1-9	Twinaxial Terminator	6091068		
S/1-10	Twinaxial Direct Connect Cable	6091075		
	5080 Graphics			
5080-1	Red Coaxial Balun Assembly	8642546		
5080-2	Single Cableless Balun Assembly	6339082		
5080-3	Double Cableless Balun Assembly	6339083		
5080-4	Y Assembly	8642549		
	General Purpose Attachment			
Gen-1	General Purpose Attachment Cable	8310554		
Gen-2	Patch Cable (8 feet)	8642551		
Gen-3	Patch Cable (30 feet)	8642552		

Complete Order Summary Worksheet (Part 1 of 4)

Cables: For installation and maintenance, order 15% additional cable.

Type	Part Number	Meters (feet)
1	4716748	
1 Plenum	4716749	
1 Outdoor	4716734	
2	4716739	
2 Plenum	4716738	
5	4716744	
6	4716743	
8 *	4716750	
9 *	6339583 **	

Equipment Racks: Racks are not available from IBM. Order from your electrical supplier or contractor. Racks may not be a stock item, so allow enough lead time.

Type	Quantity
Open Rack	
Enclosed Rack	

* Not available from IBM
** Specification number

Accessories:

Description	Part Number	Quantity
Cable Tester Kit (includes tester, case, data wrap plug, and batteries)	4760500	
Cable Tester (includes batteries)	4760501	
Twinaxial Test Accessories (includes twinaxial test adapter, twinaxial test terminator, and two twinaxial straight adapters)	6339087	
Telephone Tester Attachment Kit	4760509	
Data Wrap Plug	4760507	

Note: For large installations where extensive tester usage is anticipated, order:

- One 8-foot patch cable
- Additional data wrap plugs.

This will extend the life of the data test cable connector and also facilitate testing multiple offices from the wiring closet.

Complete Order Summary Worksheet (Part 2 of 4)

Accessories: For installation and maintenance, order 10% additional accessories.
Order at least two additional surge suppressors of each type used.

Description	Part Number	Quantity
Data Connector *	8310574	
3-Pair Telephone Jack *	8310575	
3- or 4-Pair Telephone Jack *	8310551	
Type 1 Faceplate *	8310572	
Type 1 Faceplate for Japan *	6339094	
Type 2 Faceplate for 3-Pair Telephone Jack *	8310573	
Type 2 Faceplate for 3- or 4-Pair Telephone Jack *	6091025	
Type 2 Faceplate for 3- or 4-Pair Telephone Jack for Japan *	6339095	
Type 1W 87mm *	6091048	
Type 1W 80mm *	6091049	
Type 1S Surface Mt	4760486	
Type 2S Surface Mt for 3-Pair Telephone Jack	4760485	
Type 2S Surface Mt for 3- or 4-Pair Telephone Jack	6091029	
Distribution Panel	8642520	
Rack Ground Kit	4716804	
Indoor Surge Suppressor	4760469	
Outdoor Surge Suppressor	6091063	
Cable Location Chart	4716816	
Cable ID Label (8 sheets)	4716817	
Undercarpet Cable Connector Kit *,**	6339123	
Floor Monument **	6339128	
Floor Monument Faceplate Kit **	6339131	
Undercarpet Cable Wall Box **	6339130	

Note:
* Can only be ordered in multiples of 25
** Not available from IBM

Complete Order Summary Worksheet (Part 3 of 4)

Accessories: For installation and maintenance, order 10% additional accessories.

Accessories used in more than one application

Description	Part Number	Quantity
Loop Wiring Concentrator (LWC)	6091077	
Cable Bracket	6091042	
Red Coaxial Balun Assembly	8642546	
Single Cableless Balun Assembly (note 3)	6339082	
Double Cableless Balun Assembly (note 3)	6339083	
Y Assembly	8642549	
Twinaxial Y Assembly	8642550	
Twinaxial Impedence Matching Device	6091070	
Twinaxial Direct Connect Cable	6091075	
Twinaxial Terminator	6091068	
Patch Cable (8 feet)	8642551	
Patch Cable (30 feet)	8642552	
General Purpose Attachment Cable (note 1)	8310554	
Coaxial Accessories		
Coaxial Patch Panel	4176801	
Yellow Coaxial Balun Assembly	8642544	
Single DPC Attachment Cable (8 feet)	6339073	
Single DPC Attachment Cable (20 feet)	6339074	
Double DPC Attachment Cable	6339075	
3299 Mounting Shelf	6217036	
Spare BNC Bulkhead Connector	(note 2)	
Twinaxial Accesssories		
Twinaxial Test Accessories Kit	6339087	
Finance Communication Loop Accessories		
Plug and Jack Assembly	8310552	
Y Assembly	8642549	
Store System Loop Accessories		
WE Type-404B Receptacle	(note 3)	

Notes:
1. Can be ordered for use as data wire test cable
2. Not available from IBM. Order Amphenol 31-220 or equivalent.
3. Not available from IBM.

Continued

Complete Order Summary Worksheet (Part 4 of 4)

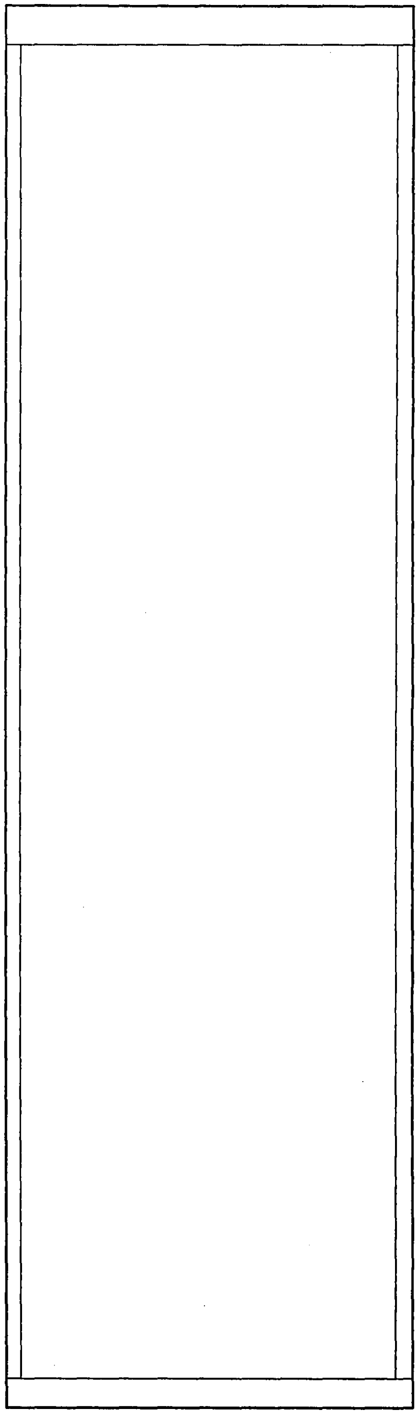
Accessories: For installation and maintenance, order 10% additional accessories.

Accessories used in more than one application

Description	Part Number	Quantity
Multiuse Communication Loop Accessories		
Type 1LS Loop Station Connector (LSC)	4760511	
Loop Wiring Concentrator (LWC)	6091077	
Component Housing	6091078	
Series/1 Accessories		
MFA/422 Attachment Cable	8310553	
Twinaxial Straight Adapter	7362230	
Series/1 Feature #5790	-------	

Rack Inventory Chart

Wiring closet number ____________________
Rack number ____________________
Date ____________________
Planner's initials ____________________

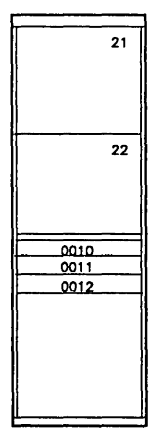


Instructions

Fill out a Rack Inventory Chart for each equipment rack.

1. Enter the wiring closet location number, the equipment rack identification number, and the planner's initials.
2. Using the template for the Rack Inventory Chart that came with this manual, draw an outline of each component that will be installed in the rack.
3. The slots at the bottom of the distribution panel tempate are used only for the lowermost distribution panel in a rack. The slots indicate that there are 38.1 mm (1-1/2 in.) between that panel and the next unit in the rack.
4. Write the unit identification number on each component on the chart.

Example:



System Configuration Worksheet

System ____________ Service Contact _________________ Telephone ________________

Attachment Description	Accessories in Work Area	Cable Runs from (wall)	Cable & Cable Length	Cable Runs to (panel)	Accessories on Equipment Rack

Suggested Accessory Abbreviations

GPA- General Purpose Attachment Cable
MFA- Multifunction Attachment Cable
Y- Y Assembly
TY- Twinaxial Y Assembly
IMD- Impedance Matching Device
TDC- Twinaxial Direct Connect Cable

RCB- Red Coaxial Balun
SCB- Single Cableless Balun
DCB- Double Cableless Balun
YCB- Yellow Coaxial Balun
SDPC- Single Dual Purpose Connector Attachment Cable
DDPC- Double Dual Purpose Connector Attachment Cable

LSC- Loop Station Connector
LWC- Loop Wiring Concentrator
PJ- Plug and Jack Assembly
AD- Adapter
P- Patch Cable
CPP- Coaxial Patch Panel
ISS- Indoor Surge Suppressor
OSS- Outdoor Surge Suppressor
UCC- Undercarpet Cable

Wiring Closet/Controller Room Worksheet

Building ________
Floor ________
Worksheet ________

Cable Routes Within a Single Building

	Wiring Closet Location/ Floor	Wiring Closet or Controller Room Location/ Floor	Number of Cables	Cable Length	Cable Requirements										
					Type 1		Type 1 P		Type 5		Type 9		Faceplate Devices		
													1	1S	1W
1															
2															
3															
4															
5															
6															
7															
8															
9															
10															
11															
12															
13															
14															
15															
Totals															

Cable Routes Between Buildings

	Wiring Closet Location/ Floor	Surge Suppressor Location/ Floor	Wiring Closet or Controller Room Location/ Floor/ Building	Cable Requirements								
				Length of Indoor Cable in this Building	Type 1		Type 1 P		Length of Outdoor Cable	Type 1 Outdoor		Surge Sup-pressors
					No.	Total Feet	No.	Total Feet		No.	Total Feet	
1												
2												
3												
4												
Totals												

Data Connectors ________

Distribution Panels ________

Rack Grounding Kit ________

Equipment Racks ________

Cable Label Packages ________

Appendix B. How to Configure Loop Wiring Concentrators (LWCs)

This appendix tells how to configure LWCs for Finance Communication Loop, Multiuse Communication Loop, and Programmable Store Loop Systems.

A Hierarchical Configuration

When configuring a loop system with the IBM Cabling System, you may need one or more loop wiring concentrators (LWCs). It is recommended that you arrange the LWCs using a *hierarchical* configuration.

The hierarchy may consist of one or two levels. Each level is described below. A hierarchical configuration simplifies planning for system installation and simplifies problem determination procedures.

One-Level Configuration

When there is only one level to the hierarchy:

- Only one LWC is used.
- The I/O port must not be used.
- The control unit is connected to one of the radial ports of the LWC. For Multiuse Communication Loop systems, the control unit must be connected to the *first* radial port of the LWC.
- Up to seven devices may be connected to the remaining radial ports of the LWC.

See Figure B-1 for an example of a one-level configuration.

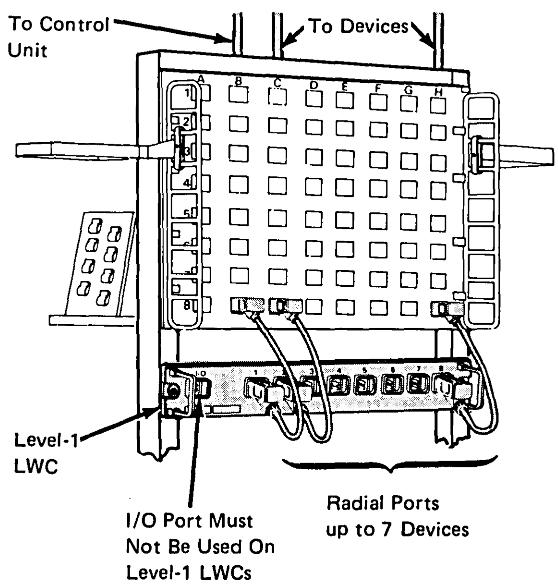


Figure B-1. Example of One-Level Configuration

Two-Level Configuration

When there are two levels to the hierarchy:

- Connections between levels are made from the level-1 LWC radial ports to the I/O ports of the level-2 LWCs.
- The I/O port of the level-1 LWC must not be used.
- The control unit is connected to one of the radial ports of the level-2 LWC that is connected to port 1 of the level-1 LWC. For the Multiuse Communication Loop, the control unit must be connected to the *first* radial port of the level-2 LWC that is connected to port 1 of the level-1 LWC.
- Up to eight devices may be connected to the radial ports of a level-2 LWC if the configuration limits for the system are not exceeded.

See Figure B-2 for an example of a two-level configuration.

Note: For additional information on how to use the hierarchical configuration with the Multiuse Communication Loop, refer to the *Guide to Multiuse Communication Loop with IBM Cabling System*, GA27-3606.

