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3277 Display Station Models 1 and 2 Troubleshooting Guide

SY27-2314-0

Preface

The IBM 3270 Information Display System consists of control units, display stations, printers, and optional feature devices. This manual contains all the information required to maintain IBM 3277 Display Stations and features such as keyboards, selector-light pen, magnetic card reader, security keylock, and audible alarm. The purpose of this manual is to present maintenance and repair information rather than theory of operation information.

This manual is organized in eight sections. Sections 1 and 2 contain introductory and maintenance background material. Sections 3, 4, and 5 contain the Symptom Index, Troubleshooting Diagrams, and repair data. These three sections contain all diagnostic procedures and repair information necessary to correct a display station malfunction. Miscellaneous reference data is included in Section 6. Section 7 contains location diagrams to aid in identifying and locating the display station components referenced in other sections of this manual. Instructions for installing the display station are presented in Section 8.

To successfully use this manual and repair IBM 3277 display stations, maintenance personnel should have a level of training equivalent to the 3270 system basic FE course. Because the 3277 attaches to both local and remote control units, an understanding of the control unit to which the display station is attached is also helpful.

The titles and form numbers of the two control unit Troubleshooting Guides are listed below under "Companion Manuals". Both Troubleshooting Guides contain a glossary of terms that are applicable to control units and display stations.

Companion Manuals:

- *3271 Control Unit Models 1 and 2 Troubleshooting Guide,* SY27-2311
- *3272 Control Unit Models 1 and 2 Troubleshooting Guide,* SY27-2312

The following publications may also prove useful:

- *An Introduction to the 3270 Information Display System,* GA27-2739
- *IBM 3270 Information Display System Component Description,* GA27-2749

First Edition (May 1972)

This manual, written at EC level 716959, will be subject to change from time to time. Any such change will be reported in subsequent revisions or Technical Newsletters.

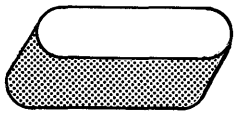
Text for this manual has been prepared with the IBM SELECTRIC ® Composer.

A form is provided at the back of this publication for reader's comments. If the form has been removed, comments may be addressed to: IBM Systems Development Division, Product Publications, Dept. 520, Neighborhood Road, Kingston, N.Y., 12401

Diagrams

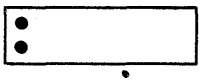
AID	attention identification
ALD	automated logic diagram
ASCII	American Standard Code for Information Interchange
CE	Customer Engineer
CK	check
CNCL	cancel
CPU	control processing unit
CRT	cathode-ray tube
CU	control unit
CW	control word
DEL	delete
DUP	duplicate
EBCDIC	extended binary-coded-decimal interchange code
EOF	end of field
FE	Field Engineering
Ferro	ferro-resonant transformer
FRU	field replaceable unit
HV	high voltage
INS MODE	insert mode
I/O	input/output
KB	keyboard
LV	low voltage
MDT	modified data tag
NL	new line
PA	program access
PC	printed circuit
PCBD	printed circuit board
PF	program function
POR	power on reset
PS	power supply
SLT	solid logic technology
SMS	standard modular system
TB	terminal board
TCU	transmission control unit
TEST REQ	test request
TP	test pattern, test point
VOM	volt-ohmmeter

LEGEND



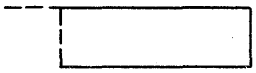
Terminal

Indicates beginning point of a Troubleshooting Diagram.



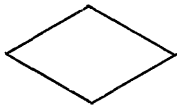
Action

Indicates a major action. When more than one action is described, bullet symbols appear to left of each action.



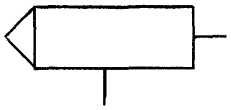
Annotation

Gives descriptive comment or explanatory note.



Decision

Indicates a point in a Troubleshooting Diagram where a branch to alternate data paths is possible.



Probe

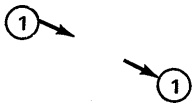
Indicates a point in a Troubleshooting Diagram where a logic pin should be probed with the logic probe. Pin is specified in the symbol. Path to be followed after probing is determined by probe result.

Card Change

Indicates that card or cards specified in symbol should be changed and new ones installed.

Off-Page Connector

Indicates connection point between different sheets of the Troubleshooting Diagrams.

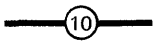


On-Page Connector

Indicates connection between two parts of the same sheet or diagram. Arrow leaving symbol points to correspondingly-numbered symbol (line-of-sight).

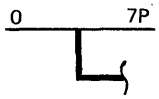
Major Data Path

Minor Data Path or Control Line



Data Bus

Number of lines on bus is identified in circle.



Data Transfer

Identifies data bits transferred to or from a logic element.

Screwdriver Adjustment

Switch

Section 1. Maintenance Approach

1.1 INTRODUCTION

Maintenance of IBM 3277 Display Stations (including repair and adjustment of Model 1 and Model 2 units) and of attached features is described in this manual. Features that can be attached to a 3277 include keyboards, a selector light-pen, and an operator identification card reader.

The objective of display station maintenance is to return the failing unit to customer service as quickly as possible. This manual guides the Customer Engineer through procedures that enable him to adjust or replace a malfunctioning component.

1.1.1 Online/Offline Maintenance

Display Station maintenance and testing can be performed online and/or offline. It is better, however, to service the unit offline when possible because it eliminates the possibility of interaction with other units of the display system. Unnecessary delays in normal customer information processing are thereby avoided. The maintenance approach described in this manual is structured to perform offline analysis first to resolve reported troubles.

1.1.2 Field Replaceable Units (FRU)

Component replacement is limited to certain field-replaceable units (FRU). When the trouble is isolated to an FRU the unit should be replaced immediately rather than repaired. The FRU parts replacement philosophy is practical because functionally packaged logic and densely packed components are used throughout the display station.

1.1.3 Troubleshooting Aids

Several tools are available to the Customer Engineer to simplify trouble analysis. The following paragraphs describe these aids.

1.1.3.1 Symptom Index

The Symptom Index (Section 3) lists (by category) malfunctions that may be encountered on display stations. The categories include such areas as display malfunctions, power malfunctions, keyboard malfunctions, etc. In each category, subcategories specify unique trouble areas. The subcategories direct the Customer Engineer to an entry in the Troubleshooting Diagrams (Section 4), which contain step-by-step isolation procedures. In some cases, the Symptom Index points directly to a replaceable unit causing the problem.

1.1.3.2 Troubleshooting Diagrams

The Customer Engineer is directed to Troubleshooting Diagrams from the Symptom Index. The diagrams detail procedures to isolate a failing FRU or an out-of-tolerance adjustment. The diagrams call out specific checks and observations that should be made during the diagnostic procedure. The logic probe test device is used in many of the diagrammed procedures.

1.1.3.3 Diagnostic Programs

Two types of diagnostic programs may be available to the Customer Engineer. Diagnostic program aids are described in Section 2 of this manual.

1.1.3.4 Customer Engineer Tool Kit

Special tools are not required to maintain 3277 Display Stations. The basic Customer Engineer tool kit, the IBM volt-ohmmeter, and the logic probe can successfully isolate most display station problems. An oscilloscope may be required in some instances when the basic tools fail to resolve a problem.

1.2 TROUBLE ANALYSIS

The sequence in which display station trouble analysis is performed is important in minimizing machine down-time. Diagram 1-1 shows the five-step procedure that should be used to isolate display station failures. The main points of the display station maintenance approach are summarized below.

1.2.1 Obvious Symptoms

Obvious symptoms are those that do not require any operator or Customer Engineer action to become evident. Failures that could cause obvious symptoms to occur include display image quality and positioning, mechanical problems, and component breakage. These failures should be remedied by going directly to the Symptom Index or to the appropriate adjustment or removal procedure in Section 5.

1.2.2 Isolation to a Display Station

If an obvious symptom does not exist on a display station, the cause of the failure must be isolated between the control unit and the display station. Sheet 1 of the Troubleshooting Diagrams describes the procedure for isolating the cause of a failure to either the control unit, connecting coaxial cable, or display station.

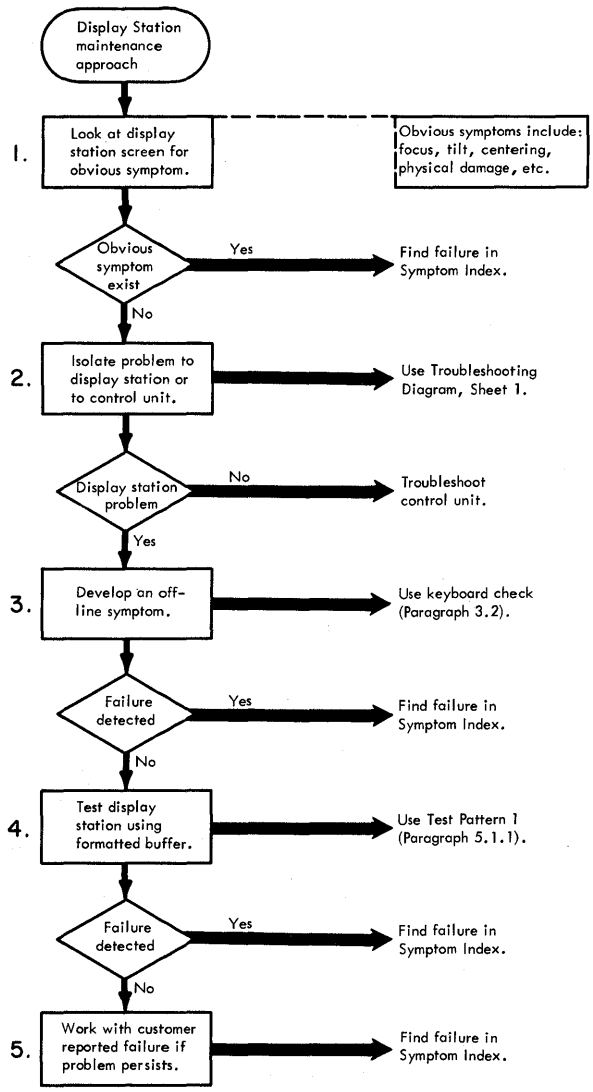


Diagram 1-1. 3277 Maintenance Approach

1.2.3 Offline Symptoms

Once it is determined that the display station is the cause of a failure, an offline symptom should be developed. A quick offline test of the display station is described in paragraph 3.2. That test should expose a repairable symptom. Stop the test as soon as a symptom becomes evident, and match the symptom with one listed in the Symptom Index. The Symptom Index tells what corrective action should be taken.

1.2.4 Formatted Buffer Symptoms

If an offline symptom does not become evident, the entire display station, including features, must be tested with the buffer formatted. The procedure described in paragraph 5.1.1 should be used with Test Pattern 1 to develop a symptom. Stop the test as soon as a symptom becomes evident, and match it in the Symptom Index. The Symptom Index tells what corrective action should be taken.

1.2.5 Customer-Reported Failures

It may be necessary to work with a customer-reported failure if a symptom cannot be developed offline or with Test Pattern 1 using the procedures described in the preceding paragraphs. Try to duplicate the conditions that existed when the customer failure occurred. Match the duplicated symptom in the Symptom Index and perform the corrective action indicated. If the originally reported failure cannot be duplicated, it must be assumed that it was either an operator error or an intermittent failure that has cleared.

1.3 FIELD ENGINEERING TROUBLE REPORT FORM

Always fill out the Trouble Report form provided by Field Engineering Technical Operations, Kingston, when the display station is repaired. Send the completed form to:

IBM Corporation
Attention:
Dept. 020/Bldg. 057-1
Neighborhood Road
Kingston, New York 12401

Forms provided with World Trade Corporation machines should be returned to the proper plant of control as directed on the forms.

This section describes the tools and programmed diagnostic aids used to maintain 3277 Display Stations. A comprehensive description of the logic probe is included because proper use of this tool is essential to successful display station maintenance.

2.1 MAINTENANCE TOOLS

2.1.1 Customer Engineer Tool Kit

The Customer Engineer tool kit contains all basic tools necessary to maintain IBM 3277 Display Stations. The standard IBM volt-ohmmeter (VOM) is adequate for all voltage measurements. The meter's input impedance of 20,000 ohms per volt causes an erroneous reading when checking the 400V dc power supply. This effect is noted when a check of that power supply is called out. When using the VOM, all dc voltage measurements should be referenced to dc return rather than to frame ground. DC return and frame ground are at different levels when the display station is not connected to a control unit.

2.1.2 Oscilloscope

In some cases of trouble analysis, it may be necessary to use an oscilloscope. The Tektronix model 453 oscilloscope, or equivalent, should be used when an oscilloscope is required. However, the logic probe is recommended for use, whenever possible, rather than an oscilloscope.

2.1.3 Logic Probe

The logic probe (PN 453652) is a unique tool provided as a service aid to probe signal levels while using Trouble-shooting Diagrams or FE ALDs. This tool should be obtained from Mechanicsburg by all Customer Engineers who service 3270 units. Normal tool-ordering procedures should be used to obtain the probe.

2.1.3.1 Description

The logic probe (Diagram 2-1) is a self-contained device consisting of an anodized aluminum tube with a red and green indicator incorporated near the probe end. A cable containing two wires and SLT-type push-on terminals leads

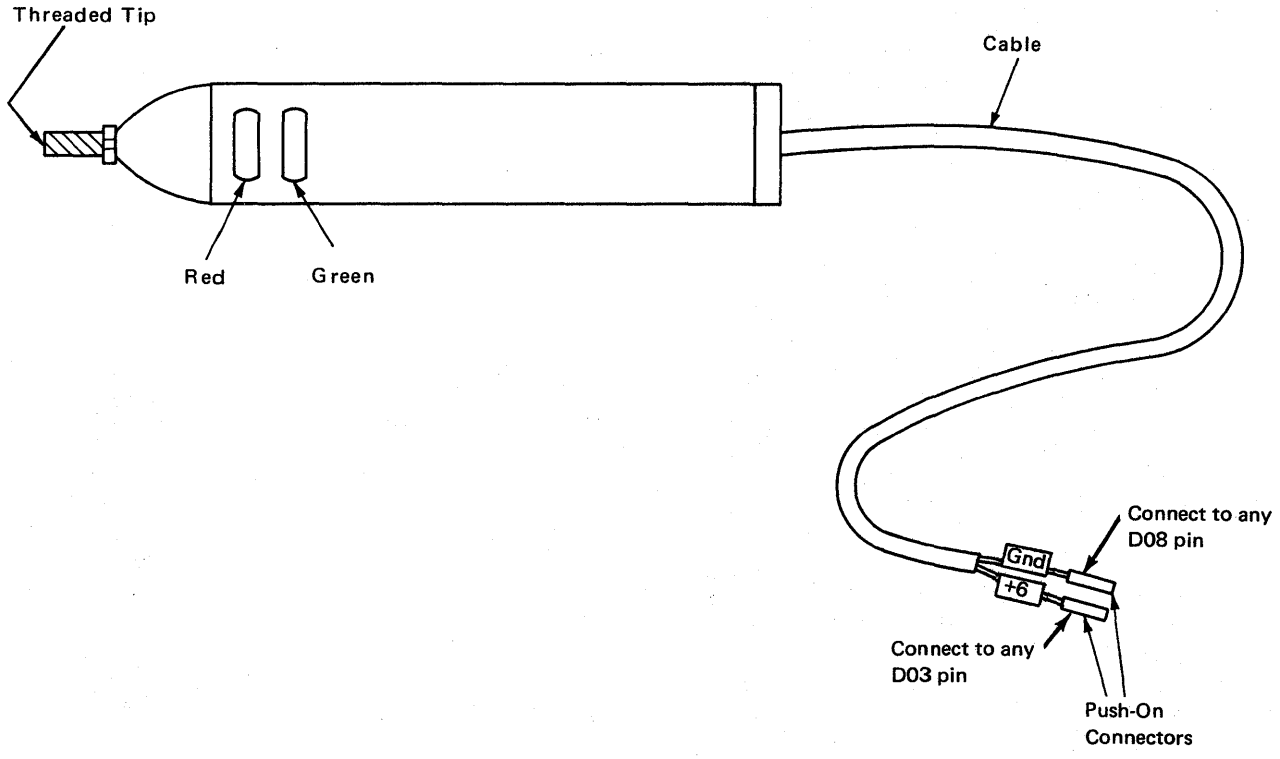


Diagram 2-1. Logic Probe

from the sealed top end of the probe. A plastic head with a threaded stud is at the probe end of the device. Red and green indicators tell the state of the net being probed. The three signal states that can be distinguished are: (1) a solid plus level, (2) a solid minus level, and (3) a pulse or the presence of pulses. The two wires with the SLT-type push-on connectors are attached to pins on the back of the logic board being probed. They carry the operating voltage (+5V dc and ground) for the probe. An oscilloscope probe tip screws on the threaded stud at the tip of the probe. This carries the input signals to the indicators.

2.1.3.2 Probe Usage

To use the logic probe, a probe tip must be attached to the threaded stud. An SLT probe tip (PN 453163, or equivalent) should be used. The two wires at the top of the probe are attached to the back of the logic board being probed. The leads are clearly labeled: GND and +6V. Connect the GND lead to any D08 pin, and connect the +6V lead to any D03 pin (+5V dc). The leads are connected to the board by pushing the connector at the end of each lead onto the designated pin. When the last wire is connected, the red indicator should light. If the indicator does not light, check that the leads are on the correct pins. Try a different probe if the red indicator does not light. A faulty probe or red lamp is the probable cause of the failure.

Connect the oscilloscope probe tip to the pin designated in the Troubleshooting Diagrams or as determined in logic. The following conditions can be observed by the logic probe:

1. Red indication
   a. Probe not attached to a pin (floating condition), or
   b. Plus signal on the net being probed.
2. Green indication – Ground (negative) signal on the net being probed.
3. Red and green indication – A pulsing signal (alternately plus and ground) is present on the net being probed. This condition can appear either as the red and the green indicator pulsing on and off, or as both indicators seemingly on at the same time (depending on the frequency of the pulsing signal). Single pulses can also be seen.

2.1.4 Alignment Mask

Alignment masks are provided for both display station models. The mask is used during all display image adjustments. Diagram 2-2 illustrates the Model 1 alignment mask (PN 2577899), and Diagram 2-3 illustrates the Model 2 alignment mask (PN 2565170). The mask is constructed of thin, clear plastic. Horizontal and vertical lines printed on the mask serve as boundaries when the display image adjustments described in Section 5 are being performed. Each line is identified by an arrow and a letter designation.

The mask is centered against the CRT, and the tabs on each edge are tucked under the CRT bezel to keep the mask in position while adjusting the display image. When the mask is not being used, it should be stored in or near the display station.

2.2 DIAGNOSTIC PROGRAMS

Diagnostic programs are provided in the form of online tests (OLTs) to align, test, and repair all units of the IBM 3270 Display System. Unique programs and routines used to service 3277 Model 1 and Model 2 Display Stations are described in the following paragraphs. Instructions for loading test patterns and programs are in the IBM 3271 and IBM 3272 troubleshooting guides.

2.2.1 Test Patterns

Three test patterns are used to troubleshoot and align 3277 Display Stations. Model 1 display stations use Test Patterns 1 and 2, and Model 2 display stations use Test Patterns 1 and 3. Test patterns appear in sequence on the CRT after they are initially called in. An explanatory message containing instructions for running the test pattern sequence precedes Test Pattern 1. The TEST REQ key is pressed to call in the next pattern. When the desired pattern appears on the screen, the CNCL key can be pressed to disconnect the CPU and leave the pattern displayed. TEST REQ and CNCL are the only interrupts honored during the test pattern sequence. Other interrupt keys and selector light-pen interrupts are ignored. The test pattern sequence terminates only when the last pattern in the sequence is displayed and the TEST REQ key is pressed.

Test patterns are also available as request-for-test (RFT) messages in most customer programs. RFTs should be used in preference to OLTs. Instructions for displaying RFTs are in the 3271 and 3272 troubleshooting guides.

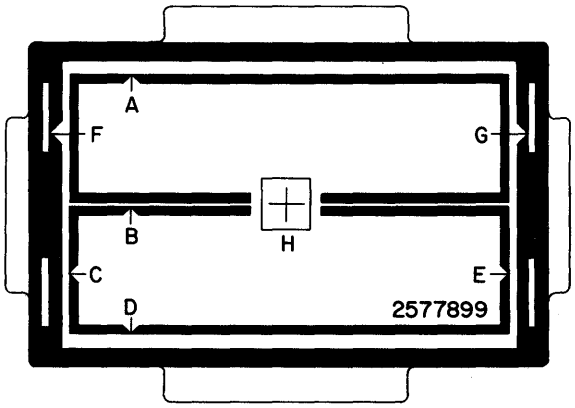


Diagram 2-2. Alignment Mask, Model 1

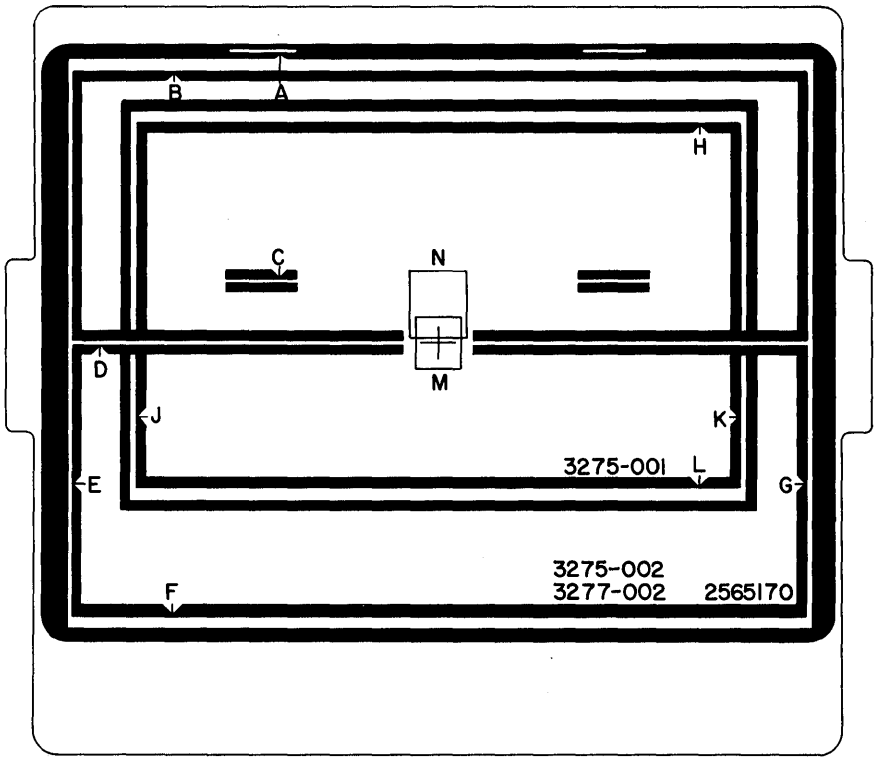


Diagram 2-3. Alignment Mask, Model 2

2.2.1.1 Test Pattern 1

Test Pattern 1 is a functional test that comprehensively checks the display station. It contains protected data fields, numeric fields, high-intensity fields, nondisplay fields, and selector light-pen-detectable fields. Diagram 2-4 shows the format of Test Pattern 1. The field marked "NON DISPLAY" is not displayed on the screen but is included in the illustration to show a programmed nondisplay field is in storage.

Paragraph 5.1.1 describes the comprehensive checkout procedure that uses Test Pattern 1. This pattern is also used in several Troubleshooting Diagrams.

Pressing the TEST REQ key when Test Pattern 1 is displayed calls in Test Pattern 2 on Model 1 display stations or Test Pattern 3 on Model 2 display stations.

2.2.1.2 Test Pattern 2

Test Pattern 2 (Diagram 2-5) is used to align the Model 1 display image as described in paragraph 5.2.1. On Model 2 display stations, this pattern is not displayed in the test pattern sequence.

2.2.1.3 Test Pattern 3

Test Pattern 3 (Diagram 2-6) is used to align Model 2 display stations. On Model 1 display stations, this pattern is not displayed in the test pattern sequence.

