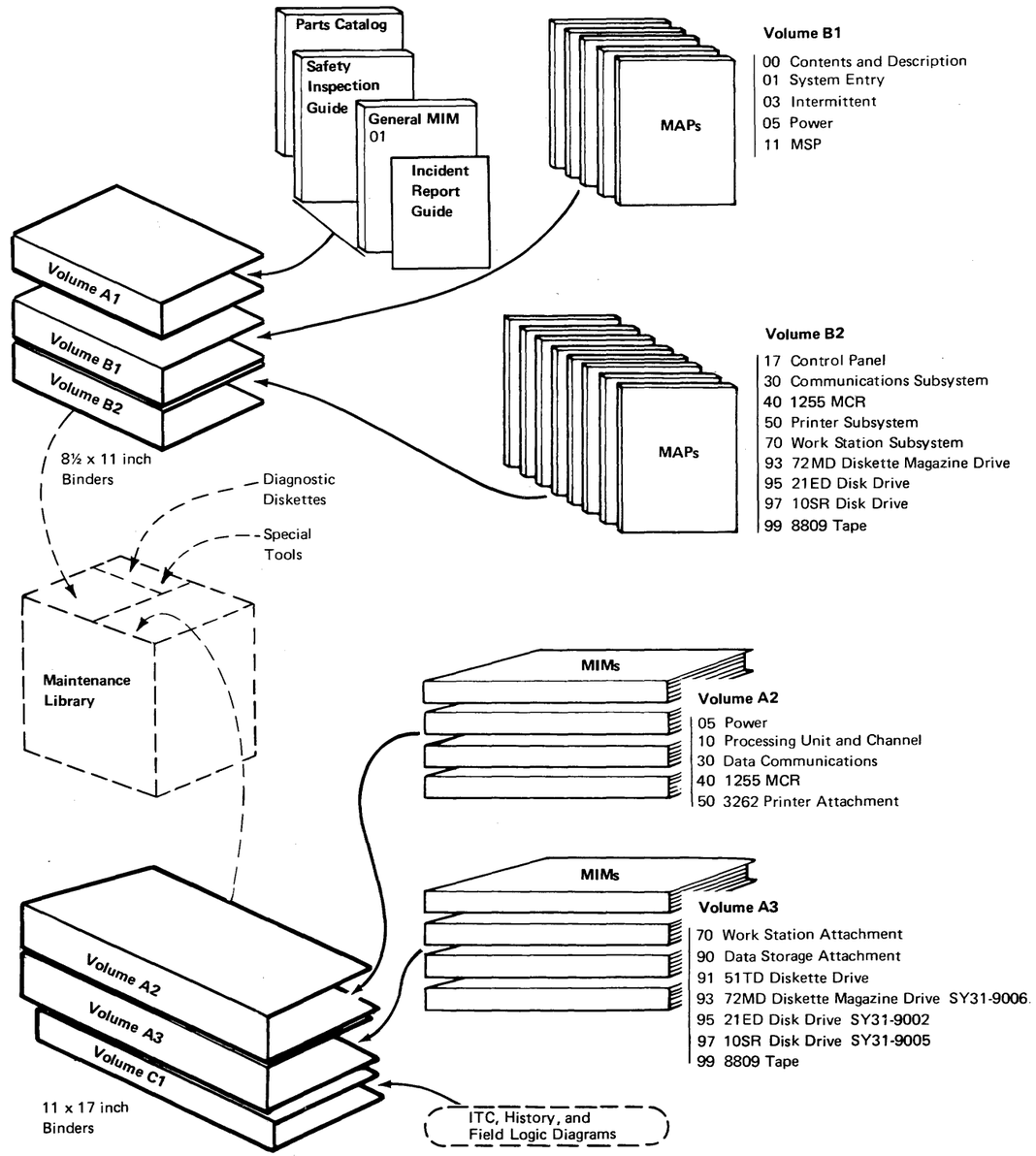
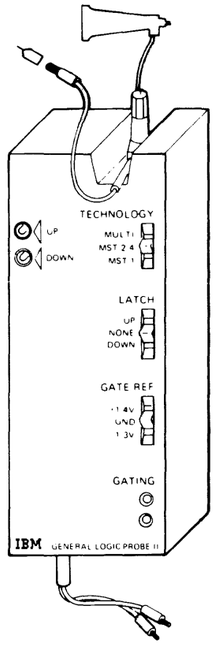
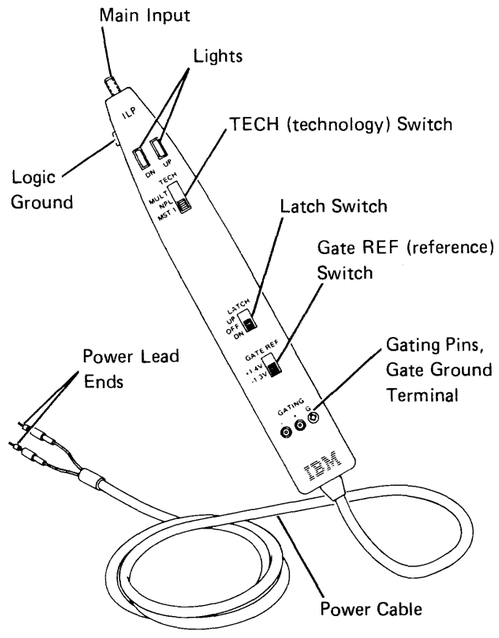


EC 826380			PN 2597079
27MAY83			

General Logic Probe II



Integrated Logic Probe



Logic Probe Power Sources

	POWER (red lead)	GROUND (black lead)
5360 Logic Gate	any D03 pin (card sockets C through T)	any D08 pin
10SR Disk Logic Gate	any D03 pin	any D08 pin

I B M

PUBLICATION DRAWING

PART NUMBER	4177109
DATE	CHANGE NUMBER
26 MARCH 82	838739
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27 MAY 83	826380
15 FEB 84	826487
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TITLE. IBM SYSTEM/36 WORK STATION ATTACHMENT
MAINTENANCE INFORMATION MANUAL

NOTE. ALL ITEMS FOLLOWING THE LAST ROW OF ASTERISKS ARE TO BE SHIPPED.

CHANGE NUMBER	FORM / TNL	DESCRIPTION / COMMENTS
**********	**********	**********
838739	SY31-9004-B	CHECKPOINT 9 DRAFT
**********	**********	**********
838798	SY31-9004-C	CHECKPOINT 11 DRAFT
**********	**********	**********
826380	SY31-9004-0	RELEASE 1, FIRST CUSTOMER SHIP
**********	**********	**********
826487	SY31-9004-1	RELEASE 2, FIRST CUSTOMER SHIP
**********	**********	**********
839954	SY31-9004-2	RELEASE 3, FIRST CUSTOMER SHIP
**********	**********	**********
842350	SY31-9004-3	RELEASE 4, FIRST CUSTOMER SHIP

IBM System/36

IBM System/36
Work Station Attachment
Maintenance Information Manual

Order Number
SY31-9004-3

Section 70

Preface

This manual contains the maintenance information necessary to service the System/36 work station attachment. This manual includes maintenance procedures, FRU descriptions, interface descriptions, and sequence of events sections to aid in diagnosing machine failures not found by the MAPs.

This manual uses a specific range of words so that the text can be understood by customer engineers in countries where English is not the normal language.

It is assumed that the service representative using this manual has been trained on System/36 as described in the System/36-5360 *New Product Planning Technical Service Letter*.

About This Manual

The service procedures in this manual are numbered.

- The MAPs can send you to a specific procedure in this manual.
- Other System/36 MIMs can send you to a specific procedure in this manual.
- Steps in a procedure in this manual can send you to another procedure in this manual or in other System/36 MIMs.
- The index can send you to procedures where key words can be found.

Related Publications

System/36 Hardware Publications

- *General Maintenance Information Manual*, SY31-8999
- *Processing Unit and Channel Maintenance Information Manual*, SY31-9000

Fourth Edition (January 1986)

This major revision makes obsolete SY31-9004-2. Changes and additions were made to reflect technical changes to the product.

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IBM has prepared this maintenance manual for use by hardware service representatives in the maintenance or repair of the specific machines indicated. IBM makes no representations that it is suitable for any other purpose.

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Safety

Danger and Caution Notices

In the System/36 maintenance manuals, the word *DANGER* informs you of conditions that could cause personal injury or death. (The word *HAZARDOUS* or *WARNING* may appear on labels on machines and field-supply items.) The word *CAUTION* informs you of an action that could cause damage to a program, to a device or system, or to data.

Danger Notices

A danger notice appears on page v of this Safety section, under *Electrical Accidents—First Aid*.

Caution Notices

There are no caution notices in this MIM.

Rules for Safety

If you know the safety rules for working with electrical and mechanical equipment and you observe the rules, you can work safely with IBM equipment.

Do not fear electricity, but respect it.

While you are maintaining IBM equipment, observe every safety precaution possible and the following safety rules.

Work Environment

- Do not work alone in hazardous conditions or near equipment that has dangerous voltage. Always inform your manager if the conditions or voltages are a possible problem.
- Always look for possible hazards in your work environment. Examples of hazards are: moist floors, nongrounded extension cables, power surges, and missing grounds.
- Do not perform any action that makes the product unsafe or that causes hazards for customer personnel.
- Before you start the equipment, ensure that other CEs, and customer personnel, are not in a hazardous position.
- Do not wear loose clothing that can be trapped in the moving parts of a machine. Ensure that the sleeves of your clothing are fastened or are rolled above the elbow.
- Insert your necktie into your clothing or fasten it with a clip (preferably nonconductive) at approximately 8 centimeters (3 inches) from its end.
- Lift the equipment or parts by standing or pushing up with your stronger leg muscles; this action removes the strain from the muscles in your back. Do not lift any equipment or parts that are too heavy for you.
- Put removed machine covers in a safe place while you are servicing the machine. Reinstall the covers before returning the machine to the customer.
- Always keep your CE tool kit away from walk areas so that other persons cannot trip over it. For example, keep the kit under a desk or table.
- Observe good housekeeping practices in the area of the machines while you are performing maintenance and after completing it.
- After maintenance, reinstall all safety devices, such as guards, shields, labels, and grounding devices. Exchange safety devices that are worn or defective. Remember, the safety devices protect you from a hazard. You destroy their purpose if you do not reinstall them when you have completed the service call.

Electrical Safety

- If possible, always disconnect the power-supply cables before you work on a machine. When you switch off power at the wall box, lock the switch in the off position or attach a DO NOT OPERATE tag (Z229-0237) to the switch.

  Note: A non-IBM attachment to an IBM machine may be powered from another source and may be controlled by a different switch or circuit breaker.
- Switch off all power before:
  - Removing or assembling the main units of the equipment
  - Working near power supplies
  - Inspecting power supplies
  - Installing changes in machine circuits
- If you really need to work on equipment that has exposed live electrical circuits, observe the following precautions:
  - Ensure that another person who understands the power off controls, is near you. Another person must be there to switch off the power, if necessary.
  - Do not wear jewelry, chains, metal-frame eyeglasses, or other personal metal objects. Remember, if the metal touches the machine, the flow of current increases because the metal is a conductor.
  - Use only insulated probe tips or extenders. Remember, worn or cracked insulation is unsafe.
  - Use only one hand while you are working on live equipment. Keep the other hand in your pocket or behind your back. Remember, there must be a complete circuit for an electrical shock to occur. This precaution prevents your body from completing the circuit.
  - When you use a tester, set its controls correctly and use insulated probes that have the correct electrical specification.
  - Do not touch objects that are grounded, such as metal floor strips, machine frames, or other conductors. Use suitable rubber mats obtained locally, if necessary.
- When you are working with machines having voltages more than 30 Vac or 42 Vdc, observe the special safety instructions given in customer engineering memorandums (CEMs).
- Never assume that power has been removed from a circuit. First, ensure that power has been removed.
- Do not touch live circuits with the surface of a plastic dental mirror. Remember, the surface of the dental mirror is conductive and can cause damage or personal injury.
- If an electrical accident occurs:
  - Use caution. Do not be a victim yourself.
  - Switch off the power.
  - Instruct another person to get medical aid.
  - If the victim is not breathing, perform mouth-to-mouth rescue breathing. See *Electrical Accidents—First Aid*.

Mechanical Safety

Do not touch moving mechanical parts when you are lubricating a part, checking for play, or doing other similar work.

Safety Glasses

Wear safety glasses when:

- Using a hammer to drive pins or other similar parts
- Using a power drill
- Using a spring hook to attach or remove a spring
- Soldering parts
- Cutting wire or removing steel bands
- Using solvents, chemicals, or cleaners to clean parts
- Working in any other conditions that could injure your eyes

Tools, Testers, and Field-Use Materials

- Do not use tools or testers that have not been approved by IBM. Ensure that electrical hand tools, such as Wire-Wrap[1] tools and power drills, are inspected regularly.
- Exchange worn or broken tools or testers.
- Do not use solvents, cleaners, or lubricants that have not been approved by IBM.

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[1]Trademark of the Gardner-Denver Co.

Summary

Prevention is the main aid to electrical safety. Always think about electrical safety and use good practice; for example:

- Ensure that the customer's power receptacle matches the IBM equipment specifications.
- Inspect power cables and plugs; check for loose, damaged, or worn parts.
- Review the procedures in the maintenance documents before you remove a part that can hold an electrical charge from the machine. Carefully discharge the necessary parts exactly as instructed by the procedure.

Never assume that a machine or a circuit is safe. No machine is always completely safe. You may not know the exact condition of a machine because, for example:

- The power receptacles could be wrongly wired.
- Safety devices or features could be missing or defective.
- The maintenance or machine level change history could be wrong or not complete.
- The design could have a problem.
- The machine could have damage, caused when it was shipped.
- The machine could have an unsafe change or attachment.
- An engineering change or a sales change could be wrongly installed.
- The machine could be deteriorated because it is old, or because it operates in an extreme environment.
- A part could be defective, therefore causing a hazard.
- A part could be wrongly assembled.

These are some of the ways that the condition of the machine could affect safety. Before you start a service call or procedure, have good judgment and use caution.

Electrical Accidents–First Aid

When performing rescue procedures for an electrical accident, do as follows:

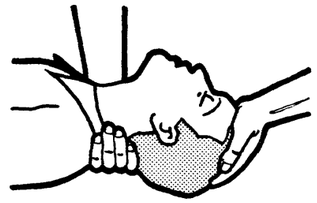
- *Use Caution:* If the victim is touching the electrical-current source, remove the power. To do this, you may need to operate the room emergency power-off switch or the disconnecting switch. If you cannot find the switch, use a dry wooden rod or other nonconductive object to pull or push the victim away so he or she is not touching the electrical-current source.
- *Work Quickly:* If the victim is unconscious, he or she may need mouth-to-mouth rescue breathing and possibly external cardiac compression if the heart is not beating.
- *Get Medical Aid:* Instruct another person to dial the rescue service (such as the ambulance or the hospital).

Determine if the victim needs mouth-to-mouth rescue breathing. If he or she does, perform the following steps:

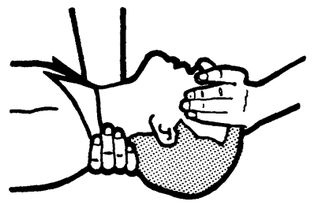
DANGER

Use extreme care when you perform rescue breathing for a victim who may have breathed in toxic fumes. Do not breathe in air that the victim has breathed out.

1. Prepare for rescue breathing:
   a. Ensure that the victim's airway is open and that it is not obstructed; check the mouth for objects that may be obstructing the airway, such as chewing gum, food, dentures, or the tongue.
   b. Place the victim on his or her back, put one hand behind the victim's neck, and put the other hand on his or her forehead.
   c. Lift the neck with one hand, and tilt the head backward by pressing on the forehead with the other hand.

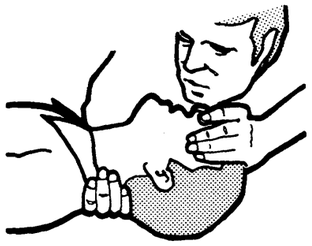


2. Look, listen, and feel to determine if the victim is breathing freely.
   a. Put your cheek near the victim's mouth and nose.
   b. Listen and feel for the breathing out of air. At the same time, look at the victim's chest and upper abdomen to see if they move up and down.
3. If the victim is not breathing correctly:
   a. Keep the victim's head tilted backward. Continue to press on the forehead with your hand; at the same time, position the same hand so that you can pinch together the victim's nostrils with your thumb and finger.



   b. Open your mouth wide and take a deep breath. Make a tight seal with your mouth around the victim's and blow into the victim's mouth.

   c. Remove your mouth to let the victim breathe out, and check that the victim's chest moves down.



   d. Repeat steps b and c once every 5 seconds either until the victim breathes for himself or herself, or until medical aid comes.

Reporting Accidents

Report, to your field manager, all electrical accidents, possible electrical hazards, and accidents that nearly occurred. Remember, an accident that nearly occurs might be caused by a design problem; your immediate reporting ensures that the problem will be solved quickly.

Also report all small electrical shocks. Remember, a condition that causes a small shock need only differ slightly to cause serious injury.