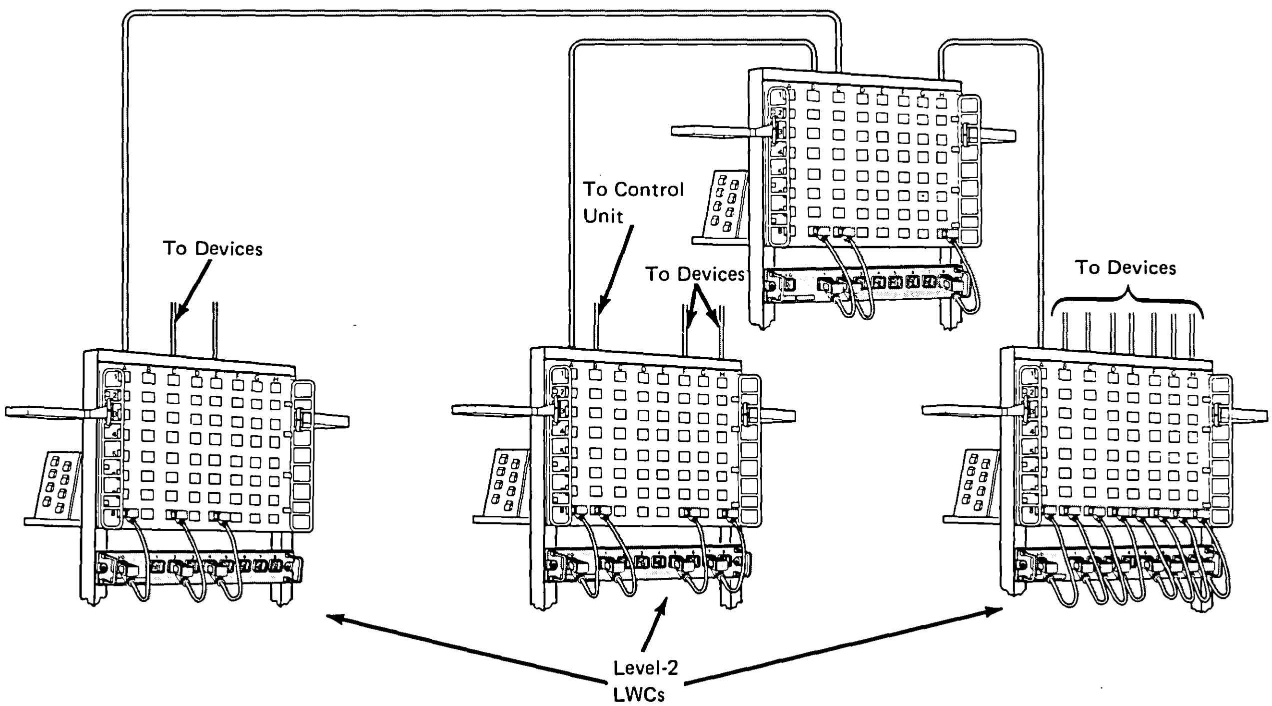


Figure B-2. Example of Two-Level Configuration

Appendix C. How to Install Accessories

This appendix tells how to install:

- Coaxial patch panels
- Rack-mounted LWCs and cable management brackets
- Remote housing
- 3299 mounting shelf
- Replacement surge suppressors.

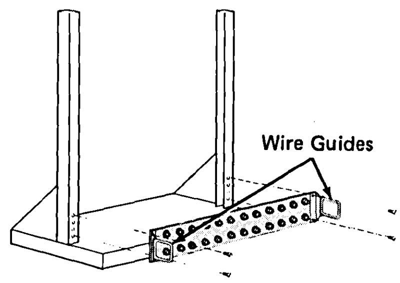
Space for Components in Equipment Rack

There is space in the equipment rack for the following combinations of distribution panels, LWCs, and coaxial patch panels:

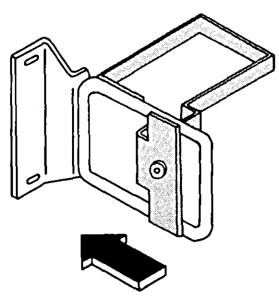
Dist. Panels	LWCs	Coaxial Patch Panels
2	9	4
2	10	3
2	12	2

Coaxial Patch Panel Installation

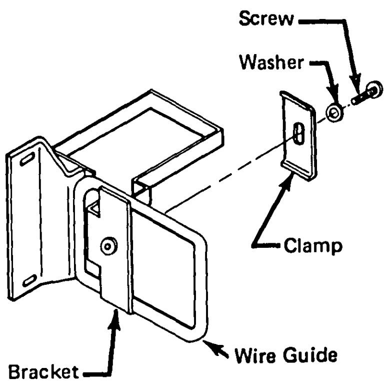
A maximum of four patch panels may be installed in an equipment rack.



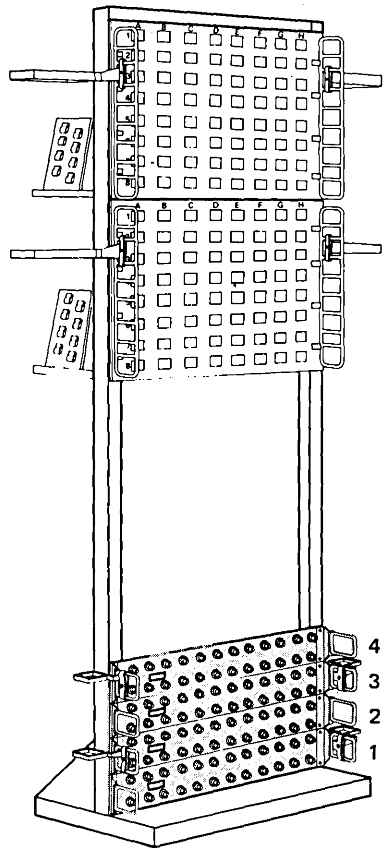
1. Begin mounting coaxial patch panels in the lowermost position of the rack. Use four screws to install a wire guide at each side of the panel and to hold the patch panel on the rack. (Screws are provided with the rack. Save any extra mounting screws for future use.)



2. Position the offset bracket on the wire guide as shown. Slide the offset bracket toward the face of the patch panel as far as it will go.



3. Attach the bracket to the wire guide using the clamp, washer, and screw as shown.



4. Place the proper identification labels on the front and rear of each patch panel in the designated space below ports 2 and 3.

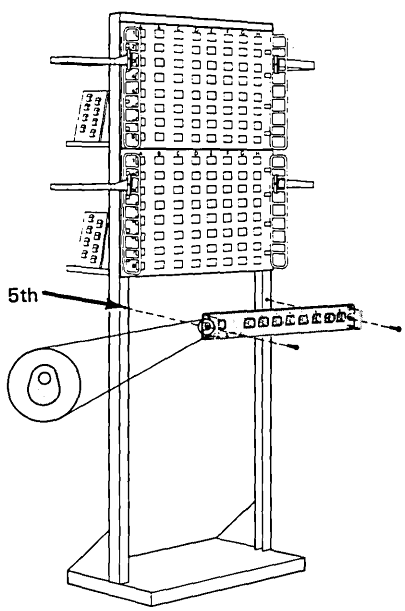
5. Install additional patch panels as required up to a maximum of four, working from the bottom up. When more than one patch panel is in the rack, alternate the bracket mounting positions from left to right as shown in the illustration of four mounted patch panels. This will permit the best cable management.

Rack-Mounted Loop Wiring Concentrator (LWC) and Cable Bracket Installation

This task requires:

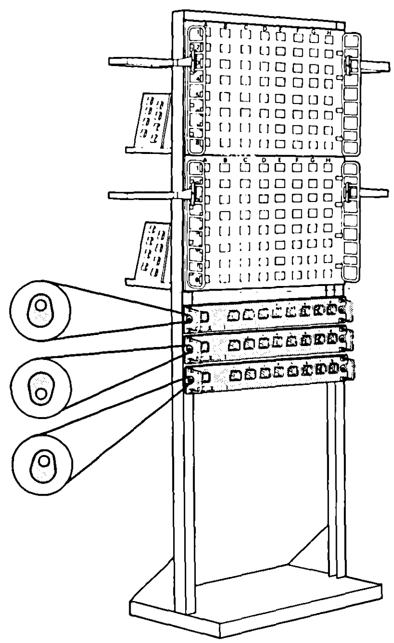
- LWC, part number 6091077
- Cable bracket, part number 6091042
- Completed Rack Inventory Chart (from your supervisor or cabling system planner)
- Unit identification label for each LWC (from your supervisor or cabling system planner)

1. Adjust the plastic bushings on the LWC so that the thicker sides are down as shown.



2. Mount the first (LWC) with the screws in the fifth hole down from the lowermost distribution panel. This should yield a space of 38.1 mm. (1-1/2 in.) between the distribution panel and the first LWC.

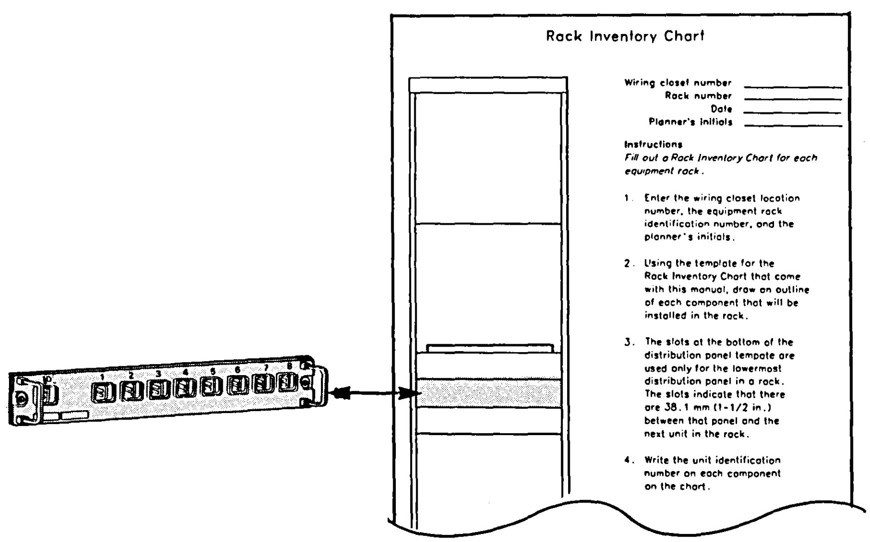
3. Adjust the bushings on the second LWC (if required) so that the thicker sides are up. Alternate the bushings on each successive unit to keep the LWCs close together.



4. Hold the LWC in the rack, leaving no space between LWCs.

5. Mount the LWC with two screws.

6. The Rack Inventory Chart shows you where you should install the LWCs in the equipment rack and the unit identification number of each LWC you installed. Following the numbers on the Rack Inventory Chart, label each LWC with the correct unit identification label. Place the unit identification label in the space between the I/O port and port 1.

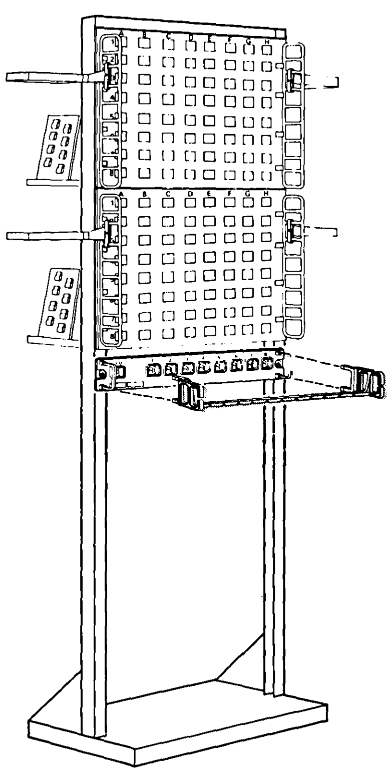


Installing the Cable Bracket

1. The cable bracket is designed for use with rack-mounted LWCs. If you are installing a cable bracket on more than one LWC, begin the installation at the lowermost LWC.

2. Before mounting the cable bracket, make sure that the space in front of the LWC is clear of cables and other obstructions. The required clearance is a space the height and width of the LWC with a depth of 6 inches (measured from the mounting surface of the rack toward the installer).

3. Align the cable bracket with the handles on the LWC.



4. Push the cable bracket onto the handles at each end of the LWC.

Installing Cables in a Rack-Mounted LWC

1. Attach the cable bracket to the LWC, according to the instructions in "Installing the Cable Bracket" in this appendix.

2. Before connecting a cable, identify the locations that each end of the cable will be connected to. The locations should have been recorded on the System Configuration Worksheets.

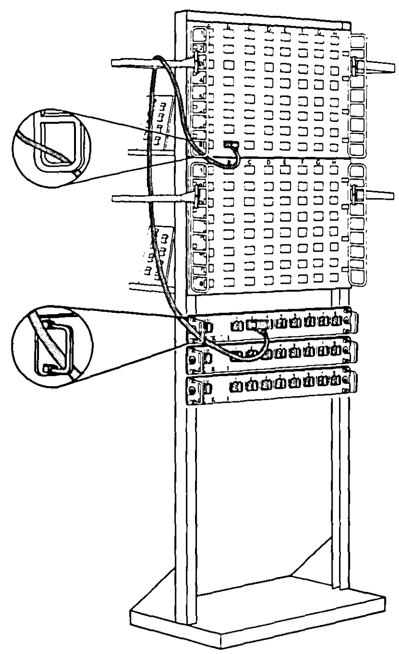
3. Connect one of the data connectors on the cable to the correct position on the distribution panel.

4. Route the cable to the left or right side of the rack, as appropriate. The correct routing depends on how the cables will be routed at the LWC:

   - All cables attached to an LWC are routed to the same side.

   - Cables attached to the next LWC in the rack are routed to the opposite side.

5. Route the cable through the wire guide opening adjacent to the row where the data connector is connected.



6. Route the cable through offset brackets on one or both of the distribution panels.

   a. If the cable will be routed from the first distribution panel, route the cable through the offset bracket on both the first panel and the second panels.

   b. If the cable will be routed from the second distribution panel to an LWC *mounted low on the rack*, route the cable through the offset bracket on the second distribution panel only.

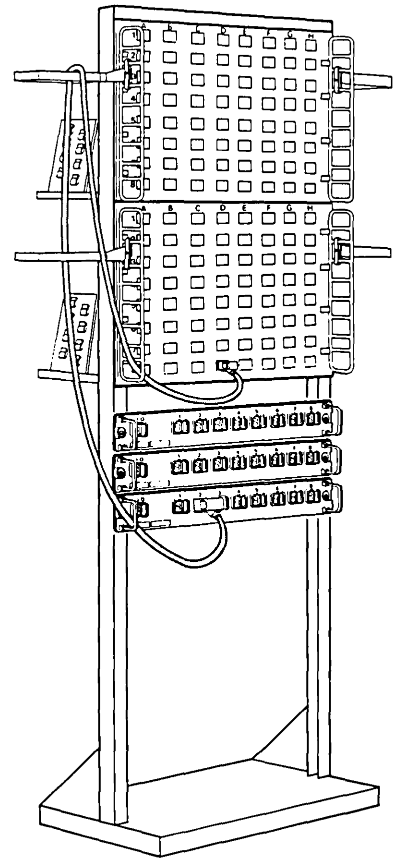
   c. If the cable will be routed from the second distribution panel to an LWC *mounted high on the rack*, route the cable through the offset bracket on the second panel and then through the bracket on the first panel.

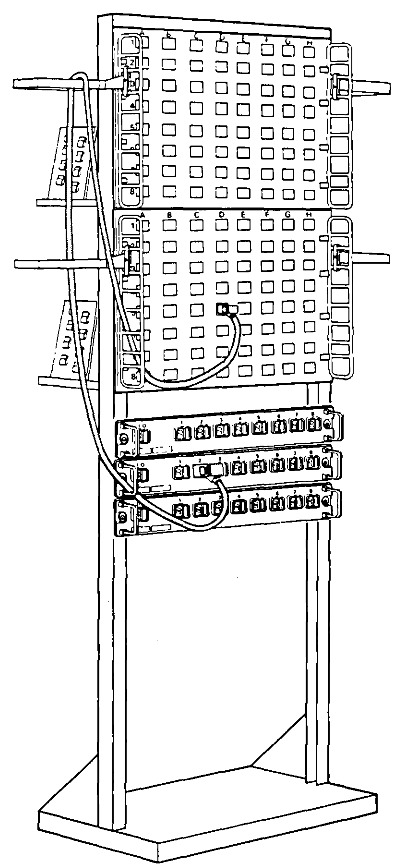
7. Route the cable under the fanning bar of the cable bracket. Plug the data connector into the LWC port.