2.2.1.4 Test Pattern 5

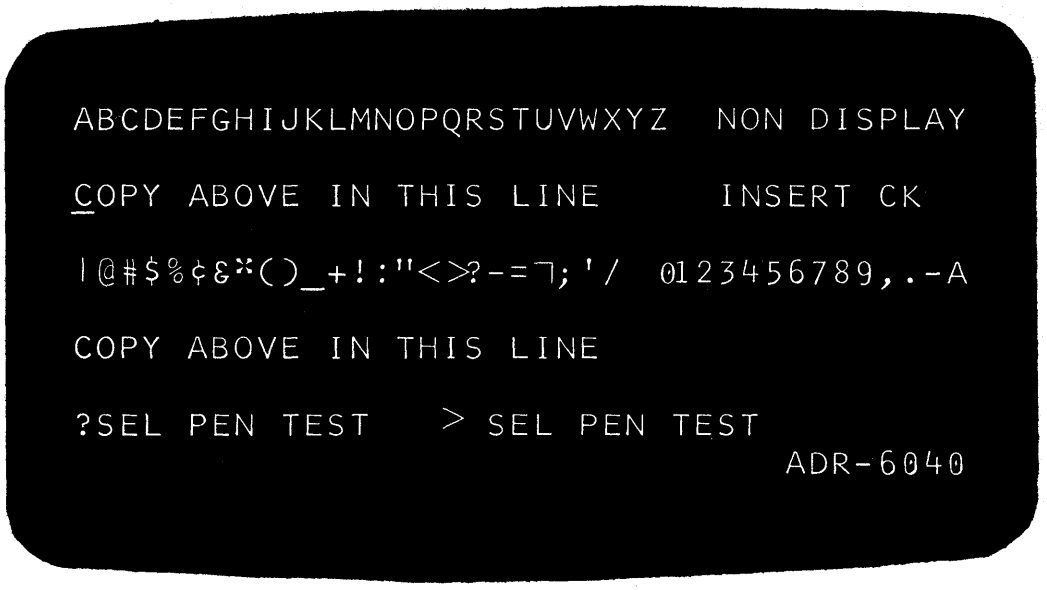
Test Pattern 5 (Diagram 2-7) is used to load the display station with both uppercase and lowercase character codes.

2.2.2 Manual Interrupt AID Check (OLT only)

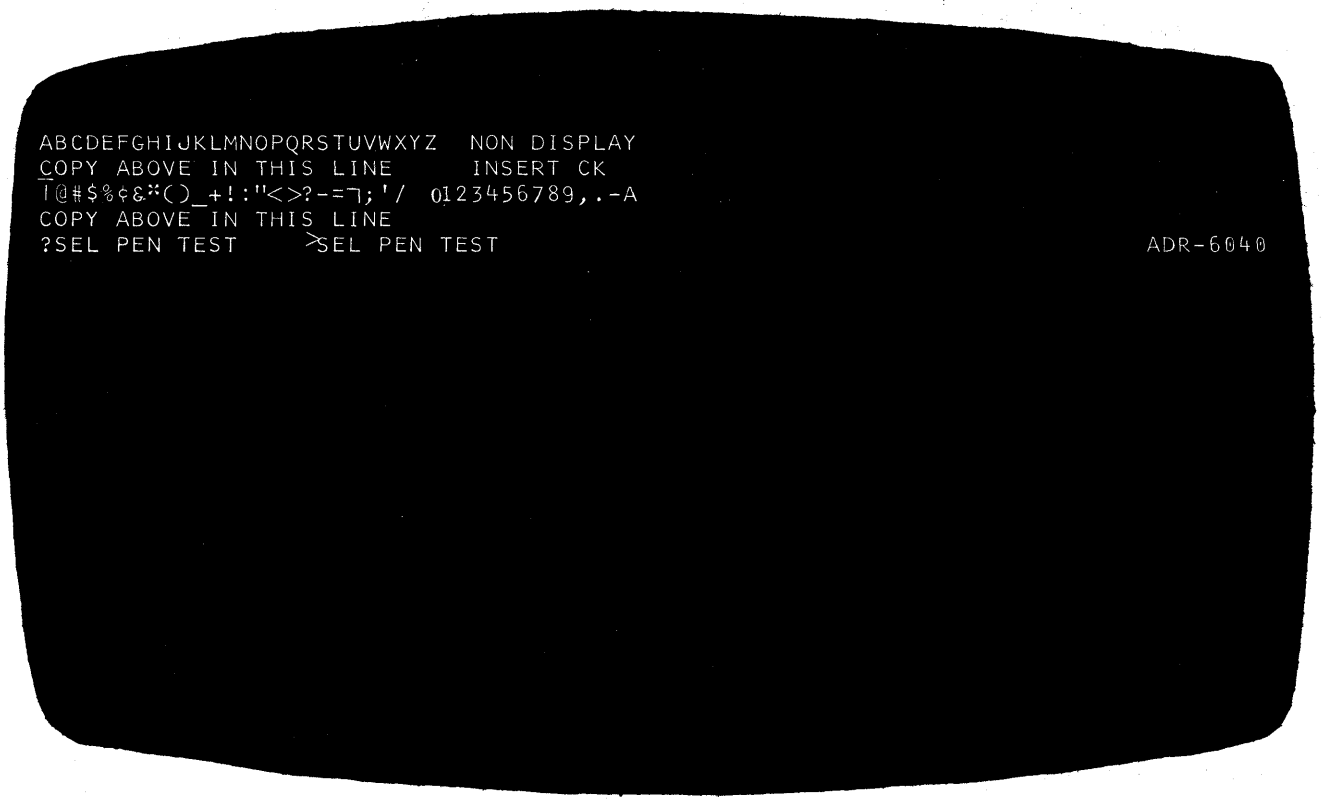
This program handles manually generated interrupts from the keyboard, selector light-pen, and program function keyboard. The results of the interrupts are presented on the display station screen, informing the Customer Engineer of the success or failure of the interrupt operation.

2.2.3 Lowercase Keyboard Check (OLT only)

This program reads back data entered from the keyboard to check lowercase character codes.



(Model 1 Pattern)



(Model 2 Pattern)

Note: ADR— appears only when pattern is called in from OLTEP.

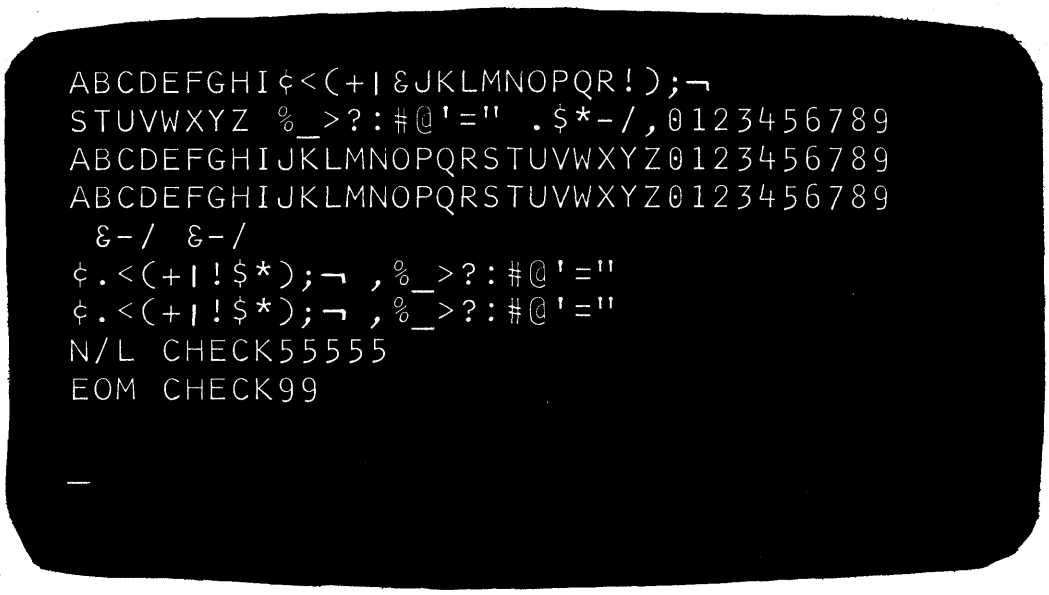
Diagram 2-4. Test Pattern 1 (EBCDIC)

Note: ADR— appears only when pattern is called in from OLTEP.

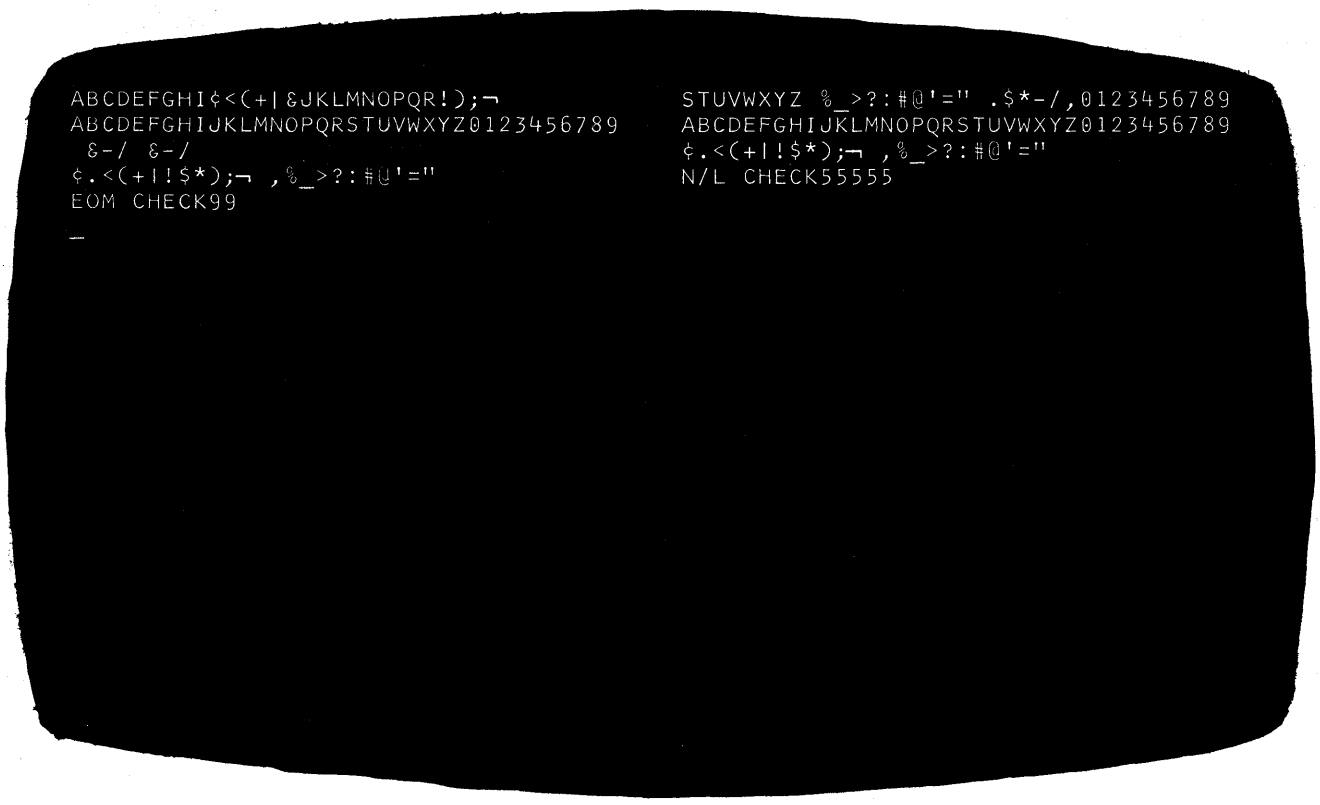
Diagram 2-5. Test Pattern 2

Note: ADR— appears only when pattern is called in from OLTEP.

Diagram 2-6. Test Pattern 3



(Model 1 Pattern)



(Model 2 Pattern)

Diagram 2-7. Test Pattern 5 (EBCDIC)

3.1 SYMPTOM INDEX USAGE

The Symptom Index lists trouble symptoms that could be encountered on 3277 Display Stations and features. Illustrations that show both correct and incorrect display images are also contained in this section. Use the Symptom Index and illustrations as the first step in a systematic method of resolving display station problems. The index is divided into six major categories:

1. Display malfunctions.
2. Keyboard malfunctions.
3. Selector light-pen malfunctions.
4. Power malfunctions.
5. CPU error indications.
6. Operator identification card reader malfunctions.

Some categories are divided into subcategories, making it easier to relate the trouble experienced to the correct item in the index. The item that most closely describes the display station trouble should be used. Categories and specific items are identified by a one-, two-, or three-letter/number code (e.g., 1A1, 2G, or 4) in the left column of the index. The code specifies the entry point into the Troubleshooting Diagrams in Section 4.

The right column of the Symptom Index specifies action to take to remedy the display station problem. That column directs the Customer Engineer to a section troubleshooting diagram sheet or specifies a logic card (or cards) to replace. The column may also specify an adjustment procedure in Section 5.

Diagrams 3-1 through 3-23 show both correct and incorrect display images. The symptom list refers to these illustrations to aid in identifying display station symptoms.

3.2 DEVELOPING SYMPTOMS

Display station malfunctions should be isolated offline unless the trouble occurs only when operating online through the control unit to the host CPU. Failures of this type are listed in Category 5 (CPU Error Indications). Display station operations that require a formatted buffer for failure symptoms to become evident are:

1. Selector light-pen operations.
2. Display intensity control (high intensity and non-display).
3. Protected and numeric field operations.
4. Tab operations.
5. Erase input and erase field operations.

Test Pattern 1 contains fields that test these operations. The test pattern may be loaded from the system as an RFT or OLT. Symptoms that require a formatted buffer are marked with an asterisk (*) in the Symptom Index.

Offline symptoms should be developed by performing the following test sequence after the I/O signal cable is removed.

1. Turn power on. (Always begin from a power-on reset condition.)
2. Test cursor move keys →, ↑, ↓, ←, →|, |←, ↵.
3. Test CLEAR key.
4. Enter four or five characters.
5. Press Tab (→|) key.
6. Press Backspace (←) four times.
7. Enter four characters.
8. Press Backspace (←) four times.
9. Press INS MODE.
10. Enter four or five characters.
11. Test DEL key.

Stop the test sequence and go to the Symptom Index when the first failure occurs.

SYMPTOM INDEX

Symptom	Diagram Sheet or Direct Action Repair
1. DISPLAY MALFUNCTIONS	
A. No Display:	
1. No visible light or glow on CRT. (Device Check not indicated; no cursor, characters, or indicators displayed.)	Sheet 2
2. Glow only on CRT (Diag 3-9)	Sheet 4
B. Intensity and Focus:	
1. One horizontal line on CRT (Diag 3-10)	Sheet 4
2. Model 2 – 24 rows of nine scan lines with space between each row (one row of ten scan lines) (Diag 3-11),	
OR	
Model 1 – Full raster on screen (Diag 3-12)	Sheet 5
3. Block displayed in every character position; cursor normal (Diag 3-14).	
a. INPUT INHIBITED lighted	Change card J2.
b. INPUT INHIBITED not lighted	Change card K2.
4. Display too dim or too bright (No control of intensity)	Sheet 5
5. Characters out of focus (Diag 3-18)	Sheet 5
*6. Dual-intensity problems or characters displayed that should not	Sheet 6
7. 24 horizontal lines on upper half of CRT (Diag 3-17)	Change card J2.
8. Display erratic (e.g., display flashes, characters move, more than one cursor)	Sheet 6
9. Screen full of dashes or lines	Sheet 6
10. Retrace unblanked	Change cards H2, J2, K2.
11. Random data on screen. INPUT INHIBITED lighted	Change card H2.
12. Cursor on left side in all rows	Change card H2.
13. One dot at character location zero cursor position	Change card J2.
C. Display Position and Size:	
1. Horizontal size too large or too small (vertical normal),	
OR	
Vertical size too large or too small (horizontal normal)	Adjust analog card. If out of range of adjustment, change analog card and card J2.
2. Both horizontal and vertical size too large or too small	If less than 1 inch in either direction, adjust analog card. If more than one inch, or if display size erratic, change HV power supply.
3. No space between rows of characters (Model 2 only) (Diag 3-16)	Sheet 7

*Requires a formatted buffer

Symptom	Diagram Sheet or Direct Action Repair
1. DISPLAY MALFUNCTIONS (Cont)	
C. Display Position and Size: (Cont)	
4. Rows of characters not evenly spaced	Change analog card
5. Display not centered (Diag 3-7)	See centering procedure (5.2.1.5).
6. Display tilted (Diag 3-6)	See yoke adjustment procedure (5.2.1.4)
D. Characters:	
1. No characters displayed, but cursor displayed. (See Symptom 2B4 if keyboard problem only.)	Sheet 7
2. Display out of sync. (Characters may be recognizable but are moving, and more than one cursor is seen. INPUT INHIBITED not lighted.) (Diag 3-15)	Sheet 6
3. Character(s) not formed correctly wherever displayed on screen	Change card K2.
4. Screen full of quote marks (no Device Check)	Change cards A2, K2.
5. Wrong character displayed from program or keyboard input:	
a. Without Device Check	Change card K2.
b. With Device Check	Sheet 7
6. Data displayed that should not	Change cards J2, K2.
7. Screen full of one character with or without INPUT INHIBITED lighted	Sheet 8
8. Screen slowly fills with character of last keyboard key pressed. INPUT INHIBITED not lighted	Change card A2.
E. Cursor:	
1. No cursor on screen, but rest of display normal (no Device Check)	Change card K2.
2. No cursor with INPUT INHIBITED lighted. Cursor cannot be returned to screen by Power On Reset or CLEAR key	Sheet 9
3. Cursor appears normally. INPUT INHIBITED lighted	Sheet 9
4. Cursor under all or most character positions, and Device Check indicated (INPUT INHIBITED lighted) (Diag 3-13)	Sheet 10
5. Cursor under all character positions, but Device Check not indicated (Diag 3-13).	Change card K2.
6. Cursor not positioned correctly under a character; may be in character area	Change card K2.
7. Cursor too long or too short	Change card K2.
8. No cursor, and INPUT INHIBITED not on. Partial cursor appears as each character enters until 80 characters in row appear with partial cursor under each character. Occurs on one row at a time	Change card J2.
9. Screen slowly fills with cursors	Change cards A2, C2, H2.
10. Cursor appears in three or four rows equally spaced on left side of display after POR. Characters may or may not enter and appear at cursor location. Display may blink	Sheet 10
11. No cursor on screen after POR. Characters may enter, but only first scan line of each row displays as character enters. (INPUT INHIBITED not lighted)	Change card J2.

Symptom	Diagram Sheet or Direct Action Repair
1. DISPLAY MALFUNCTIONS (Cont)	
F. Indicators:	
1. No indicators light. (Characters and cursor normal.)	Sheet 11
*2. One indicator fails to light	Sheet 11
*3. One indicator lit when it should not be	Sheet 9
2. KEYBOARD MALFUNCTIONS	
Note: If card reader feature is installed on failing display station, remove card reader feature logic card at location N2, and move keyboard cable from socket Z4 to socket Z1. If keyboard operates correctly with card removed and cable swapped, change card N2, and return keyboard cable to socket Z4. If keyboard still fails with card removed and cable swapped, select symptom that best describes failure.	
A. All Keys:	
1. Keyboard inoperative	Sheet 12
2. Keyboard operation erratic (INPUT INHIBITED on after certain keys.)	Sheet 12
3. Diagonal row of dots appears starting at lower left corner of screen as characters enter. INPUT INHIBITED not lighted	Change card J2.
B. Character Keys:	
1. Wrong character for one key	See keyboard check procedure 5.1.4.
2. Wrong character for more than one key	Sheet 12
3. No characters enter for all keys	Sheet 13
*3a. Correct character enters, but INPUT INHIBITED lights for one or more keys	Sheet 7
4. No character enters for all keys; cursor advances with each key depression. Dots may appear on one line. (INPUT INHIBITED indicator does not light.)	Sheet 13
*5. Alpha characters enter into "numeric only" fields	Sheet 13
*6. Numeric characters cannot enter in "numeric only" fields	Change card B2.
7. Typamatic failures	See keyboard check procedure 5.1.4.
8. Cursor disappears when character enters	Sheet 1
9. Characters entered not displayed. Cursor move keys work correctly. (INPUT INHIBITED not lighted.)	Change cards A2, B2, G2.

*Requires a formatted buffer.

*Requires a formatted buffer.

*Requires a formatted buffer.

See Diagram 2–4 for greater detail of the test pattern data.

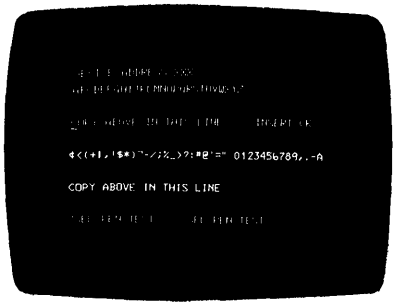


Diagram 3–1. Test Pattern 1, Model 1

See Diagram 2–4 for greater detail of the test pattern data.

Diagram 3–2. Test Pattern 1, Model 2

See Diagram 2–5 for greater detail of the test pattern data.

Diagram 3–3. Test Pattern 2

See Diagram 2–6 for greater detail of the test pattern data.

Diagram 3–4. Test Pattern 3

Model 1 malfunction produces similar results.

Diagram 3–5. Yoke Back Too Far on CRT Neck

Model 1 malfunction produces similar results.

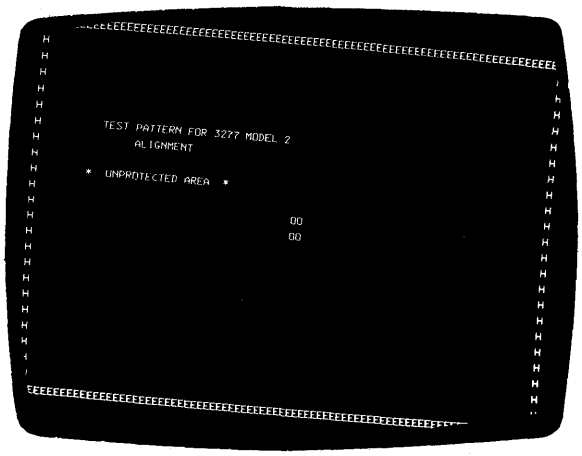


Diagram 3–6. Yoke Tilted

Model 1 malfunction produces similar results.

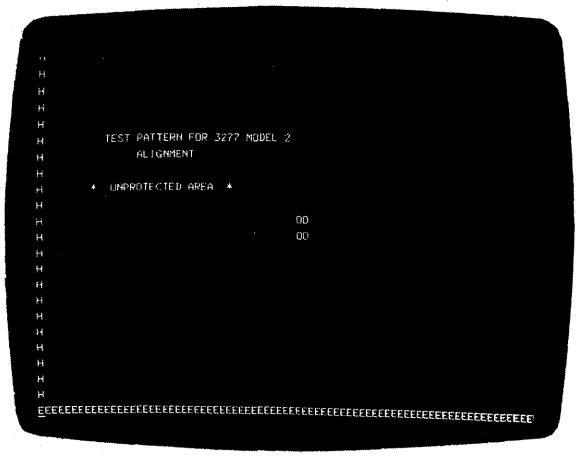


Diagram 3–7. Centering Rings Not Adjusted Properly

Model 1 malfunction produces similar results.

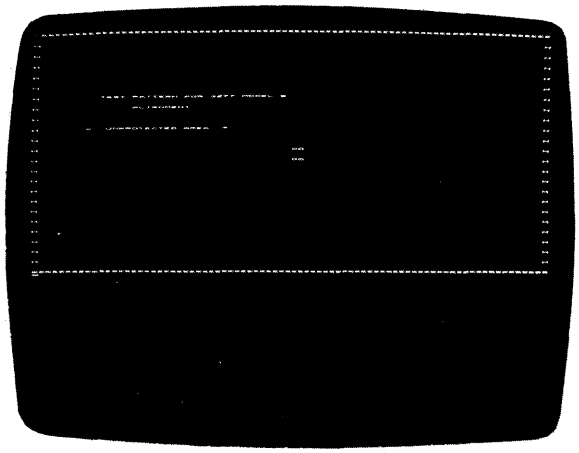


Diagram 3–8. Character Height Too Small

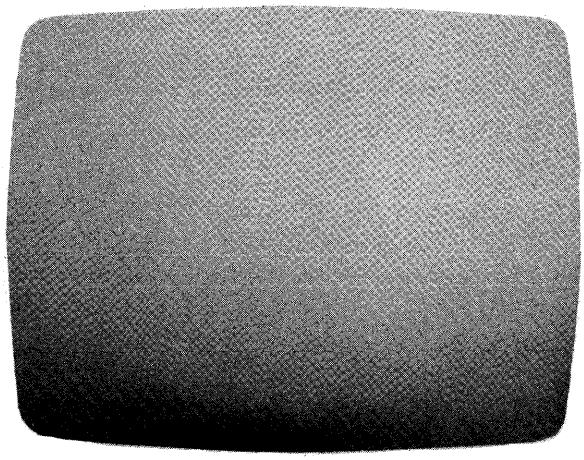


Diagram 3–9. Glow Only on CRT

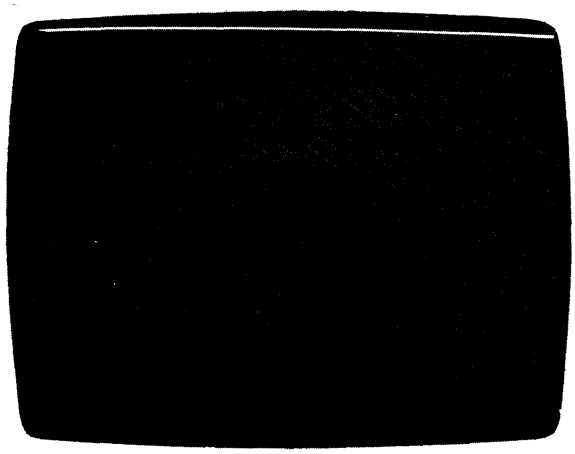


Diagram 3–10. Single Horizontal Line on CRT

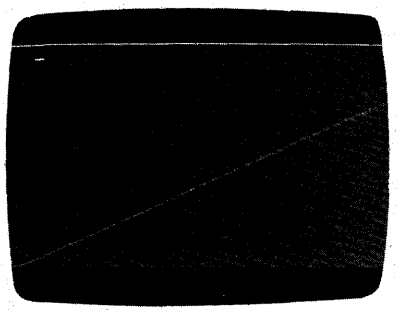


Diagram 3–11. Model 1 Raster

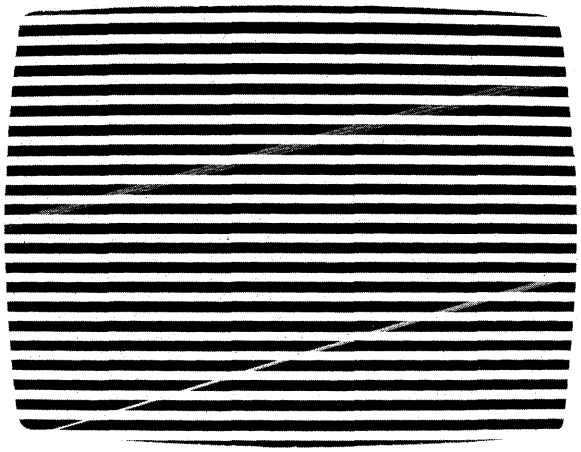


Diagram 3–12. Model 2 Raster

Model 1 malfunction produces similar results.