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Overview

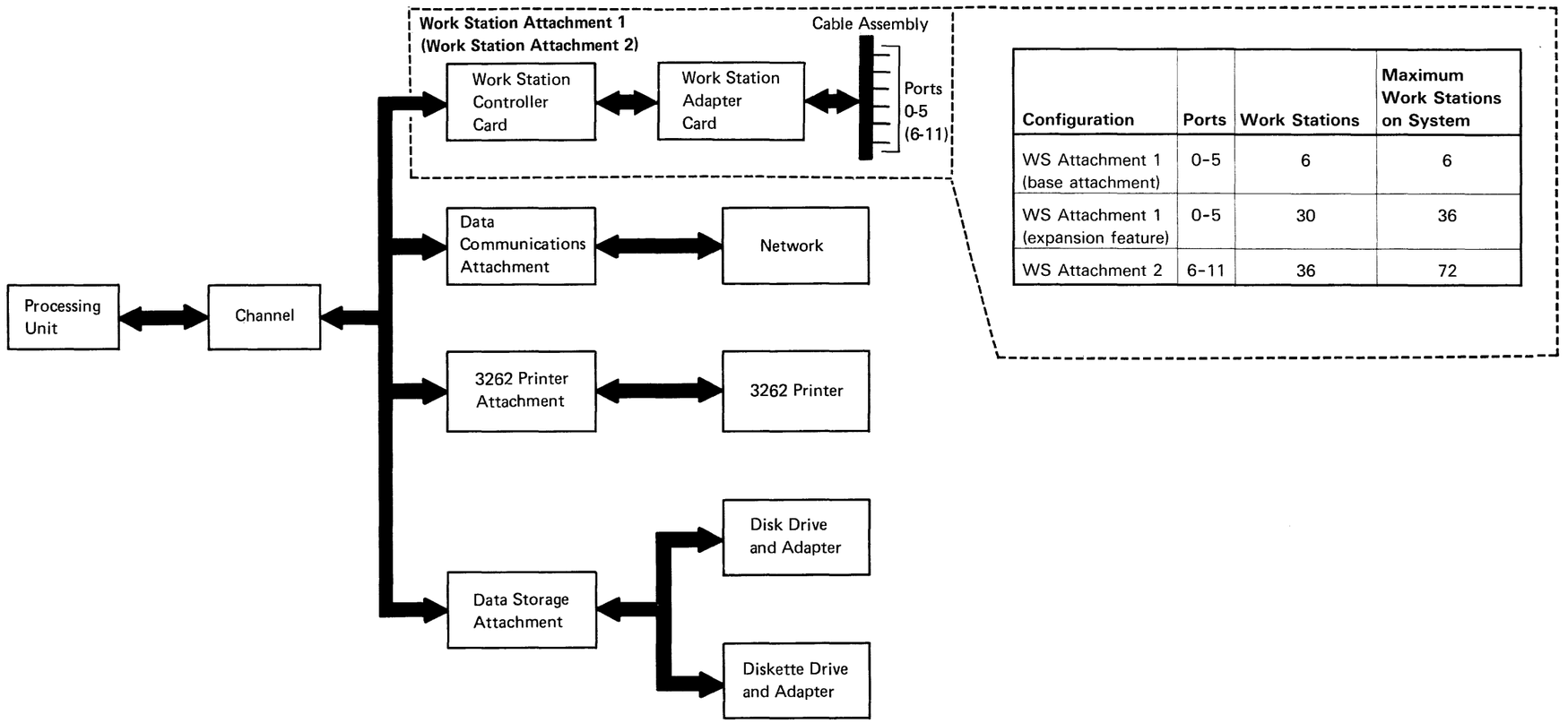
70-110
Work Station Attachment

The work station attachment connects work stations to System/36. A work station can be any device attached to the work station cable; for example, keyboard/displays and work station printers. Up to six work stations can be attached to work station attachment 1 (base attachment). A keyboard/display must be assigned as the system console and attached to port 0 with a station address of 0. An expansion feature for work station attachment 1 permits the attachment of 30 more work stations for a system total of 36. A second work station attachment permits the attachment of 36 more work stations for a system total of 72.

Each work station is connected to the attachment through a work station cable connected to a port. There are six ports (0 through 5) on work station attachment 1 and six ports (6 through 11) on work station attachment 2. Each port can have as many as seven work stations attached. However, the total number of work stations is limited by the configuration. The maximum length of each work station cable from the cable tower to the last work station on the cable is 1524 meters (5000 feet).

Each work station attachment contains the following major FRUs:

- Controller card
- Adapter card
- Cable assembly

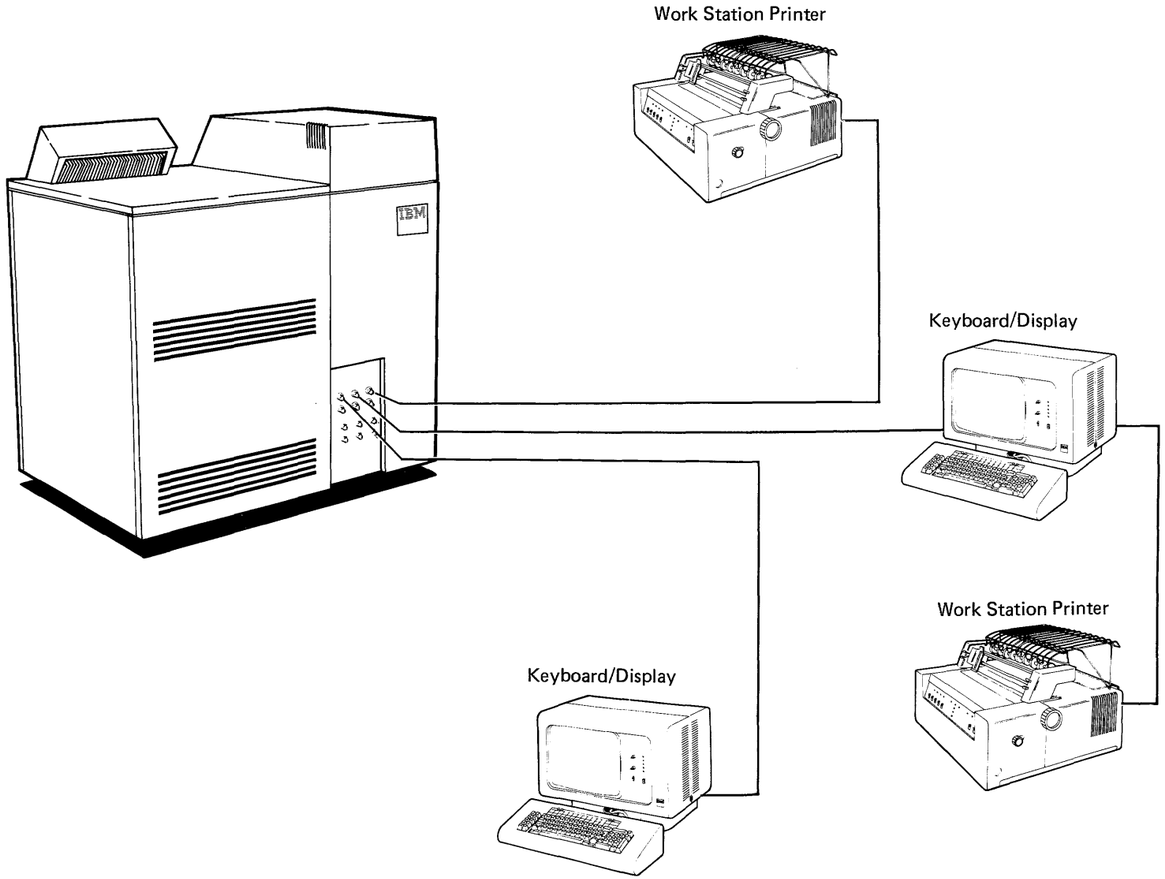


Configuration	Ports	Work Stations	Maximum Work Stations on System
WS Attachment 1 (base attachment)	0-5	6	6
WS Attachment 1 (expansion feature)	0-5	30	36
WS Attachment 2	6-11	36	72

70-120
Configuration Example

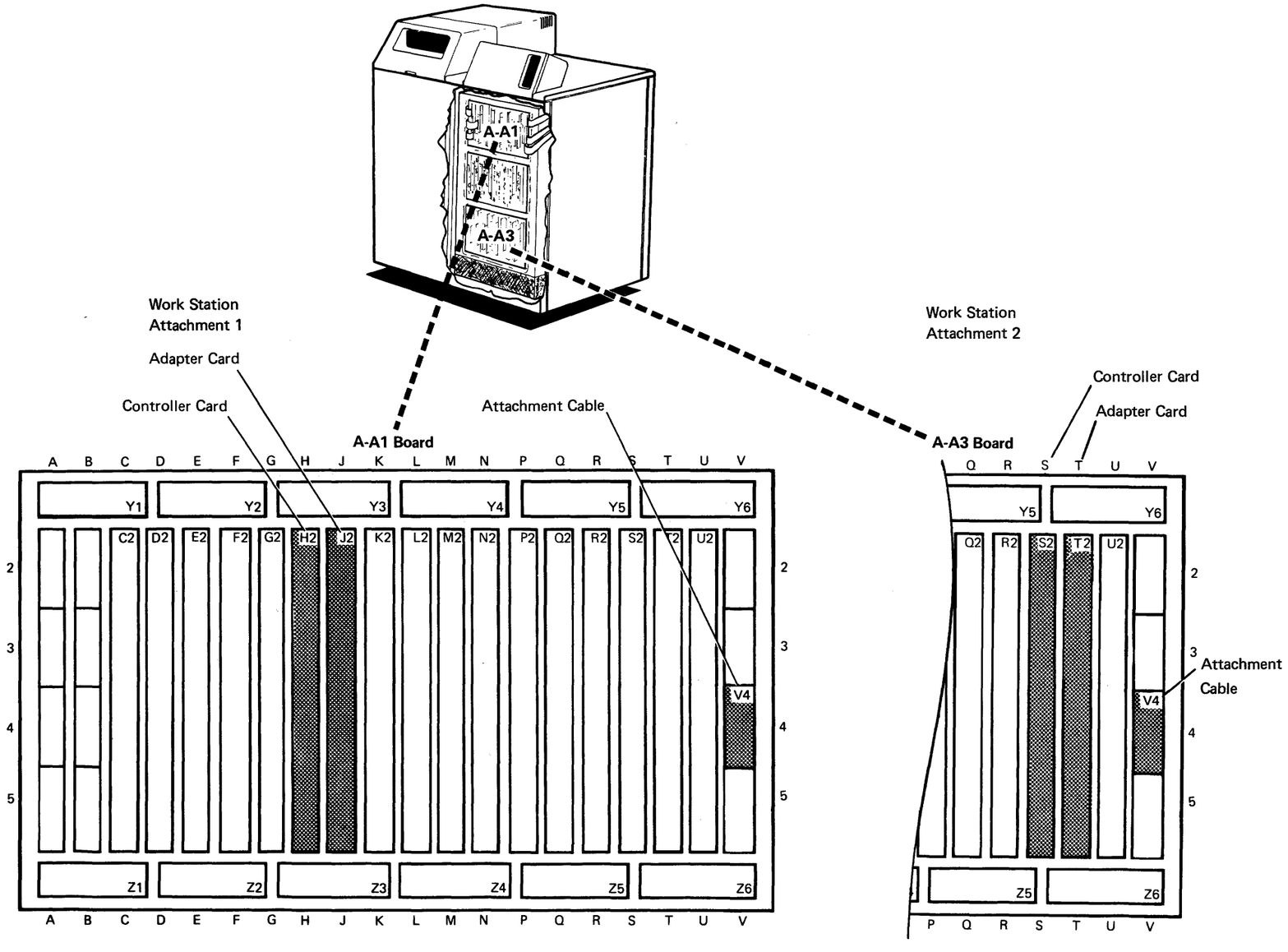
For specific information about work station cables, see the following manuals:

- *IBM 5250 Information Display System Planning and Site Preparation Guide*, GA21-9337
- *IBM Cabling System Planning and Installation Guide*, GA27-3361
- *IBM Cabling System Problem Determination Guide for Twinaxial Applications*, GA21-9491



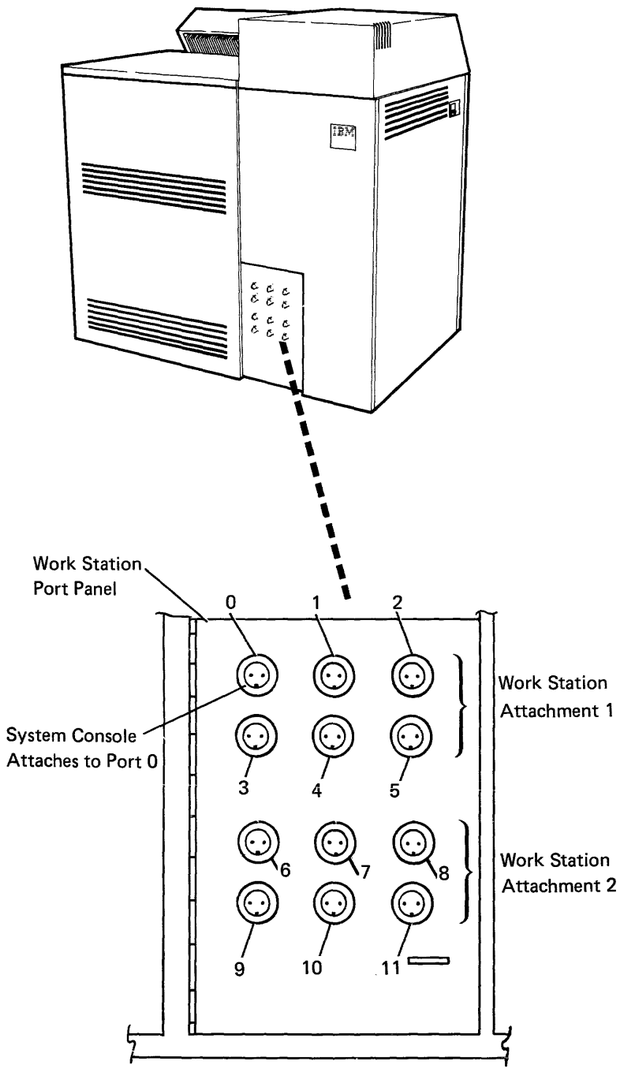
Locations

70-210
Card Locations



Port Locations

70-220



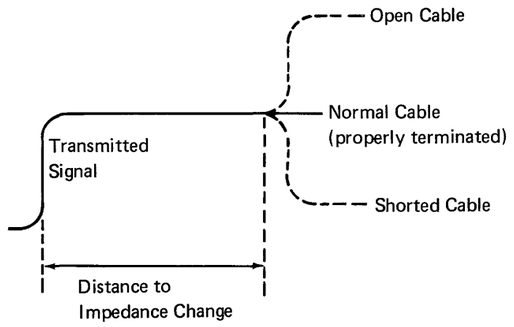
Maintenance Procedures

SCOPING PROCEDURES

70-310
Twinaxial Cable Signal Quality Check

For an alternative method of checking cables with an ohmmeter, see 70-350.

The cable signal quality check determines if a failure is present in a work station cable (twinaxial), the cable connectors, or an attached work station. This test sends a signal down the twinaxial cable using the square wave from the B-gate output on the oscilloscope. Cables up to a maximum length of 1524 meters (5000 feet) can be checked. To check the cables in the IBM Cabling System, see 70-330.



Normal Cable

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

Defective Cable

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

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

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

Note: If station protectors are installed, a glitch may appear on the displayed waveshape. See sample oscilloscope signals Ⓔ and Ⓗ on 70-320.

For additional information on cable quality and assembly, see:

- *An Oscilloscope Measurement Procedure for Twisted and Coax Cables*, S226-3913.
- *IBM 5250 Information Display System Planning and Site Preparation Guide*, GA21-9337.

Note: The system cable (twinaxial) is normally assembled and maintained by the customer. However, if aid is requested, use the procedures in the *IBM 5250 Information Display System Planning and Site Preparation Guide*, GA21-9337.

To perform the cable signal quality check, you should have the following (or similar) equipment:

- One Tektronix[1] 453, 454, or 475 oscilloscope. (This procedure uses the 475 oscilloscope.)
- One BNC T-connector (part 1650789) Ⓐ.
- One probe-tip-to-BNC adapter (part 453199) Ⓑ.
- One coaxial cable with a BNC end and alligator clips (part 1650790) Ⓒ, or a BNC-to-banana-plug adapter and multimeter leads.
- One X1 probe (a X10 probe may be used by changing the vertical input setting).
- One resistor assembly (part 7362344). A resistor assembly is needed only if the end of the cable being checked is not terminated at a work station.

[1]Trademark of Tektronix, Inc.

Perform the following steps:

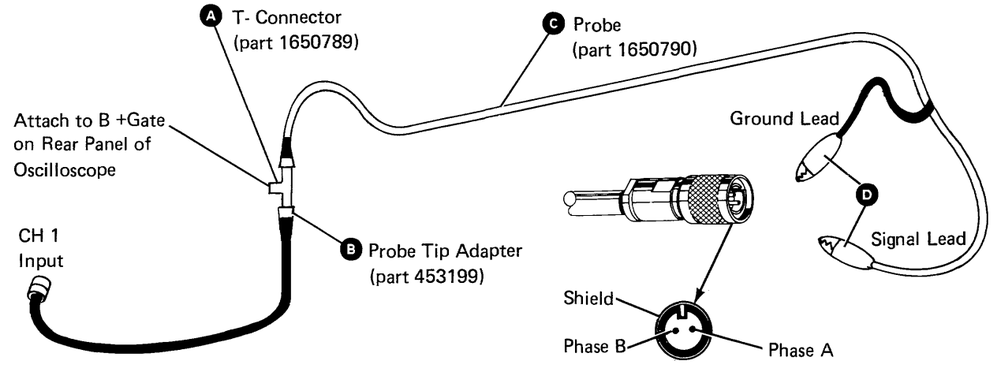
1. Set the scope switches as follows:

   CH 1 VOLTS/DIV: 0.5 volts
   AC-GND-DC: AC
   INVERT: Out
   VERT MODE: CH 1
   A and B
   TIME/DIV
   and DELAY Time: Set A to 10 microseconds, pull knob to unlock, and set B to 2 microseconds.
   HORIZ DISPLAY: B DLY'D
   TRIG MODE: AUTO
   COUPLING: AC
   SOURCE: STARTS AFTER DELAY
   SLOPE: Minus

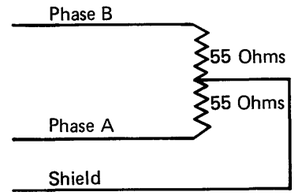
2. Attach the T-connector Ⓐ to B +GATE on the rear panel of the oscilloscope.