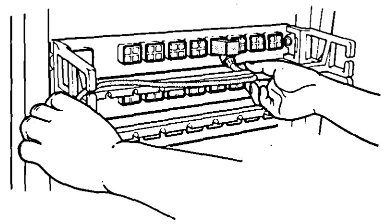
8. Find the slot on the fanning bar aligned with the port on the LWC. Insert the cable in the slot:

   a. Press and hold the cable against the rear edge of the slot as shown.

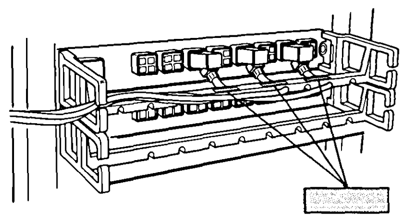
   b. Slide your fingers toward you as you press the cable against the front edge of the slot.





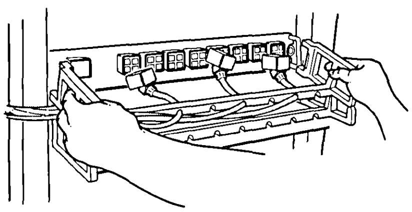


9. Slide the cable through the opening at the front of the cable guide on the cable bracket.



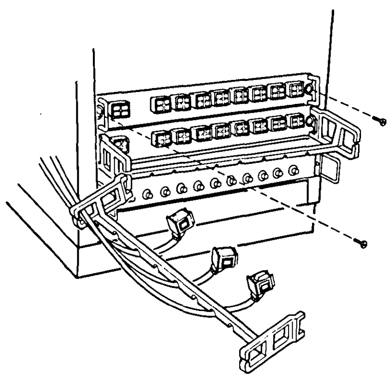
10. After all of the cables have connected to the LWC, label all of the patch cable connections. Place a cable identification label on the fanning bar in the indented space above the slot for each cable. Do not place the label on the cable.

Replacing a Cabled Rack-Mounted LWC



1. Disconnect all patch cables from the LWC. Leave the cables attached to the cable bracket.

2. Grasp the cable guide on each side of the cable bracket and remove the bracket by pulling it straight toward you.



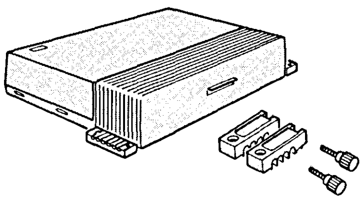
3. Swing the cable bracket aside to gain access to the LWC.

4. Before removing the LWC, note the position (upward or downward) of the eccentric bushings.

5. Remove the screws at each end of the LWC and remove the LWC from the equipment rack.

6. Install a new LWC by following the instructions in "Rack-Mounted Loop Wiring Concentrator (LWC) and Cable Bracket Installation" in this appendix.

Component Housing Installation



The instructions in this section apply to the loop wiring concentrator (LWC) only.

Use this procedure:

- To install the housing on a wall or desk
- To install an LWC in the housing.

For this task you will need:

- Component housing, part number 6091078

  You should find in the component housing carton:

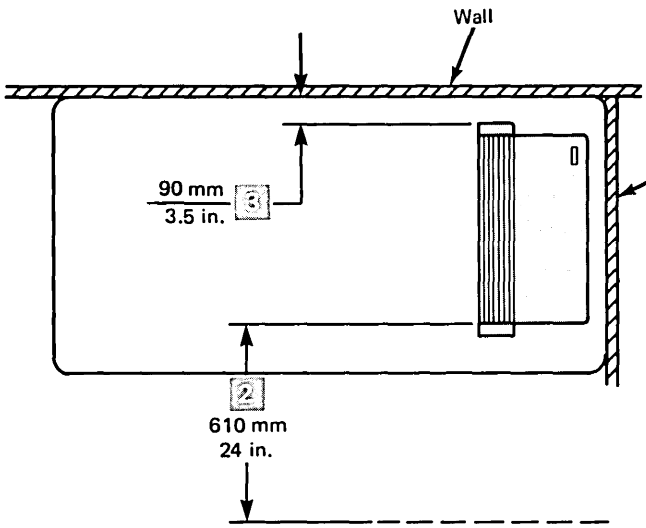
  - Component housing cover (with door) attached to base panel.
  - Two top clamp sections.
  - Four thumbscrews, #8-B, 38 mm (1-1/2 in.) long. Two are inside housing.

- LWC, part number 6091077
- Two copies of the unit identification label for the LWC (from your supervisor or cabling system planner)
- For wall-mounting you will need in addition:

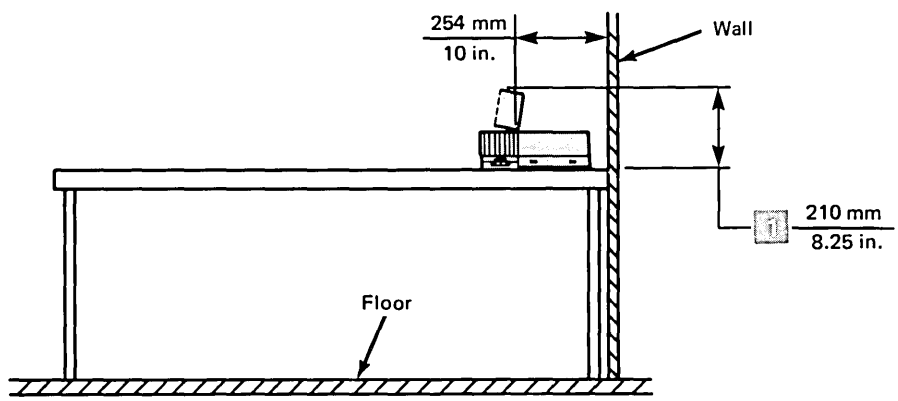
  - Four wall fasteners and screws (not provided): M6 or 1/4 in. (maximum diameter). Wall fasteners must support at least 6.8 kg (15 lb).
  - Pencil.
  - Screwdriver (1/4 inch blade type).
  - Drill.
  - Tape measure.

Installing the Component Housing

1. Before mounting the housing on a desk, make sure the installation and service clearance dimensions shown below can be met. The housing can be mounted with the hinged door on the left or the right.



Top View



Front View

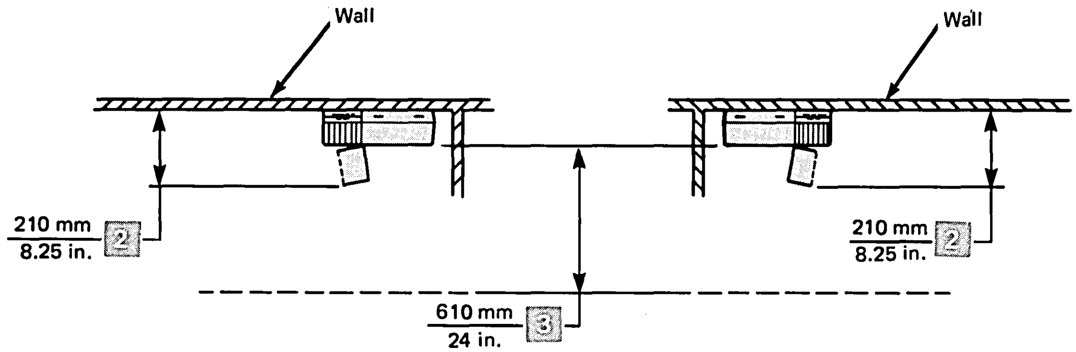
Note:

1 Minimum clearance required for hinged door to open

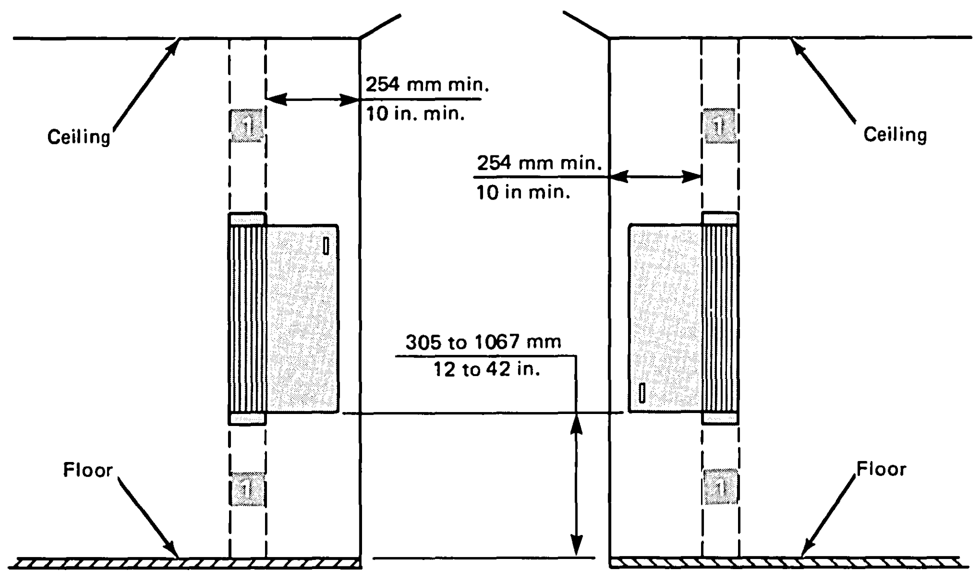
2 Minimum clearance (at the level of the component housing) required for personnel access to LWC

3 Minimum clearance for bend radius of patch cables routed from the wall

2. Before mounting the housing on a wall, make sure the installation and service clearance dimensions shown below can be met. The housing can be mounted with the hinged door on the left or right as shown.



Top View



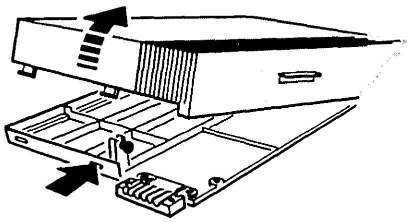
Front View

Note:

1 90 mm. (3.5 in.) wide area for routing patch cable from the ceiling or floor to the component housing

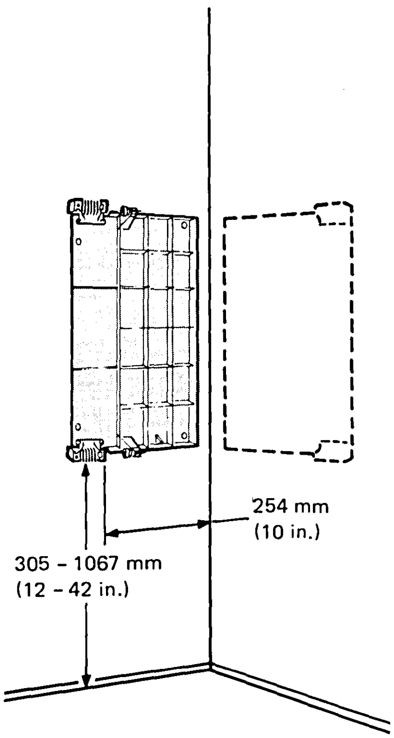
2 Minimum clearance required for hinged door to open

3 Minimum clearance (at the level of the component housing) required for personnel access to the LWC



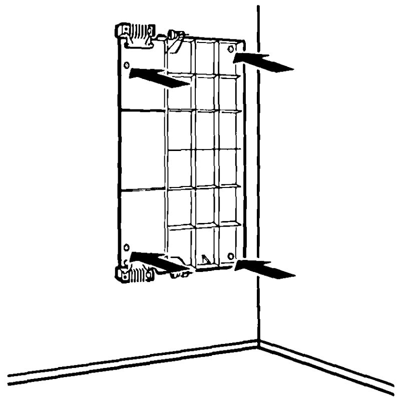
3. If the housing is to be mounted to a wall, continue with step 4. If the housing is to be laid on top of a desk or table without fastening, continue with step 8.

   Note: The housing should not be placed on the floor.



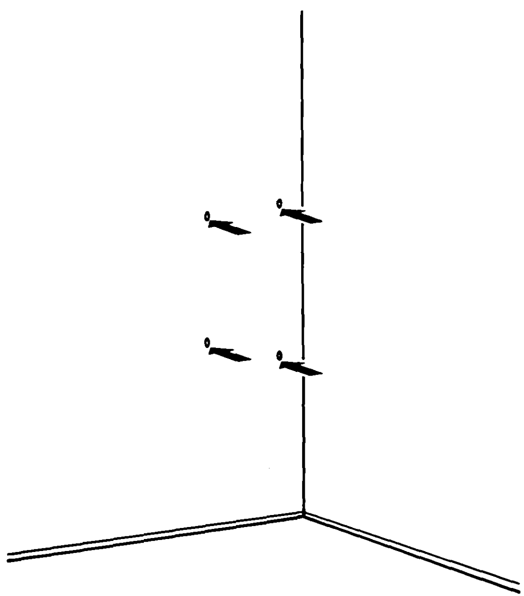
4. When the housing is to be mounted on a wall, remove the cover of the housing from the base panel by pressing in one of the cover tabs and lifting the cover straight up.

5. Hold the base panel vertically against the wall so that there are at least 305 mm. (12 in.) and not more than 1070 mm (42 in.) from the floor to the bottom of the housing. If the panel will be mounted near a corner, make sure that it is at least 254 mm (10 in.) from the corner.

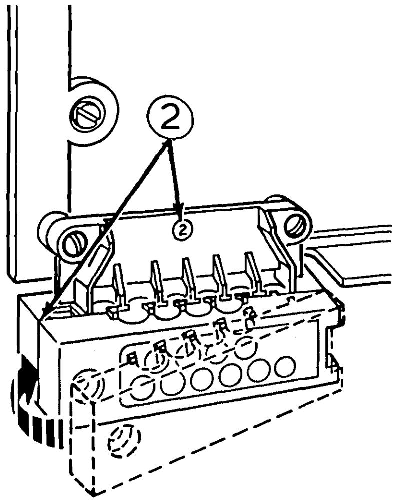


6. Use the base panel as a guide to mark the wall where the four mounting screws or wall fasteners will go.

   The panel may be mounted so that the clamps are on the left or on the right side of the panel as shown.