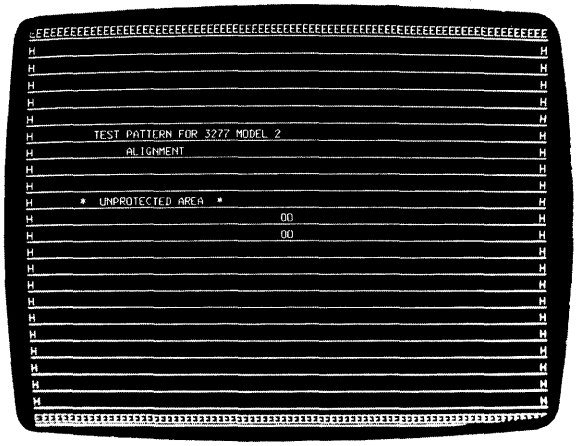


Diagram 3–13. Cursor in Every Row

Model 1 malfunction produces similar results.

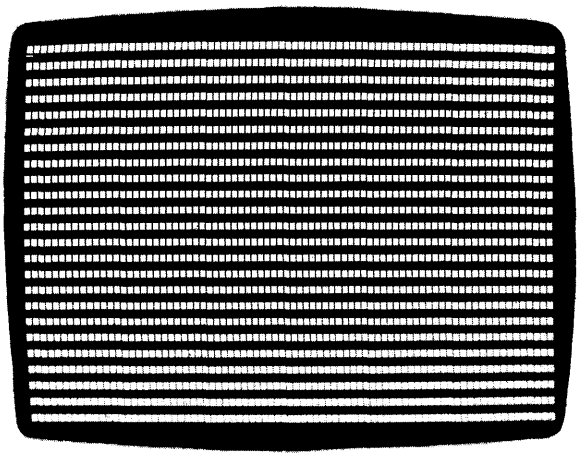


Diagram 3–14. Box in Every Character Position

Model 1 malfunction produces similar results. The density of each row is determined by the number of characters in that row.

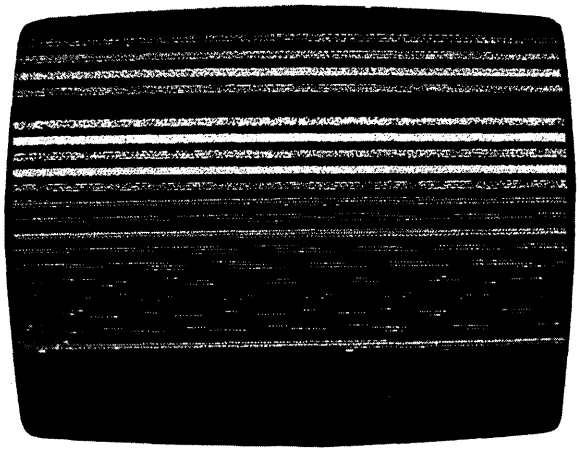


Diagram 3–15. No Horizontal Sync

This failure applies to Model 2 displays only.

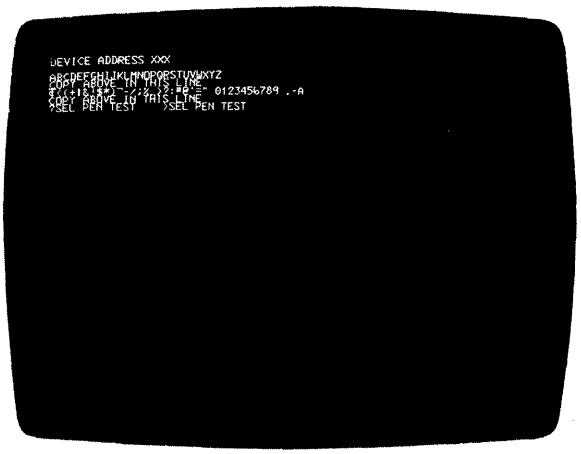


Diagram 3–16. No Interrow Spacing

Model 1 malfunction produces similar results.

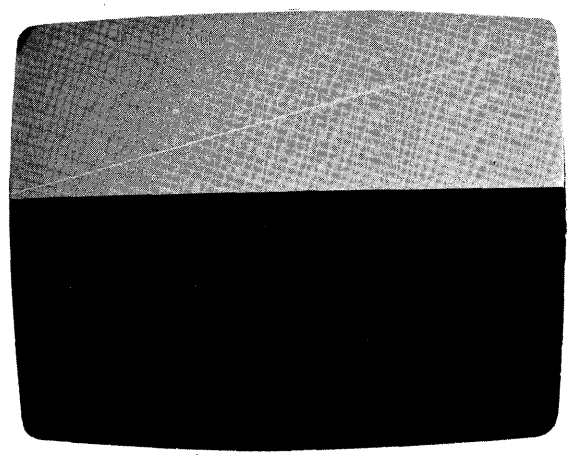


Diagram 3–17. 24 Horizontal Scan Lines

Model 2 malfunction produces similar results.

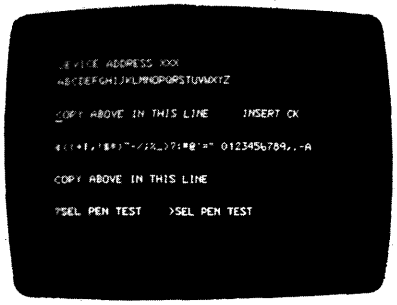


Diagram 3–18. Out of Focus Image

Model 1 malfunction produces similar results.
The density of the superimposed characters is determined by the number of characters in the row.

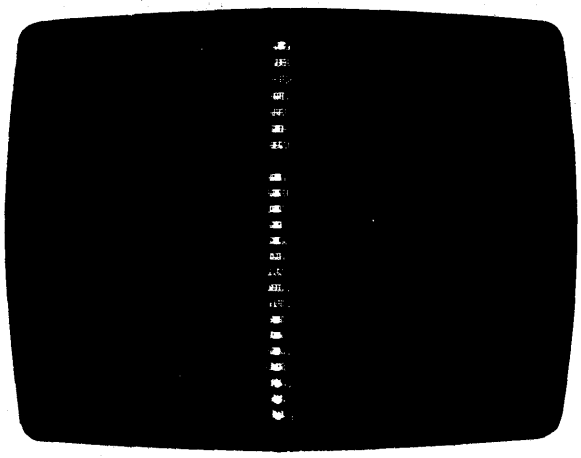


Diagram 3–19. Yoke Horizontal Return Line Open

Model 1 malfunction produces similar results.

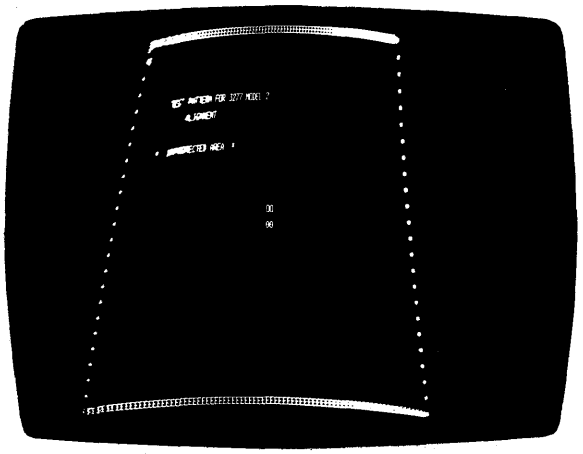


Diagram 3–20. Open in Yoke Horizontal Winding

Model 1 malfunction produces similar results.

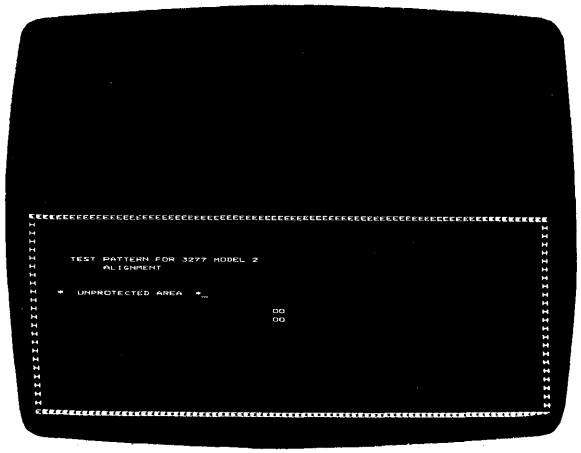


Diagram 3–21. 1/2 Vertical Yoke Open

Model 1 malfunction produces similar results.
The vertical bar appears in every row that has data.

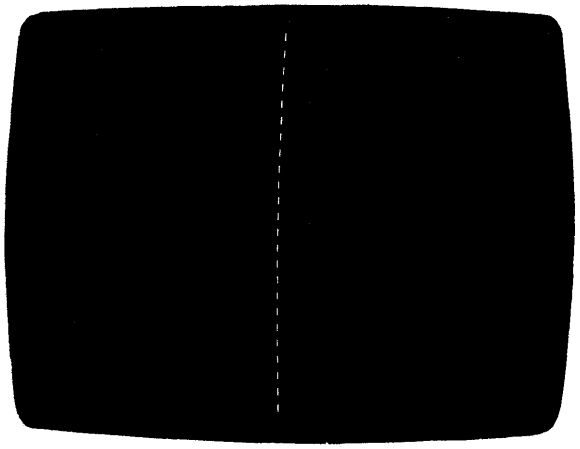


Diagram 3–22. Horizontal Yoke Open

Model 1 malfunction produces similar results.
The pattern displayed is data dependent.

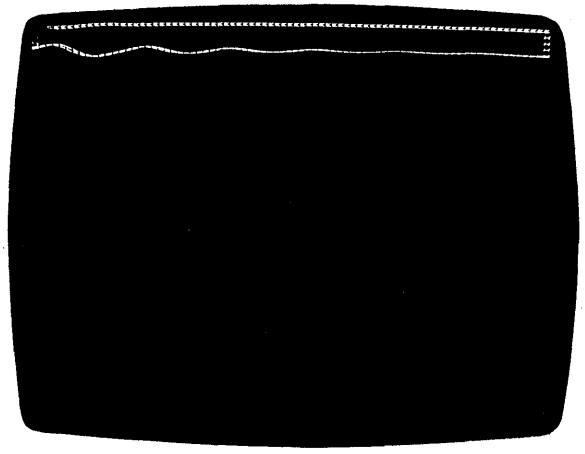


Diagram 3–23. Vertical Yoke Open

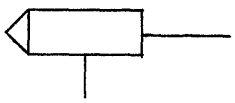
The Troubleshooting Diagrams (27 sheets) in this section should be used as directed by the Symptom Index (Section 3). The diagrams are flowcharts arranged in a sequence that ensures successful trouble resolution in a minimum time. The steps in the flowcharts must be followed in sequence because successive steps depend on the actions and results obtained in preceding steps. Although the sequence may seem illogical and shortcuts may seem apparent, deviation is discouraged to avoid unnecessary duplication of effort and prolonged service calls.

Sheet 1 determines whether the symptom experienced is caused by a display station problem or by a control unit problem. Subsequent flowcharts cover display, keyboard, selector pen, and card reader malfunctions. Additional sheets analyze power troubles and miscellaneous keyboard assembly electrical and mechanical troubles.

Observe good safety habits while working on the display station with power on. High voltage is present at the CRT anode, the yoke assembly, the HV power supply, and the voltage distribution points. Always remove power from the display station when removing or replacing logic cards. This avoids damaging circuitry on that card or other cards feeding it.

The flowcharts use the terms "replace card XX" and "change card XX". "Replace" means to reinstall the same card that was earlier removed; "change" means to install a new card from stock. The old card being changed is the probable cause of the failure.

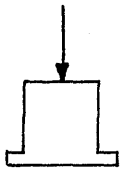
Two unique symbols are used in the flowcharts. The symbol



means to probe (with the logic probe) the point designated in the symbol. Seven logic probe conditions can be seen. An output line from the probe symbol specifies one of the seven conditions. If the observed condition is the same as that specified in the flowchart, continue down that part of the flowchart. If the observed result is different from the specified result, use the part of the flowchart labeled "Other". The seven logic probe observations specified in the flowcharts and their definitions are as follows:

1. Red – solid red.
2. Green – solid green.
3. Red Blink – solid green with one (and only one) red blink.
4. Green Blink – solid red with one (and only one) green blink.
5. Pulsing Red – solid green with regular red pulses. (Any frequency of pulses as long as green indicator appears to stay on.)
6. Pulsing Green – solid red with regular green pulses. (Any frequency of pulses as long as red indicator appears to stay on.)
7. Red and Green – approximately equal red and green pulses (any frequency).

The card-shaped symbol



appearing at the end of a diagnostic sequence gives the location of the card(s) to be replaced that will repair the problem. It also means to take the following action:

1. Turn power off.
2. Change card(s).
3. Turn power on.
4. Verify that trouble is repaired.
5. Replace covers.
6. Return display station to user.

When more than one card is listed in the symbol, isolate the failing card by card-swapping from among those specified. Change the failing card, and return the others to stock.

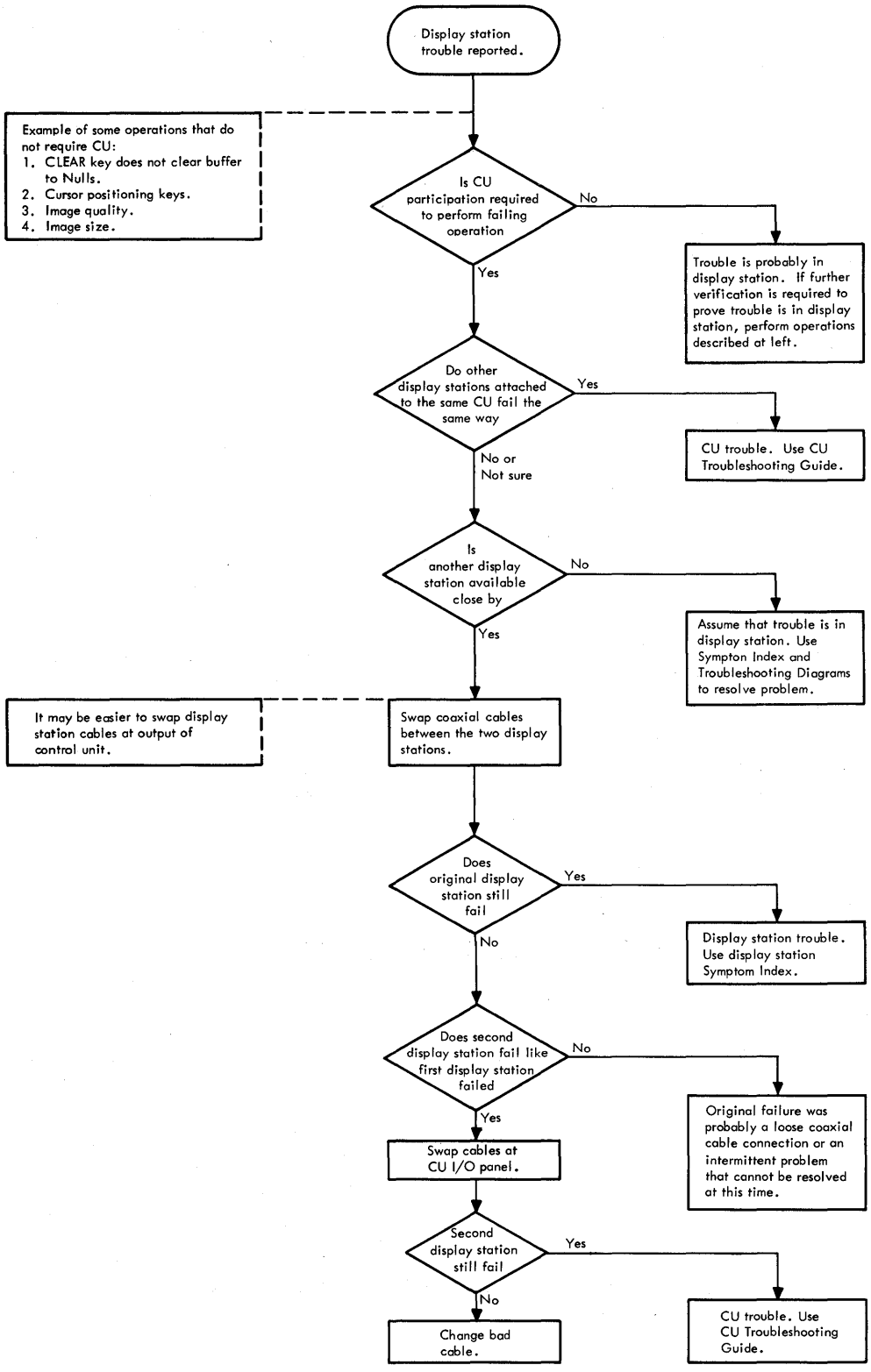


Diagram 4-1. Display Station Troubleshooting Diagrams (Sheet 1 of 27)

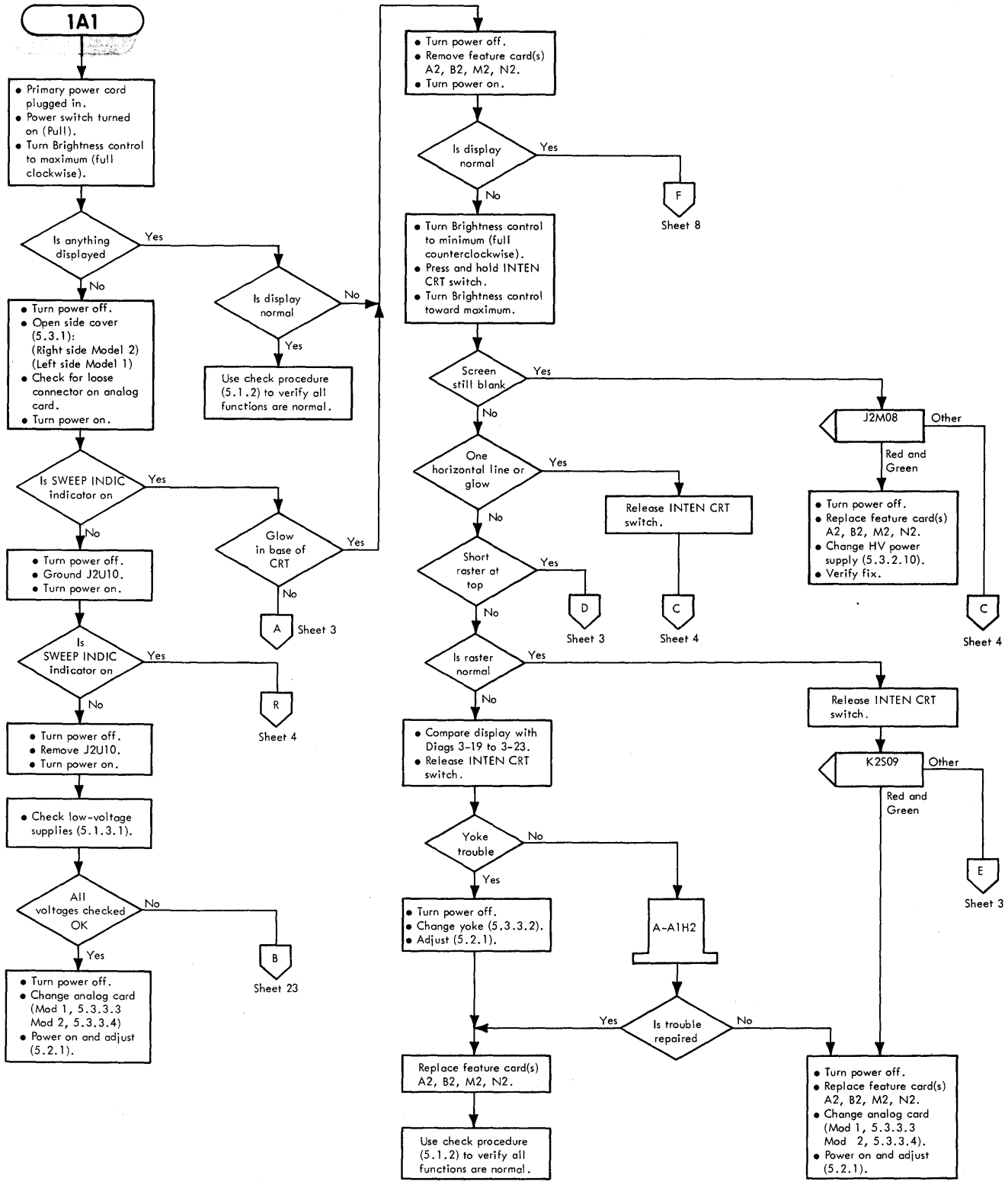


Diagram 4-1. Display Station Troubleshooting Diagrams (Sheet 2 of 27)

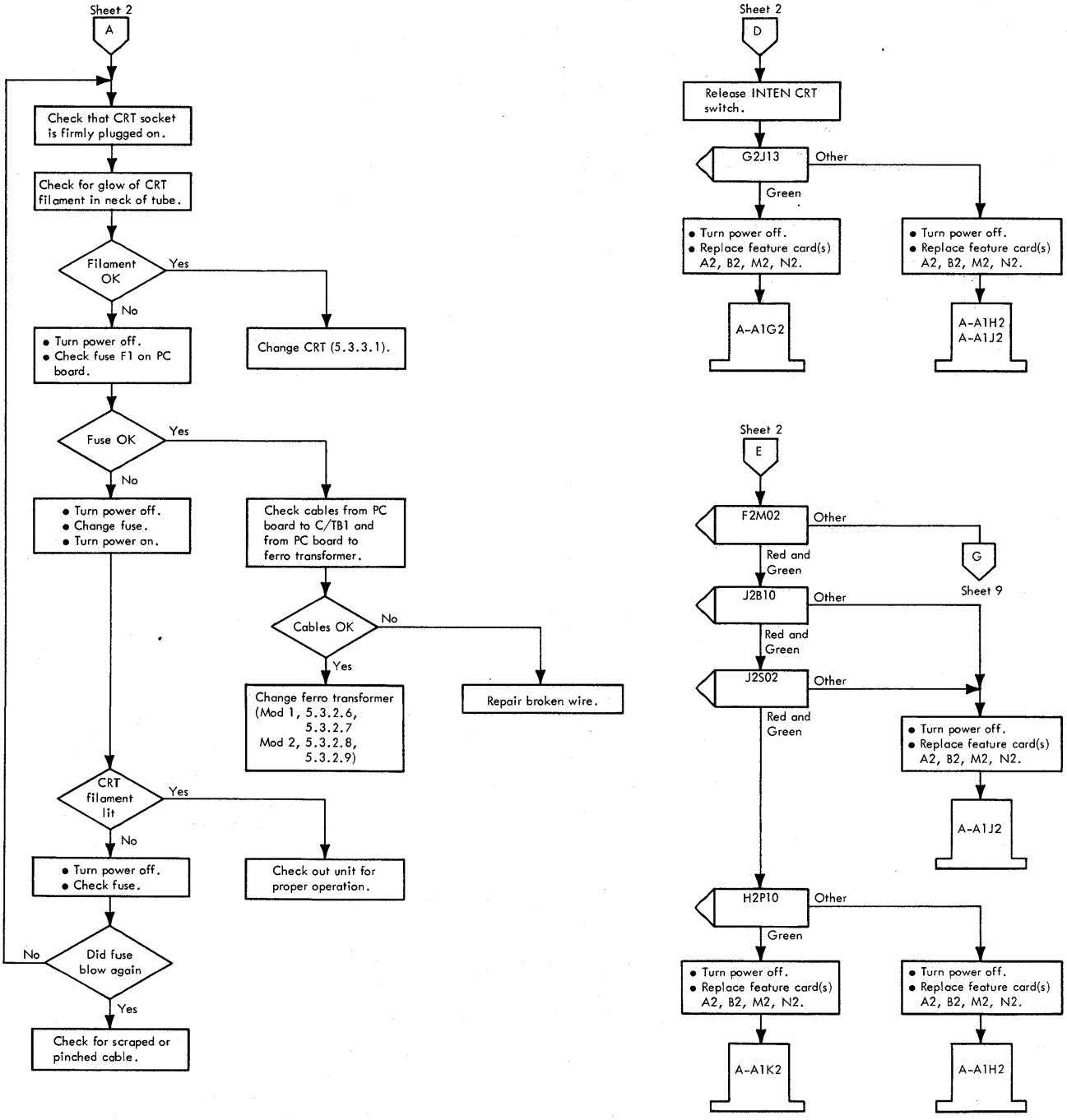


Diagram 4-1. Display Station Troubleshooting Diagrams (Sheet 3 of 27)