3. Use the probe tip adapter Ⓑ (part 453199) to connect the channel 1 probe to one side of the T-connector.

4. Connect the coaxial cable with the BNC end and alligator clips Ⓒ (part 1650790) to the other side of the T-connector.



5. Terminate the other end of the cable by one of the following methods:
   a. Attach the cable to the work station. If the Cable Thru feature is present, set the terminator switch on the last work station to 1.
   b. Terminate the end of the cable with a resistor assembly (part 7362344) as shown here:



6. Connect the alligator clips Ⓓ to the end of the cable for each combination below. Look at the oscilloscope signal for each combination to determine if a cable failure is present. Use the tables that follow and the sample oscilloscope signals on 70-320 to find any problems that are present.
   a. Ground lead to shield, signal lead to phase A.
   b. Ground lead to shield, signal lead to phase B.
   c. Ground lead to phase A, signal lead to phase B.

70-310 (continued)
Twinaxial Cable Signal Quality Check

Adjusting the Oscilloscope for the Correct Display

Oscilloscope Display	Action
No reflection. See examples Ⓐ and Ⓑ on 70-320.	If the B-sweep time/div is set on 2 microseconds, the maximum cable length of 1524 meters (5000 feet) is displayed. No reflection indicates that the cable is good, if all the combinations in step 6 have been checked.
Multiple reflections. See examples Ⓓ and Ⓖ on 70-320.	Decrease the B-sweep time/div so that only a single reflection is displayed. See the action for single reflections.
Single reflections. See examples Ⓒ, Ⓔ, Ⓕ, and Ⓗ on 70-320.	Measure the time divisions on the oscilloscope to the point where the signal level just starts to change either upward or downward. Use the distance table to find the distance to the cable failure.

Notes:

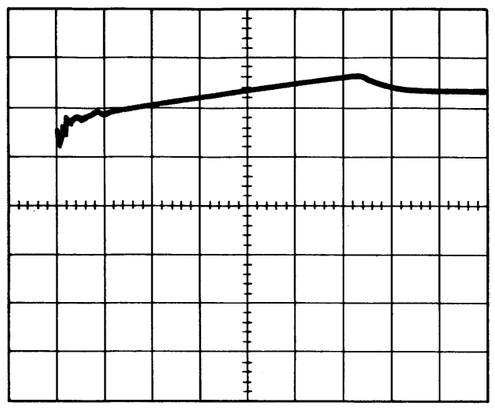
1. To increase the size of small changes, move the signal down (channel 1 Position knob) and decrease the channel 1 volts/div setting.
2. For long cables, failures at the far end may not be easy to see on the oscilloscope. Reconnect the cable to the system and disconnect or remove the terminating resistor from the work station end of the cable. Repeat the scoping procedure using the work station end of the cable.
3. Failures too close to the tested end of the cable cause reflections to occur within the rise time of the oscilloscope.
4. If you suspect that the cable is too long and you want to check the length, disconnect the cable from the other end. The oscilloscope will show an open circuit, as shown in Ⓒ or Ⓓ of 70-320.

Distance Table

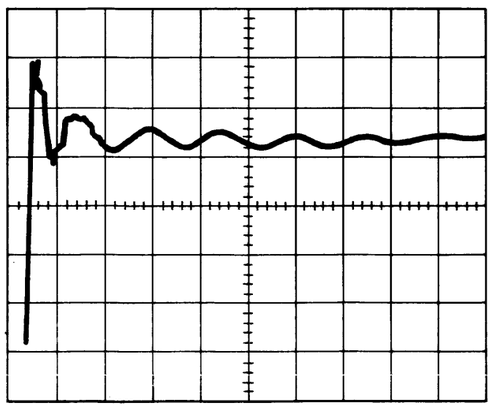
B-Sweep Setting	Meters/Div	Feet/Div	Maximum Cable Length Displayed
2 microseconds	198	649.4	1980 meters (6494 feet)–Maximum cable length is 1524 meters (5000 feet)
1 microsecond	99	324.7	990 meters (3247 feet)
0.5 microsecond	49.5	162.4	495 meters (1624 feet)
0.2 microsecond	19.8	64.9	198 meters (649 feet)
0.1 microsecond	9.9	32.5	99 meters (325 feet)

70-320
Twinaxial Sample Oscilloscope Signals

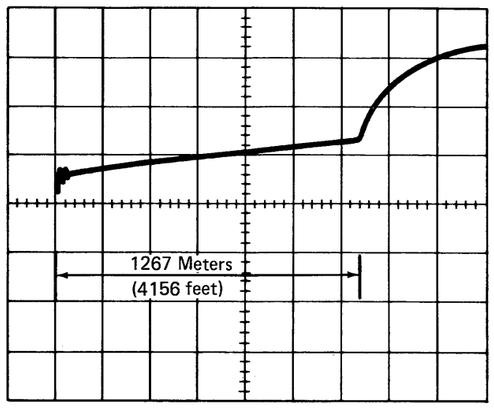
Good Cable–1267 meters (4156 feet) Ⓐ
0.5 volts/div
A = 10 microseconds
B = 2 microseconds



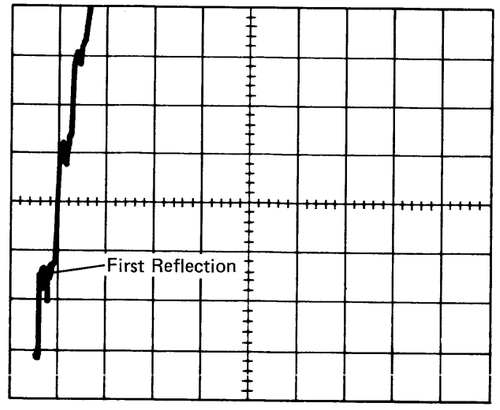
Good Cable–15 meters (50 feet) Ⓑ
0.2 volts/div
A = 10 microseconds
B = 2 microseconds



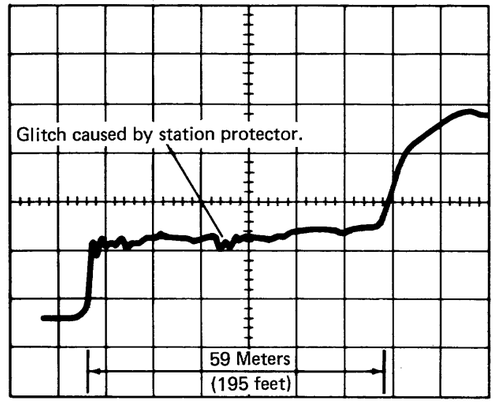
Open Circuit–Single Reflection Ⓒ
0.5 volts/div
A = 10 microseconds
B = 2 microseconds



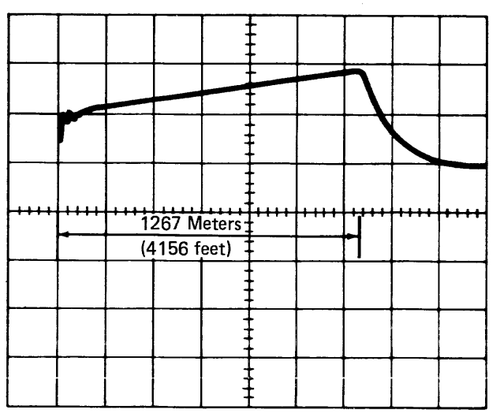
Open Circuit–More Than One Reflection Ⓓ
0.5 volts/div
A = 10 microseconds
B = 2 microseconds
Change B time base to 0.1 microsecond.
(See Ⓔ)



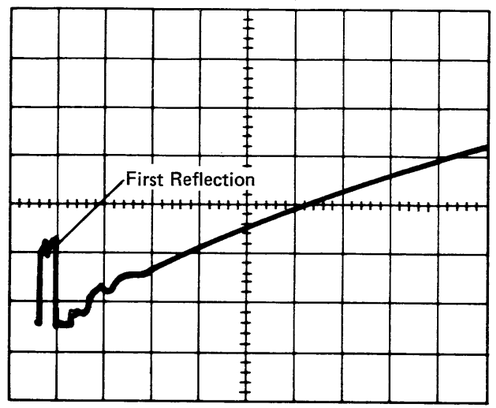
Open Circuit–Single Reflection Ⓔ
0.5 volts/div
A = 10 microseconds
B = 0.1 microsecond



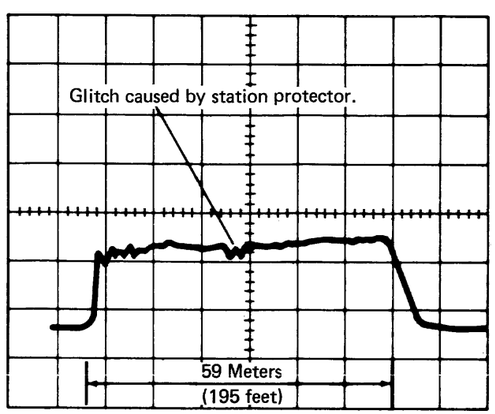
Short Circuit–Single Reflection Ⓕ
0.5 volts/div
A = 10 microseconds
B = 2 microseconds



Short Circuit–More Than One Reflection Ⓖ
0.5 volts/div
A = 10 microseconds
B = 2 microseconds
Change B time base to 0.1 microsecond.
(See Ⓗ)



Short Circuit–Single Reflection Ⓗ
0.5 volts/div
A = 10 microseconds
B = 0.1 microsecond



70-330
IBM Cabling System Signal Quality Check

The product IBM Cabling System will be referred to simply as cabling system.

The following procedure is for systems attached to a cabling system. For more information, see the *IBM Cabling System Planning and Installation Guide*, GA27-3361, and the *IBM Cabling System Problem Determination Guide for Twinaxial Applications*, GA21-9491.

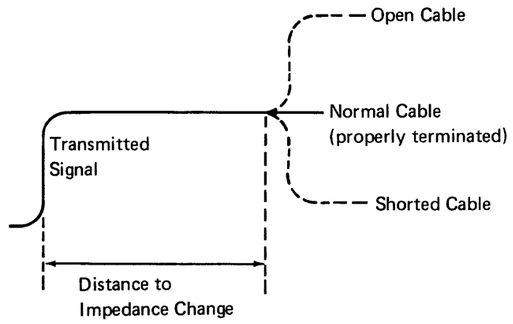
The purpose of this procedure is to determine if there is a failure in the cabling system or an attached work station.

This test sends a signal down the common cable, using the square wave from the B-gate output on the oscilloscope. Data paths up to a maximum of 1524 meters (5000 feet) can be checked.

Normal Cable

If the cable is terminated by the correct load impedance (150 ohms), all the power of the transmitted signal is used by the terminating impedance.

It is normal for a surge suppressor to cause a glitch of the signal. See cabling system sample oscilloscope signals **C** and **F** in 70-340.



Defective Cable

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

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

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

To perform the cable signal quality check, you should have the following (or similar) equipment:

- One Tektronix 453, 454, or 475 oscilloscope. (This procedure uses the 475 oscilloscope.)
- One BNC T-connector (part 1650789).
- One probe-tip-to-BNC adapter (part 453199).
- One coaxial cable with a BNC end and alligator clips (part 1650790), or a BNC-to-banana-plug adapter and multimeter leads.
- One X1 probe (an X10 probe may be used by changing the vertical input setting).
- One 75-ohm resistor assembly. A resistor assembly is needed only if the end of the cable being checked is not terminated at a work station.

Perform the following steps:

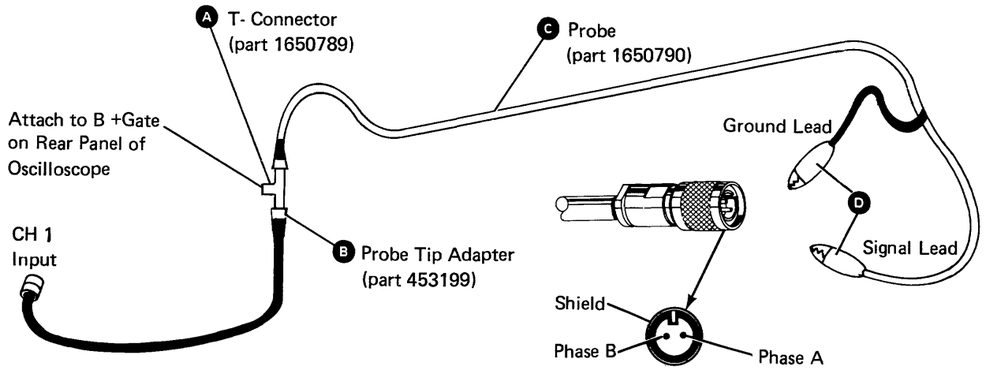
1. Set the scope switches as follows:

   CH 1 VOLTS/DIV: 0.5 volts
   AC-GND-DC: AC
   INVERT: Inverted (out)
   VERT MODE: CH 1
   A and B
   TIME/DIV
   and DELAY Time: Set A to 10 microseconds, pull knob to unlock, and set B to 2 microseconds.
   HORIZ DISPLAY: B DLY'D
   TRIG MODE: AUTO
   COUPLING: AC
   SOURCE: STARTS AFTER DELAY
   SLOPE: Minus

2. Attach the T-connector Ⓐ to B +GATE on the rear panel of the oscilloscope.

3. Use the probe tip adapter Ⓑ (part 453199) to connect the channel 1 probe to one side of the T-connector.

4. Connect the coaxial cable with the BNC end and alligator clips Ⓒ (part 1650790) to the other side of the T-connector.

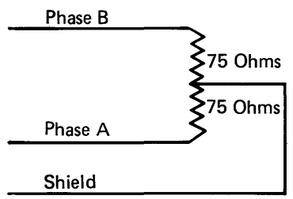


5. Terminate the end of the cable going to the last work station on the port being tested. Use one of the following methods:

   a. If the work station has the Cable Thru feature, set the terminator switch to the not terminated position and connect the twinaxial terminator (part 6091068) to port 2. Verify that the cable from the distribution panel to port 1 of the work station is a twinaxial direct connect cable (part 6091075).

   b. If the work station does not have the Cable Thru feature, verify that the cable from the distribution panel to the work station is an impedance matching device cable (part 6091070).

   c. If you want to test a cable that is not attached to a work station, terminate the end of the cable with a 75-ohm resistor assembly (part 6091068 can be used) as follows:



6. Disconnect the cable at the system port. Connect the alligator clips Ⓓ to the end of the cable for each combination below. Look at the oscilloscope signal for each combination to determine if a cable failure is present. Use the tables on the following page and the cabling system sample oscilloscope signals on 70-340 to find any problems that are present.
   a. Ground lead to shield, signal lead to phase A.
   b. Ground lead to shield, signal lead to phase B.
   c. Ground lead to phase A, signal lead to phase B.

70-330 (continued)
IBM Cabling System Signal Quality Check

Calculating the Distance to the Failure

For the IBM Cabling System, the total signal path is longer than the total cable length. For each cable from the distribution panel to a work station (except for the last work station or the only work station on the port), the signal path is twice the length of the cable. To find the failure, you must use the total length of the signal path, not the length of the cable.

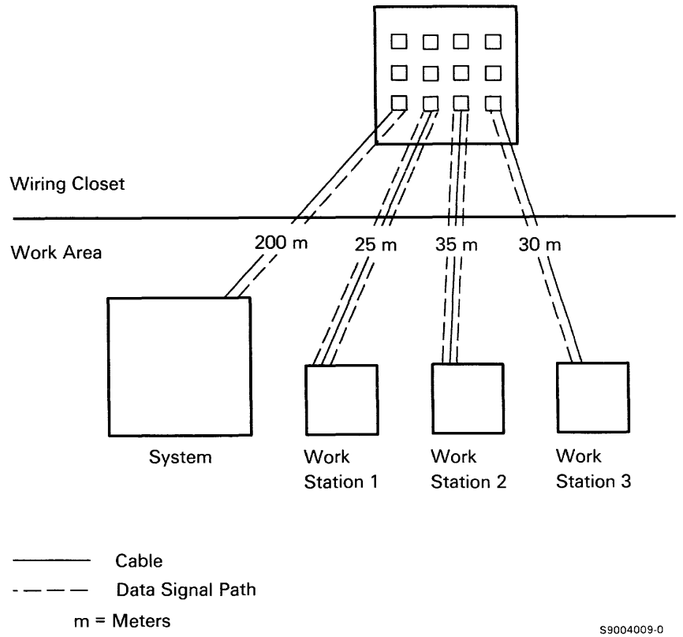
In the diagram below, the total cable length is 290 meters (951 feet): 200 m + 25 m + 35 m + 30 m = 290 meters.

To determine the total signal path, use the following procedure:

1. Add together the lengths of the cables from the distribution panel to all the work stations except the last.
2. Multiply the total from step 1 by 2.
3. Add the length of the cable between the distribution panel and the last work station to the total from step 2.
4. Add the length of the cable from the system to the distribution panel to the total from step 3.

For the diagram below, this results in a total signal path of 350 meters, as follows:

1. 25 m + 35 m = 60 m
2. 60 m x 2 = 120 m
3. 30 m + 120 m = 150 m
4. 200 m + 150 m = 350 m



Adjusting the Oscilloscope for the Correct Display

Oscilloscope Display	Action
No reflection. See examples A and B on 70-340.	If the B-sweep time/div is set on 2 microseconds, the maximum cable length of 1524 meters (5000 feet) is displayed. No reflection indicates that the cable is good, if all the combinations in step 6 have been checked.
Multiple reflections. See examples D and G on 70-340.	Decrease the B-sweep time/div so that only a single reflection is displayed. See the action for single reflections.
Single reflections. See examples C, E, F, and H on 70-340.	Measure the time divisions on the oscilloscope to the point where the signal level just starts to change either upward or downward. Use the distance table to find the distance to the cable failure.

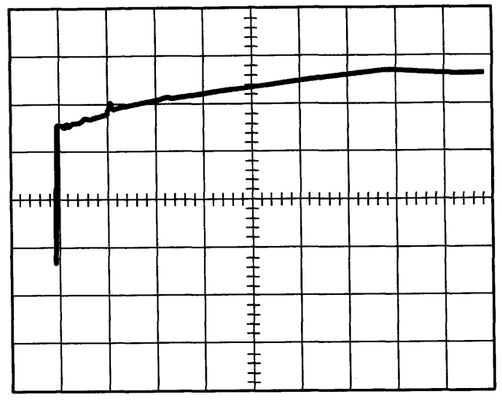
Notes:
1. To increase the size of small changes, move the signal down (channel 1 Position knob) and decrease the channel 1 volts/div setting.
2. For long cables, failures at the far end may not be easy to see on the oscilloscope. Reconnect the cable to the system and disconnect or remove the terminating resistor from the work station end of the cable. Repeat the scoping procedure using the work station end of the cable.
3. Failures too close to the tested end of the cable cause reflections to occur within the rise time of the oscilloscope.
4. If you suspect that the cable is too long and you want to check the length, disconnect the cable from the other end. The oscilloscope will show an open circuit, as shown in C, D, or E of 70-340.