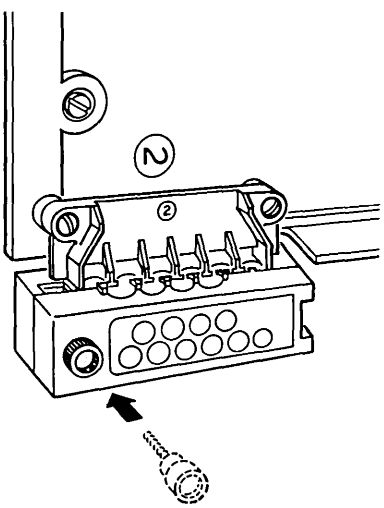


7. Drill holes at the marked places. Install wall fasteners if necessary and mount the base panel by inserting a screw in each mounting hole. Tighten each screw after all four screws have been inserted.

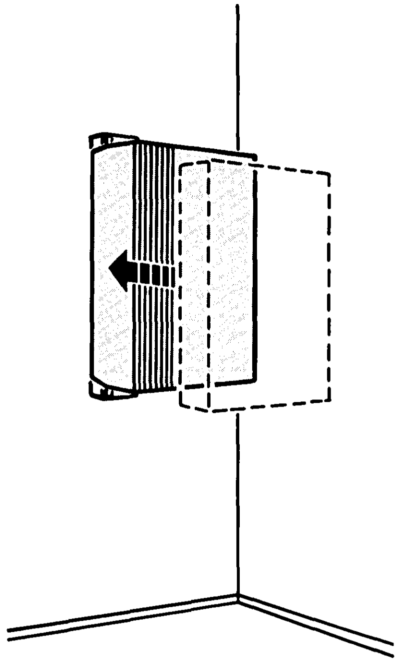


8. Match each of the top clamp halves with the appropriate bottom halves (attached to the base panel) using the numbers (1 or 2) marked on the sections. If you are installing the housing on a desk, open the door of the cover to see the numbers on the bottom halves of the clamps.

   Fit together the two sections as shown.



9. Install a thumbscrew into each clamp and tighten. Avoid overtightening the thumbscrew.



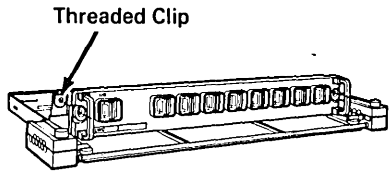
10. If you are installing the housing on a desk, you have completed this procedure.

    If you are installing the housing on a wall, go to the next step.

11. Align the cover tabs with the base panel and push the cover onto the base until it is securely attached.

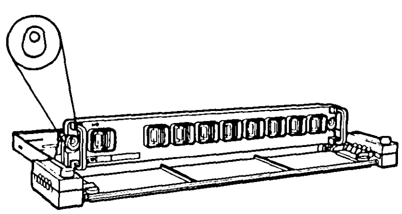
(

Installing an LWC in the Component Housing



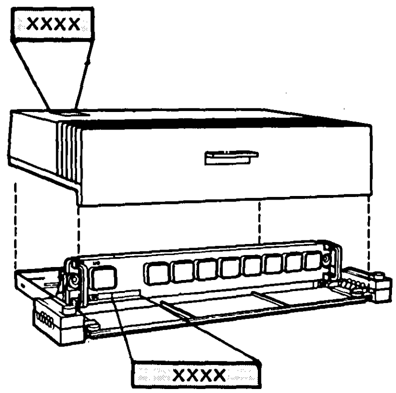
1. Remove the two thumbscrews from the threaded clips.

2. Place the LWC against the base panel as shown.



3. Adjust the bushings on the LWC so that the thicker sides are toward the base of the housing.

4. Install thumbscrews through the mounting holes as shown. Avoid overtightening the thumbscrews.



5. Attach a unit identification label in the space between the I/O port and port 1.

6. Attach an identical unit identification label to the cover of the housing.

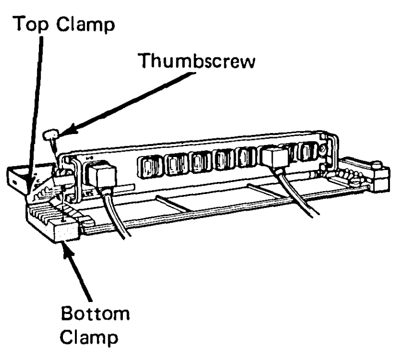
7. If you are going to install cables at this time, leave the cover off the housing. Otherwise, line up the cover tabs with the base panel and push the cover onto the base until the cover and base snap together.

Installing Cable in an Assembled Component Housing

The component housing will accept only type 6 cable because of the restricted cable bend radius area in the housing and the design of the cable clamps. It is recommended that patch cables be used with the housing.

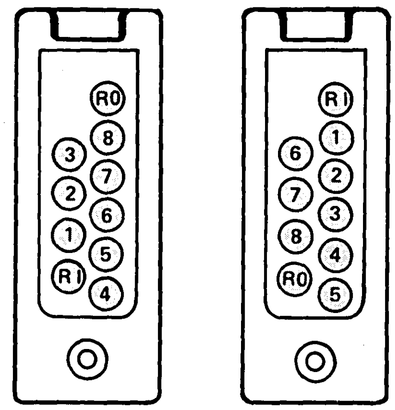
1. If the cover is attached to the component housing, remove it by following the instructions in "Installing the Component Housing" in this appendix.

2. You will need one patch cable for each LWC port used.



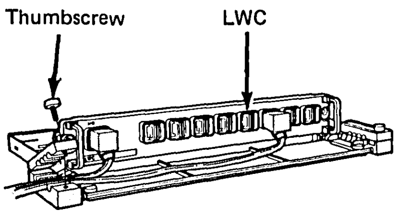
3. Open the hinged door on the housing cover to gain access to the ports. Connect the patch cables to the correct port on the LWC. The ports are labeled on the face of the LWC.

4. All of the patch cables should be routed to one end of the housing. Remove the thumbscrew from the clamp at that end and remove the top clamp section from the bottom section.



5. Locate the correct clamp slot for each cable. The slots on the top and bottom clamp sections are numbered to correspond to the numbered LWC ports:

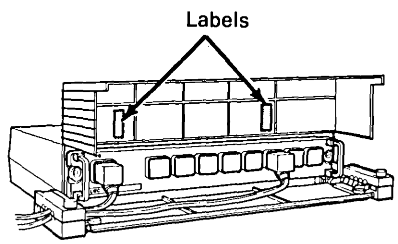
RI	**Corresponds to**	**I/O**
1		1
2		2
3		3
4		4
5		5
6		6
7		7
8		8
RO (not used)		



6. Insert each cable into the appropriate slot. Leave enough slack in the cable inside the housing so that the cable will not kink when the data connector is connected to the LWC port.

7. Reassemble the cable clamps and tighten the thumbscrews securely.

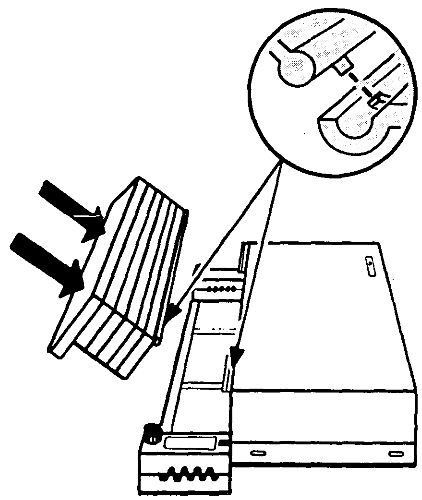
8. Align the cover tabs with the base panel and push the cover onto the base until the cover is securely attached.



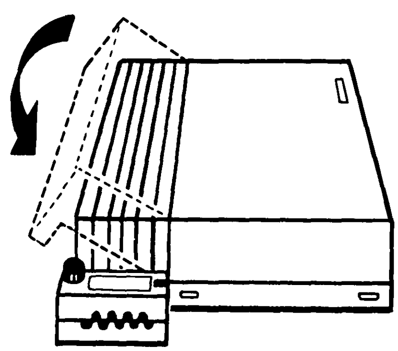
9. There are indented spaces on the inside of the housing door. For each patch cable used, place a cable identification label in the space beside the port to which the cable is connected.

Reassembling the Component Housing Door

The hinged door on the component housing is designed to detach from the cover when the door is opened too far or when the housing is not properly handled. To reattach the door to the cover:



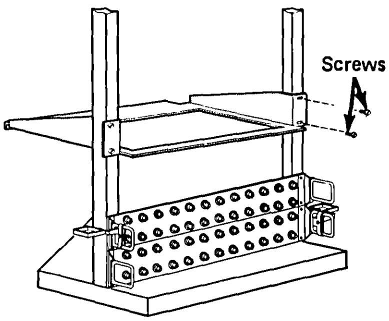
1. Find the sockets for the hinge at each end of the housing cover. Find the pin along the edge of the door.



2. Hold the door at an angle of approximately 45 degrees and push the door pin into the cover sockets.

3. Push and simultaneously rotate the door toward the closed position. This will cause the pins and sockets to snap together.

3299 Mounting Shelf Installation

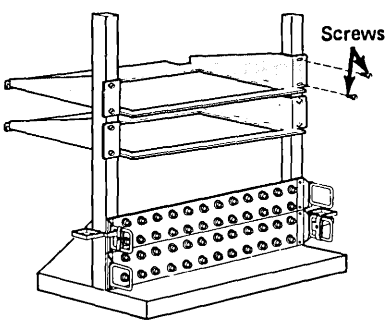


1. Mount the shelf at a position above the uppermost patch panel in the equipment rack. Use four screws to install a wire guide at each side of the shelf and to hold the shelf on the rack. (Screws are provided with the rack.)

2. Place the 3299 in the recessed area of the shelf. This secures the unit and prevents it from sliding off the shelf.

   To remove the 3299 from the shelf, lift up and pull the unit out.

Installing Multiple 3299 Mounting Shelves in the Same Rack



1. Install additional shelves, as required, above the shelf that was mounted first.

2. Place the 3299 units in the shelves *after* all of the shelves have been mounted.

Surge Suppressor Replacement

DANGER
Do not replace surge suppressors during periods of lightning activity.

This procedure involves disconnecting conductors that could be carrying ground fault or induced currents that may be hazardous if not handled properly.

Do not remove both surge suppressors at the same time from an outdoor cable run. Keep one end of the outdoor cable grounded at all times.

To remove the surge suppressors, do the following:

1. First, check for the presence of AC current. Use a clamp-on ammeter to measure the current on all cable shields and on the surge suppressor grounding wire.

   If any reading exceeds 1.0 amp, find and correct the problem before continuing.

2. Remove the cover or open the surge suppressor to be replaced.

3. Remove the wires from the surge suppressor terminal blocks.

4. Remove the 5/16 in. hex nuts and the screws that secure the outdoor cable shields to their grounding tabs.

5. Cut off the portion of the shield with the rivet to remove the outdoor cable if you are replacing an outdoor surge suppressor.

6. Remove the cable clamp mounting screws or nuts.

7. Remove the four surge suppressor mounting screws.

8. Slide the surge suppressor away from the cables. If sufficient service loop has been provided, leave the grounding conductor in place until the surge suppressor has been pulled away. Otherwise, disconnect the conductor from the ground post before sliding the surge suppressor away.

9. If you have not already done so, disconnect the grounding conductor from the ground post.

10. If you are replacing an outdoor surge suppressor, remove and reuse the hardware called for in "Outdoor Surge Suppressor Installation" in Chapter 8 of the *IBM Cabling System Planning and Installation Guide.*

11. Install the new surge suppressor according to the instructions that were shipped with it, or according to the instructions in "Indoor Surge Suppressor Installation" or "Outdoor Surge Suppressor Installation" in Chapter 8 of the *IBM Cabling System Planning and Installation Guide.*

Appendix D. How to Manage Cable on the Distribution Rack

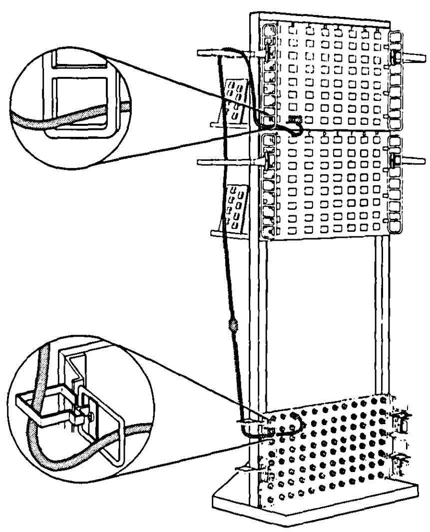
This appendix tells how to route coaxial balun assemblies, dual purpose connector attachment cables, Y assemblies, and patch cables on the distribution rack. See "Installing Cables in a Rack-Mounted LWC" in Appendix C for information on how to route patch cable from the distribution panel to a rack-mounted loop wiring concentrator.

Cable Management

The following sections tell how to route specific types of cable on the distribution rack. Following these instructions will minimize cable congestion and make it easier to trace cable connections later on. Read through the instructions before the installation begins. Remember to keep all cables off the floor.

Routing Coaxial Balun Assemblies

Follow the instructions when installing red, yellow, or cableless coaxial balun assemblies. Make sure the coaxial jumper cable has been connected to the cableless baluns.



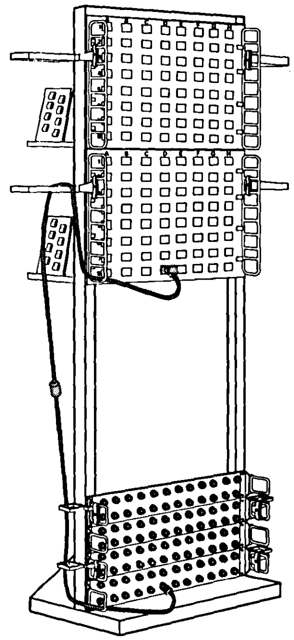
1. Before connecting the balun assembly, identify the locations that each end of the cable will be connected to. (Balun assemblies may be routed from the distribution panel to a patch panel or 3299 Terminal Multiplexer. The 3299 Terminal Multiplexer should be installed in an IBM 3299 mounting shelf.) The locations should have been recorded on the System Configuration Worksheets.

2. Connect the data connector end of the balun assembly to the correct data connector on the distribution panel.

3. Determine whether the patch cable should be routed to the left or right side of the equipment rack.

   a. If the balun is connected to a location in columns A through D on the distribution panel, route the cable to the left side of the equipment rack.