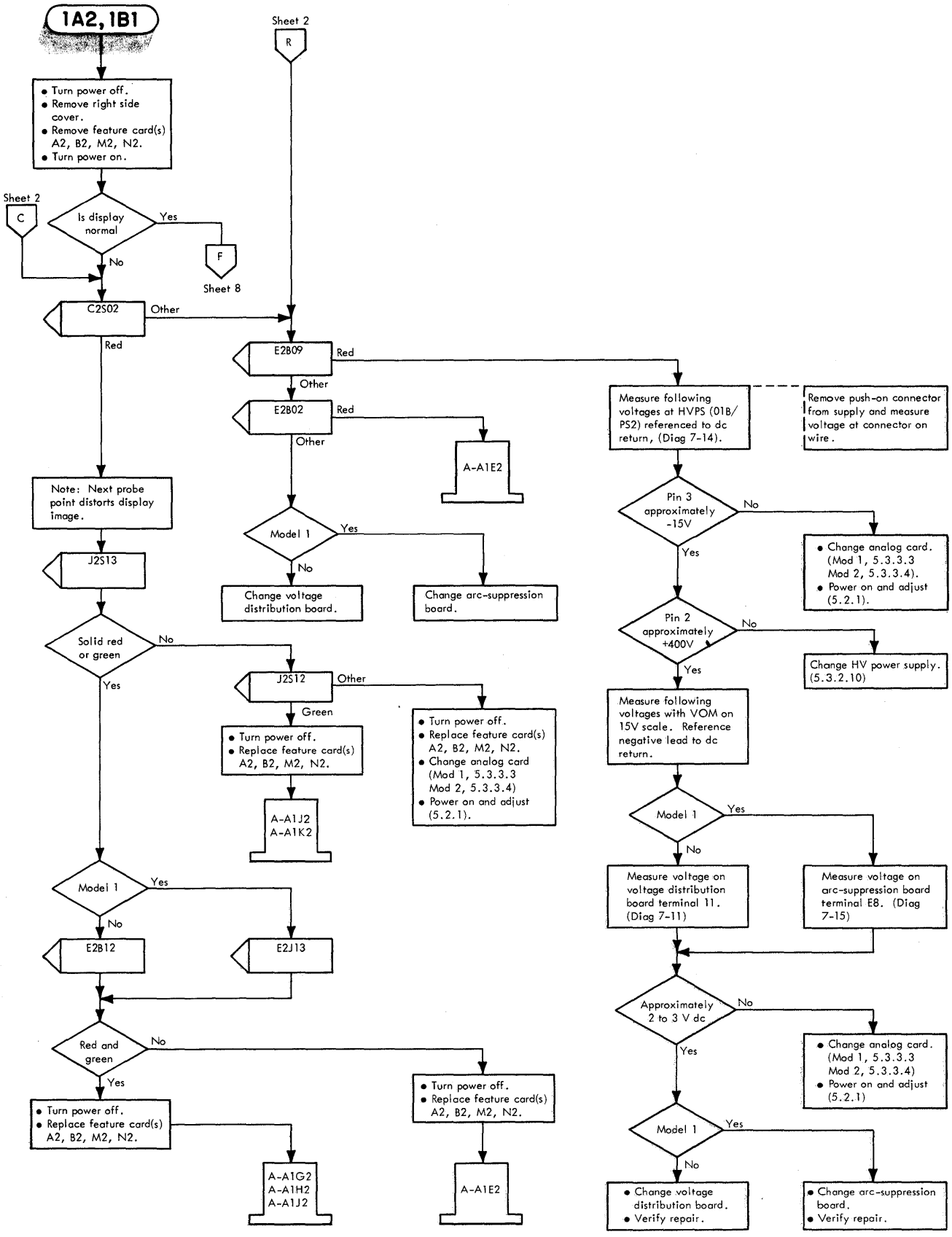


Diagram 4-1. Display Station Troubleshooting Diagrams (Sheet 4 of 27)

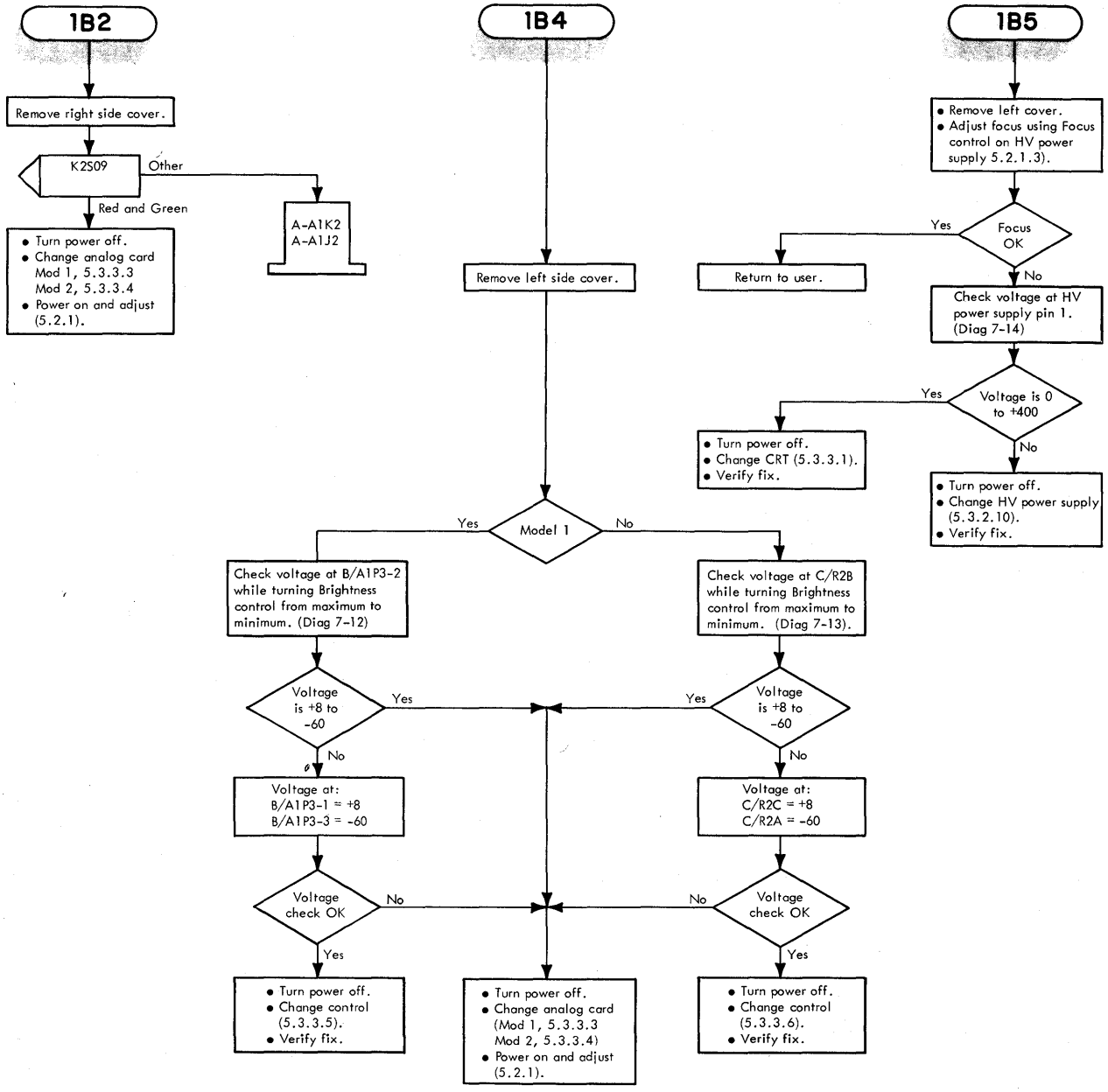


Diagram 4-1. Display Station Troubleshooting Diagrams (Sheet 5 of 27)

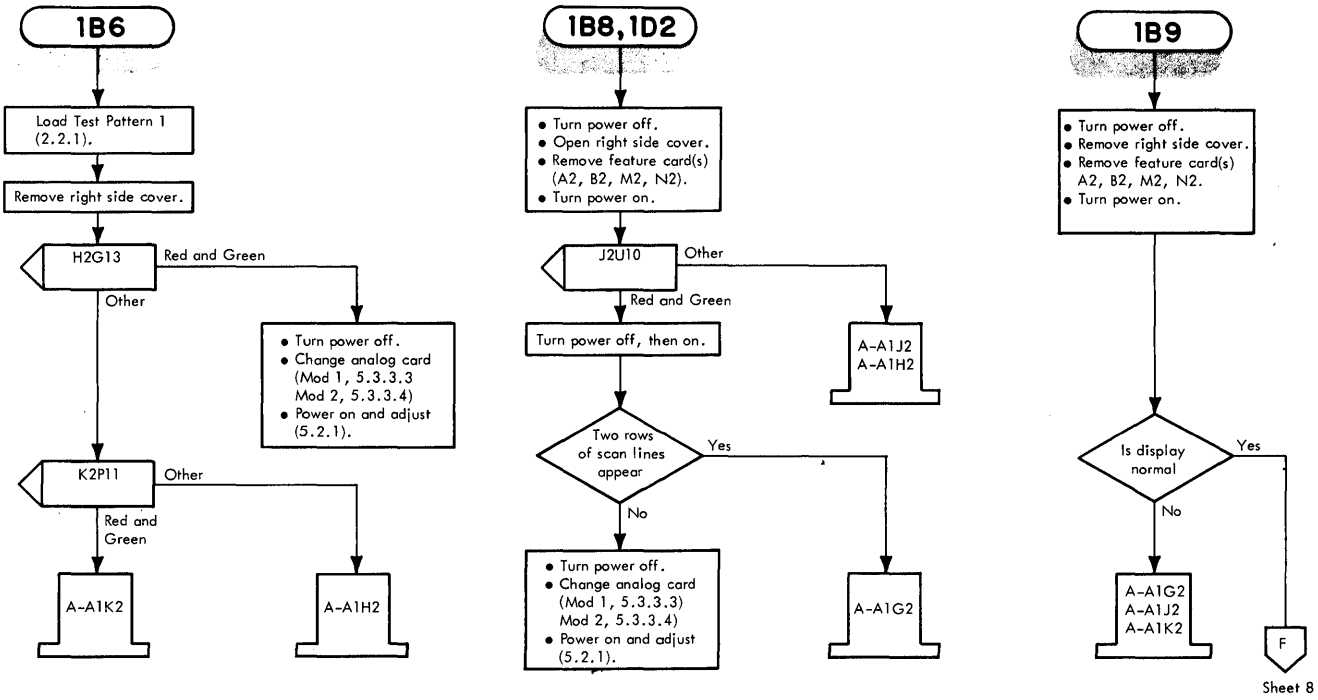
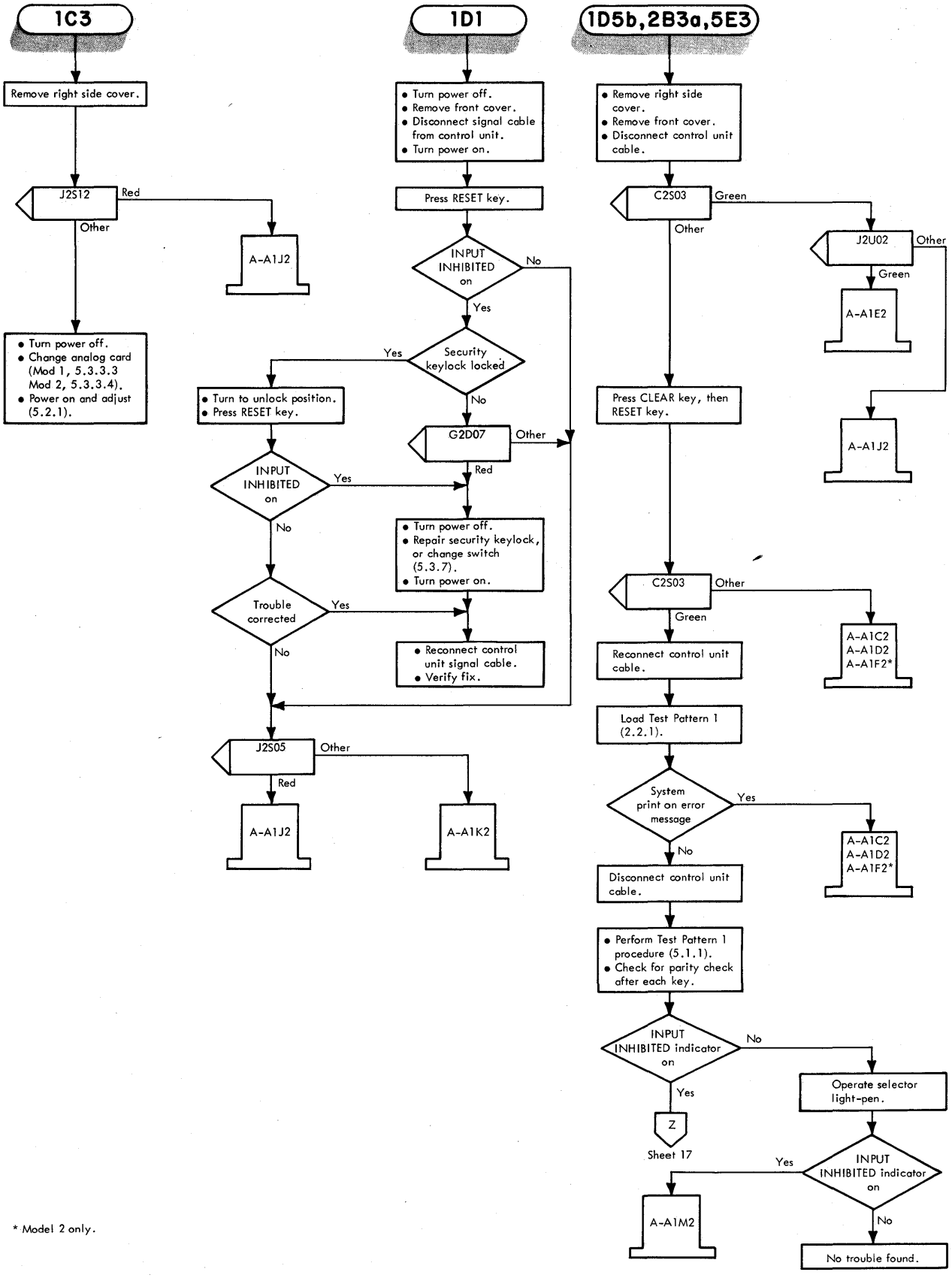


Diagram 4-1. Display Station Troubleshooting Diagrams (Sheet 6 of 27)



* Model 2 only.

Diagram 4-1. Display Station Troubleshooting Diagrams (Sheet 7 of 27)

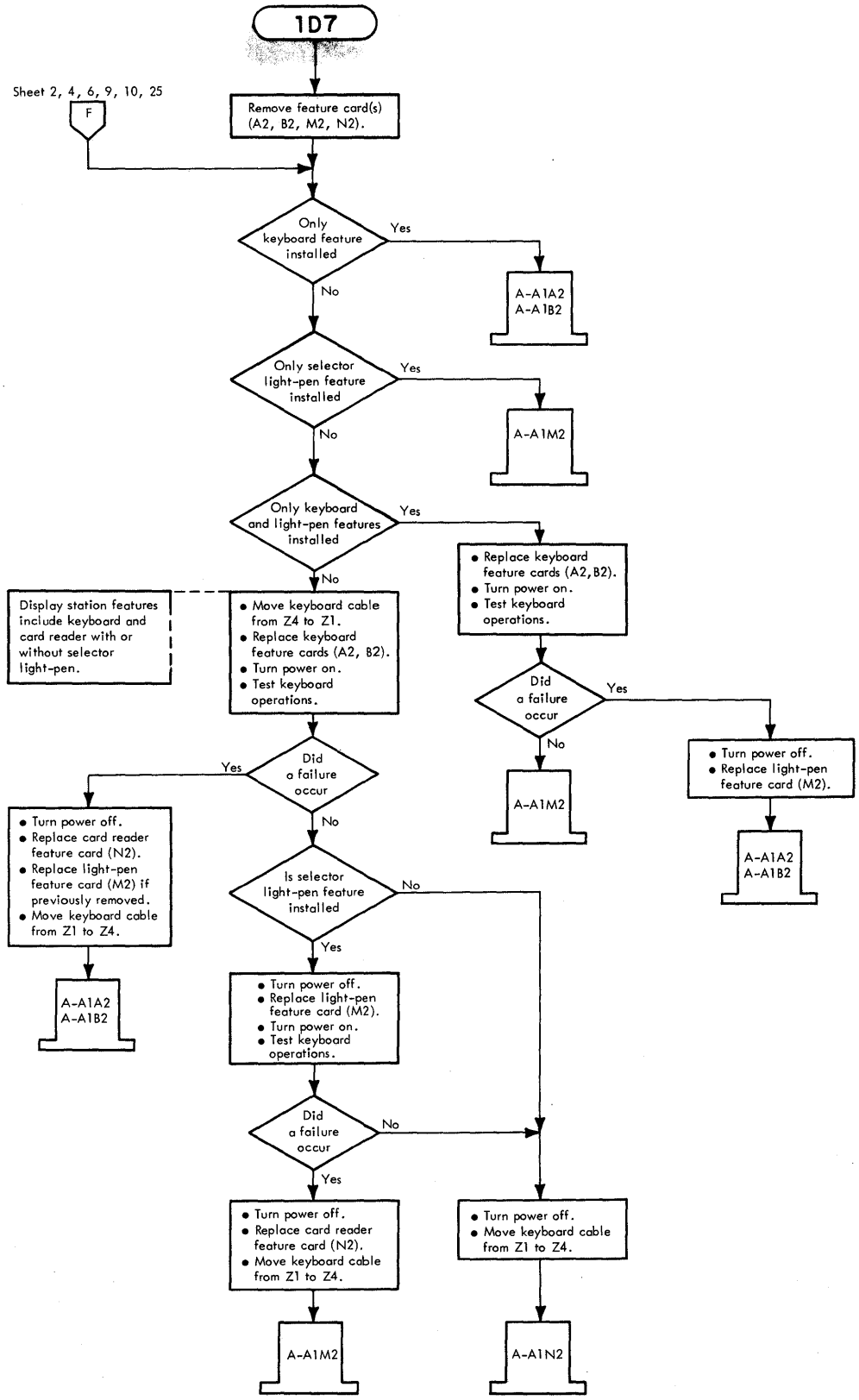
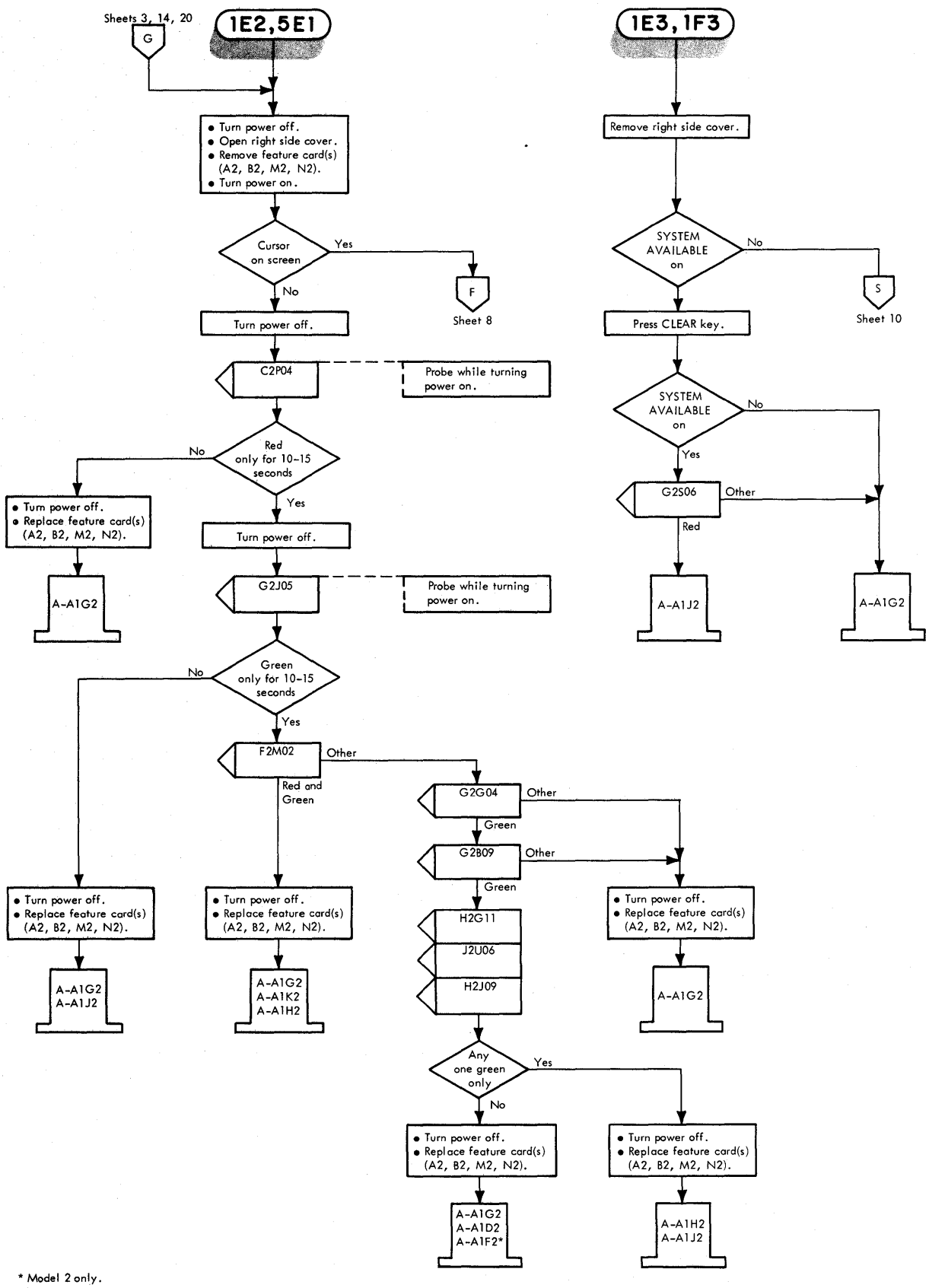
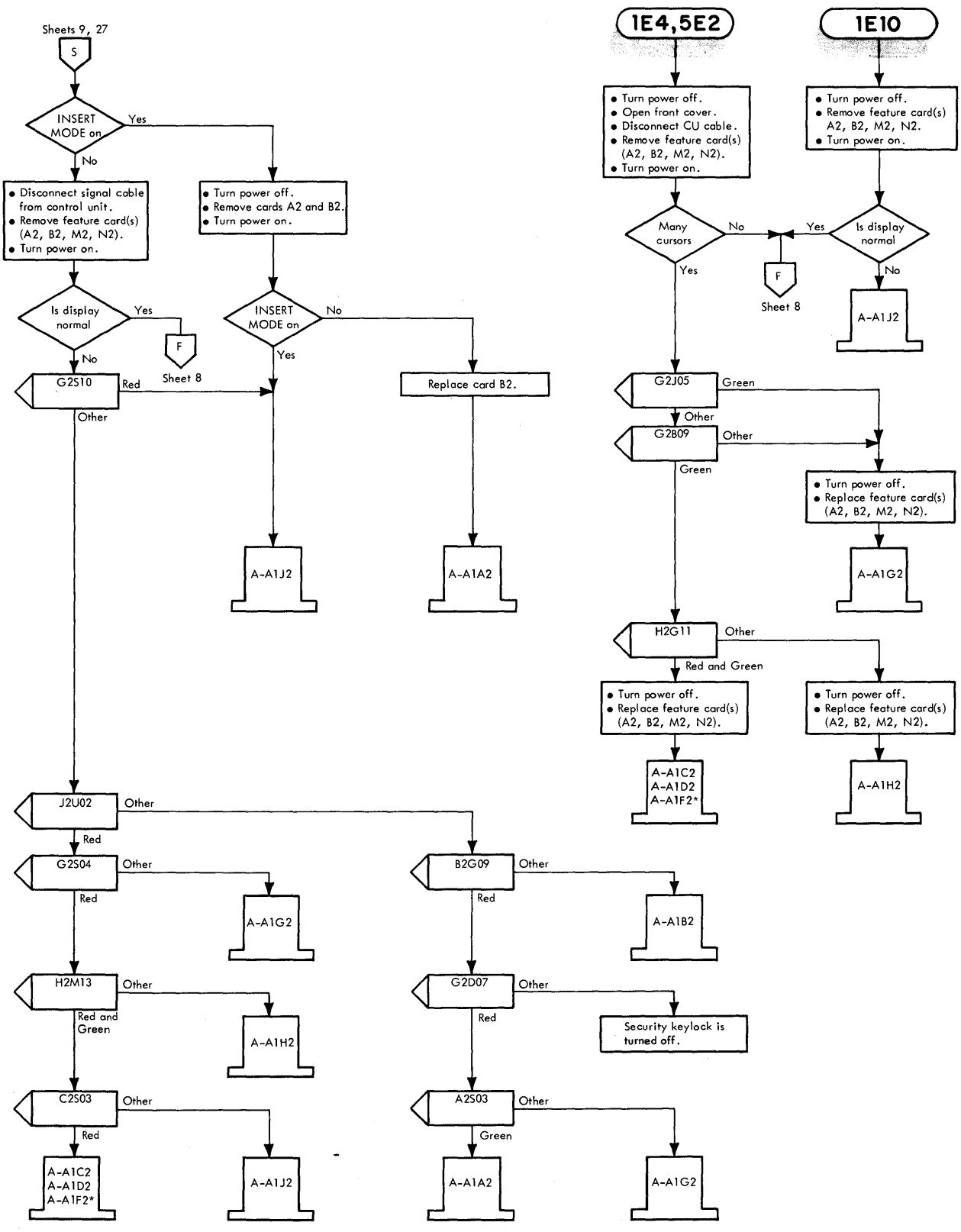


Diagram 4-1. Display Station Troubleshooting Diagrams (Sheet 8 of 27)



* Model 2 only.