Distance Table

B-Sweep Setting	Meters/Div	Feet/Div	Maximum Signal Path Displayed
2 microseconds	222	730	2220 meters (7300 feet)–Maximum cable length is 1524 meters (5000 feet)
1 microsecond	111	365	1110 meters (3650 feet)
0.5 microsecond	55.5	182.5	555 meters (1825 feet)
0.2 microsecond	22.2	73	222 meters (730 feet)
0.1 microsecond	11.1	36.5	111 meters (365 feet)

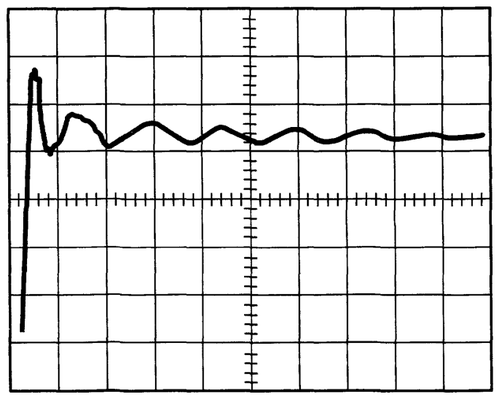
70-340
IBM Cabling System Sample Oscilloscope Signals

Good Cable–1509 meters (4950 feet) Ⓐ
0.5 volts/div
A = 10 microseconds
B = 2 microseconds



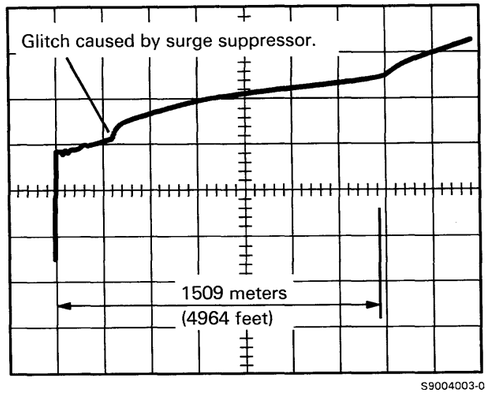
S9004001-0

Good Cable–15.2 meters (50 feet) Ⓑ
0.2 volts/div
A = 10 microseconds
B = 2 microseconds



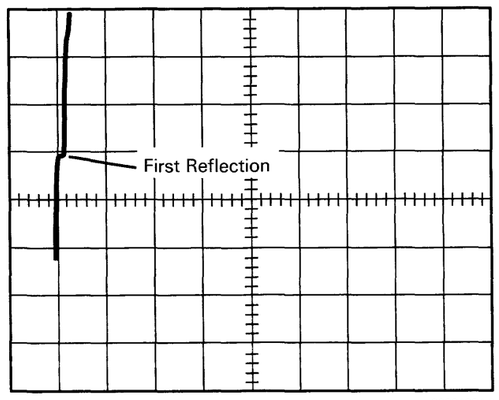
S9004002-0

Open Circuit–Single Reflection Ⓒ
0.5 volts/div
A = 10 microseconds
B = 2 microseconds



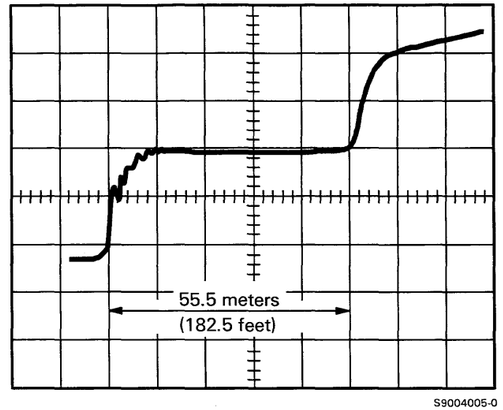
S9004003-0

Open Circuit–More Than One Reflection Ⓓ
0.5 volts/div
A = 10 microseconds
B = 2 microseconds
Change B time base to 0.1 microsecond.
(See Ⓔ)



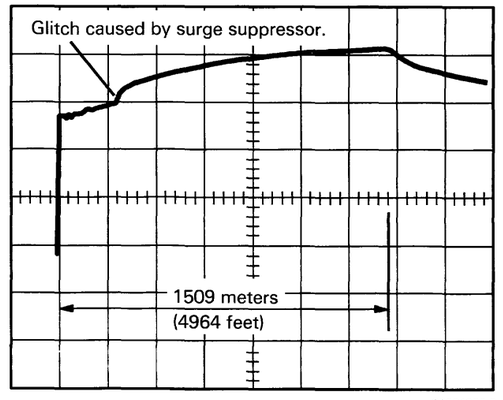
S9004004-0

Open Circuit–Single Reflection Ⓔ
0.5 volts/div
A = 10 microseconds
B = 0.1 microsecond



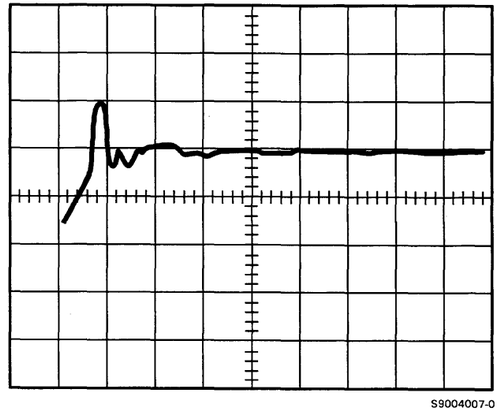
S9004005-0

Short Circuit–Single Reflection Ⓕ
0.5 volts/div
A = 10 microseconds
B = 2 microseconds



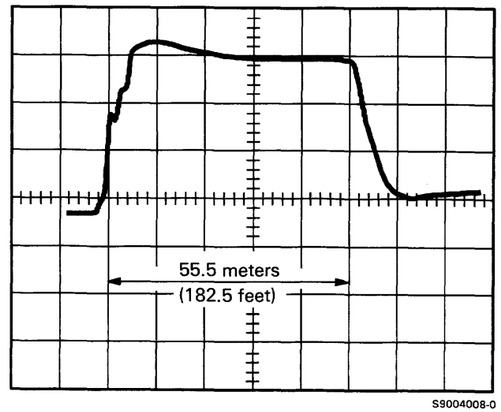
S9004006-0

Short Circuit–More Than One Reflection Ⓖ
0.5 volts/div
A = 10 microseconds
B = 2 microseconds
Change B time base to 0.1 microsecond.
(See Ⓗ)



S9004007-0

Short Circuit–Single Reflection Ⓗ
0.5 volts/div
A = 10 microseconds
B = 0.1 microsecond



S9004008-0

70-350
Local Work Station Cable Ohmmeter Test

Station protectors must be removed before using this procedure.

Perform the following steps:

1. Power off all work station devices attached to the work station cable.

2. Set the ohmmeter to the times 10 (X10) scale.

3. Disconnect the cable to be checked from the system unit.

4. Measure the resistance between each pin of the cable and the ground shield of the cable.

   If the resistance is less than 20 ohms (short circuit) or more than 200 ohms (open circuit), repair or exchange the cable. See note.

5. Measure the resistance between the two pins of the cable.

   If the resistance is less than 80 ohms (short circuit), repair or exchange the cable. See note.

6. Disconnect the cable being checked from the last work station on the port. The system unit end of the cable should still be disconnected.

7. Measure the resistance between each pin of the cable and the ground shield of the cable.

   If the resistance is less than 200 ohms (short circuit), repair or exchange the cable. A low resistance can also be caused by a terminating resistor on the planar board in a work station. See note,

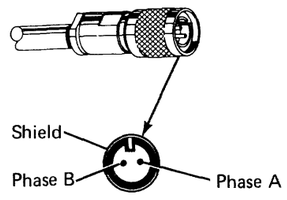
8. Measure the resistance between the two pins of the cable.

   If the resistance is less than 200 ohms (short circuit), repair or exchange the cable. See note.

9. At the work station end of the cable, jumper Phase A of the connector to the shield.

   At the system unit end of the cable, measure the resistance between Phase A and the shield.

   If the resistance is more than 200 ohms, Phase A and Phase B are reversed. Remove the jumper and repair the cable. See note.



Note: If more than one work station is attached to the port, it may be necessary to disconnect each section of cable to determine the location of the failure.

DIAGNOSTIC INFORMATION

70-400
MDI Good Machine Path

The MDI good machine path is divided into four major groups. Each group has an MDI that loads stand-alone test units (TUs) to test a specific part of the attachment. See 01-510 for the procedure to run the work station MDI MAPs.

The table on this page shows the sequence of the MDIs and the sequence in which the TUs are run. If an error occurs while running the MDIs for work station attachment 1, a system reference code is displayed in the control panel display. If an error occurs while running the MDIs for work station attachment 2, a system reference code is displayed on the system console. See MAPs 0113, 0114, 0115, and 0116 for a list of the system reference codes.

MDI Good Machine Path

Attachment 1 MDI	Attachment 2 MDI	Description	TU Sequence
1 MC201	1 MC206	Tests the bus coupler-to-system channel interface.	T6101 T6102 T6103 T6104
2 MC202	2 MC207	Tests the bus coupler-to-adapter interface and tests the adapter card. **Note:** The processor and storage on the controller card are bypassed.	TC246 TC235 TC236 TC237 TC238 TC239 TC23A TC23B TC23C TC23D TC23E TC23F TC240 TC241 (Note 1) TC291 (Note 2)
3 M6102	3 M6102	Tests the controller card.	T610F T6106 T6110 T6111 T6112 T6113 T6114 T6115 T6116 T6108 T6109 T610A T610B T610C
4 MC204	4 MC208	Tests the operation of the adapter card using the controller card processor. Also, tests the ability of the controller card to poll the system console.	TC242 TC243 TC244 (Note 1) TC294 (Note 2) TC247 (Note 1) TC249 (Note 2)

Notes:
1. Work station attachment 1 only.
2. Work station attachment 2 only.

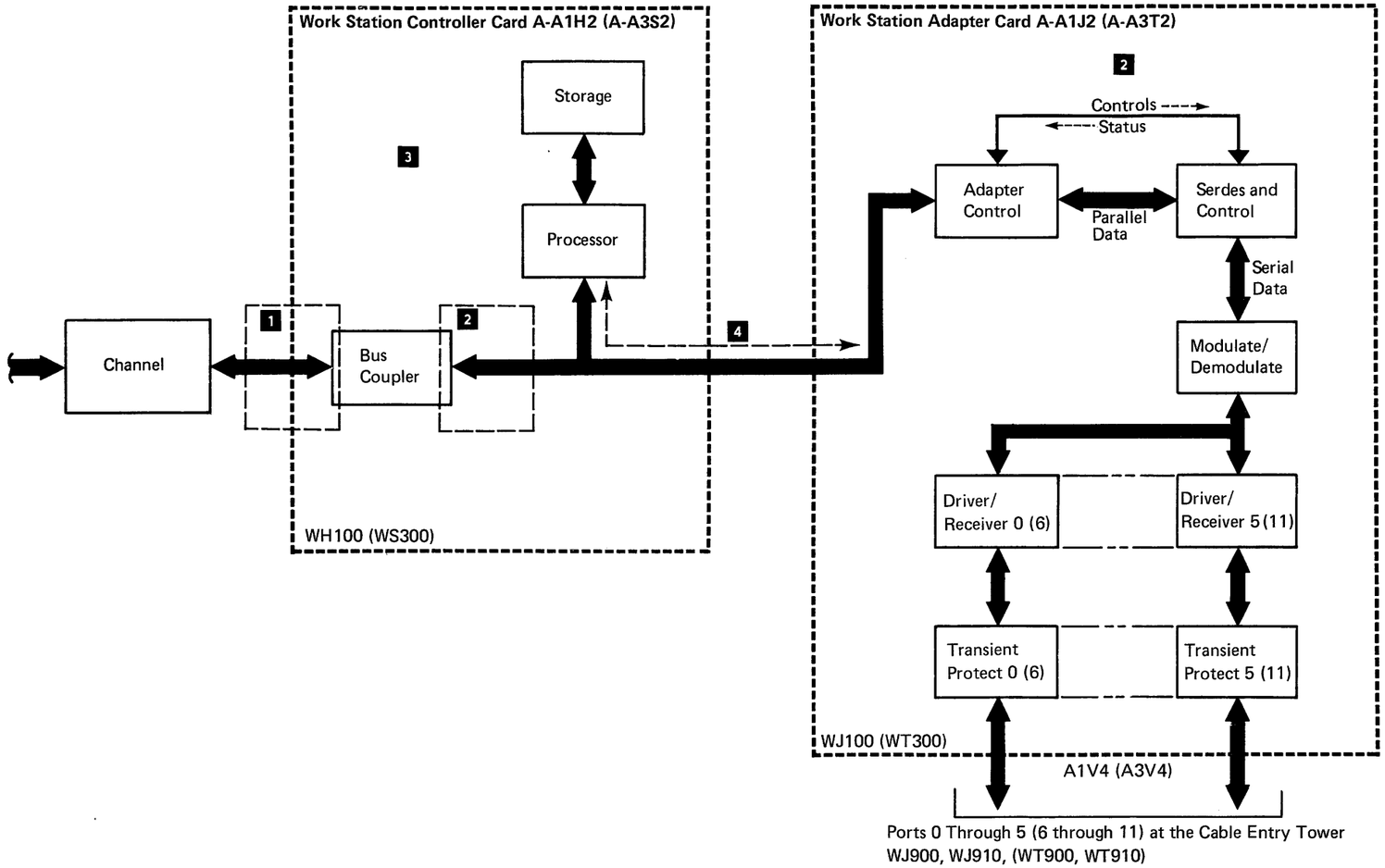
70-410
IPL Good Machine Path

The table on this page shows the work station attachment test units (TUs) that are run during the IPL sequence. If a work station attachment wrap error occurs during IPL, the system displays a reference code in the control panel display. See MAPs 0113, 0114, 0115, and 0116 for a list of the system reference codes.

IPL Good Machine Path

TU Sequence
T6101 T6102 T6103 T6104 T6110 T6111 T6112 T6113 T6114 T6115 T6116 T6117 T6118 TC246 TC235 TC236 TC237 TC238 TC239 TC23A TC23B TC23C TC23D TC23E TC23F TC244 (Note 1) TC241 (Note 1) TC242 TC243 TC248 TC249 (Note 2)

Notes:
1. Work station attachment 1 only.
2. Work station attachment 2 only.


Work Station Controller Card A-A1H2 (A-A3S2)
Storage
3
Processor
1
2
Channel
Bus
Coupler
4
WH100 (WS300)
Work Station Adapter Card A-A1J2 (A-A3T2)
2
Controls
Status
Adapter
Control
Parallel
Data
Serdes and
Control
Serial
Data
Modulate/
Demodulate
Driver/
Receiver 0 (6)
Driver/
Receiver 5 (11)
Transient
Protect 0 (6)
Transient
Protect 5 (11)
WJ100 (WT300)
A1V4 (A3V4)
Ports 0 Through 5 (6 through 11) at the Cable Entry Tower
WJ900, WJ910, (WT900, WT910)

70-420
TU Descriptions

In addition to being run as part of the IPL testing and the MDI good machine path, the work station attachment TUs can be loaded and run separately to check one area of the attachment operation. For most I/O devices, the descriptions of the tests and their result bytes appear on the system console when the tests are selected. However, when work station attachment TUs are run, the system console is not available. For that reason, this section contains a short description of each test and its result bytes to aid in interpreting results from the test.

To run a TU and display the result bytes, see 01-520.

T6101
Bus Coupler Initial Address Load

This TU loads the first address to the bus coupler and senses the results.

Result Byte 1

Bit(s)	Description
0	Machine check
1	Sense bus coupler configuration failed
2	Initial address load sequence failed to occur
3	Interrupt request A failed
4	Data buffer 1 failed to reset
5	Data buffer 2 failed to reset
6	Channel error
7	Not used

Result Byte 2

Bit(s)	Description
0-7	Not used

T6102
Bus Coupler Data Buffer and CS Counter Test

This TU loads the bus coupler data buffer and the CS counter with three data patterns and senses the results.

Result Byte 1

Bit(s)	Description
0	Data buffer 2 failed to load hex 55
1	Data buffer 1 failed to load hex 55
2	Data buffer 2 failed to load hex AA
3	Data buffer 1 failed to load hex AA
4	Data buffer 2 failed to load hex FE
5	Data buffer 1 failed to load hex FE
6	Channel error
7	Data buffer 1 or 2 failed to reset

Result Byte 2

Bit(s)	Description
0	Counter high failed to load hex 55
1	Counter high failed to load hex AA
2	Counter high failed to load hex FE
3	Counter bits 0-2 failed to decrement
4	Counter bits 3-10 failed to decrement
5	Counter bit 10 failed to decrement
6	Counter bits 0-2 failed to increment
7	Counter bits 3-10 failed to increment

T6103
Bus Coupler/CSP Interrupt Test

This TU tests the control processor interrupts from the control processor to the bus coupler.

Result Byte 1

Bit(s)	Description
0	Wrong device caused interrupt
1	Interrupt not valid
2	Interrupt caused by wrong condition
3	'Interrupt request' latch failed to reset
4	Interrupt failed to occur
5	'Master enable' latch failed to reset
6	Bus coupler failed on SILSB instruction
7	Not used

Result Byte 2

Bit(s)	Description
0-7	Not used

T6104
System Cycle Steal Interface Test

This TU tests the cycle steal control lines using six cycle steals.

Result Byte 1

Bit(s)	Description
0	Failure during cycle steal
1	Test 1 failed
2	Test 2 failed
3	Test 3 failed
4	Test 4 failed
5	Test 5 failed
6	Test 6 failed
7	Cycle steal pointer not correct

Result Byte 2

Bit(s)	Description
0-7	Not used

T6105
Cycle Steal Test

This TU transfers 10 bytes of data to the attachment processor. When the transfer is completed, the attachment processor returns the 10 bytes of data to verify correct operation.