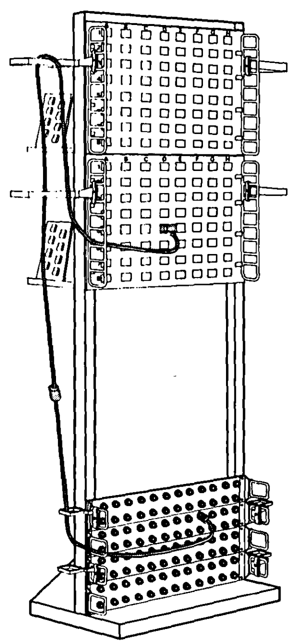
   b. If the balun is connected to a location in columns E through H on the distribution panel, route the cable to the right side of the equipment rack.



4. Route the cable through the wire guide opening adjacent to the row where the data connector is connected.

5. Route the cable through the offset bracket on one or both distribution panels.

   a. If the cable will be routed from the first distribution panel, route the cable through the offset bracket on both the first and the second panels.



   b. If the cable is connected to the second distribution panel and the other end is to be connected to a patch panel or a 3299 that is *mounted low on the rack,* route the cable through the offset bracket on the second distribution panel only.

   c. If the cable is connected to the second distribution panel and the other end is to be connected to a patch panel or a 3299 that is *mounted high in the rack,* route the cable through the offset bracket on the second panel and then through the bracket on the first panel.

6. For patch panel connections, route the cable through the offset bracket and then through the wire guide on the patch panel.

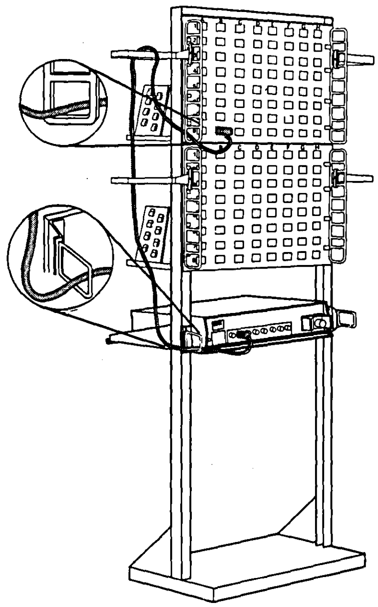
   For 3299 connections, route the cable through the wire guide on the 3299 mounting shelf.

7. Connect the coaxial connector end of the cable to the appropriate connector on the patch panel or to the correct port on the 3299 multiplexer.

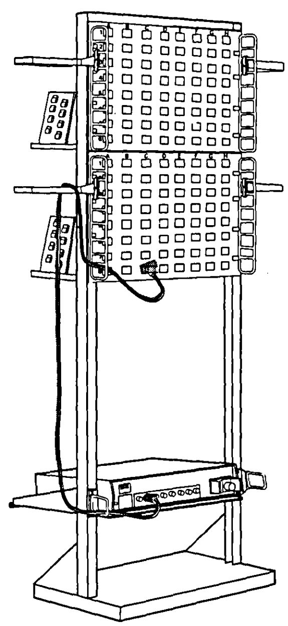
8. To keep the cable dressed neatly in the offset brackets and at the side of the rack, gently pull the loop of the cable.

9. Check both ends of the cable to make sure the connections are secure.

Routing Dual Purpose Connector (DPC) Attachment Cables



1. Before connecting the DPC, identify the locations (on the distribution panel and 3299-2 Terminal Multiplexer) that each end of the cable will be connected to. The location should have been recorded on the System Configuration Worksheets.



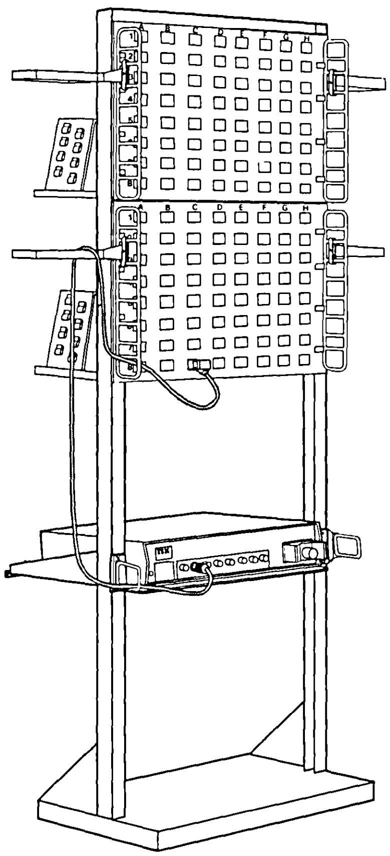
2. Connect the data connector end of the DPC to the correct data connector on the distribution panel.

3. Determine whether the DPC should be routed to the left or right.

   a. If the cable is connected to a location in columns A through D on the distribution panel, route the cable to the left side of the distribution rack.

   b. If the cable is connected to a location in columns E through H on the distribution panel, route the cable to the right side of the distribution rack.

4. Route the cable through the wire guide opening adjacent to the row where the data connector is connected.



5. Route the cable through the offset bracket on one or both distribution panels.

   a. If the cable will be routed from the first distribution panel, route the cable through the offset bracket on both the first and the second panels.

   b. If the cable is connected to the second distribution panel and the other end is to be connected to a 3299-2 that is *mounted low in the rack,* route the cable through the offset bracket on the second distribution panel only.

   c. If the cable is connected to the second distribution panel and the other end is to be connected to a 3299-2 that is *mounted high in the rack,* route the cable through the offset bracket on the second distribution panel and then through the bracket on the second panel.

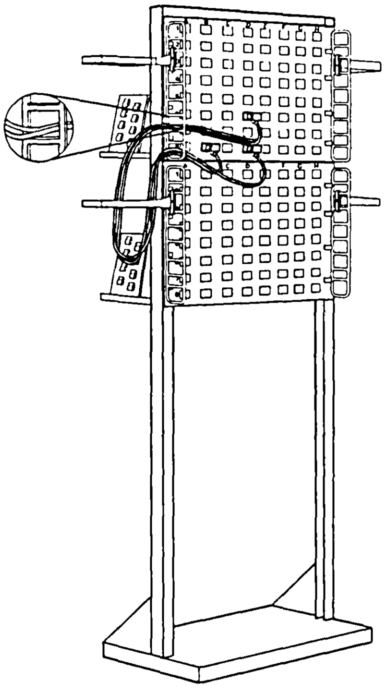
6. Route the cable through the wire guide on the 3299 mounting shelf.

7. Connect the coaxial connector end of the cable to the correct port on the 3299-2 Terminal Multiplexer.

8. To keep the cable dressed neatly in the offset brackets and at the sides of the rack, gently pull the loop of the cable.

9. Check both ends of the cable to make sure the connections are secure.

Routing Y Assemblies



1. Before connecting the Y assembly, identify the locations on the distribution panel that each end of the cable will be connected to. The locations should have been recorded on the System Configuration Worksheets.

2. Connect the junction data connector of the Y assembly to the correct data connectors on the distribution panel.

3. Route the Y assembly to the nearest side of the distribution panel. Cables connected to columns A through D should be routed to the left of the panel. Route cables connected to columns E through H to the right side.

4. Route the cables through the wire guide opening adjacent to the row where the junction data connector is connected.

5. Route the cable through the nearest offset bracket as shown.

6. Before connecting the data connectors on the red and blue legs of the Y assembly, route each leg through the wire guide opening adjacent to the row where the data connector will be connected.

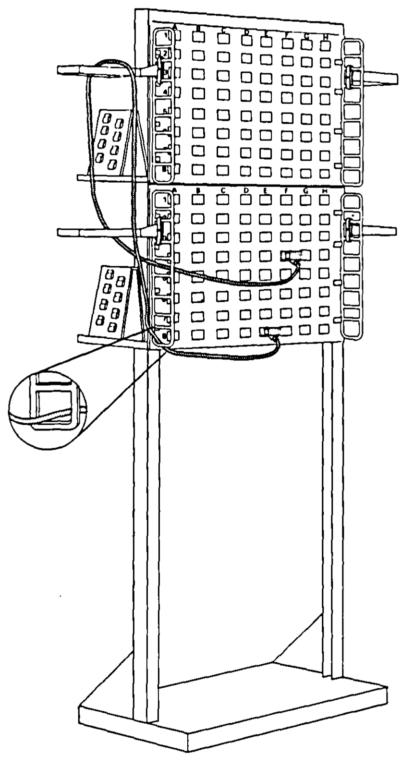
7. Connect the data connectors on the red and blue legs to the correct data connectors on the distribution panel.

8. To keep the cable dressed neatly in the offset brackets and at the sides of the rack, gently pull the loop of the cable.

9. Check both ends of the cable to make sure the connections are secure.

Routing Patch Cables on the Distribution Panel

This section tells how to route patch cables from point to point on the distribution panel. See "Installing Cables in a Rack-Mounted LWC" in Appendix C for information on how to route patch cables from the distribution panel to a loop wiring concentrator.



1. Before connecting the patch cable, identify the locations on the distribution panel that each end of the cable will be connected to. The locations should have been recorded on the System Configuration Worksheets.

2. Connect one of the patch cable data connectors to the correct data connector on the distribution panel.

3. Route the patch cable to the nearest side of the distribution panel. Cables connected to columns A through D should be to the left of the panel. Route cables connected to columns E through H to the right side.

4. Route the cable through the wire guide opening adjacent to the row where the first data connector of the cable is connected.

5. Route the cable through the offset bracket on the distribution panel where the cable is connected and then through the offset bracket on the other distribution panel.

6. Route the cable through the wire guide opening adjacent to the row where the second data connector of the cable is to be connected.

7. Connect the other end of the cable to the distribution panel.

8. To keep the cable dressed neatly in the offset brackets and at the side of the rack, gently pull the loop of the cable.

9. Check both ends of the cable to make sure the connections are secure.

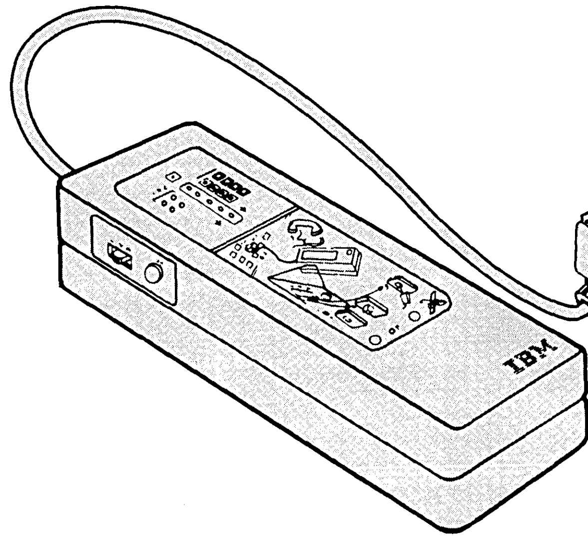
Appendix E. How to Use the IBM Cabling System Tester

This appendix describes the IBM Cabling System Tester and tells you how to:

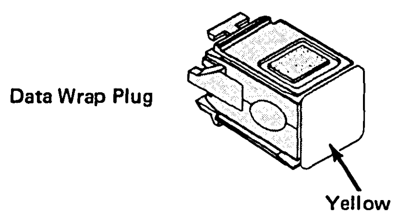
- Test the tester
- Replace the batteries
- Interpret the red light indicators.

IBM Cabling System Tester

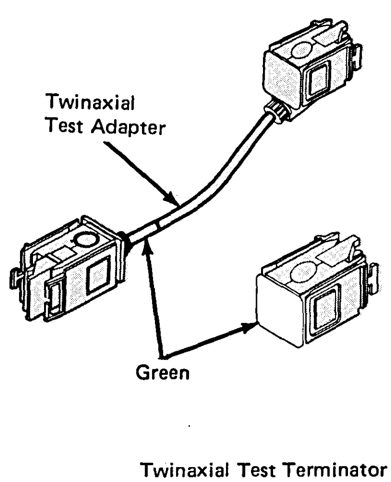
The IBM tester detects faults in copper data wiring by measuring continuity in the IBM Cabling System.



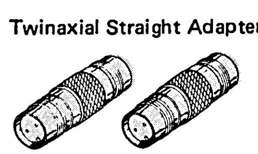
Accessories



Data wrap plug (part number 4760507). Included in the tester kit (part number 4760500).



Twinaxial test accessories kit (part number 6339087). Includes twinaxial test adapter, twinaxial test terminator and two twinaxial straight adapters.

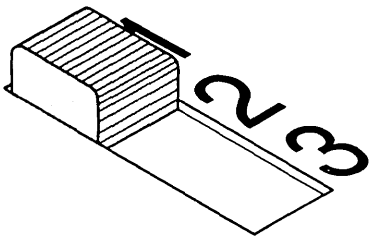


Features

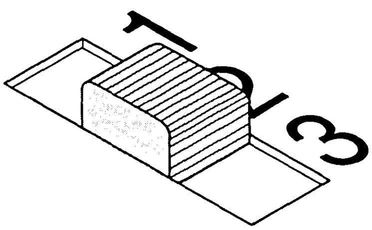
The IBM tester has an on-off push button, mode switch with three test mode settings, and six indicator lights.

Mode Switch Positions

- Positions 1 and 2 are for the data cable test.



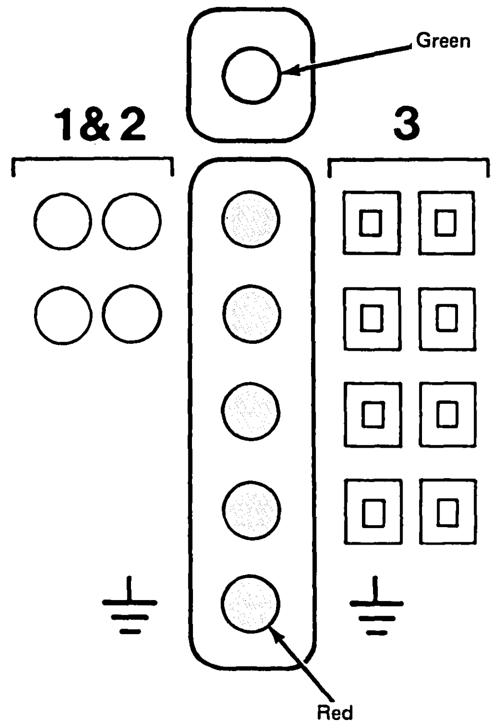
- Position 1 checks for a short circuit of the shield to any of the data conductors, and breaks in the data conductors. It also checks for connector assembly errors and tests the operation of the data connector shorting bars at the other end of the cable. The data cable test is not complete until the test in position 2 is performed.



- Position 2 checks for certain conditions that position 1 can't. These conditions are swaps and short circuits between the red and orange and the green and black pairs, and an open shield. The data wrap plug connects a known resistance between the data conductors and between one data conductor and the shield, allowing the tester to check for these conditions.