Diagram 4-1. Display Station Troubleshooting Diagrams (Sheet 9 of 27)



* Model 2 only.

Diagram 4-1. Display Station Troubleshooting Diagrams (Sheet 10 of 27)

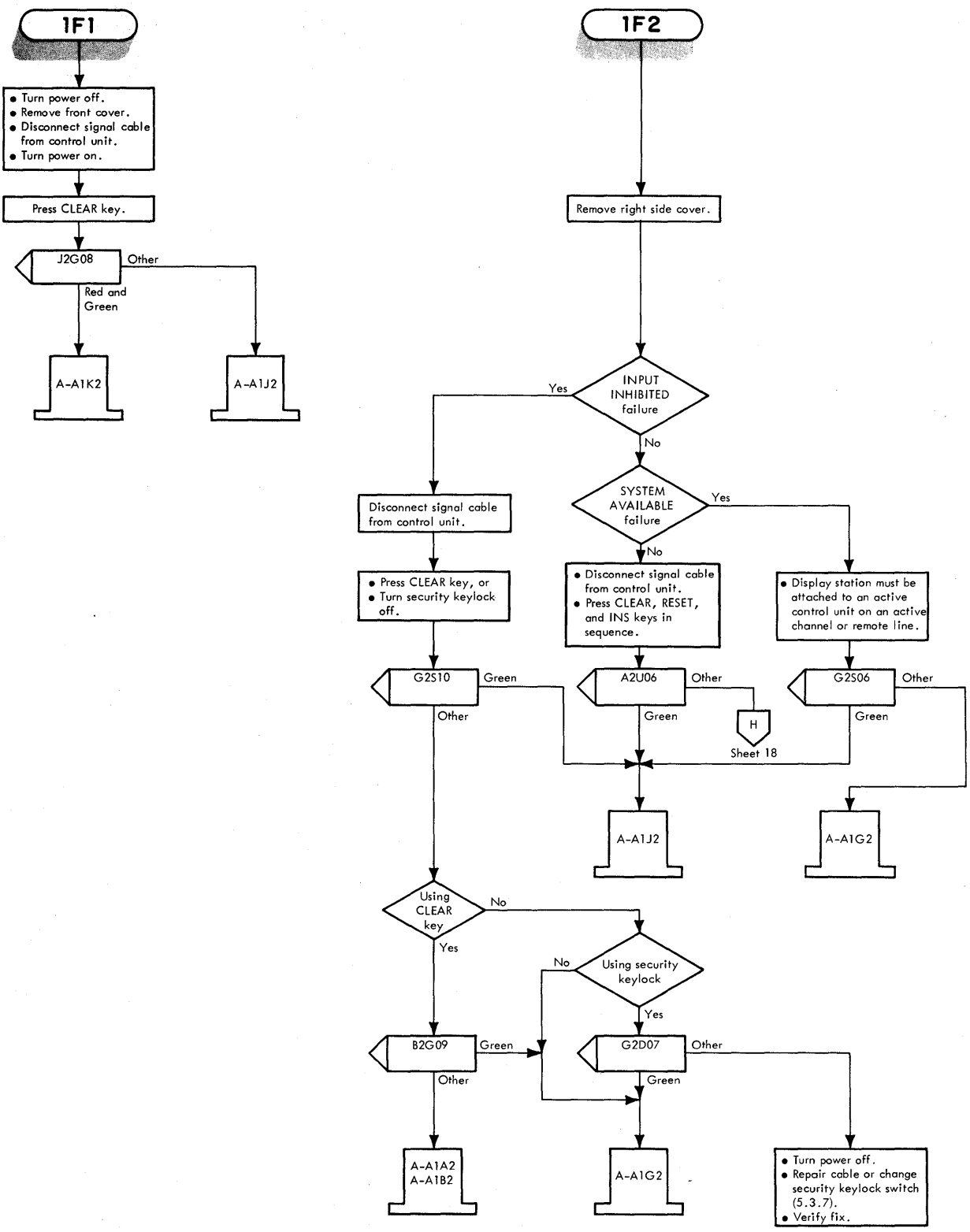


Diagram 4-1. Display Station Troubleshooting Diagrams (Sheet 11 of 27)

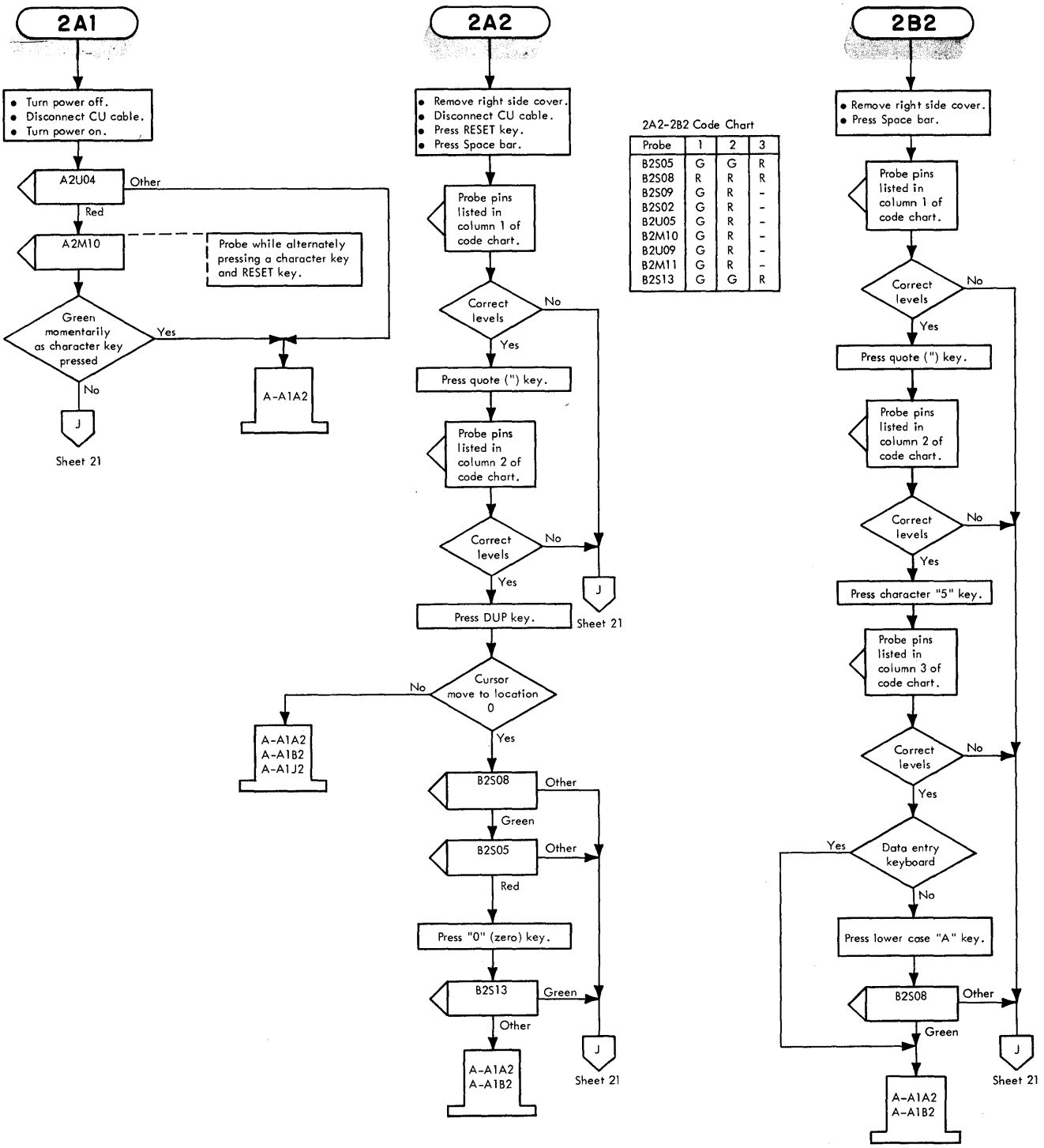


Diagram 4-1. Display Station Troubleshooting Diagrams (Sheet 12 of 27)

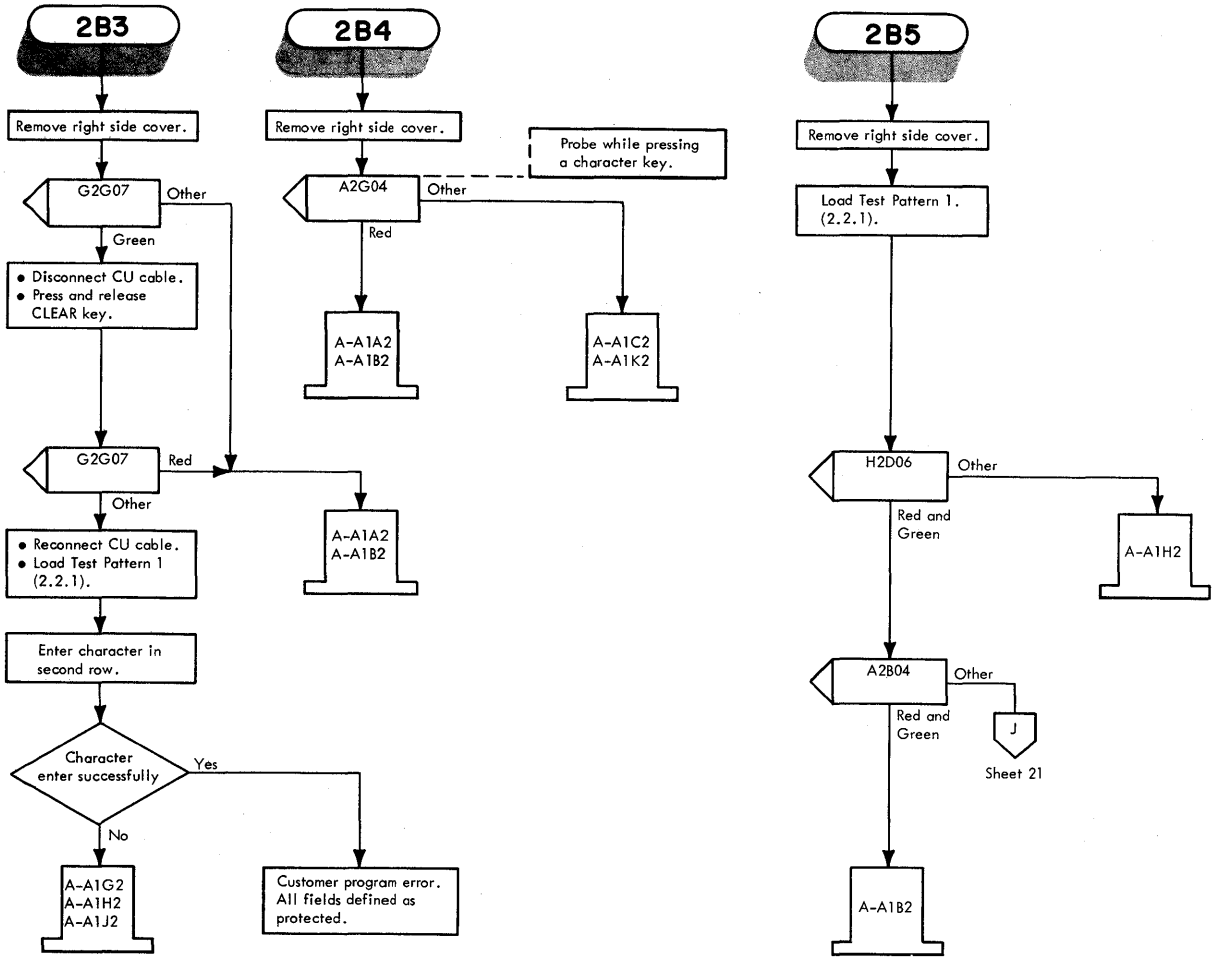


Diagram 4-1. Display Station Troubleshooting Diagrams (Sheet 13 of 27)

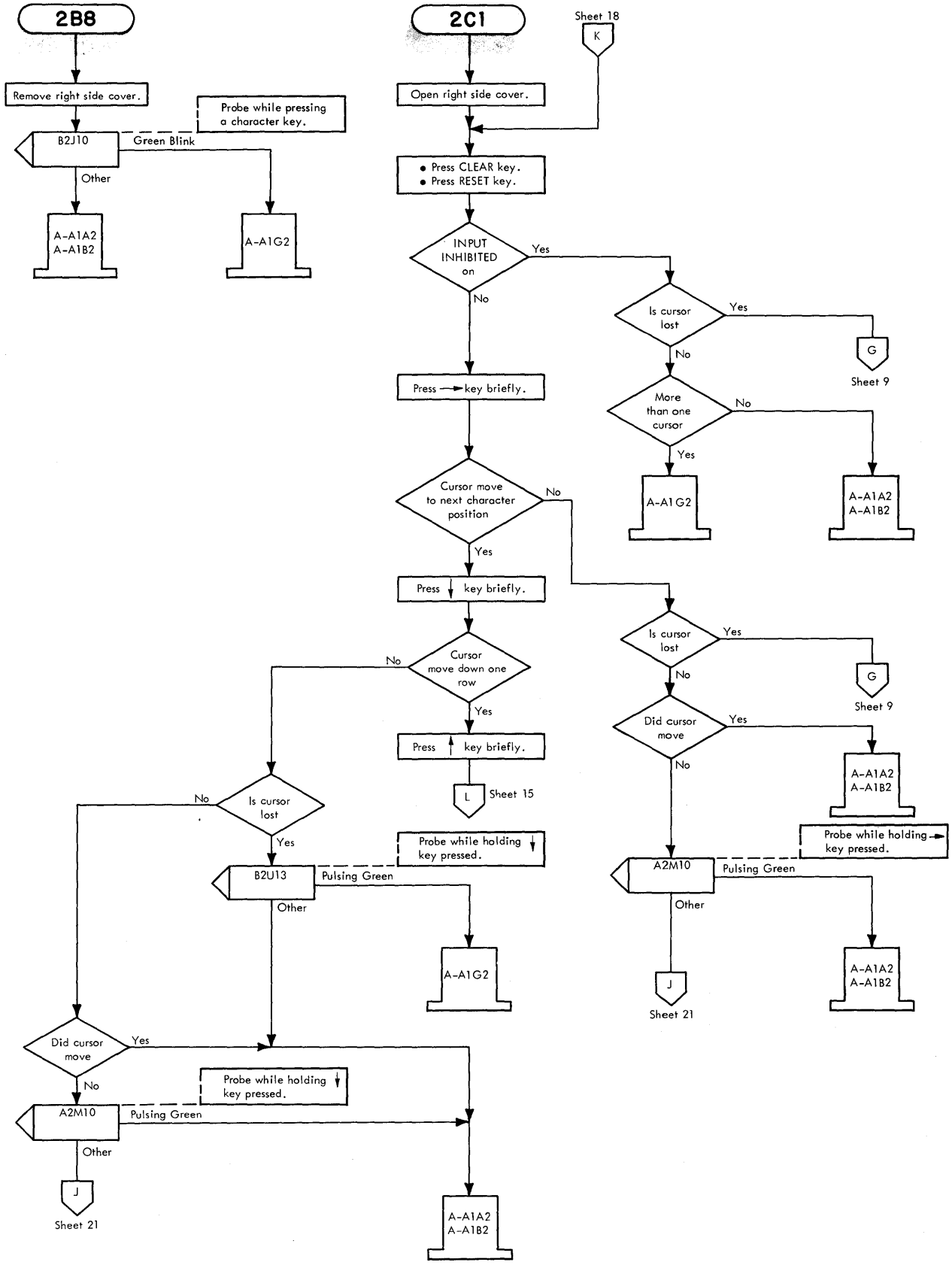


Diagram 4-1. Display Station Troubleshooting Diagrams (Sheet 14 of 27)

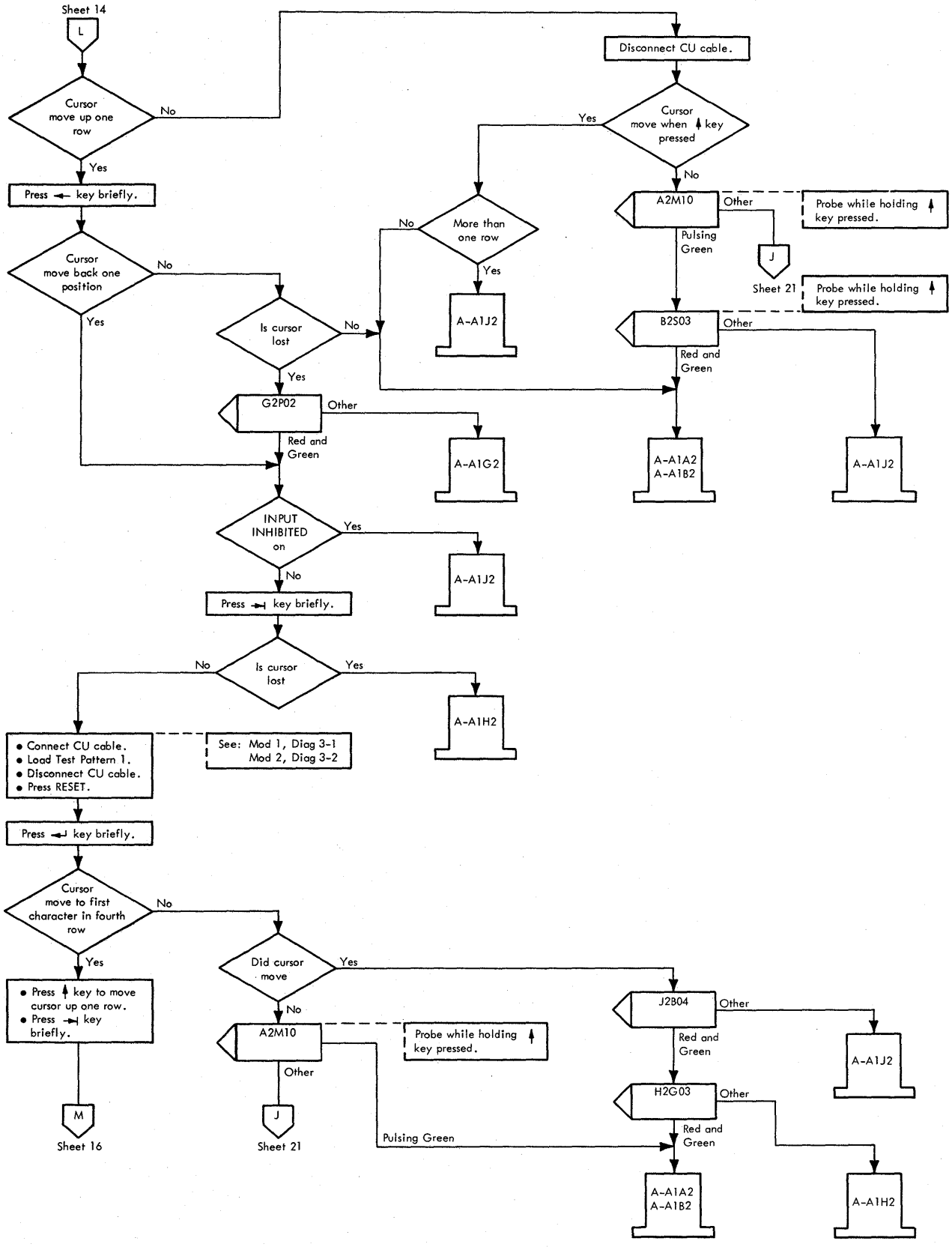


Diagram 4-1. Display Station Troubleshooting Diagrams (Sheet 15 of 27)

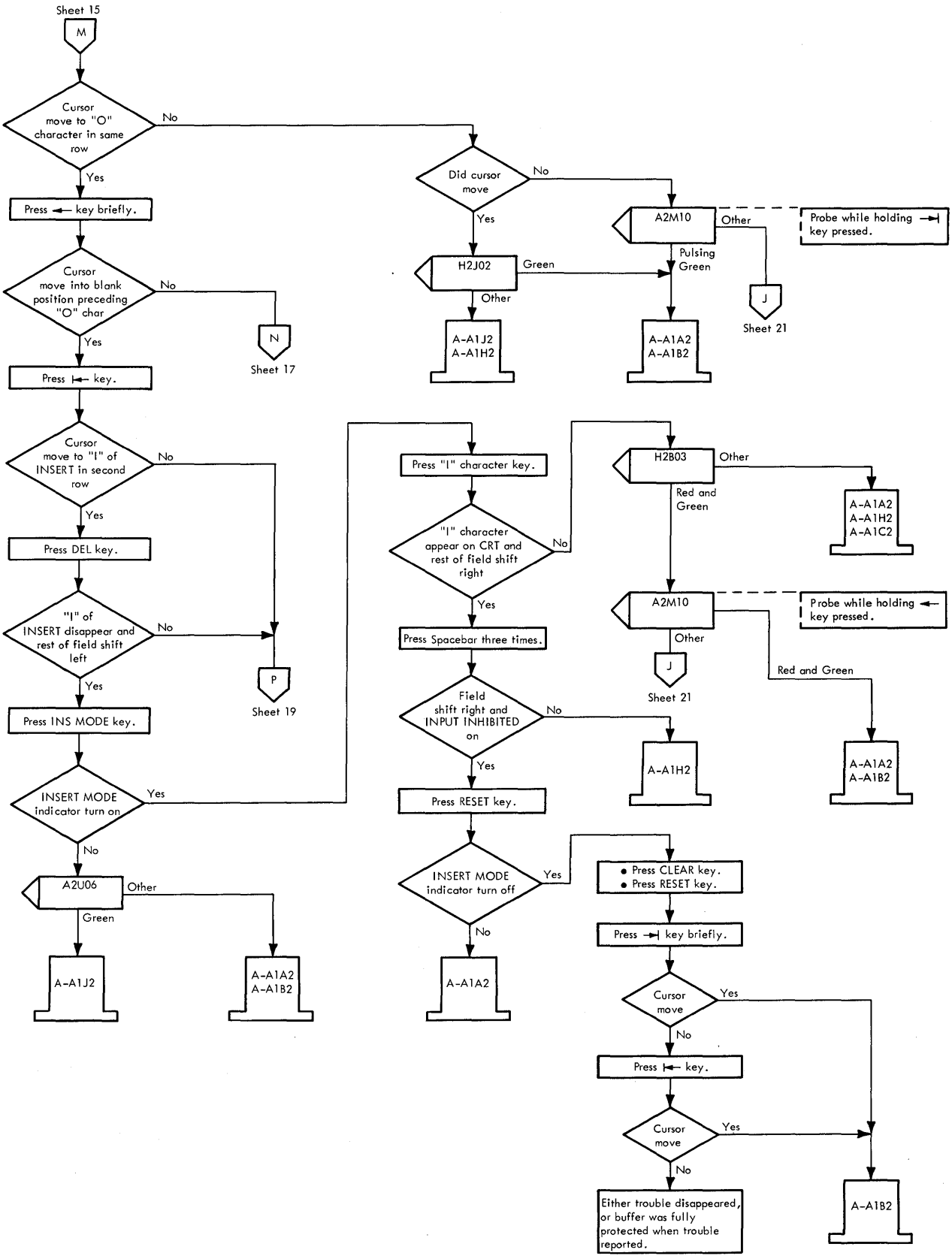


Diagram 4-1. Display Station Troubleshooting Diagrams (Sheet 16 of 27)