Result Byte 1 (CSP-to-Attachment Transfer)

Bit(s)	Description
0	Not used
1	Operation end interrupt caused by failure
2	Operation end interrupt failed to occur
3	Base cycle steal pointer not correct
4	Not used
5	Not used
6	Not used
7	Attachment processor check during cycle steal

Result Byte 2 (Attachment-to-CSP Transfer)

Bit(s)	Description
0	Channel error
1	Operation end interrupt caused by failure
2	Operation end interrupt failed to occur
3	Base cycle steal pointer not correct
4	Data returned to the CSP was not the same as data that was sent out
5	Not used
6	Not used
7	Attachment processor check during cycle steal

T6106
Attachment Processor Program Load

This TU loads the attachment processor with a program. The program causes an interrupt, and the processor performs a cycle steal operation to sense the results.

Result Byte 1

Bit(s)	Description
0	Interrupt caused by wrong device
1	Operation end interrupt caused by attachment processor check
2	Operation end interrupt failed to occur
3	CBI bit error
4	Condition A interrupt caused by attachment processor check
5	Condition A interrupt failed to occur
6	Condition A interrupt not enabled
7	Condition A interrupt not correct

Result Byte 2

Bit(s)	Description
0	External condition caused interrupt (not valid)
1	Condition A interrupt disable failed
2	Condition A interrupt reset failed
3	Channel error
4	Operation end interrupt caused by attachment processor check
5	Operation end failed to occur
6	Attachment processor failed to complete cycle steal
7	I/O program error (see byte 3)

Result Byte 3

Bit(s)	Description
0	Bit 0 on means channel error occurred after cycle steal; bit 0 off means channel error occurred before cycle steal
1	Failed to load data buffer 1
2	Failed to load data buffer 2
3	Data transfer failed
4	Data buffer 1 loaded wrong
5	Data buffer 2 loaded wrong
6	Not used
7	Not used

Result Byte 4

Bit(s)	Description
0-7	Not used

70-420 (continued)
TU Descriptions

T6108
Interrupt Test

This TU tests the interrupt hardware logic between the CSP and the attachment processor.

Result Byte 1

Bit(s)	Description
0	Attachment processor failed to interrupt CSP
1	CSP interrupt caused by wrong condition
2	Attachment processor sensed an error
3	Attachment processor check
4	Interrupt request A (condition B) disable failed
5	Interrupt request A (condition B) reset failed
6	Interrupt request A failed to reset
7	Disable interrupts failed

Result Byte 2

Bit(s)	Description
0-7	Not used

Result Byte 3 (See Byte 4)

Bit(s)	Description
0	Interrupt request 5 (operation end) failed
1	Interrupt request 5 (condition A) failed
2	Interrupt request 5 (condition B) failed
3	Interrupt request 5 (condition C) failed
4	8-millisecond timer interrupt failed
5	Interrupt request 5 self-interrupt failed
6	Interrupt request 1 self-interrupt failed
7	Interrupt request 1 failed

Result Byte 4 (Describes Byte 3)

Bit(s)	Description
0	Condition failed to set
1	Condition failed to reset
2	'Master enable' latch failed
3	'Master disable' latch failed
4	'Condition enable' latch failed
5	'Condition disable' latch failed
6	Interrupt failed to reset
7	Wrong condition caused interrupt

T6109
Cycle Steal Rate and Block Length Test

This TU tests the cycle steal operations for the eight possible data transfer rates and the seven possible block lengths.

Result Byte 1

Bit(s)	Description
0	Zero delay failure
1	6-microsecond delay failure
2	14-microsecond delay failure
3	22-microsecond delay failure
4	30-microsecond delay failure
5	38-microsecond delay failure
6	46-microsecond delay failure
7	Inhibit cycle steal failure

Result Byte 2

Bit(s)	Description
0	Block length 1 failure
1	Block length 4 failure
2	Block length 16 failure
3	Block length 32 failure
4	Block length 64 failure
5	Block length 128 failure
6	Block length 256 failure
7	Not used

T610A
Software/Hardware Time-out Test

This TU tests the hardware and software time-out circuits.

Result Byte 1

Bit(s)	Description
0	Reset retry/3-second time-out failed
1	Enable 3-second time-out failed
2	3-second time-out interrupt failed
3	4-second time-out interrupt failed
4-7	Not used

Result Byte 2

Bit(s)	Description
0-7	Not used

T610B
Cycle Steal to Control Storage and MSP Registers Test

This TU performs a cycle steal from the controller card processor to control storage and MSP registers.

Result Byte 1

Bit(s)	Description
0	TU failed
1	Attachment processor check
2	Attachment processor cycle steal of registers failed
3	Attachment processor status sense failed
4	TU did not execute
5	Error during TU cycle steal
6	Load attachment processor IMPL failed
7	Run attachment processor IMPL failed

Result Byte 2

Bit(s)	Description
0-7	00 = No system processor check FF = System processor machine check

T610C
Miscellaneous Tests

This TU performs an I/O storage to bus coupler test, a diagnostic set machine check test, and a set initial address load test.

Result Byte 1

Bit(s)	Description
0	TU failed
1	Attachment processor check
2	Attachment processor cycle steal of registers failed
3	Attachment processor status sense failed
4	TU did not execute
5	Error during TU cycle steal
6	Load attachment processor IMPL failed
7	Run attachment processor IMPL failed

Result Byte 2

Bit(s)	Description
0-7	00 = No system processor check FF = System processor machine check

T610F
Cycle Steal/Storage Test

This TU transfers 10 bytes of data to the attachment processor. A 4-second delay occurs, and the 10 bytes of data are transferred back to the CSP.

Result Byte 1 (CSP-to-Attachment Transfer)

Bit(s)	Description
0	Not used
1	Operation end interrupt caused by failure
2	Operation end interrupt failed to occur
3	Base cycle steal pointer not correct
4	Not used
5	Not used
6	Not used
7	Attachment processor check during cycle steal

Result Byte 2 (Attachment-to-CSP Transfer)

Bit(s)	Description
0	Channel error
1	Operation end interrupt caused by failure
2	Operation end interrupt failed to occur
3	Base cycle steal pointer not correct
4	Data returned to the CSP was not the same as data that was sent out
5	Not used
6	Not used
7	Attachment processor check during cycle steal

T6110
Branch Instructions Test

This TU tests the branch instructions.

Result Byte 1

Bit(s)	Description
0	TU failed
1	Attachment processor check
2	Cycle steal of registers failed
3	Attachment processor status sense failed
4	TU did not execute
5	Error during TU cycle steal
6	Load attachment processor IMPL failed
7	Run attachment processor IMPL failed

Result Byte 2

Bit(s)	Description
0-7	00 = No system processor check FF = System processor machine check

70-420 (continued)
TU Descriptions

T6111
Register Instructions Test

This TU tests the register instructions.

Result Byte 1

Bit(s)	Description
0	TU failed
1	Attachment processor check
2	Attachment processor cycle steal of registers failed
3	Attachment processor status sense failed
4	TU did not execute
5	Error during TU cycle steal
6	Load attachment processor IMPL failed
7	Run attachment processor IMPL failed

Result Byte 2

Bit(s)	Description
0-7	00 = No system processor check FF = System processor machine check

T6112
ALU Instructions Test

This TU tests the ALU instructions.

Result Byte 1

Bit(s)	Description
0	TU failed
1	Attachment processor check
2	Attachment processor cycle steal of registers failed
3	Attachment processor status sense failed
4	TU did not execute
5	Error during TU cycle steal
6	Load attachment processor IMPL failed
7	Run attachment processor IMPL failed

Result Byte 2

Bit(s)	Description
0-7	00 = No system processor check FF = System processor machine check

T6113
Register-to-Storage Instructions Test

This TU tests the register-to-storage instructions.

Result Byte 1

Bit(s)	Description
0	TU failed
1	Attachment processor check
2	Attachment processor cycle steal of registers failed
3	Attachment processor status sense failed
4	TU did not execute
5	Error during TU cycle steal
6	Load attachment processor IMPL failed
7	Run attachment processor IMPL failed

Result Byte 2

Bit(s)	Description
0-7	00 = No system processor check FF = System processor machine check

T6114
Channel/Attachment Processor Check Test

This TU tests the channel and work station attachment error circuits.

Result Byte 1

Bit(s)	Description
0	TU failed
1	Attachment processor check
2	Attachment processor cycle steal of registers failed
3	Attachment processor status sense failed
4	TU did not execute
5	Error during TU cycle steal
6	Load attachment processor IMPL failed
7	Run attachment processor IMPL failed

Result Byte 2

Bit(s)	Description
0-7	00 = No system processor check FF = System processor machine check

T6115
Attachment Processor Instructions Test

This TU tests the microcode instructions for the controller card.

Result Byte 1

Bit(s)	Description
0	TU failed
1	Attachment processor check
2	Attachment processor cycle steal of registers failed
3	Attachment processor status sense failed
4	TU did not execute
5	Error during TU cycle steal
6	Load attachment processor IMPL failed
7	Run attachment processor IMPL failed

Result Byte 2

Bit(s)	Description
0-7	00 = No system processor check FF = System processor machine check

T6116
Base Displacement Instructions

This TU tests additional attachment processor microcode instructions.

Result Byte 1

Bit(s)	Description
0	TU failed
1	Attachment processor check
2	Attachment processor cycle steal of registers failed
3	Attachment processor status sense failed
4	TU did not execute
5	Error during TU cycle steal
6	Load attachment processor IMPL failed
7	Run attachment processor IMPL failed

Result Byte 2

Bit(s)	Description
0-7	00 = No system processor check FF = System processor machine check

T6117 and T6118
Storage Tests

These TUs test the storage on the controller card.

Result Byte 1

Bit(s)	Description
0	TU failed
1	Attachment processor check
2	Attachment processor cycle steal of registers failed
3	Attachment processor status sense failed
4	TU did not execute
5	Error during TU cycle steal
6	Load attachment processor IMPL failed
7	Run attachment processor IMPL failed

Result Byte 2

Bit(s)	Description
0-7	00 = No system processor check FF = System processor machine check

TC235
I/O Channel Lines Test

This TU tests the I/O DBO lines using 10 data patterns, and the I/O CBO lines using IOS (I/O sense) instructions that are valid and IOCS (I/O controller sense) instructions that are not valid.

Result Byte 1

Bit(s)	Description
0	Device address not valid
1	No I/O DBI parity check on IOCS instruction
2	I/O DBI parity check on IOS instruction
3-7	Not used

TC236
Adapter Wrap Test

This TU tests the I/O DBI lines to the adapter card using six data patterns. This wrap test sends data through the transmit buffer and the serdes to the receive buffer.

Result Byte 1

Bit(s)	Description
0	I/O DBI parity check occurred
1	I/O DBO parity check occurred
2-7	Not used

70-420 (continued)
TU Descriptions

TC237
Adapter Reset Test

This TU performs an adapter reset and senses the results.

Result Byte 1

Bit(s)	Description
0	Program interrupt request set
1	Operation end set
2	Any check set
3	Not used
4	End of block set
5	'Carry detect' latch set
6	'Load active' latch set
7	Header transfer active set

Result Byte 2

Bit(s)	Description
0	'Spare' latch set
1	Diagnostic mode set
2	Stop clock set
3-5	Not used
6	Delayed transmit enabled set
7	Sample receive enable set

Result Byte 3

Bit(s)	Description
0	Serdes time-out check
1	Receive length check
2	Receive buffer overrun
3	Serial parity check
4	Driver active check
5	'Operation active' latch set
6	'Transmit enable' latch set
7	'Receive enable' latch set

TC238
Set/Reset Latch Test

This TU tests the 'spare' latch, the 'program request' latch, and diagnostic mode (which also tests the 'operation active' latch) using the correct I/O commands and an adapter reset.

Result Byte 1

Bit(s)	Description
0	'Spare' latch not set
1	Diagnostic mode not set
2	'Operation active' latch not set
3	'Program request' latch not set
4	'Spare' latch not reset
5	Diagnostic mode not reset
6	'Operation active' latch not reset
7	'Program request' latch not reset

Result Byte 2

Bit(s)	Description
0	Adapter reset did not reset latches
1	Not valid condition set
2-7	Not used

TC239
Diagnostic Serdes Test

This TU sends data through the address buffer and the transmit buffer to the serdes, shifts the data in the serdes, then senses the results in the receive buffer.

Result Byte 1

Bit(s)	Description
0	Receive buffer data in error
1	Serdes bits in error
2-7	Not used

TC23A
Program Interrupt Test

This TU tests whether interrupt levels 3 and 4 can be set, reset, enabled, and disabled using I/O commands and an adapter reset.

Result Byte 1

Bit(s)	Description
0	Interrupt level 3 request failed
1	Interrupt level 4 request failed
2	Reset interrupt level 3 request failed
3	Reset interrupt level 4 request failed
4	Adapter reset failed
5	Disable interrupt level 3 request failed
6	Disable interrupt level 4 request failed
7	Adapter interrupt waiting

TC23B
Cycle Steal (SICB) Test

This TU tests serial interface control block (SICB) cycle steals and the cycle steal pointer (with the chain bit on and off) by sending a command to a station address that is not valid. Interrupts are disabled during this test.

Result Byte 1

Bit(s)	Description
0	Serdes time-out check
1	Receive length check
2	Receive buffer overrun
3	Serial parity check
4	Operation end did not occur
5	Any check set
6	Cycle steal pointer error
7	Channel check

TC23C
Cycle Steal Byte Counter Test

This TU tests whether the cycle steal byte counter is decreased correctly for each SICB cycle steal using a write data command to a station address that is not valid. Interrupts are disabled during this test.

Result Byte 1

Bit(s)	Description
0	Carry detect not set
1	Carry detect not reset
2-7	Not used

TC23D
Hardware Interrupt Test

This TU tests whether hardware interrupts (levels 3 and 4) can be set, reset, enabled, and disabled using I/O commands and an adapter reset.

Result Byte 1

Bit(s)	Description
0	Interrupt level 3 hardware request failed
1	Interrupt level 4 hardware request failed
2	Reset interrupt level 3 request failed
3	Reset interrupt level 4 request failed
4	Adapter reset failed
5	Disable interrupt level 3 request failed
6	Disable interrupt level 4 request failed
7	Not used

TC23E
Receive Mode Test

This TU tests whether the 'receive enable' latch and the 'sample receive enable' latch are set correctly when the turnaround bit in the SICB is set.

Result Byte 1

Bit(s)	Description
0	'Receive enable' latch not set
1	'Sample receive enable' latch not set
2	Operation end not set
3	Serdes time-out not set
4-7	Not used

TC23F
Driver and Receiver Test

This TU tests whether the driver and receiver circuits are working correctly by transmitting a command to each station address 0 and sensing the results.

Result Byte 1

Bit(s)	Description
0	Port 0 failed
1	Port 1 failed
2	Port 2 failed
3	Port 3 failed
4	Port 4 failed
5	Port 5 failed
6, 7	Not used

Result Byte 2

Bit(s)	Description
0	Operation end failed
1	Any check
2	Driver active check
3-7	Not used

TC240
Poll System Console

This TU bypasses the controller to poll the system console and senses the results.

Result Byte 1

Bit(s)	Description
0	Program interrupt request set
1	Operation end not set
2	Any check set
3	Not used
4	End of block set
5	'Carry detect' latch set
6	'Load active' latch set
7	Header transfer active set

Result Byte 2

Bit(s)	Description
0	'Spare' latch set
1	Diagnostic mode set
2	Stop clock set
3	Serdes bit 1 set
4	Serdes bit 2 set
5	Serdes bit 3 set
6	'Delayed transmit enable' latch set
7	'Sample receive enable' latch set

Result Byte 3

Bit(s)	Description
0	Serdes time-out check
1	Receive length check
2	Receive buffer overrun
3	Serial parity check
4	Driver active check
5	'Operation active' latch set
6	'Transmit enable' latch set
7	'Receive enable' latch set

70-420 (continued)
TU Descriptions

TC241 (Attachment 1 Only)
Adapter Checks Test

This TU tests whether the following error conditions can be set and reset correctly: serial parity check, receive length check, receive buffer overrun, serdes time-out check, any check, and reset adapter check.

Result Byte 1

Bit(s)	Description
0	Any check failed
1	Serial parity check failed
2	Receive length check failed
3	Receive buffer overrun failed
4	Serdes time-out check failed
5	Reset adapter check latches failed
6	Reset interrupt level 4 request failed
7	Interrupt did not occur

TC242
Cycle Steal Register Select Test

This TU tests whether an adapter cycle steal operation uses the cycle steal register selected with the start command. All registers are tested to determine if they were updated correctly. Both main storage and control storage cycle steals are tested.

Result Byte 1

Bit(s)	Description
0	Select register 4 failed
1	Select register 5 failed
2	Select register 6 failed
3	Select register 7 failed
4	Control storage cycle steal error
5	Main storage cycle steal error
6, 7	Not used

TC243
Controller Interrupt Test

This TU tests whether interrupts (levels 3 and 4) from the adapter can be sensed by the controller. The SILSB (sense interrupt level status byte) instruction is also tested.

Result Byte 1

Bit(s)	Description
0	Interrupt level 3 did not occur
1	Interrupt level 4 did not occur
2	Interrupt level 3 SILSB error
3	Interrupt level 4 SILSB error
4	Interrupt was not reset
5-7	Not used

TC244 (Attachment 1 Only)
Controller Poll System Console

This TU uses the controller to poll the system console and senses the results.

Result Byte 1

Bit(s)	Description
0	Program interrupt request set
1	Operation end not set
2	Any check set
3	Not used
4	End of block set
5	'Carry detect' latch set
6	'Load active' latch set
7	Header transfer active set

Result Byte 2

Bit(s)	Description
0	'Spare' latch set
1	Diagnostic mode set
2	Stop clock set
3	Serdes bit 1 set
4	Serdes bit 2 set
5	Serdes bit 3 set
6	'Delayed transmit enable' latch set
7	'Sample receive enable' latch set

Result Byte 3

Bit(s)	Description
0	Serdes time-out check
1	Receive length check
2	Receive buffer overrun
3	Serial parity check
4	Driver active check
5	'Operation active' latch set
6	'Transmit enable' latch set
7	'Receive enable' latch set

TC246
Controller Setup Test

This TU tests whether an initial address can be loaded to the controller. This TU also tests whether transparent mode can be set and reset.