Indicator Lights

- The green light indicates that is no fault. The red lights indicate which conductors are most likely the cause of a fault. The label is color-coded to match the conductors with the fault. The left side of the label indicates the color-coding for the data conductors.

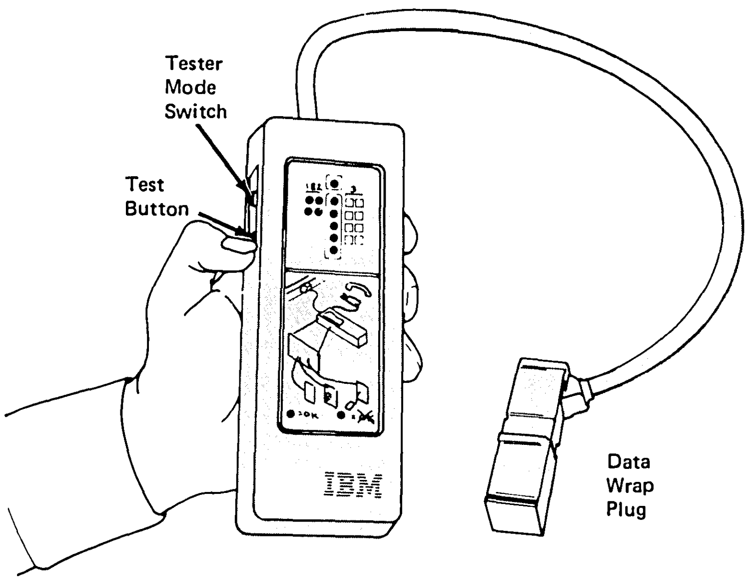


Testing the Tester

1. **Testing the red lights.**

   Set the tester mode switch to *position 3*, connect the data wrap plug to the tester, and press the test button. If the red lights are working correctly, all five will come on.

   Note: The red lights can come on, even if the batteries are too low for operation, or if one battery is installed backwards. Continue with either of the next two steps to make sure the batteries are good.



2. **Testing the data section.**

   Set the tester mode switch to *position 2*, connect the data wrap plug to the tester, and press the test button. If the data section is working correctly, the green light will come on.

3. **Determining if the tester is good.**

   If the tester worked correctly at steps 1 and 2, it is ready to test data cable. Go to the next step only if the tester failed to work correctly.

4. **Determining the problem.**

   If the tester failed any of the above tests, the problem is one or more of the following (in order of likelihood):

   - *Discharged batteries.* See "Replacing the Tester Batteries" later in this appendix.

   - *Broken wrap plug.* Replace with a new one.

   - *Broken data connector on the tester.* Repair or replace the connector. See "Data Connector Disassembly Procedure" and "Data Connector Installation" in Chapter 8 of the *IBM Cabling System Planning and Installation Guide.* If a new connector is used, remove the shorting bars before you assemble it.

   - *Broken tester.* Replace it and test the new one with this procedure.

Replacing the Tester Batteries

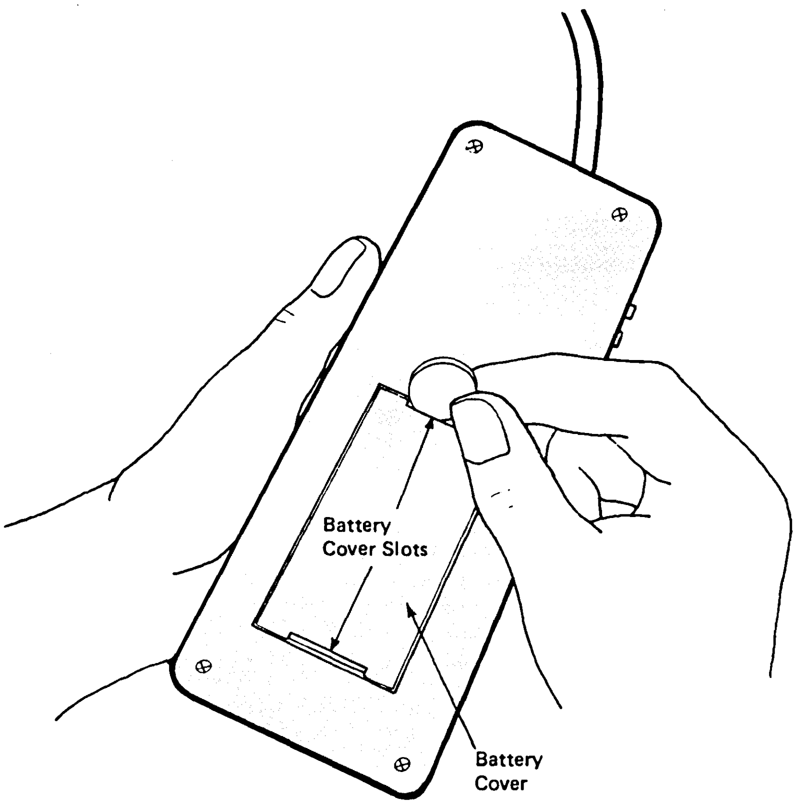
To replace the tester batteries, use the following procedure. Always use four new type AA batteries.

1. Disconnect the tester from all external circuits.

2. Lay the tester on the table, face down.

3. Insert a coin or small screwdriver in either battery cover slot.

4. Wedge the battery cover up.



5. Remove the four batteries from the battery compartment.

6. Install four new batteries in the compartment.

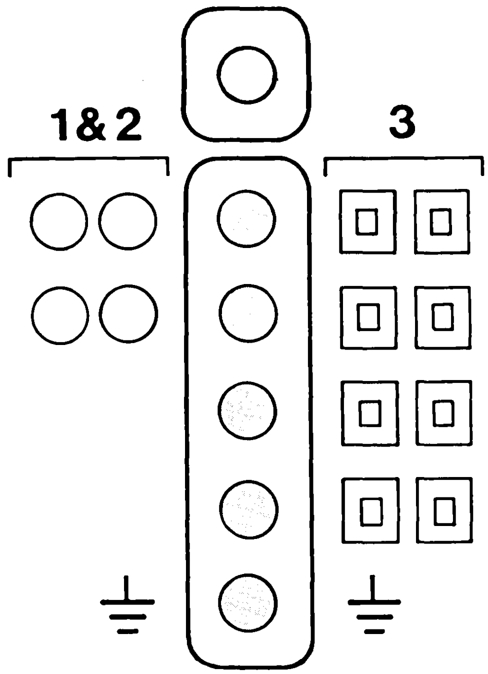
   Note: Observe the battery polarity (+ -) markings on the tester when inserting the batteries. If the batteries are installed incorrectly, they will discharge prematurely and the tester will not function properly.

7. Replace the battery cover and press it firmly in place.

8. Test the tester by following the procedure under "Testing the Tester."

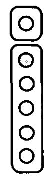
Red Light Descriptions

The red lights indicate which conductors are most likely the cause of a fault. The label is color-coded to match the conductors with the fault. The left side of the label indicates the color-coding for the data conductors.

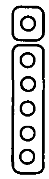


This chart describes the most likely cause of the red lights.

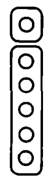
Data test with mode switch in position 1.



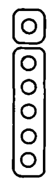
Break in the red or orange wire. Red/orange shorting bar not working.



Break in the green or black wire. Green/black shorting bar not working.



Shield shorted to one or more of the data wires.

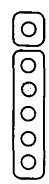


Short circuit between or swap of one or more of these pairs:
-red and green
-red and black
-orange and green
-orange and black.

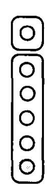
Data test with mode switch in position 2, *using the data wrap plug.*

Note: Use these results only after getting a green light with the tester mode switch in position 1.

Short circuit between or swap of the red and orange wires.



Short circuit between or swap of the green and black wires.



Shield open

Appendix F. Making Data Wire Test Cables and Store Loop Attachment Assemblies

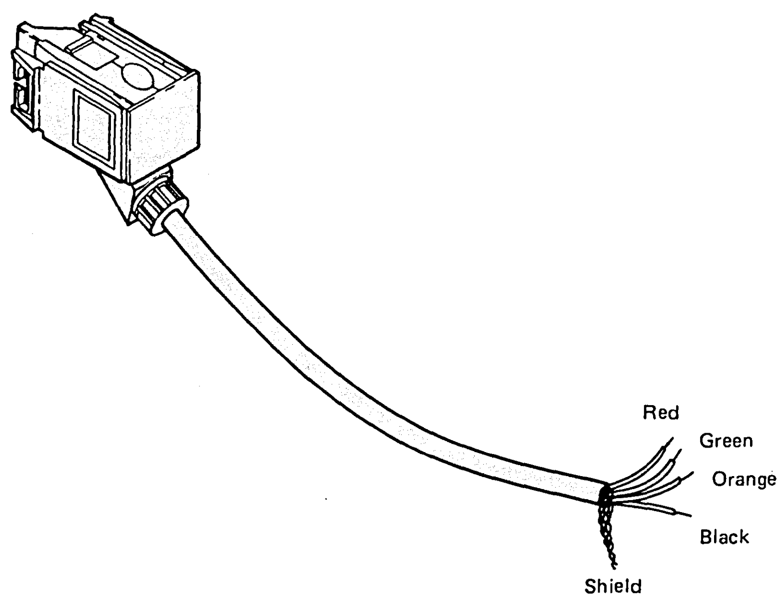
This appendix tells you how to:

- Make a data wire test cable
- Make a store loop attachment assembly.

Making a Data Wire Test Cable

Testing data cable with an ohmmeter requires a cable with a data connector on one end and bare wires on the other end. You can either use the IBM General Purpose Attachment Cable (part number 8310554), or you can make your own by following this procedure.

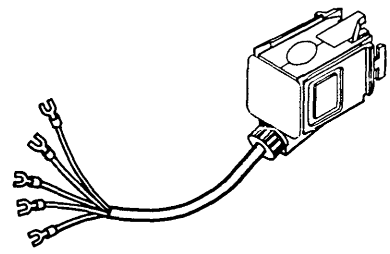
1. Cut an 8-foot patch cable in half.
2. Strip off about 200 mm (8 in.) of the cable outer jacket.
3. Carefully cut the exposed shield along the cable and twist it into a strand of wire.
4. Remove the foil and plastic wrap around the data wires.
5. Strip 25 mm (1 in.) of insulation from each of the four data wires. These wires are for attaching the ohmmeter test leads.



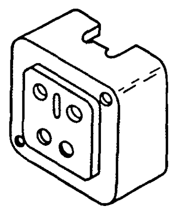
Making Store Loop Attachment Cables

A store loop attachment cable can be made using the following components:

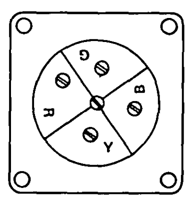
- General Purpose Attachment Cable, part number 8310554



- WE type-404B receptacle, or equivalent.



Connect the wires of the attachment cable to the type-404B receptacle as shown:



(Rear View)
WE Type — 404B Receptacle

Appendix G. Testing Data Cable

This appendix tells you how to:

- Test data cable with an IBM Cabling System Tester
- Test data cable with an ohmmeter.

Testing Data Cable with the IBM Cabling System Tester

This test requires the IBM Cabling System Tester and a data wrap plug, both included in the tester kit (part number 4760500).

1. Disconnect any devices or accessories (except patch cables and surge suppressors) from the ends of the data cable you are going to test.

2. Connect the tester to one end of the data cable.

3. Set the tester mode switch to position 1.

4. Press the test button:

   a. If the green light comes on, continue with step 5.

   b. If any red lights come on, the data cable you are testing is defective. Write down the cable identification label or mark the defective cable. Go to step 10.

5. Connect the tester to the other end of the data cable you are testing. (This test is repeated at both ends of the data cable to check the shorting bars in both connectors.)

6. Press the test button:

   a. If the green light comes on, continue with step 7.

   b. If any red lights come on, the data cable you are testing is defective. Write down the cable identification label or mark the defective cable. Go to step 10.

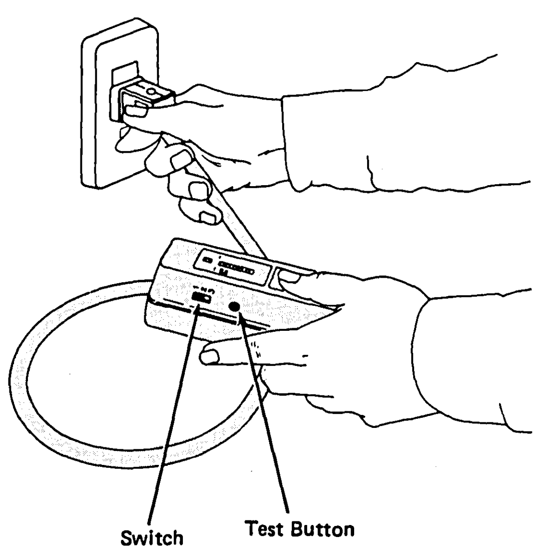


Figure G-1. Testing Data Cable with the IBM Cabling System Tester

7. With the tester still connected to one end, connect the data wrap plug to the other end of the data cable you are testing.

8. Set the tester mode switch to position 2.

9. Press the test button:

   a. If the green light comes on, the data cable you are testing is defect free. Continue with step 10.

   b. If any red lights come on, the data cable you are testing is defective. Write down the cable identification label or mark the defective cable. Continue with step 10.

10. Disconnect the tester and the data wrap plug, if it is being used. Reconnect anything that was disconnected in step 1.

11. Return to the procedure that brought you here.

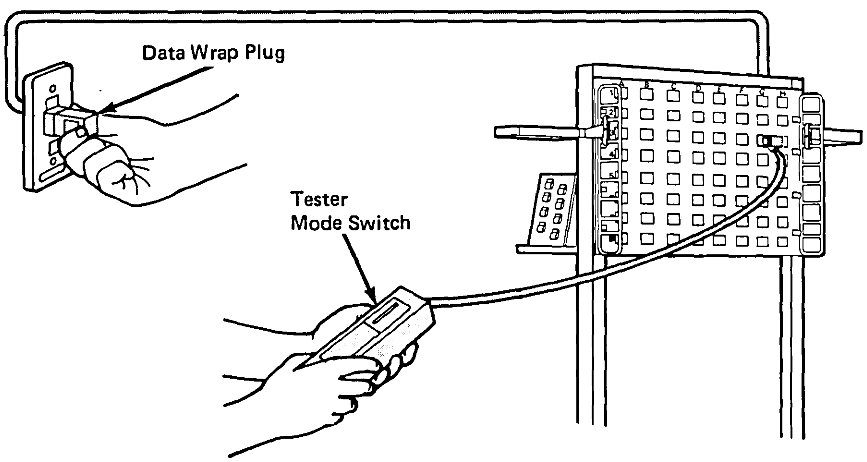


Figure G-2. Testing Data Cable with the IBM Cabling System Tester and the Data Wrap Plug

Testing Data Cable with an Ohmmeter

This procedure requires the use of an ohmmeter and two data wire test cables. Use the General Purpose Attachment Cable (part number 8310554) or see "Making a Data Wire Test Cable" in Appendix F.