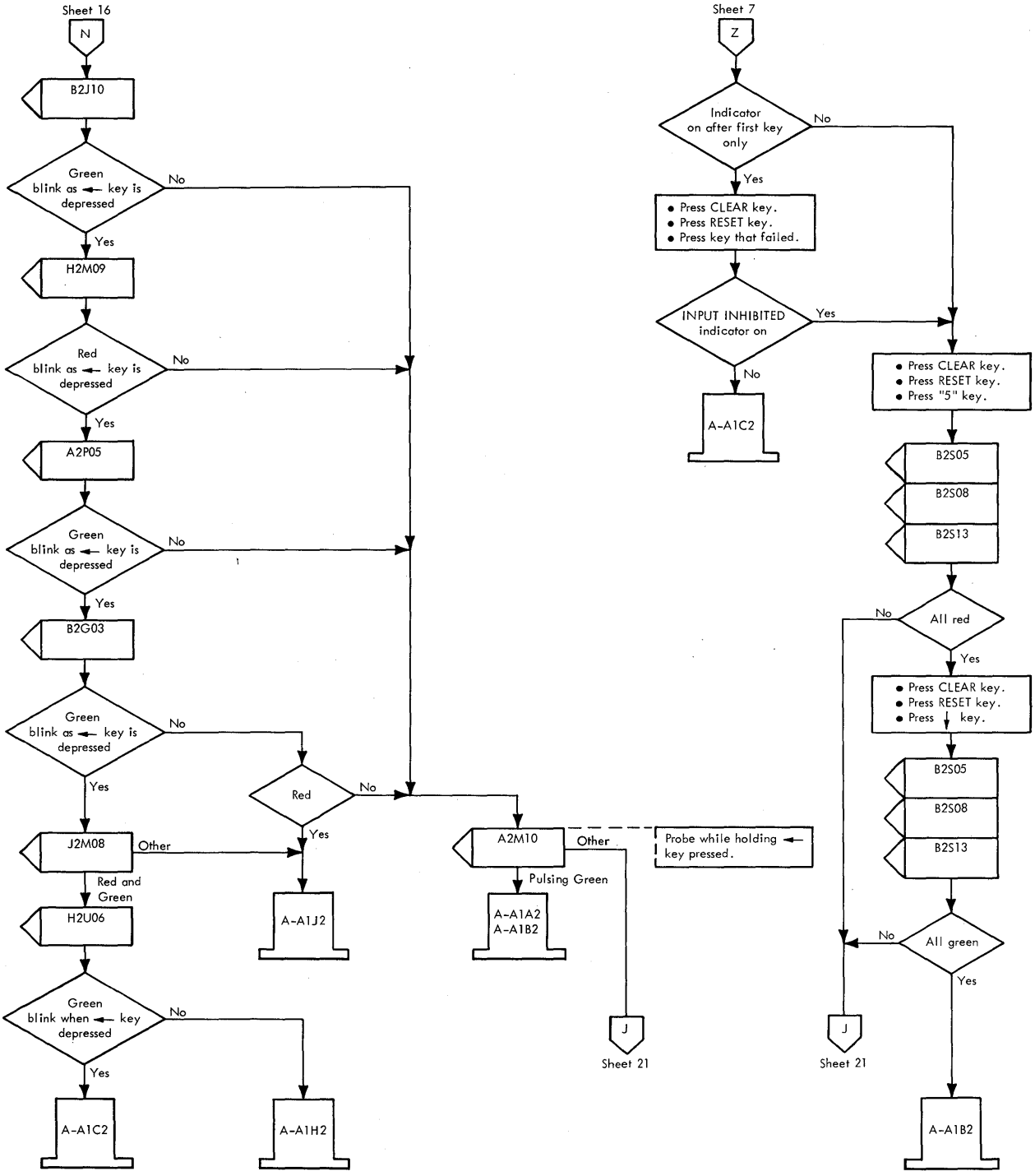


Diagram 4-1. Display Station Troubleshooting Diagrams (Sheet 17 of 27)

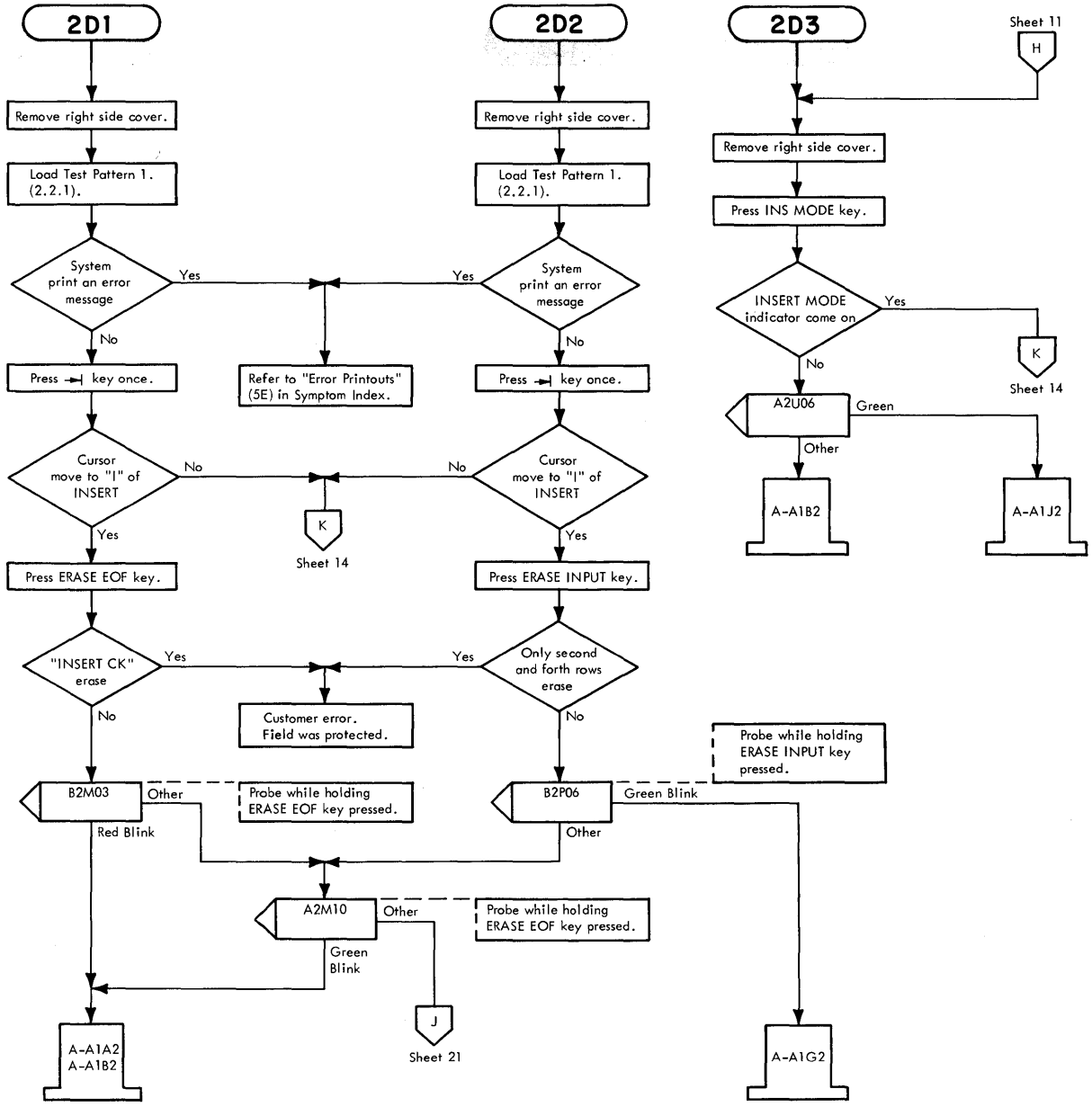


Diagram 4-1. Display Station Troubleshooting Diagrams (Sheet 18 of 27)

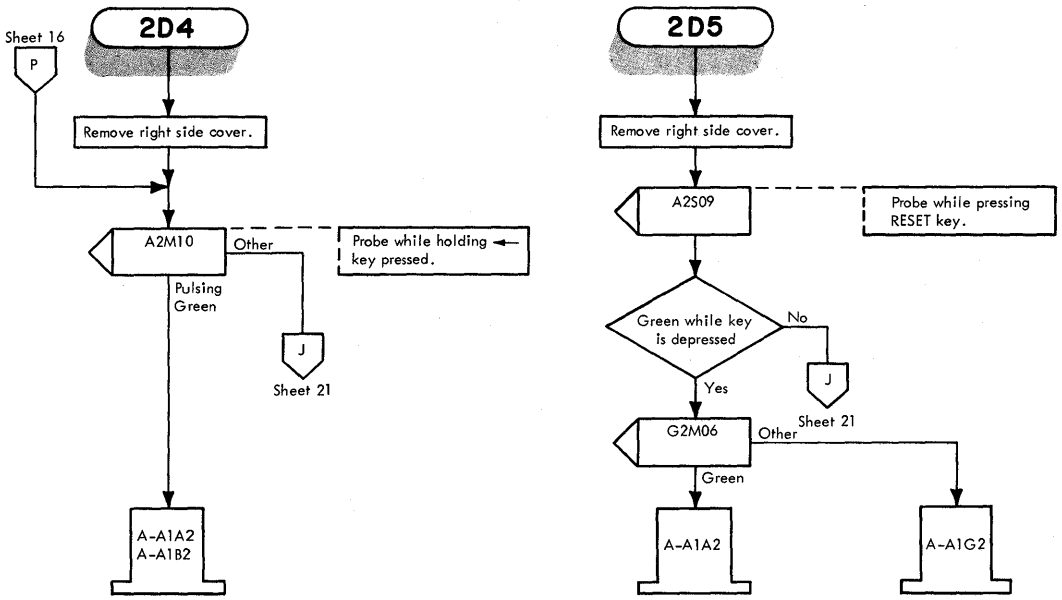


Diagram 4-1. Display Station Troubleshooting Diagrams (Sheet 19 of 27)

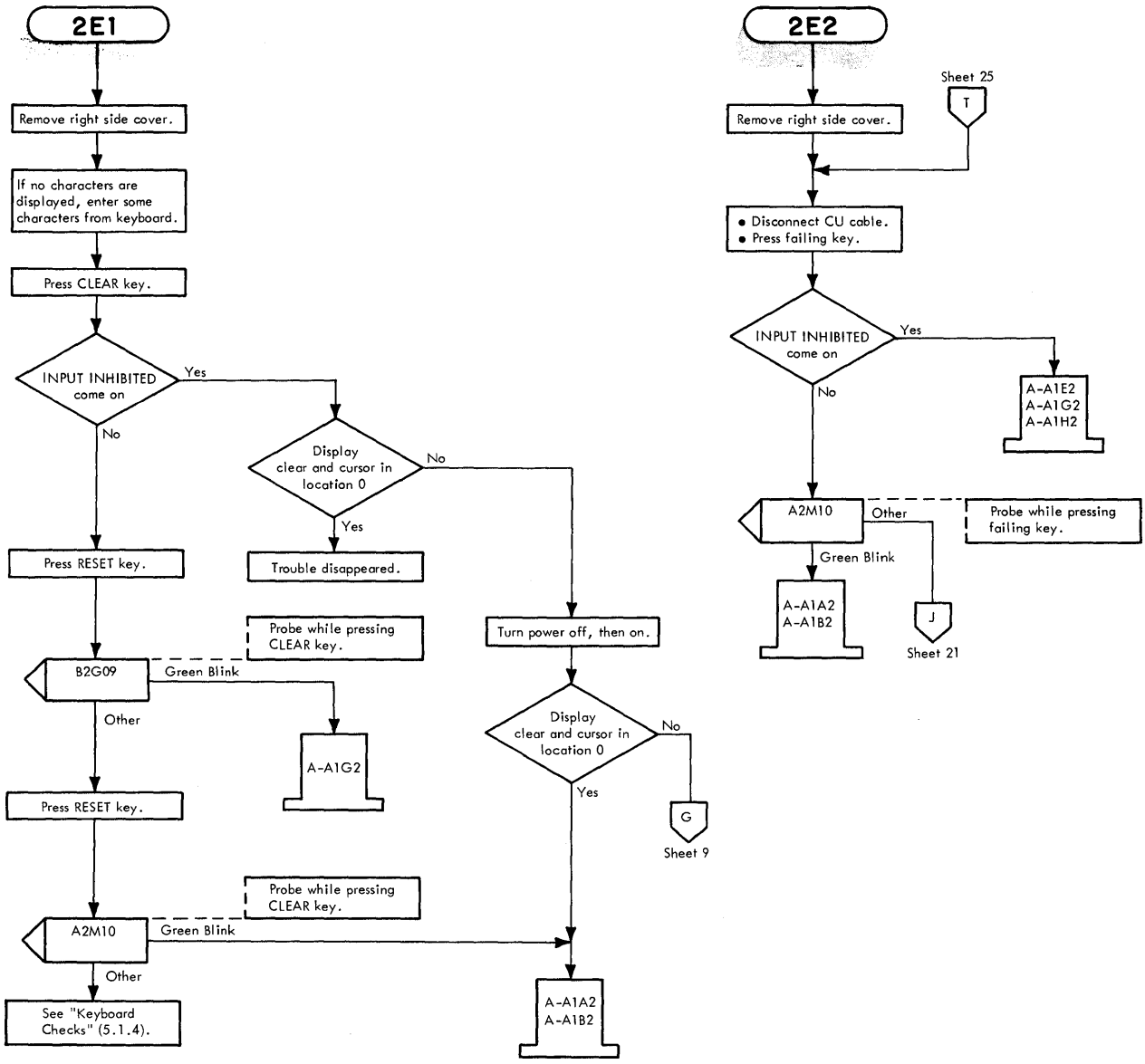


Diagram 4-1. Display Station Troubleshooting Diagrams (Sheet 20 of 27)

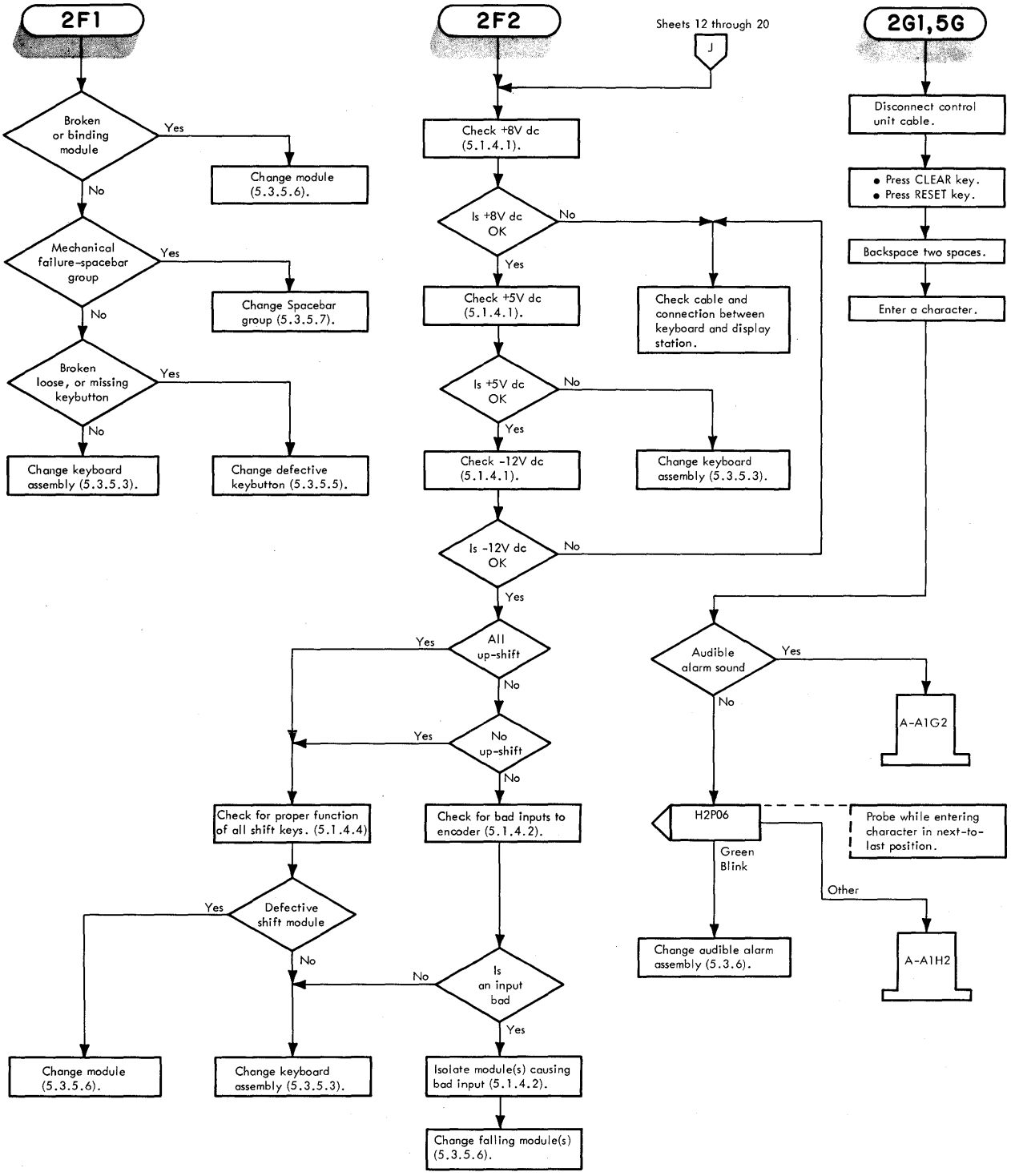


Diagram 4-1. Display Station Troubleshooting Diagrams (Sheet 21 of 27)

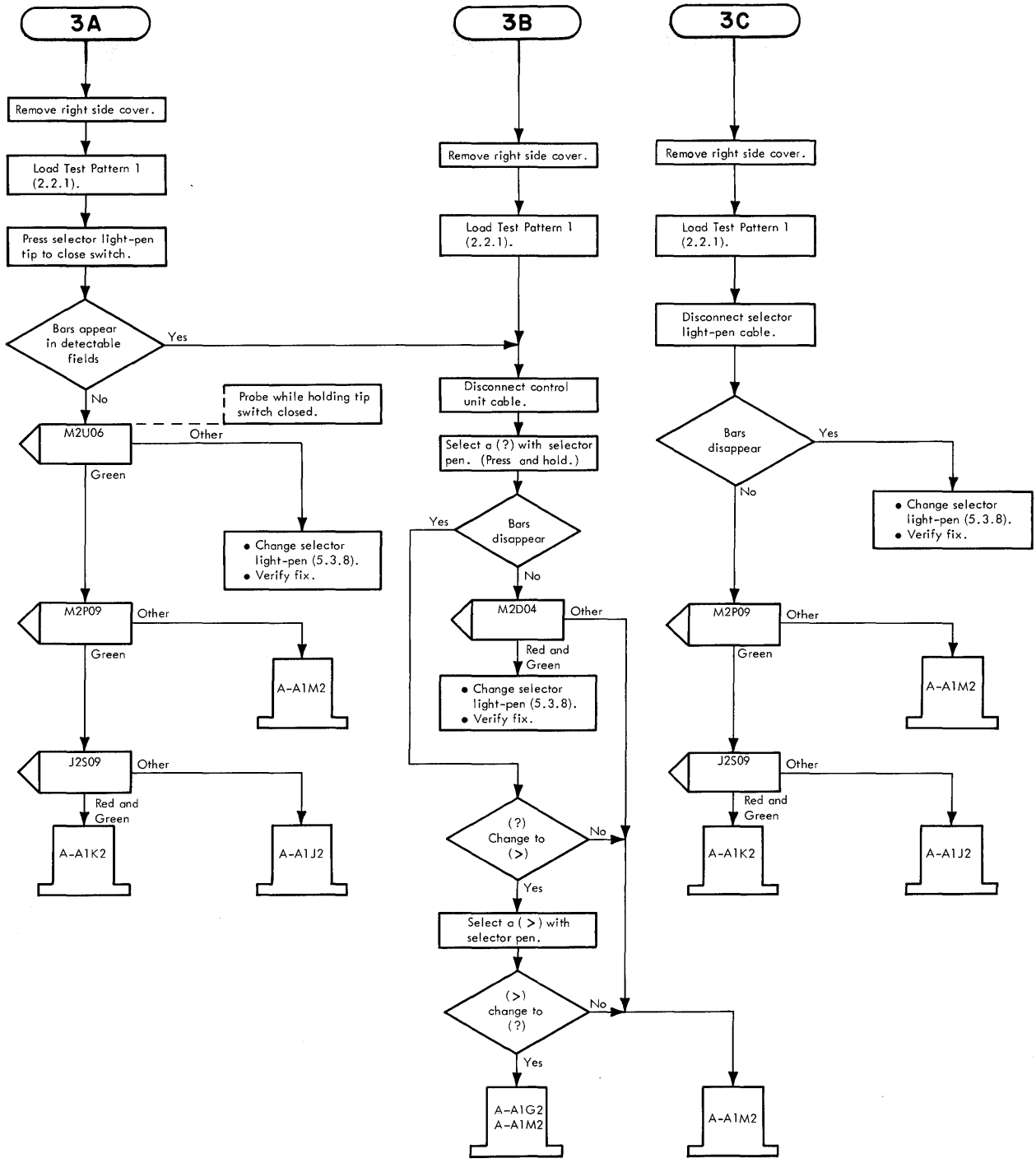


Diagram 4-1. Display Station Troubleshooting Diagrams (Sheet 22 of 27)

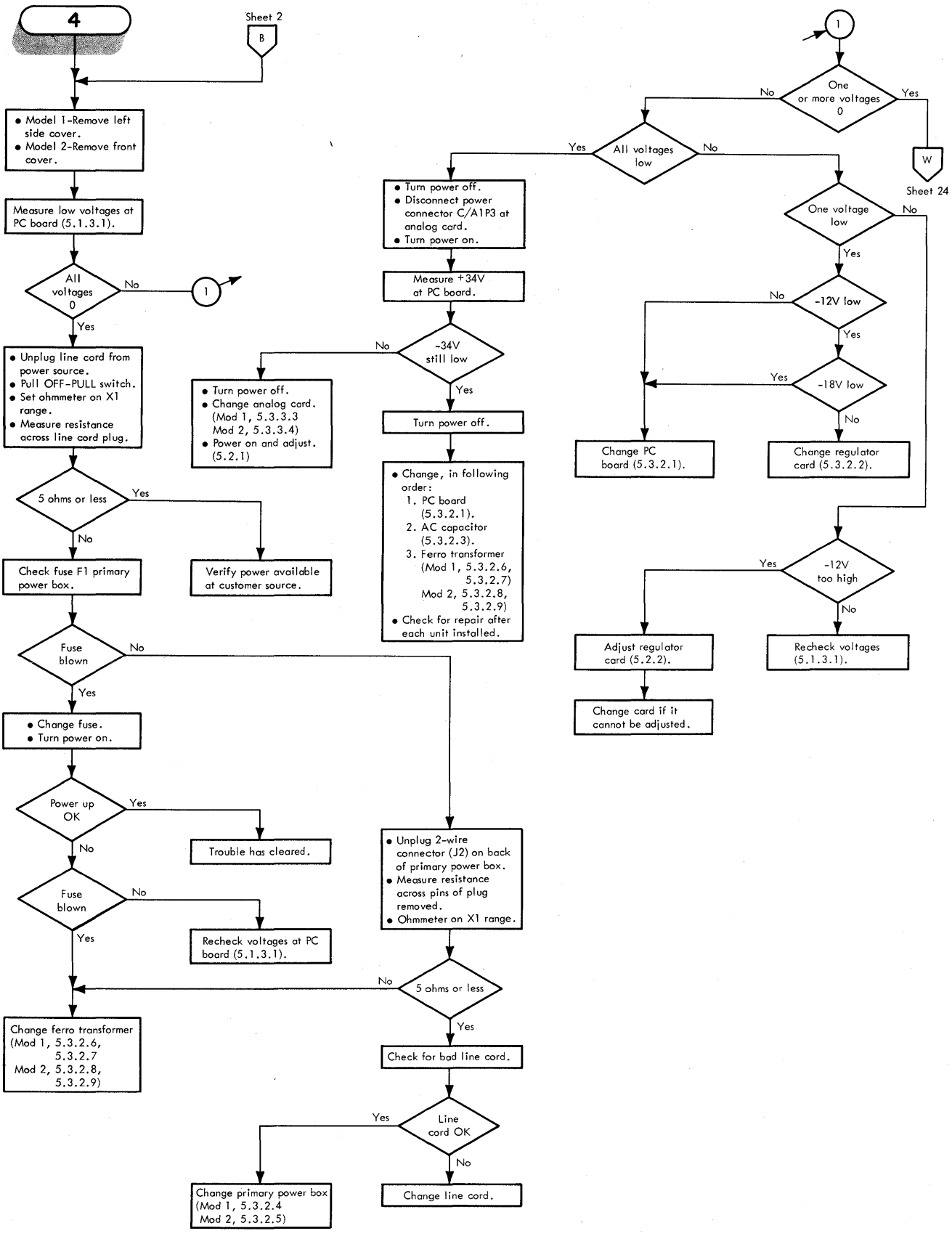


Diagram 4-1. Display Station Troubleshooting Diagrams (Sheet 23 of 27)