Result Byte 1

Bit(s)	Description
0	Initial address load failed
1	Set transparent mode failed
2	Reset transparent mode failed
3-6	Not used
7	Base cycle steal active

TC247 (Attachment 1 Only)
MDI Valid Stop Display

This TU causes a valid stop message to be displayed on the system console at the end of the work station diagnostic program.

TC248
Controller Storage Size Test

This TU displays a message if the work station controller storage size does not match the configuration.

TC249 (Attachment 2 Only)
MDI Valid Stop Display

This TU causes a valid stop message to be displayed on the system console at the end of the work station diagnostic program.

TC291 (Attachment 2 Only)
Adapter Checks Test

This TU tests whether the following error conditions can be set and reset correctly: serial parity check, receive length check, receive buffer overrun, serdes time-out check, any check, and reset adapter check.

Result Byte 1

Bit(s)	Description
0	Any check failed
1	Serial parity check failed
2	Receive length check failed
3	Receive buffer overrun failed
4	Serdes time-out check failed
5	Reset adapter check latches failed
6	Reset interrupt level 4 request failed
7	Interrupt did not occur

TC294 (Attachment 2 Only)
Controller Poll Test

This TU uses the controller to poll address 0 port 6.

Result Byte 1

Bit(s)	Description
0	Program interrupt request set
1	Operation end not set
2	Any check set
3	Not used
4	End of block set
5	'Carry detect' latch set
6	!Load active! latch set
7	Header transfer active set

Result Byte 2

Bit(s)	Description
0	'Spare' latch set
1	Diagnostic mode set
2	Stop clock set
3	Serdes bit 1 set
4	Serdes bit 2 set
5	Serdes bit 3 set
6	'Delayed transmit enable' latch set
7	'Sample receive enable' latch set

Result Byte 3

Bit(s)	Description
0	Serdes time-out check
1	Receive length check
2	Receive buffer overrun
3	Serial parity check
4	Driver active check
5	'Operation active' latch set
6	'Transmit enable' latch set
7	'Receive enable' latch set

70-430
System Test

Any locally attached work station or combination of work stations can be tested with system test. System test may be useful in causing an intermittent failure to occur again. Errors that occur during system test are recorded in ERAP.

System test must be run on a dedicated system (no customer job running under SSP).

- To run system test, see 01-720.
- To display the system test results, see 01-725.

70-440
Verification Tests

Verification tests are online tests that run concurrently with customer jobs. These tests permit the CE/CSR to test functions performed at all levels of the work station subsystem: work station, work station attachment, SSP, and application program. The verification tests are useful in causing a failure to occur again when an intermittent or customer problem is suspected. The following functions can be checked using the verification tests:

- Displaying all characters and attributes that can be displayed
- Verifying the operation of the Roll and Cmd keys
- Verifying the operation of all data keys
- Displaying and entering data into several field types
- Printing patterns on work station printers using all printer commands
- Displaying existing local and remote work station configurations

To run the verification tests, see 01-535.

70-450
Free-Key Mode

In free-key mode, information from the keyboard is displayed on the display screen. The information is sent from the keyboard to the attachment. The attachment decodes the information and sends it back to the display screen.

Free-key mode lets the CE/CSR test the work station subsystem from the attachment to the work station. In free-key mode:

- All of the screen is specified as a single input field.
- All keys (alphameric and function) that are normally interpreted by the work station controller will perform their normal function.
- Operator errors sensed during normal operation are also sensed and displayed in free-key mode.
- Keys that need system action will cause an operator error.

To use free-key mode, see 01-550.

70-460
Network Analysis Program

The network analysis program supplies the CE/CSR with a detailed report on the status of the local work station network. All cable and station addresses are reported with information such as response, no response, parity check, length check, and so on.

The network analysis program must be run on a dedicated system under the diagnostic control program (DCP). This test assumes that the keyboard/display assigned as the system console is working correctly.

To run the network analysis program, see 01-530.

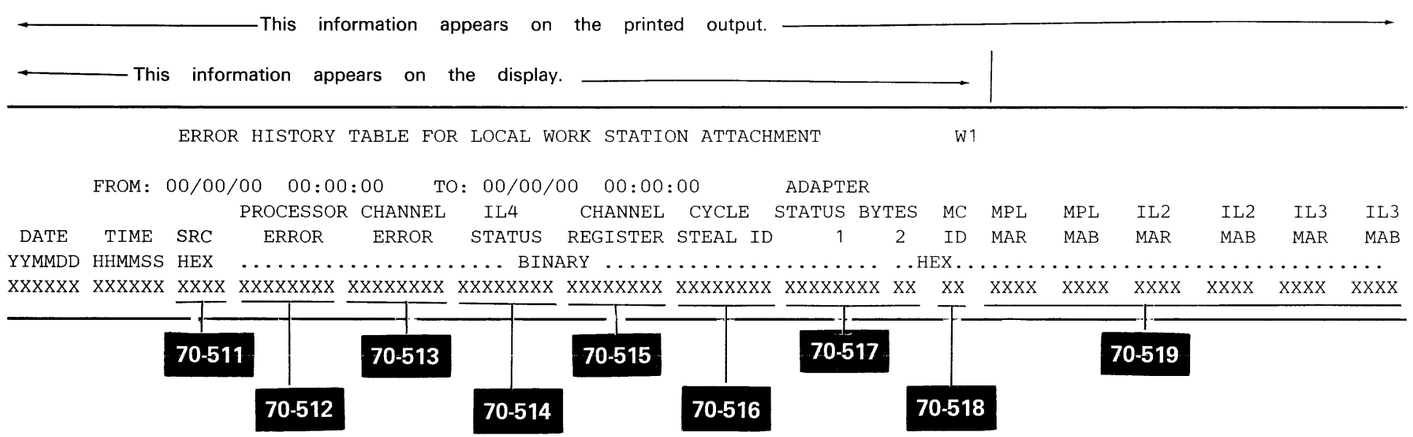
HOW TO INTERPRET ERAP REPORTS

70-500
Error History Table

The error history table can be displayed on the console or printed on the system printer. See 01-360 for information on how to run ERAP.

- See 70-510 for the work station attachment error history table.
- See 70-520 for the keyboard/display or work station printer error history table.

70-510
Attachment Error History Table



70-511
System Reference Code

This field contains the system reference code (SRC) that is generated when an error occurs. See MAPs 0113, 0114, 0115, and 0116 for a list of the system reference codes.

70-512
Processor Error

Bit(s)	Description
0	Storage Parity Check An internal parity error occurred in the controller card storage.
1	3-Second Time-out The processor on the controller card went into a loop while executing microcode instructions.
2	LSR Parity Check A parity error occurred in an internal register on the controller card.
3	Storage Address Not Valid The storage address used for a controller card read/write operation was higher than the maximum storage configuration.
4	4-Second Time-out This error is the same as a 3-second time-out, except a WSC processor check is set. See 70-514, bit 1.
5-7	Machine Check Level These bits indicate which level the controller card processor was in at the time the failure occurred. *5 6 7* 0 0 0 Interrupt level 5 0 0 1 Base cycle steal/interrupt level 4 0 1 1 Base cycle steal/interrupt level 3 1 0 0 Interrupt level 2 1 0 1 Bus coupler cycle steal/interrupt level 1 1 1 1 Main level

70-513
Channel Error (Controller-to-Adapter Interface)

Bit(s)	Description
0	DBO Parity Check A parity error was sensed by the adapter card on the '-I/O DBO bits P, 0-7' lines.
1	Device Address Not Valid The controller sent an instruction to the adapter address but received no answer (the '-I/O service in' line did not go active) in the time permitted (a time-out occurred).
2	DBI Parity Check A parity error was sensed by the controller card on the 'I/O DBI bits P, 0-7' lines.
3	I/O Time-out The adapter card failed to deactivate the '-I/O service in' line in the permitted time (5.3 microseconds after the '-I/O service out' line is activated).
4	SILSB Operation An error occurred during a sense interrupt level status byte (SILSB) instruction from the controller card.
5	System Bus Parity Check A parity error was sensed by the controller card on the '-bi-di DBO/DBI' bus.
6	Cycle Steal Operation An error occurred during a cycle steal operation.
7	Bus Coupler Cycle Steal Operation An error occurred during a bus coupler cycle steal operation. Bit 6 will also be set to 1.

70-514
Interrupt Level 4 Status

Bit(s)	Description
0	Not used.
1	WSC Processor Check The controller card sensed a hardware error while recovering from a machine check error, or a 4-second time-out occurred. See 70-512, bit 4.
2	WSC Machine Check A microcode-forced machine check occurred. See 70-518.
3	WSC Operation End This bit indicates that the attachment completed the requested operation.
4	Not used.
5	Always 0.
6	Not used.
7	Always 0.

70-515
Channel Register (Controller-to-Adapter Interface)

Bit(s)	Description
0-3	Device/Cycle Steal Address Bits 0 through 4 contain the device address during I/O instructions or the cycle steal device ID during data transfers.
4, 5	Bits 4 and 5 describe the controller card as follows: *4 5* 0 0 64K controller card (Bits 6 and 7 contain the EC level) 0 1 EC level (Bits 6 and 7 contain the card storage size) 1 0 EC level (Bits 6 and 7 contain the card storage size)
6, 7	Bits 6 and 7 contain the EC level of the controller card (bits 4 and 5 = 00); or the storage size of the controller card as follows: *6 7* 0 0 16K words 0 1 Not used 1 0 48K words

70-516
Cycle Steal ID

Bit(s)	Description
0	Bus coupler cycle steal active.
1	Interrupt level 3 (work station attachment) cycle steal active.
2	Main program level (work station attachment) cycle steal active.
3	Always 0.
4-7	Not used. These bits can be on or off.

70-517
Adapter Status Bytes

Byte 1

Bit(s)	Description
0	Serdes Time-out Check A time-out on a data transmission occurred, or data expected from a work station was not received. The time permitted is 128 microseconds.
1	Receive Length Check The data received by the controller on a receive operation was either more or less than expected.
2	Receive Buffer Overrun Check The adapter card's 1-byte receive buffer was not emptied, and the serdes was ready to load another byte of data into the buffer.
3	Serial Parity Check This error indicates that bad (odd numbered) parity was received from the work station.
4	Driver Activity Check The transmit operation failed because of an adapter card, twinaxial cable, or work station failure.
5	Operation Active This bit indicates that the adapter card received a start command from the controller card.
6	Transmit Enable This bit indicates that the adapter card was in transmit mode when the failure occurred.
7	Receive Enable This bit indicates that the adapter card was in receive mode when the failure occurred.

Byte 2

Bit(s)	Description
0	Programmed Interrupt This bit indicates that a program request interrupt condition has been set on the adapter card.
1	Cycle Steal Operation End This bit is set when a serial operation is completed.
2	Any Check This bit is set if any of the five checks in adapter status byte 1 (bits 0-4) occur.
3	1-Millisecond Timer Interrupt A 1.02-millisecond timer interrupt condition was set in the adapter card.
4	End of Block This bit is set when the last frame is received from the work station.
5	'Carry detect' latch set.
6	'Load active' latch set.
7	'Header transfer active' latch set.

70-518
Machine Check ID

Bit(s)	Description
0-7	This byte describes the type of machine check (70-514, bit 2). Only the following hexadecimal values are valid. 00 = Hardware failure. 02 = Interrupt level 5 condition not valid. 05 = An instruction was executed that was not valid. 0A = Adapter card data failure.

70-519
Instruction Registers

MPL MAR

Bit(s)	Description
0-15	Bytes 12 and 13 contain the main program level machine address (in controller card storage) of the instruction that was executing when the failure occurred.

MPL MAB

Bit(s)	Description
0-15	Bytes 14 and 15 contain the main program level return address (in controller card storage) of the instruction that was executing when the failure occurred.

IL2 MAR

Bit(s)	Description
0-15	Bytes 16 and 17 contain the interrupt level 2 machine address (in controller card storage) of the instruction in interrupt level 2 that was executing when the failure occurred.

IL2 MAB

Bit(s)	Description
0-15	Bytes 18 and 19 contain the interrupt level 2 return address (in controller card storage) of the instruction in interrupt level 2 that was executing when the failure occurred.

IL3 MAR

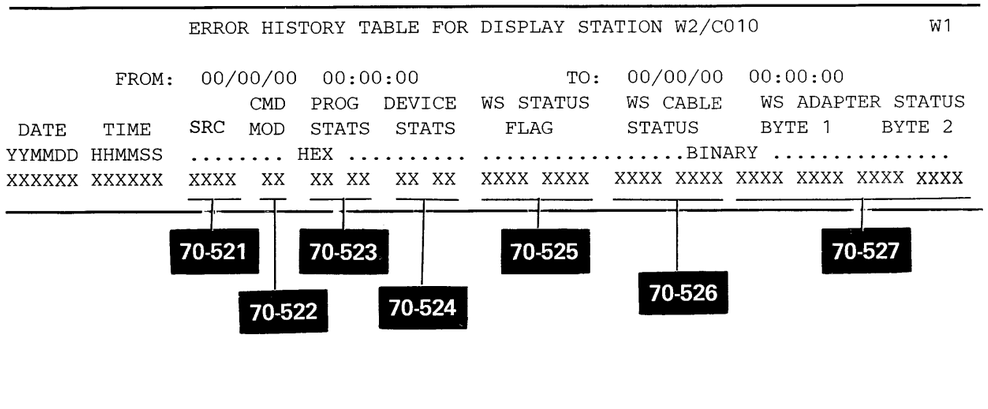
Bit(s)	Description
0-15	Bytes 20 and 21 contain the interrupt level 3 machine address (in controller card storage) of the instruction in interrupt level 3 that was executing when the failure occurred.

IL3 MAB

Bit(s)	Description
0-15	Bytes 22 and 23 contain the interrupt level 3 machine return address (in controller card storage) of the instruction in interrupt level 3 that was executing when the failure occurred.

70-520
Device Error History Table

The error history table shown on this page is for a keyboard/display. The error history table for a work station printer has the same format. If the Test Request key or TESTREQ procedure is used to display the error history table, see the local work station maintenance manual to interpret the table.



70-521
System Reference Code

This field contains the system reference code (SRC) that is generated when an error occurs. See MAPs 0113, 0114, 0115, and 0116 for a list of the system reference codes.

70-522
Command Modifier

Bit(s)	Description
0-7	This byte contains the work station control field command modifier. Only the following hexadecimal values are valid. 02 Save screen 22 Read modified fields 27 Output data stream 42 Read input fields 62 Read screen 33 Set operator indicators 40 Clear printer 43 Reset operator indicators 81 Configure new work stations 82 Read device configuration table A7 Output/invite

70-523
Program Status

Byte 1 (Hex)	Byte 2 (Hex)	Description
01		Data Stream Reject The data in the output data stream was not valid. Program status byte 2 describes the error.
	01	The byte count in the IOB control field contained a number that caused the output data stream to end too soon.
	02	The row or column address was not valid.
	03	The address specified in a repeat-to-address order was valid, but it was less than the current value in the display address register.
	04	Either an escape character (hex 04) was missing, or the command byte was not valid.
	05	The length bytes following the start-of-field order were 0.
	06	An attempt was made to specify an input field with a starting address that was less than, or equal to, the starting address of an input field already specified in the format table. The error was sensed during a start-of-field order.
	07	Either a restore command was sent to the wrong display station, or there was not enough information following the command.
	08	An attempt was made to specify an input field that extended past the end of the display screen area. The error was sensed during a start-of-field order.
	09	Too many input fields were specified in the format table.
	0A	An attempt was made to write data past the end of the display screen area.
	0B	The parameter byte following the start-of-header order was not hex 03.
	0C	One of the 3 parameter bytes following the roll command was not valid.
	0D	The starting field attribute or field format word was either missing or not valid.
	0E	The load work station RAM command was not valid.
	0F	The parameter byte following the clear unit alternate command was not hex 40 or hex 00.
02		Work Station Control Field Error The work station control field contained data that was not valid. Program status byte 2 describes the error.
	01	The command modifier was not valid.
	02	The byte count was not valid. The byte count was either 0 for a keyboard/display, or it was between 256 and 4097 for a work station printer.
	03	The device address was not valid.
	04	The byte count for read input fields was not equal to the number of field positions.
03		Resources Not Available Program status byte 2 describes why the work station was not available.
	01	The print buffers were full.
	02	The device was in error mode and was not operational.
	03	The work station was offline.
	05	The keyboard/display was in operator error mode or system request mode.
	06	The read input fields command was rejected because the keyboard was not locked.
04		Screen Format Error An input field was not specified correctly. Program status byte 2 describes the error.
	01	An input field length error was sensed during a read input fields operation, or during keyboard entry into this field: – The field length was 0. – The field had no ending screen attribute. – The signed numeric field was 1 byte long. – The field read was not the same length as the field defined.
	02	A resequence error in the format table during a read input fields operation was caused by either of the following: – The resequence number was 0. – The resequence number was larger than the number of fields specified on the display screen.
	04	The shift character was either missing, or it was not in the correct place in an IGC open field.
05		Configuration Error A configuration error occurred for one of the following reasons.
	02	The data stream byte count was not valid.
	03	The device address was not valid.
	04	The device address was already configured.
	05	An attempt was made to configure too many work stations.
06	00	The work station printer was not initialized.

70-524
Device Status

Byte 1 (Hex)	Byte 2 (Hex)	Description
		Device status bytes 1 and 2 contain device status that was logged when a failure occurred. If device status byte 1 is equal to hex 04, 05, 06, or 07, status byte 2 will give more information about the failure.
01		An activate command failed.
02		Even/Odd Time-out Status response to the controller did not change in 225 milliseconds after the work station received a poll command with a positive answer and a not busy response.
03		Busy Time-out The busy bit is always on, or it was on longer than 400 milliseconds.
04	xx	Scan Code Not Valid Byte 2 contains the bad scan code.
05		Magnetic Stripe Reader Error
	00	A magnetic stripe reader is not installed.
	80	The magnetic stripe reader does not have data.
06		Printer Unit Error Type 1
	01	A graphic check occurred.
	02	An end of forms check occurred.
	04	The printer is not ready (5256 only).
	08	Cancel request.
	10	Print complete (not an error).
	20	Print buffers full (not an error).
	40	The printer data stream parameter is not valid.
	80	The printer data stream command is not valid.
07	xx	Printer Unit Error Type 2 A printer hardware error occurred. For more information, see the maintenance manual for your work station printer. The error information can be found under error codes, status, printer statistics, or a similar heading.