1. See Figure G-3 and connect the first data wire test cable to one end of the data cable being tested. Make sure no device or control unit is connected to the other end of the data cable.

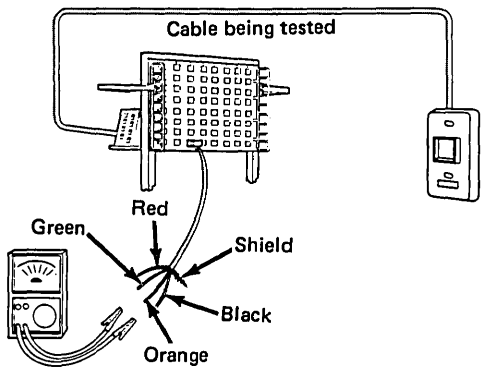


Figure G-3. Testing Data Cable with an Ohmmeter and One Data Wire Test Cable

2. Using an ohmmeter, check for continuity between the following data wires. See Figure 12-55 for a table of maximum allowable resistances for cables of various lengths.

   - Red and orange
   - Green and black.

   a. If you get the desired result in each case, continue with step 3.
   b. If you do not, the data cable is defective. Write down the cable identification label or mark the defective cable. Go to step 9.

3. Using an ohmmeter, check for an open between the following data wires:

   - Red and green
   - Red and shield
   - Orange and black
   - Green and shield.

   a. If you get the desired result in each case, continue with step 4.
   b. If you do not, the data cable is defective. Write down the cable identification label or mark the defective cable. Go to step 9.

4. Connect the *second* data wire test cable to the other end of the data cable you are testing.

5. Using an ohmmeter, check for an open between the following data wires in the second data wire test cable:

   - Red and orange
   - Green and black.

   a. If you get the desired result in each case, continue with step 6.

   b. If you do not, the data cable is defective. Write down the cable identification label or mark the defective cable. Go to step 9.

6. See Figure G-4 and twist or tape together the following wires of the second data wire test cable:

   - Red and shield
   - Orange and black.

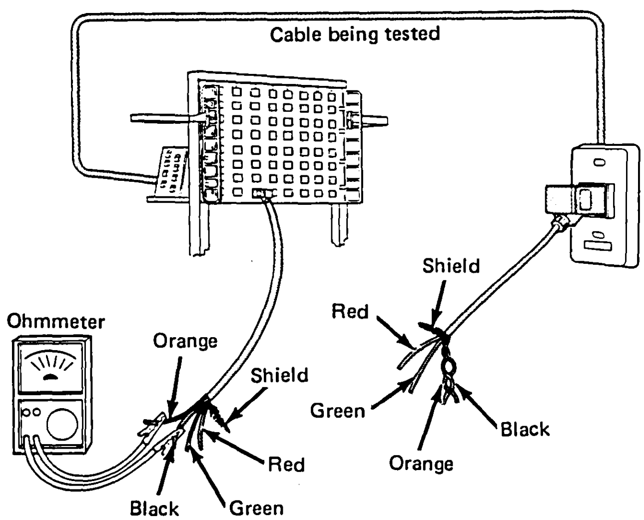


Figure G-4. Testing Data Cable with an Ohmmeter and Two Data Wire Test Cables

6. Using an ohmmeter at the *first* data wire test cable, check for continuity between the following data wires:

   - Red and shield
   - Orange and black.

   a. If you get the desired result in each case, continue with step 7.

   b. If you do not, the data cable is defective. Write down the cable identification label or mark the defective cable. Go to step 9.

7. Disconnect the first data wire test cable.

8. Untwist the wires at the *second* data wire test cable and use an ohmmeter to check for continuity between the following data wires:

   - Red and orange
   - Green and black.

   a. If you get the desired results, the data cable is not defective. Continue with step 9.

   b. If you do not, the data cable is defective. Write down the cable identification label or mark the defective cable. Continue with step 9.

9. Disconnect the data wire test cable.

10. Return to the procedure that brought you here.

Appendix H. Grounding Requirements for the Cabling System

This appendix describes cable separation from electromagnetic sources and radio frequency interference. It also tells you how to measure ground potential difference.

Cable Separation from Electromagnetic Sources

Normal sources of electromagnetic fields are usually not a problem. However, as a precautionary measure, install the cable (except type 5) as far as possible from such sources, and never closer than 1 meter (3.3 feet). Also, interference can result when the cable (except type 5) is installed near a radio frequency source such as:

- Radio transmitting equipment (antennas, transmission lines, transmitters, and other radiating elements)
- A radar installation
- Some industrial machines (such as radio frequency induction heaters, radio frequency arc welders, and insulation testers).

Radio Frequency Interference

For the *United States*, the FCC statement on the inside front cover of this manual applies to the cabling system.

For the *European Community* countries, the following statement applies to the cabling system:

- This product was produced to conform to the requirements of EEC Directive No. 76/889 related to the control of Radio Frequency Interference.

Measuring Ground Potential Difference

Between Wiring Closets

Two data wire test cables are needed for this procedure. See "Making a Data Wire Test Cable" in Appendix F.

Do the following to make sure that the difference in ground potential between wiring closets is acceptable:

1. Connect the red data wire to the shield on one data wire test cable. This *shorted cable* is used in one wiring closet and the other cable is used as the *measurement cable.*

2. Locate a data cable that connects the two wiring closets and make note of its cable number.

3. Connect the *shorted cable* to one end of this data cable and the *measurement cable* to the other end.

4. Connect the voltmeter to the red data wire and the shield of the *measurement cable.*

5. If you measure more than 1.0 volt AC, contact the responsible party. See "Ground Potential Difference" in Chapter 3 of the *IBM Cabling System Planning and Installation Guide* and have the condition corrected. Continue only after the voltage measures less than 1.0 volt AC.

6. If more than two wiring closets are connected to the network, repeat this procedure using one of the previously tested wiring closets and one that hasn't been tested.

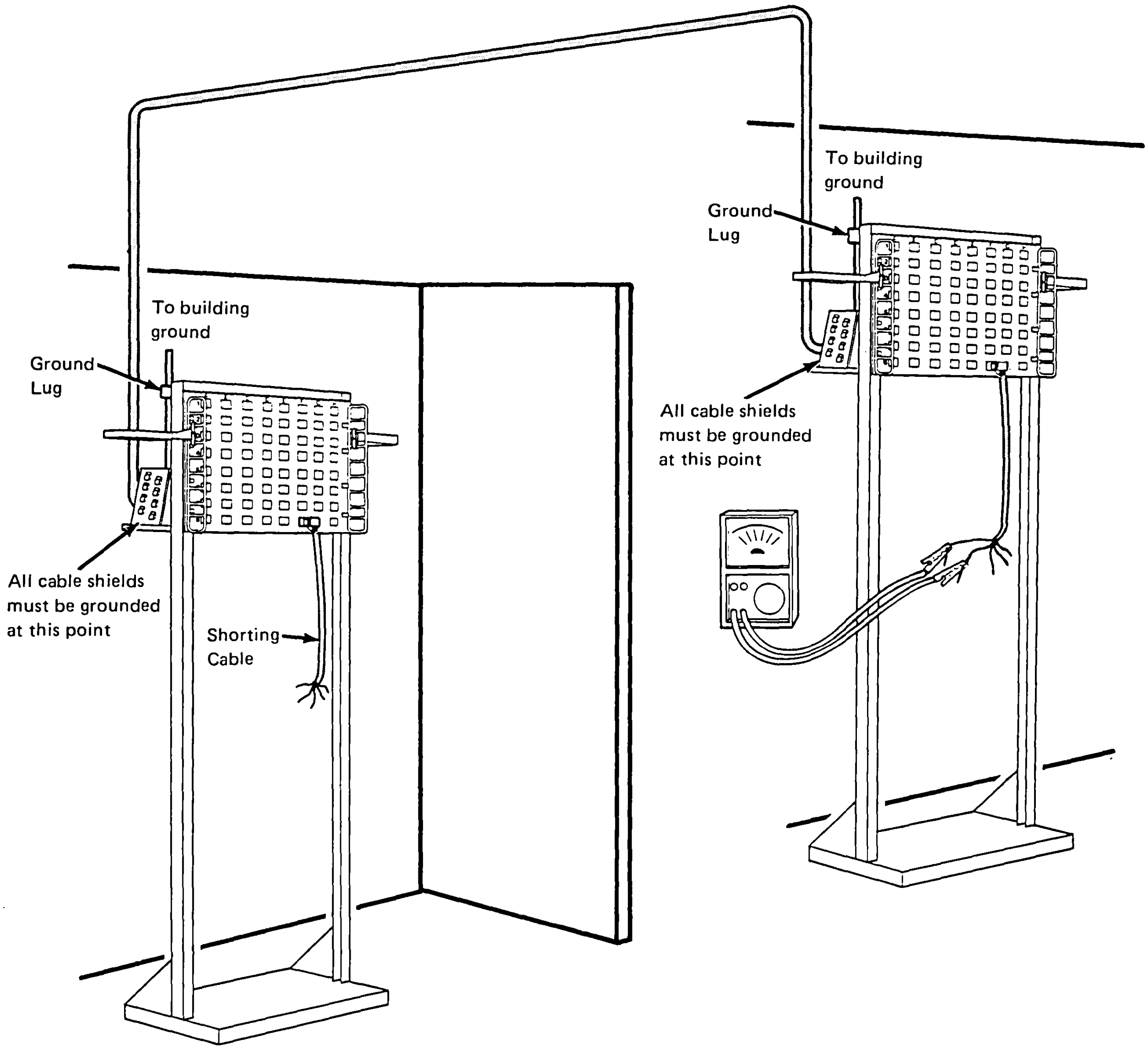


Figure H-1. Measuring Ground Potential between Wiring Closets

Between the Wiring Closet and Wall Outlets

DANGER
Be careful when measuring from the equipment grounding terminal of the power receptacle. The voltage present at the receptacle is hazardous.

Do the ground potential difference measurements between wiring closets before this test. You need a data wire test cable for this procedure. See "Making a Data Wire Test Cable" Appendix F.

Do the following to make sure the ground potential difference and ground path resistance between wiring closets and wall outlets is acceptable:

1. Connect the data wire test cable to the work area data connector.

2. Measure the voltage between the data wire test cable shield and the equipment grounding terminal of the AC power receptacle. Make sure the power receptacle is the same one that the data equipment uses.

3. If you measure more than 1.0 volt AC, contact the responsible party and have the condition corrected. (See "Cable Separation" in Chapter 3 of the *IBM Cabling System Planning and Installation Guide* and "Cable Separation from Electromagnetic Sources" in Appendix H of this manual.) Continue with the next step only after the voltage measures less than 1.0 volt AC.

4. Measure the resistance between the data wire test cable shield and the equipment grounding terminal of the AC power receptacle.

5. If you measured more than 3.5 ohms, contact the responsible party and have the condition corrected. Continue only after the resistance measures less than 3.5 ohms.