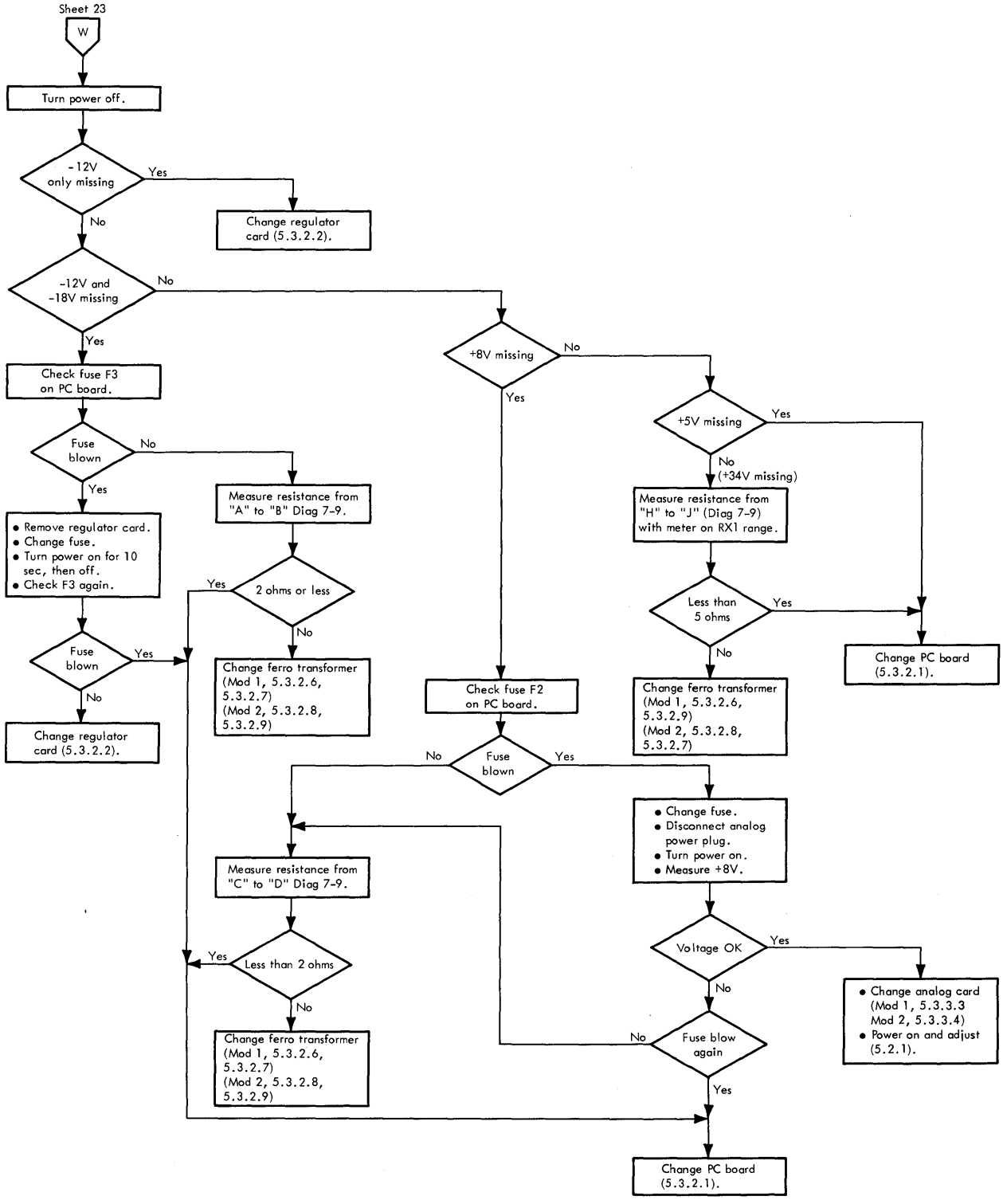


Diagram 4-1. Display Station Troubleshooting Diagrams (Sheet 24 of 27)

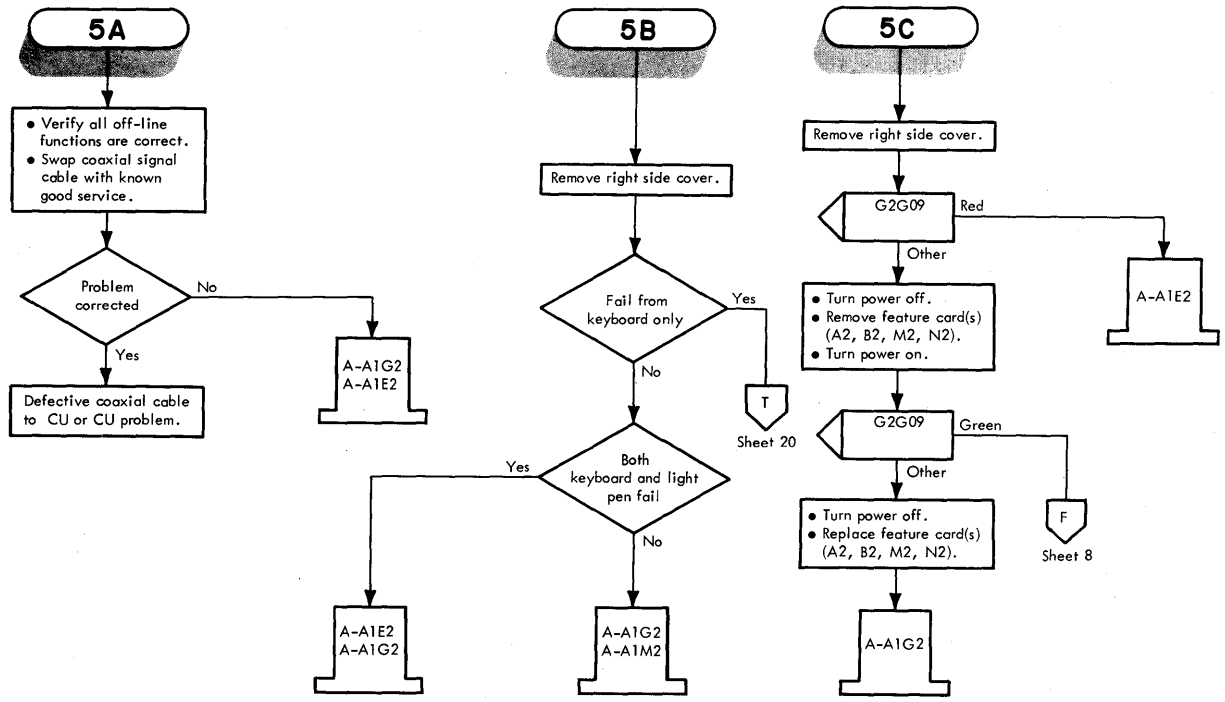


Diagram 4-1. Display Station Troubleshooting Diagrams (Sheet 25 of 27)

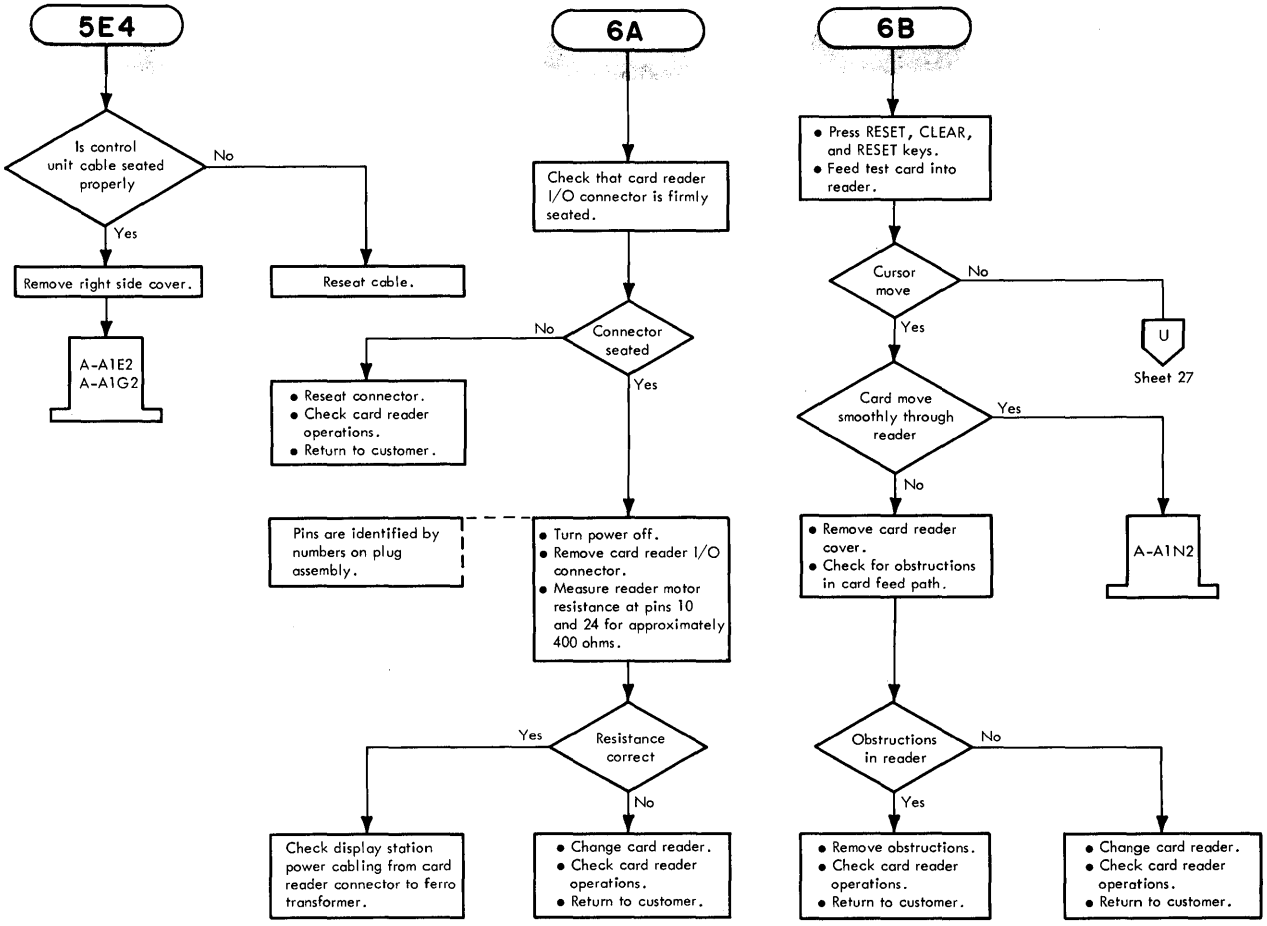


Diagram 4-1. Display Station Troubleshooting Diagrams (Sheet 26 of 27)

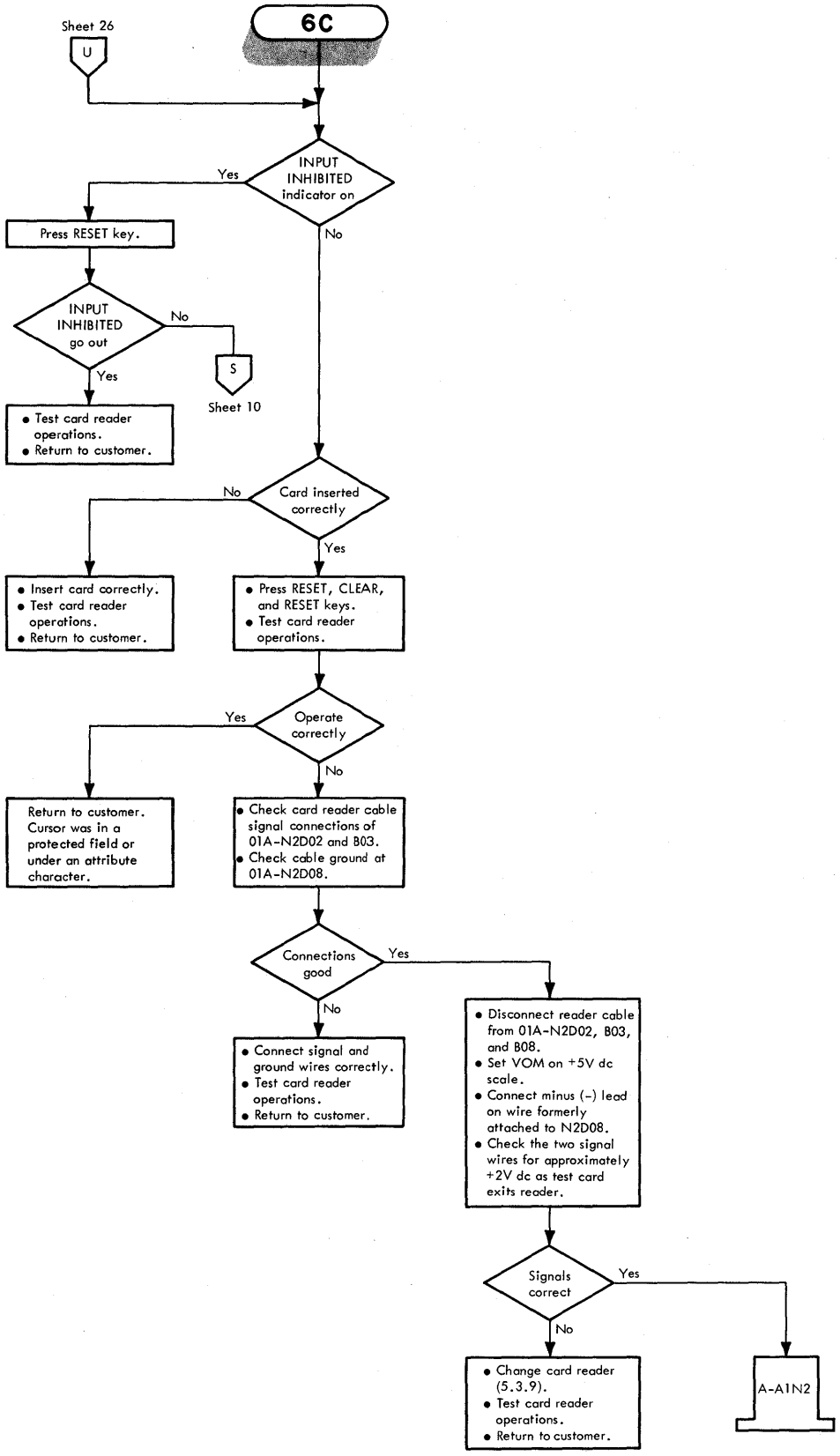


Diagram 4-1. Display Station Troubleshooting Diagrams (Sheet 27 of 27)

This section contains all alignment, adjustment, and removal procedures necessary to maintain IBM 3277 Display Stations. It also contains service checks and checkout procedures to determine whether adjustments are required and to verify the accuracy of any adjustments made.

5.1 CHECKS

5.1.1 Display Station Test Using Test Pattern 1

A comprehensive test of the display station and all attached features is performed by using diagnostic Test Pattern 1 and the procedures described in the following paragraphs. The step-by-step procedures describe the sequence in which the various operations should be performed and the results expected of each operation.

The tests should be performed in the sequence presented, because each test is dependent on data left on the screen from preceding tests. The observations described in paragraph 5.1.1.1 apply to all display stations. Further testing depends on what features are attached to the display station.

If a problem is discovered while performing this operational test, refer to the Symptom Index or the Trouble-shooting Diagrams to resolve the problem.

5.1.1.1 Initialization and Observations

1. Load Test Pattern 1 on display station being checked. (See paragraph 2.2.1 for instructions for loading Test Pattern 1.) SYSTEM AVAILABLE is the only indicator that should be on after pattern is loaded.
2. Take display station offline by removing control unit signal cable. Jack is located at front of display station, under front cover. Do not turn power off while removing cable or Test Pattern 1 will be lost.
3. Compare image on screen with expected image shown in Diagram 2-4. The "NON DISPLAY" field should be blank. Top two rows are displayed in normal intensity, next two rows are displayed in high intensity, and half of last row is displayed in high intensity.
4. Check for only one cursor. Cursor should be in first character position of second row of displayed data.
5. Check quality of displayed image. Image should not be tilted or blurred, and characters should be formed properly with correct inter-row spacing.
6. Vary Brightness control. Set it where high intensity characters have proper brightness.
7. Vary Contrast control. Set it where normal intensity characters contrast with high intensity characters at desired level.

5.1.1.2 Security Keylock Test (Optional Feature)

1. Turn security key off (vertical position). All data should disappear from screen, INPUT INHIBITED indicator should light, and cursor should remain displayed.
2. Turn security key on. Original data should reappear on screen, and INPUT INHIBITED indicator should go out.

5.1.1.3 Tests from Keyboard (Optional Feature)

Press the RESET key. The display image should appear as shown in Diagram 2-4, with the cursor located under the character C in the second row of displayed data. No indicators should be on.

1. Key in the row of alphabetic characters and the one space exactly as they appear in the row above. All characters should enter correctly, and cursor should move under I after Space bar is pressed.
2. Move cursor under C of CK in second row of displayed data, using → (Right) key.
3. Press INS MODE key. INSERT MODE indicator should light.
4. Press A key. Field should now appear AC̲K.
5. Press B key. Field should now appear ABC̲K.
6. Press C key. Field should remain ABC̲K, but INPUT INHIBITED indicator should come on (in addition to INSERT MODE indicator, which has remained on).
7. Press RESET key. Both indicators should go out.
8. Press DEL key. C should disappear, and field should now appear AB̲K.
9. Press ↵ key (New Line). Cursor should move under C character in fourth row of displayed data.
10. Enter eight symbol characters (through asterisk) as they appear in line above while holding SHIFT key (NUMERIC on data entry keyboard) when necessary.
11. Press LOCK key (NUM LOCK on data entry keyboard) to put keyboard in up shift after asterisk character enters.
12. Enter symbol characters through question mark.
13. Press SHIFT key (NUMERIC) to put keyboard in down shift after question mark character (?) enters, and complete keying in the symbols, stopping after slant character (/) enters.
14. Key in remainder of row without shifting, Use → key to move cursor through comma (,) character. This is a numeric-only field; when the A key is pressed, the

character should not enter, and the INPUT INHIBITED indicator should light.

15. Press RESET key. INPUT INHIBITED indicator should go out.
16. Check ↑ (Up), ↓ (Down) and ← (Left) cursor move keys for proper operation.
17. Check Typamatic function of spacebar or any other key with Typamatic capability. (Use unprotected field.)
18. Move cursor under first character displayed of test message.
19. Press any alphameric key. INPUT INHIBITED indicator should come on, and character should not enter or display because field is designated as a protected data field.
20. Press RESET key. INPUT INHIBITED indicator should go out.
21. Press ENTER key. INPUT INHIBITED indicator should light, and keyboard should lock.
22. Press RESET key. INPUT INHIBITED indicator should go out, and keyboard should unlock.

Note: The following steps check tab, DUP and new line functions.

23. Press →| (Tab) key. Cursor should appear under character A in second row of characters.
24. Press DUP key. An asterisk (*) should appear in cursor position, and cursor should move under I of INSERT.
25. Space one character position. The I should disappear.
26. Press |← (Back Tab) key. Cursor should move back one space to where the I was formerly located.
27. Press Back Tab key again. Cursor should appear in first character position of same row.
28. Press ↵ (New Line) key. Cursor should appear in first character position of fourth row of displayed data. (Cursor does not stop in third row because all data in that row is designated as protected.)

Note: The following steps test the erase and clear functions.

29. Position cursor under character E in second row of displayed data.
30. Press ERASE EOF key. Characters E through Z should disappear, and cursor should not move.
31. Press ERASE INPUT key. All unprotected data, including key-in characters and field that originally appeared as INSERT CK, should disappear from screen.
32. Proceed to paragraph 5.1.1.4 if display station being tested has a selector light-pen attached. If a pen is not attached, press CLEAR key. All characters remaining on screen should disappear, and cursor should reappear in first character position in first row. Press RESET key.
33. Proceed to paragraph 5.1.1.5 if display station has an operator identification card reader attached. If a card reader is not attached, test is completed. Turn power off, and reconnect control unit signal cable.

5.1.1.4 Selector Light-Pen Tests (Optional Feature)

1. Fire pen on detectable field that has a question mark (?) as its first character. Question mark should change to a greater-than (>) symbol. Remainder of field should not change.
2. Fire pen again on the field. The greater-than symbol should change back to a question mark. Remainder of field should not change.
3. Fire pen on next detectable field that has a greater-than symbol as its first character. The greater-than symbol should change to a question mark. Remainder of field should not change.
4. Fire pen again on same field. Question mark should change back to a greater-than symbol. Remainder of field should not change.
5. Press CLEAR key. All characters on screen should disappear, and cursor should move to character location 0. Press RESET key.
6. Proceed to paragraph 5.1.1.5 if display station being tested has an operator identification card reader attached. If a card reader is not attached, test is completed. Turn power off, and reconnect control unit signal cable.

5.1.1.5 Operator Identification Card Reader Tests (Optional Feature)

1. Key in a few characters on the screen.
2. Return cursor to character position 1. (Do not use CLEAR key.)
3. Read in card reader test card (PN 2143816). The following events should occur:
   a. Cursor moves 40 character positions as the keyed-in data disappears from screen.
   b. INPUT INHIBITED indicator comes on and stays on.

   If cursor does not move 40 spaces, read-in operation was unsuccessful.
4. Tests are now completed. Turn power off, and reconnect control unit signal cable.

5.1.2 Display Station Operational Test (without Test Pattern 1)

The following test sequence is a quick checkout procedure that can be used as an offline display station reliability test. This procedure tests display station circuitry extensively, but is not as comprehensive as the procedure described in paragraph 5.1.1. It can be used as a quick checkout to verify correct operation after maintenance is performed. Perform the steps in sequence for most effective results.