70-525
Work Station Status Flag

Bit(s)	Description
0	Command complete
1	Modify data tag
2	Error status present in the work station control field
3	Attention identifier present in the work station control field
4	Program Error The program status bytes (70-523) describe the type of error.
5	Twinaxial Error The twinaxial status bytes (70-526) describe the type of error.
6	Adapter Error The adapter status bytes (70-517) describe the type of error.
7	Device Error The device status bytes (70-524) describe the type of error.

70-526
Work Station Cable Status

Bit(s)	Description
0	Device busy (not an error)
1	Line parity check
2	Unit not available (printer only)
3	Outstanding status (not an error)
4-6	Exception status bits 4, 5, and 6 have the following meanings: *4 5 6* 0 0 1 Keyboard/display: null or attribute error Work station printer: activate lost without a parity check 0 1 0 Activate command not valid 1 0 0 Command or device ID not valid 1 0 1 Input queue or storage overrun 1 1 0 Register value not valid (keyboard/display only) 1 1 1 Power-on transition
7	Response level (not an error)

70-527
Work Station Adapter Status

See adapter status bytes 1 and 2 of the attachment error history (70-517) for a description of the bits.

70-530
I/O Counter Table

An I/O counter table can be displayed on the console or printed on the system printer. The I/O counter table is used for each keyboard/display and work station printer and shows the number of supervisor calls (SVCs) for the selected device. See 01-360 for information on how to run ERAP.

FRU Descriptions

70-610 Controller Card

The controller card is located in the A-A1H2 position (A-A3S2 for second attachment). This card contains a bus coupler, a processor, and the read/write storage used by the processor.

The bus coupler 1 (system channel interface block on WH100 and WS300):

- Decodes I/O instructions from the control storage processor or the work station process or
- Determines the direction of data transfer
- Lets the control storage processor communicate directly with the adapter card for diagnostics, bypassing the processor on the controller card

The processor 2 (I/O channel interface, processor controls, I/O channel control selector, and internal controller bus selector blocks on WH100 and WS300):

- Uses the same basic instruction set as the control storage processor
- Executes the work station attachment microcode to control attachment operations
- Receives and interprets commands and data from the control storage processor through the channel and bus coupler
- Sends the necessary commands to the adapter card to perform the specified operation

The storage 3 (memory controls and RAM storage blocks on WH100 and WS300):

- Contains the work station attachment microcode that is loaded by the control storage processor
- Contains the working storage needed by the processor

70-620 Adapter Card

The adapter card is located in the A-A1J2 position (A-A3T2 for second attachment). The adapter card contains adapter control logic, serdes and control logic, modulate/demodulate logic, driver/receiver logic, and transient protect logic.

The adapter control logic 4 (16-MHz oscillator, clock generator, adapter control and buffers, and adapter checks blocks on WJ100 and WT300):

- Controls the operation and timing of the adapter card
- Starts data transfers between the adapter card and the controller card
- Decodes instructions from the controller card
- Selects the driver/receiver to be used
- Senses and records error conditions

The serdes and control logic 5:

- Assembles the 16-bit frames sent to the work station
- Contains a 12-bit shift register that serializes data sent to the work station and deserializes data received from the work stations
- Controls the operation of the serdes
- Puts zero-fill bits between frames sent to the work station

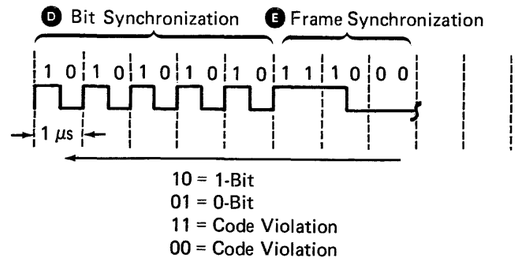
The modulate/demodulate logic 6:

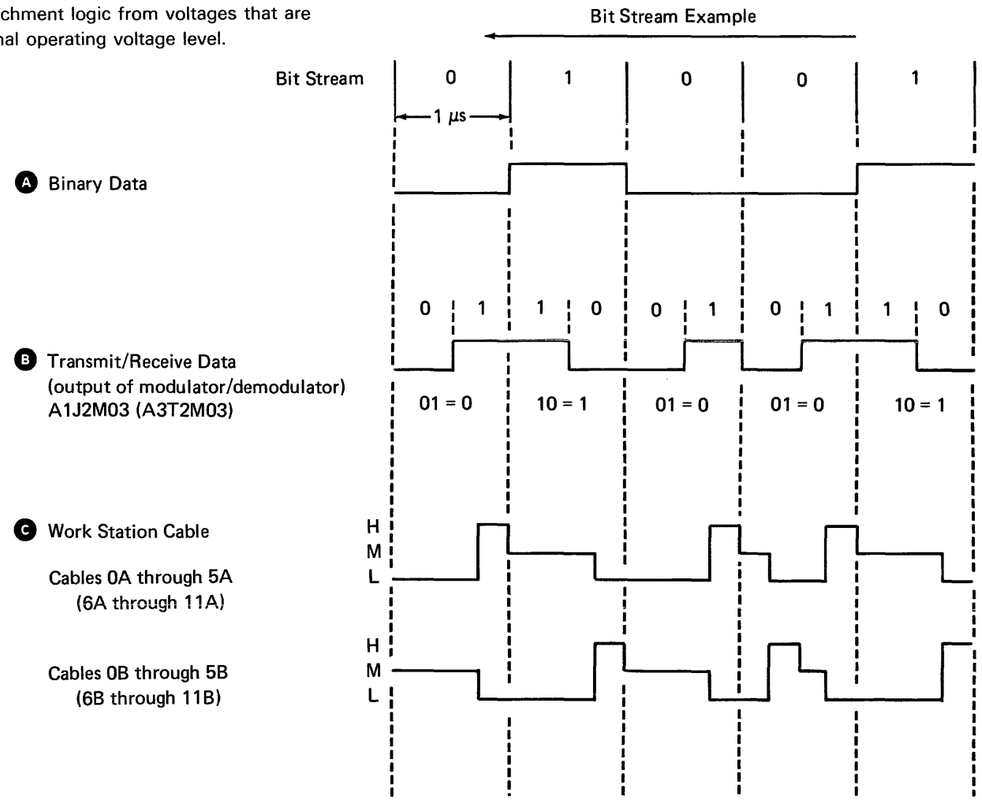
- Generates or senses the bit and frame synchronization
  - Bit synchronization (D) precedes the data that is sent to the work station. The bit synchronization bits are five 1-bits that inform the work station to check for the frame synchronization.
  - Frame synchronization (E) precedes the sync bit of the first transmitted frame.
- Changes the data sent to the work station from binary data (A) to transmit data (B)
- Changes the data received from the work station from receive data (B) to binary data (A)

The driver/receiver logic 7:

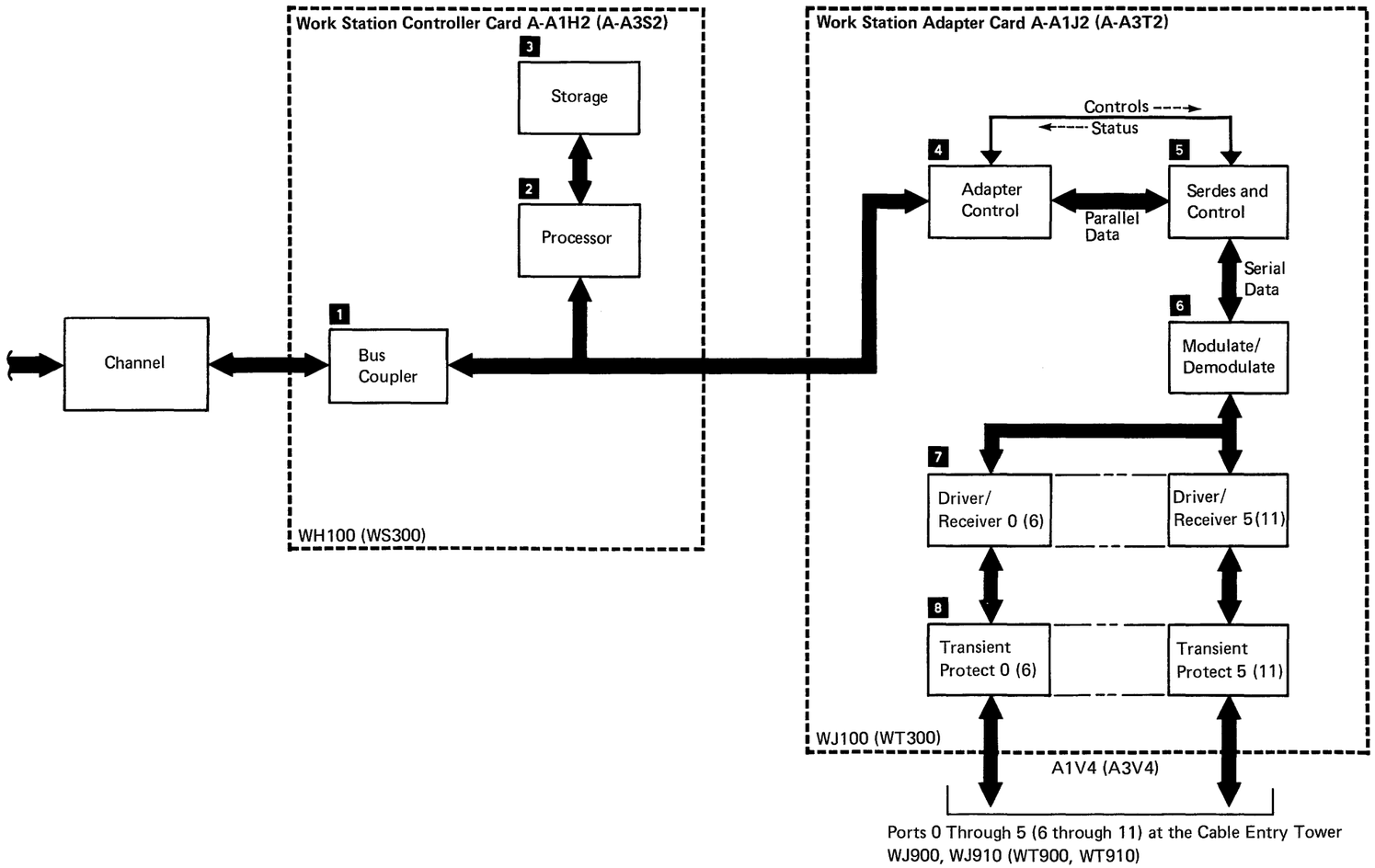
- Changes the two-level voltage signal (B) (transmit data) from the modulator/demodulator to a three-level voltage signal (C) that is placed on the work station cable
- Changes the three-level voltage signal (C) from the work station cable to a two-level voltage signal (B) (receive data) that is sent to the modulator/demodulator

The transient protect logic 8 is a group of diodes that protects the attachment logic from voltages that are outside the normal operating voltage level.





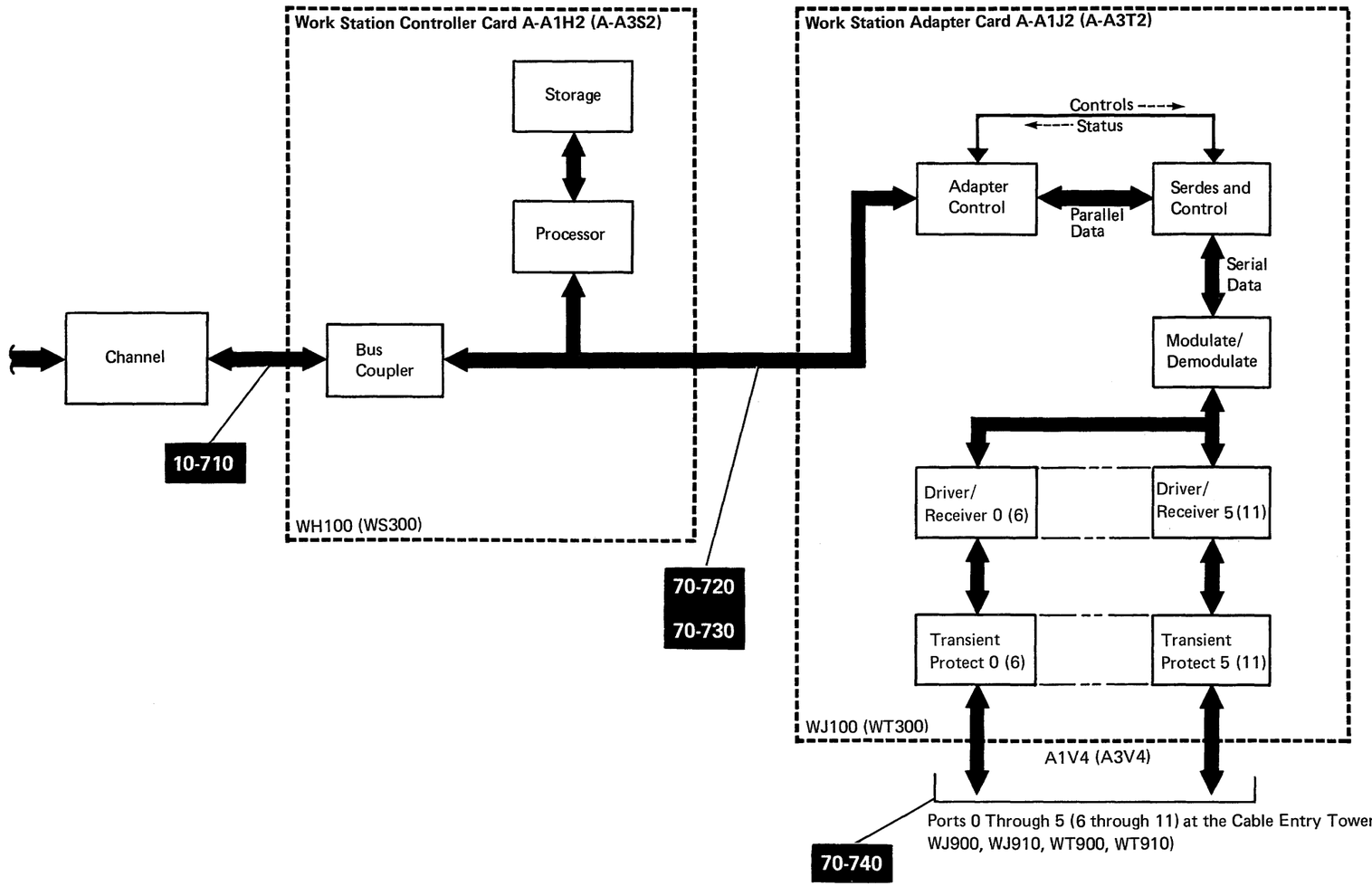
Note: H means high, M means medium, and L means low.


Work Station Controller Card A-A1H2 (A-A3S2)
3
Storage
2
Processor
1
Bus
Coupler
Channel
WH100 (WS300)
Work Station Adapter Card A-A1J2 (A-A3T2)
Controls
Status
4
Adapter
Control
5
Serdes and
Control
Parallel
Data
Serial
Data
6
Modulate/
Demodulate
7
Driver/
Receiver 0 (6)
Driver/
Receiver 5(11)
8
Transient
Protect 0 (6)
Transient
Protect 5 (11)
WJ100 (WT300)
A1V4 (A3V4)
Ports 0 Through 5 (6 through 11) at the Cable Entry Tower
WJ900, WJ910 (WT900, WT910)

Interface Descriptions

70-710
Interface Locations

See the figure on this page to determine which interfaces are being described and where you can find the description for each interface.



70-720
Controller Interface

The test unit (TU) in the reference column indicates a TU to loop when probing an interface signal.

Controller-to-Adapter Interface Signals

Signal Name	Description	Reference
-I/O CBO 0-2	These lines, together with the '-I/O control out' and '-I/O service out' lines, indicate the type of data that is on the DBO lines. The decode for 0-2 is: 000 SCSID (sense cycle steal ID) 001 SILSB (sense interrupt status) 100 IOL (load) 101 IOS (sense) 110 IOCL (control load)	TC235
-I/O control out	When active, this line indicates to the adapter that the CBO bus contains information to define either a base cycle steal or an I/O instruction. This line can also be used with the '-I/O service out' line to force the adapter off the channel.	TC235
-I/O DBO P, 0-7	These lines contain data from the channel interface to the adapter during I/O load and I/O control load instructions, and during single byte cycle steal operations.	TC235
-I/O service out	During an input operation (data from the adapter to the controller), this line indicates to the adapter that the data on the DBI lines has been recognized and that the adapter can either present new data or terminate the transfer.	TC235
	During an output operation (data from the controller to the adapter), this line indicates to the adapter that the data on the DBO lines is valid. This line remains active as long as the data on DBO is valid.	TC235
-I/O strobe	This line supplies a timing pulse for the adapter during I/O instructions and during base cycle steal operations.	TC235

70-720

Adapter-to-Controller Interface Signals

Signal Name	Description	Reference
-I/O ARS bits 6 and 7	These address register select (ARS) lines select the cycle steal address register that points to a location in controller storage.	TC242
-I/O base cycle steal request	This line requests a cycle steal data transfer. Tag bits 0, 1, and 4 and ARS bits 6 and 7 specify the action taken.	TC242
-I/O DBI P, 0-7	These lines contain data from the adapter to the channel interface during I/O sense and during single byte cycle steal operations.	TC236
-I/O interrupt request level 3 and 4	These lines carry interrupt requests from the adapter to the controller to indicate that the adapter needs service from the controller.	TC243
-I/O service in	When active, this line indicates that the adapter has received the command/address information from the controller.	TC236
-I/O tag bit 0	This line controls the selection of the high or low byte for the source or destination storage address. If bit 0 = 1, the high byte is selected. If bit 0 = 0, the low byte is selected.	TC242
-I/O tag bit 1	This line specifies the direction of the data transfer. If bit 1 = 0, the data transfer is from storage to the I/O device. If bit 1 = 1, the data transfer is from the I/O device to storage.	TC242
-I/O tag bit 4	When this line is not active (bit 4 = 0), the controller ignores the parity bit on the DBI bus.	TC242

70-730
Adapter Input Signals

The test unit (TU) in the reference column indicates a TU to loop when probing an interface signal.