6. Repeat this procedure at all other wall outlets.

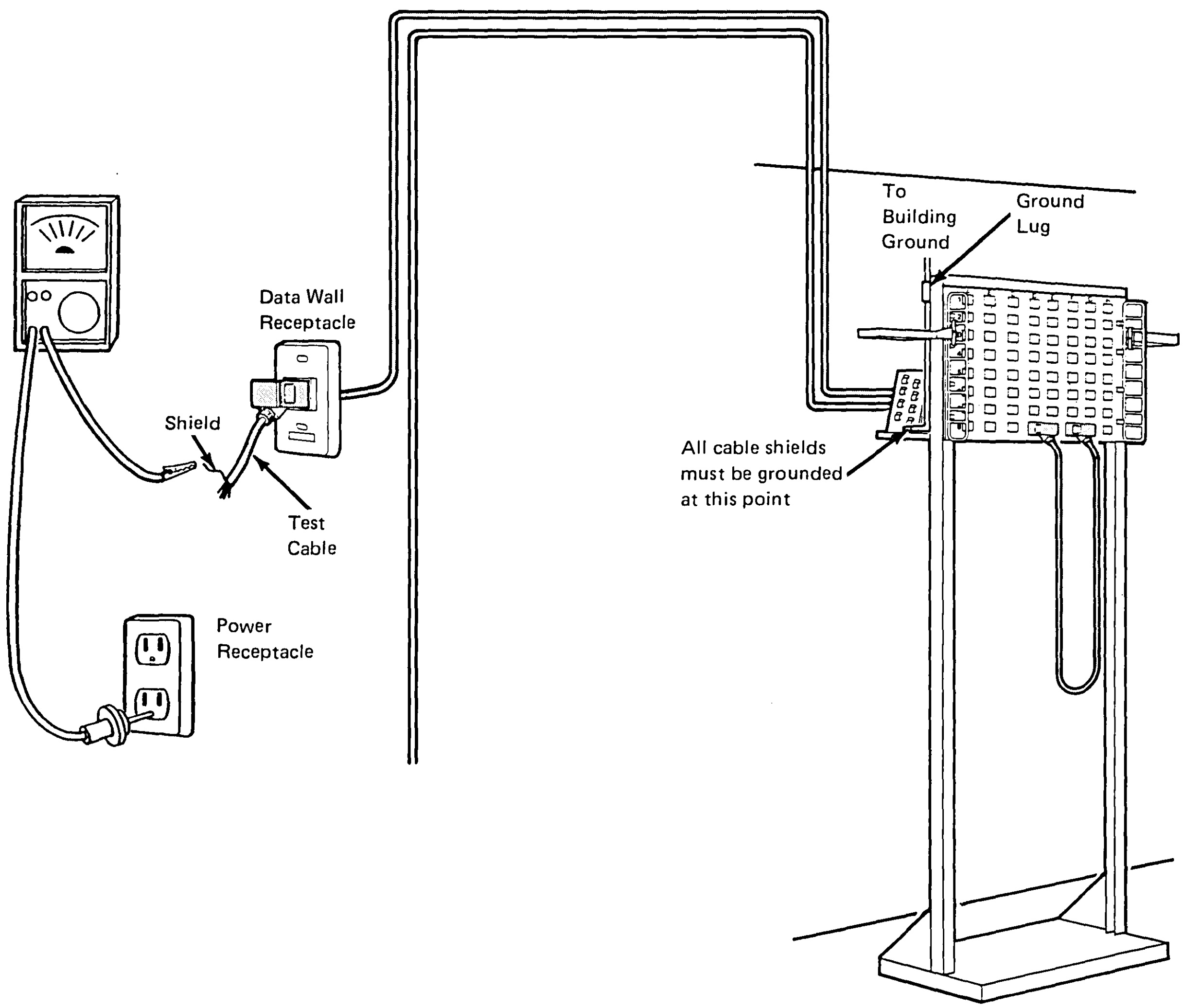
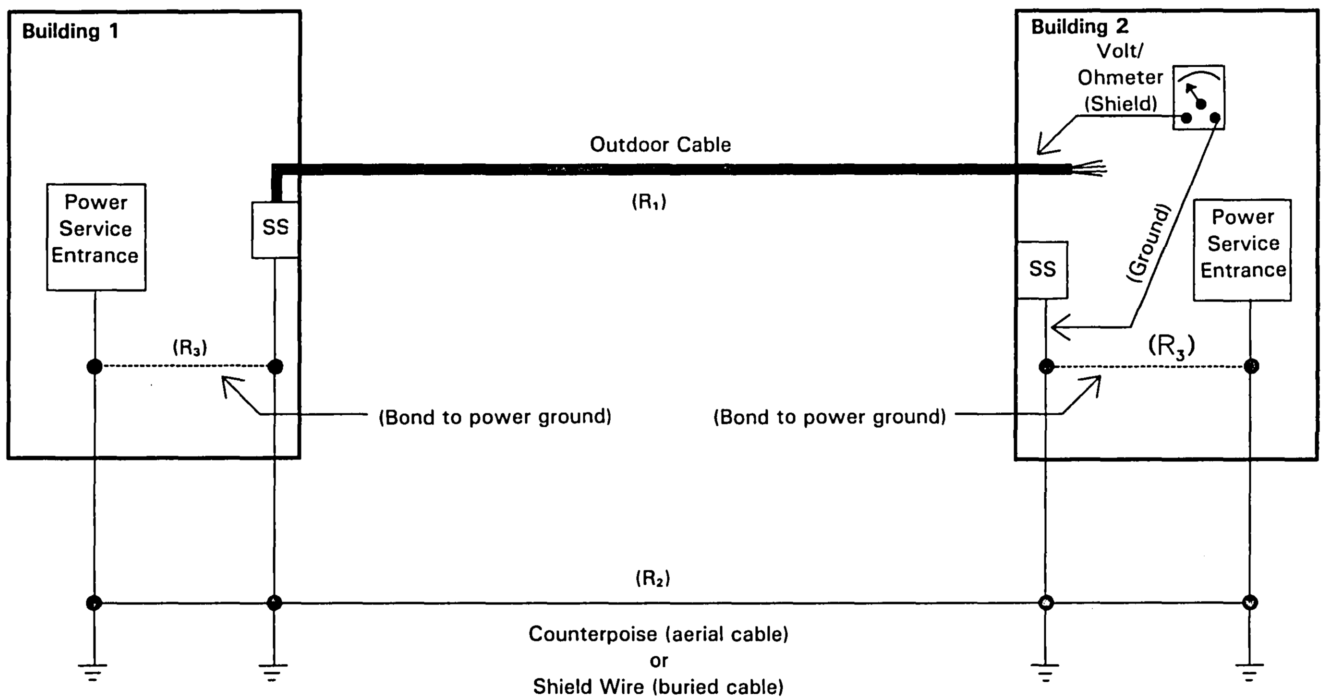


Figure H-2. Measuring Ground Path Resistance between Data Connector Ground and Power Receptacle Ground.

Ground Potential Difference and Ground Path Resistance Measurement

1. Ensure that the surge suppressor in building No. 1 is grounded and has all cables attached. Ground the surge suppressor in building No. 2, if it has not been grounded, but do not attach any cables yet.

2. In building No. 2, measure the voltage between the incoming outdoor cable shield and the surge suppressor ground terminal. (See Figure H-3.) The voltage must be no greater than that shown on the chart in Figure H-4. If the voltage is greater, contact the responsible party to have the condition corrected before doing step 3.



Total resistance is the sum of the resistances of individual segments of the path, or:

$R_T = R_1 + R_2 + 2(R_3)$

Where:

R_T = Total Resistance

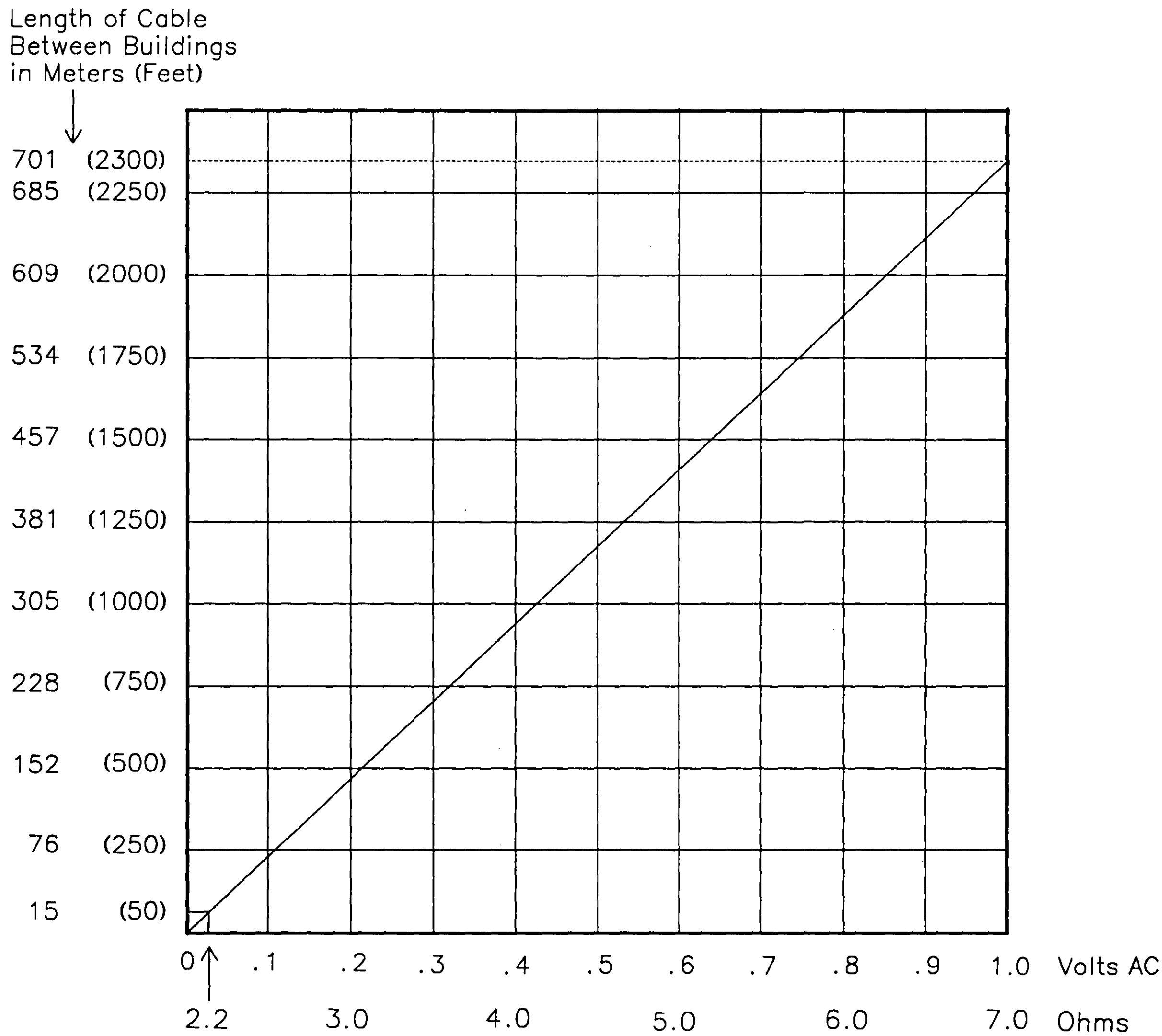
R_1 = Outdoor cable shield resistance (1.75 ohms/305m[1000ft])

R_2 = Counterpoise or shield wire resistance (0.4ohm/305m[1000ft]) - (appx. for 4-mm[#6AWG])

R_3 = Surge Suppressor ground to power ground resistance (less than or equal to 1 ohm)

Total resistance should not exceed that shown in Figure H-4 for the length of the run.

Figure H-3. Surge Suppressor Path/Ground Potential Difference Measurement



Note:
Potential Not to exceed 1.0 Volt AC
Current Not to Exceed 1.0 Amp
Resistance Not to Exceed 7.0 Ohms

Figure H-4. Voltage, Resistance, and Current Measurements

3. Measure the resistance between the cable shield and the surge suppressor ground. The resistance must be no greater than that shown on the chart in Figure H-4.

   a. If it is greater, measure the individual segments of the grounding system to determine which one is at fault.

      To measure the outdoor shield resistance, proceed as follows:

      1) Measure the resistance formed by a loop of two of the outdoor cable data wires. Record the result.

      2) Measure the resistance formed by a loop of the shield and one of the data wires. Record the result.

      3) Subtract half of the resistance recorded in step 3a1 from the resistance recorded in step 3a2.

      4) Multiply the length of the cable in feet by 0.00175 and record the result.

      5) The shield resistance determined in step 3a3 must be less than the result in step 3a4.

         You may need to select another ground point, or install a bond between grounds. Figure H-3 shows a typical grounding scheme and resistance values for components of the measurement path. If you do anything to correct the problem, go back and measure the voltage again as described in step 2.

   b. If resistance and voltage values are acceptable, continue with step {14}.

4. Connect the outdoor cable shield to the surge suppressor in building No. 2. Measure the current on the grounding lead for the surge suppressor. The current should be 1.0 amp or less if the measurements in steps 2 and 3 were acceptable.

   a. If the current is greater than 1.0 amp, go back to step 2 and measure the voltage and resistance again and correct the condition.

   b. If voltage, resistance, and current values are acceptable, record the measurements on a tag or sticker and attach to the outdoor cable close to the surge suppressor.

5. Finish connecting the outdoor and indoor cables to the surge suppressor in building No. 2.

6. Do the ground potential difference measurement between the wiring closets in building No. 1 and No. 2, as described in "Measuring Ground Potential" in Appendix G.

Appendix I. Accessory Dimensions and Weights

RACK-MOUNTED

	Height	Width	Depth	Weight
Coaxial Patch Panel millimeters inches	88.9 (3.5)	482.6 (19)	127 (5)	1.59 kilograms 3.5 pounds
LWC millimeters inches	66.80 (2.63)	482.6 (19)	107.95 (4.25)	0.79 kilograms 1.75 pounds
8218 Copper Repeater millimeters inches	154.0 (6.06)	55.6 (2.19)	279.4 (11)	1.8 kilograms 4 pounds
8219 Optical Fiber Repeater millimeters inches	154 (6.06)	55.6 (2.19)	279.4 (11)	1.8 kilograms 4 pounds
Surface Mounting Brackets millimeters inches	154.6 (6.1)	157.2 (6.2)	51 (2)	0.45 kilograms 1 pounds
Rack Mounting Assembly millimeters inches	177.8 (7)	482.6 (19)	279.4 (11)	5.44 kilograms 12 pounds

List of Abbreviations

AWG	American wire gauge
bps	bits per second
C	Celsius
dBm	decibel based on one milliwatt
DCA	device cluster adapter
DPC	dual purpose connector
EEC	European Economic Community
F	Fahrenheit
FCC	Federal Communication Commission
ft	foot (or feet)
in.	inch (or inches)
kbps	kilo (1000) bits per second
kg	kilogram (or kilograms)
kHz	kilohertz
lb	pound (or pounds)
LCC	local communication controller (used only by Series/1)
LDC	local device controller (used only by 5520 Administrative System)
LSC	loop station connector
LWC	loop wiring concentrator
MCL	Multiuse Communication Loop
MHz	megahertz
MFA	multi-function attachment (used only by Series/1)
m	meter (or meters)
mm	millimeter (or millimeters)
NEC	National Electrical Code
PN	part number
UL	Underwriters Laboratory Inc.
WE	Western Electric

Glossary

This glossary includes terms and definitions from the *IBM Vocabulary for Data Processing, Telecommunications, and Office Systems* manual, GC20-1699.

accessory. An IBM designation for a separately orderable part that (1) has no type number, (2) is for purchase only, and (3) does not receive normal IBM maintenance.

attenuation. A decrease in magnitude of current, voltage, or power of a signal in transmission between points.

balun. A transformer for connecting balanced (for instance, twisted-pair) cables to unbalanced (for instance, coaxial) cable by matching the electrical characteristics of the cables.

cable-thru. The capability of the 5250 Information Display System that allows multiple work stations to be attached to a single cable path. Cable-thru was a special feature on some early model 5250 work stations and printers. Cable-thru is standard on current model 5250 products.

coaxial cable. A cable consisting of one inner conductor within and insulated from an external shield.

controller. A unit that controls input/output operations for one or more devices.

device. An input/output unit such as a terminal, display, or printer.

drop. A cable that leads from a faceplate to the distribution panel in a wiring closet.

fault. An unintentional low-resistance connection between two or more conductors, or an open or broken conductor.

input device. A device in a data processing system by which data may be entered into the system.

lobe. In the Multiuse Communication Loop, one of two separately driven sections of a loop. In the Local Area Network, the section of cable that attaches a device to a wiring concentrator.

local device controller (LDC) line. In the 5520 Administrative System, the twinaxial cable to which printers and/or another IBM 5520 can be connected.

loop. A closed unidirectional signal path connecting input/output devices to the system.

network. The assembly of equipment through which connections are made between data stations.

output device. A device in a data processing system by which data may be received from the system.

plenum cable. A cable that is UL listed as having adequate fire resistance and low smoke producing characteristics for installation without conduit in ducts, plenums, and other spaces used for environmental air, as permitted by NEC Articles 725-2(b) and 800-3(d).

port. (1) An entrance to or exit from a network. (2) An access point for data entry or exit.

qualified person. A person who is authorized to perform a given operation and who by reason of experience or training is familiar with the operation to be performed and can adequately handle the hazards involved.

ring (network). A network consisting of a series of stations connected by unidirectional transmission links to form a closed path.

star. A wiring arrangement in which an individual cable runs from each work area to a concentration point.

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.

twinaxial cable. A shielded cable with two conductors that are within a conductor of larger size and are insulated from both it and from one another.

work area. In this manual, an area in which terminal devices (such as displays, keyboards, and printers) are located.

work station. An input/output device that allows transmission of data or reception of data as needed to perform a job.

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