Signal Name	Description	Reference
+A clock	This line is tied to ground (not used by the attachment).	
+B clock	This line is tied to ground (not used by the attachment).	
-Mod isolate in	This line is tied to +5 volts on the card (not used by the attachment).	
+Mod isolate out	This line is tied to ground (not used by the attachment).	
+Scan path (in)	This line is tied to ground (not used by the attachment).	
+System reset	When active, this line indicates to the adapter that it should set its circuits to an initial state.	
+Test receive data	This line is tied to ground (not used by the attachment).	
+Test/select address	This line is tied to ground (not used by the attachment).	
+Tieup A	This line is tied to +5 volts on the card (not used by the attachment).	
+Transmit data (in)	This line is the output of the modulator/demodulator logic and is the input to the driver/receivers.	TC23F
+1.02 ms clock	This is a 1024-microsecond clock that is supplied by the channel.	

70-740
Adapter Output Signals

The test unit (TU) in the reference column indicates a TU to loop when probing an interface signal.

Signal Name	Description	Reference
Cables 0A and 0B through cables 5A and 5B	These lines carry the commands and data to the work stations through the cable entry tower (ports 0 through 5).	TC23F
Cables 6A and 6B through cables 11A and 11B	These lines carry the commands and data to the work stations through the cable entry tower (ports 6 through 11).	TC23F
+S1 clock (out) +S2 clock (out)	These lines supply the timing controls for the adapter card.	
+Transmit data (out)	This line is the output of the modulator/demodulator that is sent to the driver/receivers.	TC235
+16 MHz (out)	The 16-MHz oscillator output is used by the adapter card to generate the !+S1 clock (out)! and the !+S2 clock (out)! lines.	

Sequence of Events

70-810
Processing Unit-to-Attachment Operation

This operation displays data on a keyboard/display or prints data on a work station printer. For more information about the work station controller commands, see the *Functions Reference Manual*.

Processing Unit	Work Station Attachment	Device (Keyboard/Display or Work Station Printer)
1 The main storage program starts an operation to write data to a keyboard/display or print data on a work station printer. See 10-820.		
2 The control storage program issues the necessary I/O commands. See 10-821.		
	3 The controller card activates the '-system base CS request' line.	
	4 The work station control field (WSCF) is sent to the processing unit 1 byte at a time by cycle steal. See 10-825.	
	5 The controller card activates the '-interrupt request level 4' line to indicate to the control storage program that it is done.	
6 The processing unit: • Assembles a new WSCF with the device address and the operation to be performed. • Places the address of the new WSCF and the address of its associated data stream in main storage into work registers 5 and 4 (interrupt level 3), respectively. See 01-225 for information on displaying work registers. • Sends the WSCF to the attachment by cycle steal. Steps 2 through 4 are repeated.		
	7 The controller card: • Decodes the WSCF to determine the device address and operation to be performed. • Moves the data stream from main storage to storage on the controller card by cycle steal. See 10-825. • Analyzes the data stream and assembles serial interface control blocks (SICBs), which are then sent to the adapter card. If the data stream is for a work station printer, the controller card does not analyze it. The work station printer data stream is put into SICB format and sent to the adapter card.	
	8 The adapter card: • Decodes the SICBs to determine the device, the number of bytes, and the operation to be performed. • Assembles the commands and data from the SICB into 16-bit frames to send to the device. • Sends the 16-bit frames to the device byte by byte. See 70-900 for a description of the 16-bit frame and 70-830 for an example of typical transmissions.	
		9 The device: • Decodes the data stream. • Displays or prints the data. • Returns operation complete or error status to the attachment, when requested by the attachment.

Processing Unit	Work Station Attachment	Device (Keyboard/Display or Work Station Printer)
	10 The controller card: • Puts the status in the WSCF. • Sends the WSCF to the processing unit by cycle steal. See 10-825. • Activates the '-interrupt request level 4 line to indicate to the control storage program that it is done.	
11 The processing unit: • Finds the address of the WSCF in work register 5 (interrupt level 3). • Codes the WSCF for operation complete or error status. • Performs steps 1 through 11 for any additional operations. If no additional operations are needed, the WSCF is returned to the controller card and the attachment waits for an operation from a keyboard/display or the processing unit.		

70-820
Attachment-to-Processing Unit Operation

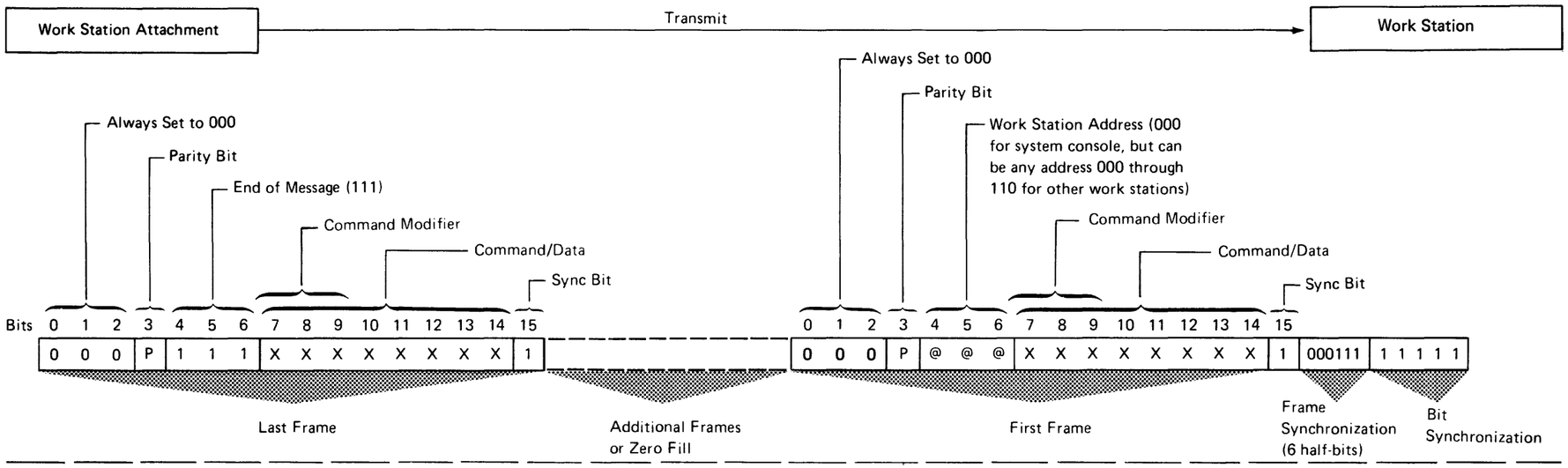
This operation uses the Enter key on the keyboard/display to start the attachment-to-processing unit sequence of events. For more information about the work station controller commands, see the *Functions Reference Manual*.

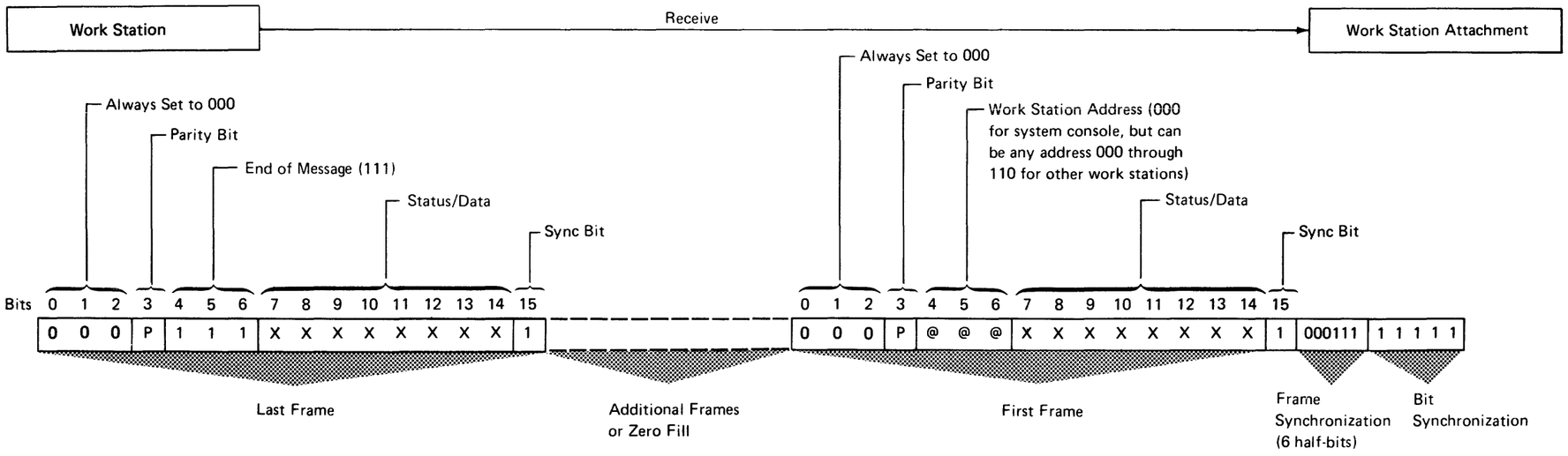
Processing Unit	Work Station Attachment	Keyboard/Display
		1 The Enter key is pressed.
	2 The controller card: • Receives the Enter key request from the keyboard/display. • Places the request in the WSCF. • Activates the '-base CS request' line. • Sends the WSCF to the processing unit by cycle steal. See 10-825. • Activates the '-interrupt request level 4' line to indicate to the processing unit that it is done.	
3 The processing unit: • Decodes the WSCF and finds the Enter key request. • Assembles a new WSCF for a read operation. • Places the address of the new WSCF and the starting address of the buffer to be used into work registers 5 and 4 (interrupt level 3), respectively. • Sends the new WSCF to the attachment by cycle steal. See 10-825.		
	4 The controller card: • Decodes the WSCF to determine the device address and operation to be performed. • Assembles the serial interface control blocks (SICBs) needed for a read operation. • Sends the SICBs to the adapter card.	
	5 The adapter card: • Decodes the SICBs to determine the device and operation to be performed. • Assembles the 16-bit frame needed to start the read operation. See the read data example on 70-830. • Sends the 16-bit frames to the keyboard/display byte by byte.	
		6 The keyboard display: • Decodes the 16-bit frames and determines that a read operation is requested. • Sends the input data byte by byte to the attachment.
	7 The controller card: • Sends the input data to the processing unit by cycle steal. See 10-825. • Activates the '-interrupt request level 4' line when all of the input data has been sent to the processing unit.	
8 The processing unit puts the data in main storage starting at the address contained in work register 4 (interrupt level 3).		

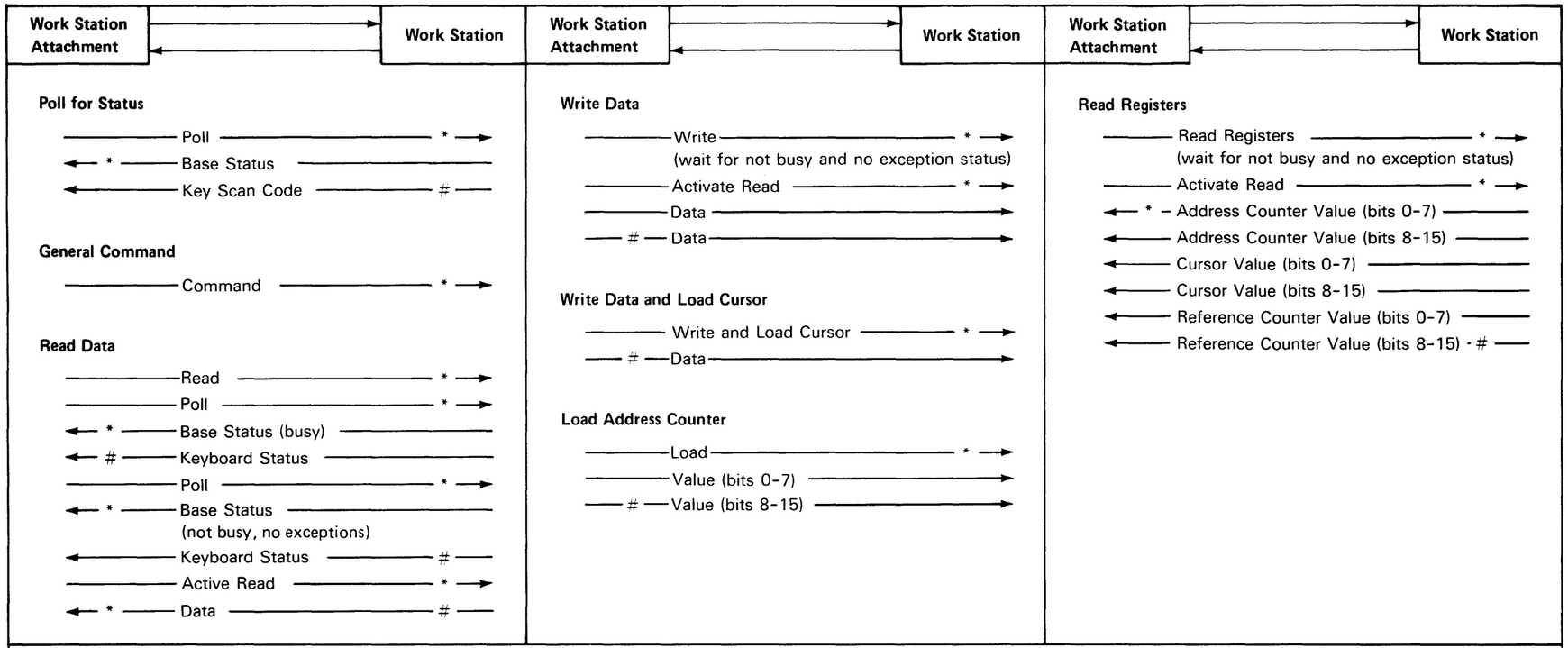
70-830
Command Transmission Example

The work stations do not start the communication to or from the attachment. Instead, the work station attachment starts all communications by the way of commands, and the work stations respond to the commands. For example, if the work station attachment sends an activate read command, the work station responds by returning data to the attachment.

The following chart shows some of the typical commands sent to the work stations and the information that is returned to the attachment.






Work Station Attachment
Work Station
Work Station Attachment
Work Station
Work Station Attachment
Work Station
Poll for Status
Poll
* Base Status
Key Scan Code #
General Command
Command
Read Data
Read
Poll
* Base Status (busy)
# Keyboard Status
Poll
* Base Status
(not busy, no exceptions)
Keyboard Status #
Active Read
* Data #
Write Data
Write
(wait for not busy and no exception status)
Activate Read
Data
Data
Write Data and Load Cursor
Write and Load Cursor
Data
Load Address Counter
Load
Value (bits 0-7)
Value (bits 8-15)
Read Registers
Read Registers
(wait for not busy and no exception status)
Activate Read
* Address Counter Value (bits 0-7)
Address Counter Value (bits 8-15)
Cursor Value (bits 0-7)
Cursor Value (bits 8-15)
Reference Counter Value (bits 0-7)
Reference Counter Value (bits 8-15) # Legend:
* Bit synchronization and frame synchronization bits are generated by the work station attachment or the work station. These bits condition the work station to start receiving a command, or they condition the work station attachment to start receiving data.
# Data stream terminating delimiter that ends the message and causes the work station to expect frame synchronization bits next. For example, under the poll for status command, the message ends as soon as the key scan code is sent to the work station attachment. Then, the work station can expect to receive the frame synchronization bits before receiving any other information.
A 16-bit frame from the work station attachment to the work station.
A 16-bit frame from the work station to the work station attachment.

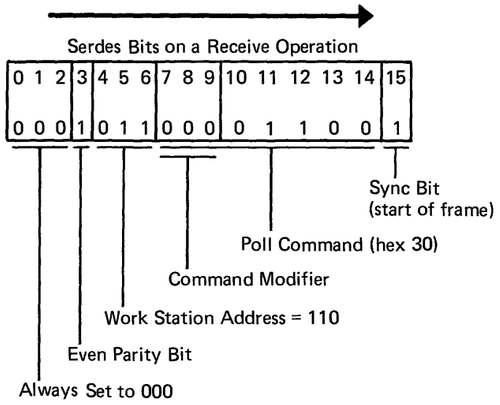
Reference

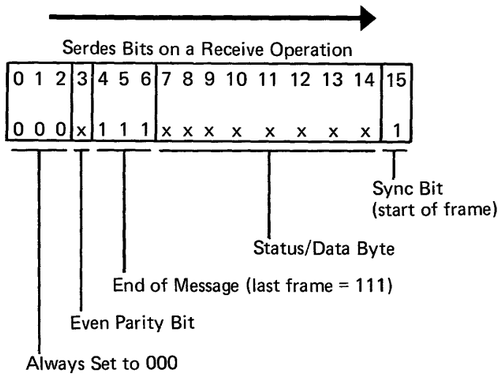
70-900
16-Bit Frame

System/36 communicates with the work stations through a data stream frame. A frame is 16-bits long and is serially transmitted to or received from the work stations. A description of the frame bits is in the following chart.

Bit(s)	Description
0-2	These bits are always set to 000.
3	This bit is generated to make the 16-bit frame contain an even number of bits (even parity) on transmit and receive operations.
4-6	These bits represent the work station address on transmit and receive operations. They also represent an end of message (111) for the last frame on transmit and receive operations.
7-14	These bits represent a data byte or a command byte on transmit operations and a data byte or a status byte on receive operations.
15	Bit 15 is the sync bit and the first bit of the frame. It is always active on transmit and receive operations.

Note: Bits 4, 5, and 6 contain the work station address if the frame is not the last frame received from a work station.





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