1. Turn power off.

2. Take display station offline by removing coaxial signal cable from display station I/O jack. Jack is located at front of display station. Front cover must be removed for access to it.
3. Turn power on. Within 15 seconds, cursor should appear on screen at character location 0. No indicators should be lighted.
4. Press → (Right) key, and hold it down. Cursor should move through each character location in the row. After reaching last character location, cursor should appear in first character location in second row.
5. Exercise ↑ (Up), ↓ (Down), ↵ (New Line), and ← (Left) cursor move keys. Observe that each key performs its operation correctly.
6. Press several alphameric keys in succession. The corresponding characters should display, and cursor should move one space as each new character appears.
7. Key in a complete row of characters. When last character of row enters, cursor should appear in first character position of next row.
8. Press an alphameric key. Character should appear in cursor location, and cursor should advance one space.
9. Exercise both upper and lower shift of all keys. Observe display screen as each key is pressed, checking that proper characters enter.
10. Exercise Typamatic function of each Typamatic key.
11. Move cursor into last row, and key in several alphameric chararacters.
12. Backspace cursor near middle of group of characters just entered.
13. Press INS MODE key. INSERT MODE indicator should light.
14. Press Space bar enough times to cause characters at right of cursor to move to end of row and wrap around to first row.
15. Press RESET key. INSERT MODE indicator should go out.
16. Delete several characters using DEL key. Character in cursor position should disappear, and characters in same row at right of cursor should move left one character position each time DEL is pressed.
17. Move cursor to middle of a row of characters.
18. Press ERASE EOF key. Characters from cursor position through last position on screen should erase, and cursor should not move.
19. Press ERASE INPUT key. All characters should erase, and cursor should move to location 0.
20. Enter several alphameric characters as in step 6.
21. If display station has the security keylock feature, turn key off. Characters should disappear from screen, INPUT INHIBITED should light, and cursor should remain displayed.
22. Turn security key on. Original data should reappear on screen, and INPUT INHIBITED should go out.
23. Press CLEAR key. All characters should disappear from screen, and cursor should reappear in character location 0.
24. Press Backspace key three times.
25. Press any character key. Audible alarm should sound when key is pressed.
26. If an operator identification card reader is attached, proceed to step 27. Turn power off, and reconnect control unit signal cable if a card reader is not attached.
27. Press CLEAR key, RESET key, then enter several alphameric characters as in step 6.
28. Return cursor to location 0 using ← (Left) key.
29. Read in card reader test card (PN 2143816).
30. Observe that INPUT INHIBITED indicator comes on, cursor moves 40 spaces, and keyed-in data disappears from screen as card passes through reader.
31. If cursor does not move 40 spaces, read-in operation was unsuccessful.
32. Offline tests are completed. Turn power off, and reconnect control unit signal cable.

5.1.3 Voltage Checks

A ferroresonant transformer (ferro) with a 110V ac primary and multiple secondary taps provides all display station voltages. The ferro is protected by fuse F1 in series with its primary winding. F1 is located in the prime power box. Display station voltages consist of low dc voltages, high dc voltages, and 6.3V ac CRT filament voltage. These voltages can be checked at the LV printed circuit (PC) board or at Terminal Board 1 (TB1).

Refer to the Symptom Index and Troubleshooting Diagrams if a voltage is incorrect or is missing.

5.1.3.1 Low-Voltage DC Checks

Model 1: Measure the low dc voltages at the capacitor screws on the LV printed circuit board. Diagram 7-9 shows the location and the polarity of the capacitor screws. Remove the left side cover for access to the circuit board.

Model 2: Measure the low dc voltages through the access holes in the shield that covers the printed circuit board. A line with arrowheads at each end designates the pairs of terminals associated with each voltage. Diagram 7-10 illustrates the PC board shield. Remove the front cover for access to the circuit board.

Observe the polarities of the terminals, and probe with the correct test leads to prevent damage to the meter. The following voltages can be measured at the PC board:

+5V
+8V (This voltage is protected by fuse F1 on PC board.)
+34V

-18V (This voltage is fuse-protected by fuse F3 on PC board and is the input to the -12V regulator card. If this voltage is missing, the -12V will also be missing.)

-12V

5.1.3.2 High-Voltage Check

The only high voltage that should be checked is the +400V dc (which is derived from the HV power supply). If this voltage is correct, the other high voltages for the CRT should also be correct. Because the +400V is a low-current supply, it is impossible to obtain an accurate measurement with the standard voltmeter. Check the arc-suppression circuitry whenever HV troubles occur.

Model 1: High voltage is measured on the arc-suppression circuit board (Z1). See Diagram 7-15 for Z1 terminal locations called out in this procedure.

1. Turn power off.
2. Set voltmeter selector switch to a position that will measure up to 400V dc.
3. Connect minus (-) test lead on Z1 terminal 4.
4. Connect plus (+) test lead on Z1 terminal 10.
5. Turn power on.
6. Check for a meter indication of +400V, ±50V dc.
7. Turn power off, and remove test leads from Z1 terminals.
8. Check arc-suppression circuitry (paragraph 5.1.3.3).

Model 2: High voltage is measured on the voltage distribution board (TB1). See Diagram 7-11 for TB1 terminal locations called out in this procedure.

1. Turn power off.
2. Set voltmeter selector switch to a position that will measure up to 400V dc.
3. Connect minus (-) test lead to any terminal on TB1 marked RET (pins 7–10, 20, or 21).
4. Connect plus (+) test lead on terminal TB1-12.
5. Turn power on.
6. Check for a meter indication of +400V, ±50V dc.
7. Turn power off, and remove test leads from TB1 terminals.
8. Check arc-suppression circuitry (paragraph 5.1.3.3).

5.1.3.3 Arc-Suppression Check

A defective arc-suppression circuit can cause component damage in the HV power supply or in the analog card. If excessive trouble is experienced in either of the two assemblies, inspect the arc-suppression circuitry. Arc-suppression circuitry is located on the arc-suppression board (Z1) on Model 1 display stations and on the voltage distribution board (TB1) on Model 2 display stations.

1. Check for bent, broken, or missing wires.
2. Check for bent capacitor leads that are too close to other components that could cause arcing.
3. Check for broken capacitors or other components showing obvious damage.

If inspection shows no obvious problem in the arc-suppression circuit and excessive trouble persists, replace the arc-suppression board or the voltage distribution board.

5.1.3.4 6.3V AC Check

The CRT filament voltage of 6.3V ac is the only ac voltage used in the display station. A quick check to determine if 6.3V ac is present is to look for a glowing filament at the back of the CRT neck, near the tube socket. This voltage, which is protected by fuse F2 located on the LV PC board in both models, can be measured on Model 2 display stations as described below:

1. Turn power off.
2. Set voltmeter selector switch to a position that will measure 6.3V ac.
3. Connect one meter lead on TB1-1, and connect other lead on TB1-2 on the voltage distribution board.
4. Turn power on.
5. Check for a meter indication of 6.3V ac.
6. Turn power off, and remove meter leads from TB1-1 and TB1-2.

5.1.4 Keyboard Checks

The following paragraphs describe several keyboard check procedures that can be used to isolate keyboard problems to any of three areas. The three areas of possible trouble are:

1. External to the keyboard.
2. An FRU in the keyboard.
3. A non-FRU in the keyboard.

Problems external to the keyboard should be diagnosed as outlined in the Troubleshooting Diagrams. Keyboard field replaceable units include keybuttons, key modules, support modules, spacebar group, and audible response device. Do not attempt to repair any other keyboard units. Diagrams 7-7 and 7-8 show the locations of the test points used while checking the keyboard.

The keyboard assembly should be visually inspected for shorts or grounds that could cause erratic operation or erroneous results while performing the following checks.

A faulty keyboard should be replaced with a good one, and the faulty keyboard should be returned to the factory if it is less than one year old. The date code is marked on the keyboard assembly by week (01-52) and year.

5.1.4.1 Voltages

1. Check for +8V dc between KB1 pins V(+) and X (ground).
2. Check for -12V dc between KB1 pins Z(-) and X (ground).
3. Check for +5V dc across keyboard capacitor C1. This voltage is developed (by the voltage regulator on the keyboard assembly) from the display station +8V dc power supply. Replace the keyboard assembly if the +8V dc is correct and the +5V dc is not correct.

5.1.4.2 Key Module and Encoding (Diagram 6-11)

Correctly functioning key modules present two active (2.5V dc minimum) input lines to the keyboard assembly encoder. With two and only two active inputs present, the encoder generates the strobe signal and the encoded character output. This procedure checks that the strobe signal is generated properly, and the key modules activate only two inputs to the encoder. Replace the key module if it is found to be defective. Replace the keyboard assembly if the encoder or the printed circuit board is defective.

Strobe check:

1. Set selector switch on volt-ohmmeter to a position that will accurately measure 5V dc.
2. Place minus (-) meter lead on KB1 tab X (ground).
3. Place plus (+) meter lead on KB1 tab R (strobe signal).
4. With no keys pressed, the meter should indicate at least 2.5V. If the meter indicates 0.6V or lower, proceed to step 7.
5. Press and hold one alphameric key. The meter should indicate less than 0.6V. If the meter indicates 2.5V or higher, replace the keyboard assembly.
6. Press and hold two alphameric keys simultaneously. The meter should indicate at least 2.5V. Proceed to paragraph 5.1.4.3 if the preceding results are correct.

0.6V (or lower) with no keys pressed: (Two inputs to encoder are active.)

7. Probe KB1 pins D, E, F, H, J, K, L, M, and N (bits 0–7 and Parity, Diagram 7-8).
8. Note bit configuration of encoded output. With logic probe, a red indication is a 1 bit, and a green indication is a 0 bit. With voltmeter, greater than 2.5V is a 1 bit, and less than 0.6V is a 0 bit.
9. Find code in Diagram 6-5 or 6-6 that corresponds to bit configuration observed in step 8.
10. Check center two lead frame terminals of suspected module for 2.5V or higher. (Keyboard assembly must be removed from bottom pan for this voltage check. See paragraph 5.3.5.3.)
11. Replace defective module if 2.5V or higher is measured in step 10.
12. Replace keyboard assembly if less than 2.5V is measured in step 10.

5.1.4.3 Output Codes

The unshifted and shifted codes for all key modules can be checked by the following procedure which uses the logic probe and by Diagrams 6-5 and 6-6.

1. Press and release desired key. Hold SHIFT (NUMERIC on data entry keyboards) key down while pressing key if character is on top half of keybutton.
2. Probe pins listed below with logic probe, and note bit configuration observed. A red indication is a 1 bit, and a green indication is a 0 bit.

Pin (1A1-B2)	Keyboard Bit
S05	0
S08	1
S09	2
S02	3
U05	4
M10	5
U09	6
M11	7
S13	Parity

3. Compare bit configuration observed in step 2 with configuration for desired character shown in Diagrams 6-5 and 6-6.

5.1.4.4 Shift Key Modules

Two SHIFT keys and the shift LOCK key (NUMERIC and NUM LOCK keys on data entry keyboards) generate an input signal to the keyboard assembly encoder. The encoder generates upshift character codes of the characters appearing on the top half of the keyboard keys. The following procedure isolates a shift module failure.

1. Set volt-ohmmeter selector switch to a position that will accurately measure up to 5V dc.
2. Place minus (-) meter lead on KB1 tab X (ground).
3. Probe pin 14 of keyboard assembly encoder. The meter should indicate 0.6V (maximum) with no shift key pressed.
4. Check all three shift keys individually for 3.6V (minimum) on pin 14 of the encoder while each key is pressed.
5. Replace shift module that fails to generate 3.6V.

5.1.4.5 Spacebar Group Checks

The module and encoding check described in paragraph 5.1.4.2 also checks spacebar module encoding.

The spacebar group torsion bar and mountings should be checked for easy motion and freedom from binds. The spacebar should depress and return to the restored position without drag or binds. Replace the spacebar group if binds,

broken mountings, or a bent torsion bar is discovered. It may not be necessary to replace the space module if the problem is mechanical.

5.2 ADJUSTMENTS

Adjustment procedures for the IBM 3277 Display Station should be performed after it is established that all operating voltages are correct. Paragraph 5.1.3 details the voltage checkout procedure.

5.2.1 Display Image Adjustments

A test pattern generated by the diagnostic program provides the display image to be used during image adjustment. Test Pattern 2 is used to adjust the Model 1 display image, and Test Pattern 3 is used to adjust the Model 2 display image. The procedure for displaying the required test pattern is described in paragraph 2.2. If the program-generated test pattern is not used, the test pattern image must be keyed in from the keyboard. Diagrams 2-5 and 2-6 show Test Patterns 2 and 3, respectively.

Adjustments should be performed in the sequence listed. However, if only minor touchup adjustment is required, analog card adjustments can be made separately. Use Diagrams 7-1 through 7-6 to locate the adjustments specified in the following procedures. The following equipment is required.

Alignment mask:
- Model 1 – PN 2577899 (Diagram 2-2)
- Model 2 – PN 2565170 (Diagram 2-3)

Jumper – Short wire with alligator clips on both ends.
Screwdriver (small blade)

5.2.1.1 Brightness

Note: The Brightness control is the outer knob on the OFF-PUSH switch.

Adjust as follows:
1. With Brightness control fully counterclockwise, no image should be visible.
2. At full clockwise rotation, raster may become visible. Image may bloom and become excessively bright for comfortable viewing if Contrast control (innner knob) is fully counterclockwise.
3. Set Brightness control at point that produces best display image for comfortable viewing.

5.2.1.2 Contrast

Note: Test Pattern 1 or a customer program that contains dual brightness fields must be loaded to properly adjust the Contrast control. The Contrast control is the inner knob on the OFF-PUSH switch.

Adjust as follows:
1. With Contrast control fully counterclockwise, contrast between normal and bright fields should be approximately equal.
2. At full clockwise rotation, contrast should be maximum. Normal brightness characters may disappear from screen if Brightness control (outer knob) is set at a low level.
3. Set Contrast control for comfortable viewing, with desired amount of contrast between normal and bright fields.

5.2.1.3 Focus

Adjust the Focus potentiometer to the point that produces the sharpest display image. Observe closely the characters at the center of the screen and those at the edges of the screen. Set the potentiometer where the best focus over the entire CRT is achieved. The Focus potentiometer is on the HV power supply.

5.2.1.4 Yoke

1. Place proper alignment mask in position against face of CRT.

   Note: Use mask PN 2577899 to adjust Model 1 display stations and mask PN 2565170 to adjust Model 2 display stations. The yoke shield must be on the yoke before making the following adjustments.

2. Connect a jumper between ground and the two test pins on analog card. (Clip one end of jumper on both pins on analog card and clip other end to dc return.) The pins are located between CHAR HEIGHT potentiometer and SWEEP INDIC neon. This jumper disables vertical deflection and produces a single horizontal trace across approximate middle of screen.
3. Loosen yoke clamp and rotate yoke until horizontal trace is parallel to, or coincides with, horizontal lines on alignment mask.
4. Ensure that yoke is firmly seated against CRT bell while maintaining horizontal alignment obtained in step 3.
5. Tighten yoke clamp loosened in step 3.

5.2.1.5 Magnetic Centering Rings

1. Leave vertical deflection grounding jumper (connected in step 2 of paragraph 5.2.1.4) attached and the alignment mask in place for this adjustment.
2. Using tabs on centering rings, rotate rings until horizontal trace passes through geometric center of screen. (Geometric center is indicated by crossed lines in center of alignment mask. Vertical center is indicated by line B on the Model 1 mask and by line D on the Model 2 mask. Horizontal center is judged by comparing ends of trace to vertical lines at edges of mask.)

3. Proceed to paragraph 5.2.1.6 (Model 1 analog card adjustments) or to paragraph 5.2.1.7 (Model 2 analog card adjustments).

5.2.1.6 Model 1 Analog Card Adjustments

The procedures described in the following paragraphs apply only to the IBM 3277 Model 1 Display Stations. See paragraph 5.2.1.7 for Model 2 analog card adjustment procedures. These procedures require that the Model 1 alignment mask (PN 2577899) be positioned against the face of the CRT.

Model 1 Horizontal Width: The vertical deflection grounding jumper (connected in step 2 of paragraph 5.2.1.4) should remain attached during this adjustment. Proceed as follows:

1. Adjust Horizontal Width potentiometer so that ends of horizontal trace on screen coincide with vertical lines C and E on alignment mask. When adjusted correctly, trace should be 6.4 inches ± 1/16 inch.
2. Check to make sure that horizontal trace still passes through geometric center of CRT (Line B). Readjust centering rings as described in paragraph 5.2.1.5 if it is necessary to move trace back through center of CRT.
3. Remove vertical deflection grounding jumper.

Model 1 Top Margin: Adjust Top Margin potentiometer so that top trace of first character row falls within line A marked on alignment mask.

Model 1 Character Height: Adjust Character Height potentiometer so that bottom trace of characters in last row falls within line D of alignment mask. When adjusted correctly, overall height of display image should be 3.9 inches.

Model 1 Linearity: After completing the yoke, centering ring, and analog card adjustments, check that 20th and 21st characters on sixth and seventh rows fall within rectangle H at center of alignment mask. Test Pattern 2 provides characters in these four locations. Recheck preceding adjustments if this specification is not met.

5.2.1.7 Model 2 Analog Card Adjustments

The procedures described in the following paragraphs apply to Model 2 display stations only. (See paragraph 5.2.1.6 for the Model 1 analog card adjustment procedures.) The following procedures require that the Model 2 alignment mask (PN 2565170) be in place at the face of the CRT and Test Pattern 3 be displayed.

Model 2 Horizontal Width: The vertical deflection grounding jumper (connected in step 2 of paragraph 5.2.1.4) should remain attached during this adjustment. Proceed as follows:

1. Adjust Horizontal Width potentiometer so that ends of horizontal trace on screen coincide with lines E and G on alignment mask. When adjusted correctly, trace should be 10.5 inches.
2. Check to make sure that horizontal trace still passes through geometric center of CRT (line D). Readjust centering rings as described in paragraph 5.2.1.5 if it is necessary to move trace back through center of CRT.
3. Remove vertical deflection grounding jumper.

Model 2 Top Margin:

1. Connect a jumper between logic board pin A1J2M03 and ground (any D08 pin). This jumper disables vertical skip circuit, causing inter-row spacing to disappear and display image to gather toward top of screen.
2. Adjust Top Margin potentiometer so that top trace of first character row falls within center of line A (marked on alignment mask).

Model 2 Character Height:

1. Leave vertical skip disabling jumper attached for this adjustment.
2. Adjust Character Height potentiometer so that bottom trace of characters in last row coincides with center of line C on alignment mask. When adjusted correctly, overall height of display image should be 3.3 inches from line A to line C.
3. Remove vertical skip disabling jumper. Display image should appear nearly normal, with inter-row spacing. Overall image may be too large or too small.

Model 2 Inter-Row Spacing: Adjust Row Spacing potentiometer so that bottom trace of characters in last row falls within line F on alignment mask. When adjusted correctly, overall height of image should be approximately 8.0 inches from line B to line F.

Model 2 Linearity: After completing yoke, centering ring, and analog card adjustments, check that 40th and 41st characters on 12th and 13th rows fall within rectangle M on alignment mask. Test Pattern 3 provides characters in these four locations. Recheck preceding adjustments if this specification is not met.

5.2.2 -12V Regulator Card

This adjustment should be performed when the -12V regulator card is replaced or when a voltage check shows that -12V is not at its nominal value. Voltage measurements are made on TB1. TB1 is located on the right side frame in Model 1 display stations and is under the left side of the CRT in Model 2 display stations.

1. Set volt-ohmmeter selector switch to a position that will accurately measure 12V dc.

2. Attach meter plus (+) lead to a dc return (-) terminal on TB1.
3. Attach meter minus (-) lead to the -12V terminal on TB1.
4. Adjust potentiometer on -12V regulator card. Use a small screwdriver. Set potentiometer so voltmeter shows 12V.
5. Remove meter leads from TB1.

5.3 REMOVALS

The following paragraphs describe removal and replacement procedures for IBM 3277 Display Station FRUs. Where the procedure for removing and replacing a unit in the Model 1 display station differs from the procedure used with the Model 2 display station, a separate paragraph describing the unique procedure is presented. All removal and replacement procedures require that the desired unit has been made accessible by the removal of necessary covers and made safe by the removal of power. The top cover can be left on the display station while performing most maintenance procedures. This provides a degree of safety by keeping the CRT covered.

5.3.1 Covers

5.3.1.1 Model 1 Cover Removal

1. Front Cover: Pull out on bottom edge.

   Note: Security key must be removed from lock before removing right-side cover.

2. Side Covers: Insert a stiff card or badge in slot in grillwork at edge of top cover to unlatch side cover.
3. Top/Rear Center Cover: Release the four quick-disconnect fasteners that hold combination top/rear center cover to frame.

5.3.1.2 Model 2 Cover Removal

1. Front Cover: Push down on latch (accessible at center underside of cover). The cover falls away from base assembly at top while pivoting on two guide pins at bottom. Lift cover off guide pins.

   Note: Security key must be removed from lock before removing right-side cover.

2. Side Covers: Pull frontmost stud (under front of side cover) toward front of display. When stud reaches limit of travel, pivot rear edge of cover slightly away from base and top cover simultaneously. Lift cover clear of display station.
3. Top Cover: Top cover can be removed only after both side covers are removed. Pull out spring-loaded knobs at lower right and lower left of top cover and pivot up. Pull top cover back slightly to disengage it from guides in CRT bezel. Carefully lift cover off display station.

5.3.2 Power Components

Note: All power component removal and replacement procedures must be performed with power turned off and with the power cord removed from the wall or from the input jack at the display station.

5.3.2.1 Low-Voltage Power Supply Assembly

1. (This step applies to Model 2 display stations only.) Remove shield covering printed circuit (PC) board by prying through slot along right edge of shield.
2. Disconnect the two cable connectors plugged into board.
3. Remove screw holding assembly to frame. (The screw is located in center bottom of PC board bracket.)
4. Slide assembly from machine.
5. Replace in reverse order. If a new assembly is being installed, remove -12V regulator card and replace in new assembly per paragraph 5.3.2.2.

5.3.2.2 -12V Regulator Card

1. Lift plastic retainer, and pull -12V regulator card from socket in same manner as an SMS card is removed from a card socket.
2. Replace card by lifting plastic retainer and sliding card into the SMS socket.
3. Perform -12V regulator card adjustment (paragraph 5.2.2).

5.3.2.3 AC Capacitor

1. Remove rubber boot from top of capacitor, and slide back on wire leads.
2. Holding insulated handle of a screwdriver, short out capacitor terminals with metal shaft of screwdriver to ensure that capacitor is fully discharged.
3. Pull off the two leads from terminals at top of capacitor.
4. Pull capacitor from spring holder.
5. Replace in reverse order.

5.3.2.4 Model 1 Prime Power Box

1. Unplug line cord from line cord jack if it was not previously removed.
2. Unplug two cable connectors plugged into prime power box. (Three cable connectors must be removed if an operator identification card reader is attached on 60-Hz units.)
3. Pull Brightness and Contrast knobs from OFF-PUSH switch.
4. Remove the two screws holding prime power box to frame.
5. Replace in reverse order.

6. If a new prime power box is being installed, Brightness and Contrast knobs from the old box must be installed on the new one.

5.3.2.5 Model 2 Prime Power Box

1. Unplug cable connector plugged into rear of box. (Two cable connectors must be removed if an operator identification card reader is attached on 60-Hz units.)
2. Unplug line cord from line cord jack if it was not previously removed.
3. Remove the two screws holding prime power box to frame.
4. Remove assembly from machine.
5. Replace in reverse order.
6. When replacing box, be sure that the on-off switches protruding from top of box are positioned under switch linkage.
7. Adjust position of box so switch plungers depress to within 1/32" of switch body with OFF-PUSH switch pulled out.

5.3.2.6 Model 1 Ferro Transformer (60 Hz)

1. Unplug ferro transformer cable that plugs into LV power supply printed circuit board.
2. Unplug ferro transformer cable that plugs into prime power box.
3. Remove the two wires from ac capacitor.
4. Remove rear screw that holds transformer to base chassis.
5. Remove front holding screw.
6. Lift transformer clear of the machine.
7. Replace in reverse order.

5.3.2.7 Model 1 Ferro Transformer (50 Hz)

1. Unplug ferro transformer cable that plugs into LV power supply printed circuit board.
2. Remove the two wires from ac capacitor.
3. Refer to Diagram 8-1. Disconnect two wires leading from ferro terminal block (TB1) to prime power box by turning cam screw counterclockwise only. Note where wires were terminated (for later reconnection).
4. If a card reader is attached, disconnect two wires leading from ferro terminal block to card reader I/O connector. Note where wires were terminated (for later reconnection).
5. Remove rear screw that holds transformer to base chassis.
6. Remove front holding screw.
7. Lift transformer clear of machine.
8. Replace in reverse order. When connecting wires to terminal block, cam screw must be turned clockwise.

5.3.2.8 Model 2 Ferro Transformer (60 Hz)

1. Disconnect LV cable connector (J2) between the two chassis.
2. Remove all I/O connectors (keyboard, card reader, I/O).
3. If a card reader is attached, unplug cable from rear of prime power box.
4. If a selector-pen is attached, remove cable from clip at lower right rear of frame.
5. Release the two clamps at sides of chassis that hold upper chassis to base chassis.
6. Release spring catches on rear guides, and slide upper chassis slightly to front to disengage the two rear guides.
7. Lift upper chassis off base chassis, and place upper chassis on a flat surface.
8. Remove ac capacitor per paragraph 5.3.2.3.
9. Remove screw holding ferro cover, and remove cover.
10. Disconnect the two cable connectors leading from ferro transformers.
11. Remove the two screws holding ferro to base chassis.
12. Slide transformer out of housing and clear of chassis.
13. Replace in reverse order.

5.3.2.9 Model 2 Ferro Transformer (50 Hz)

1. Disconnect LV cable connector (J2) between the two chassis.
2. Remove all I/O connectors (keyboard, card reader, I/O).
3. If a card reader is attached, unplug cable plugged in ferro transformer cover.
4. If a selector-pen is attached, remove cable from clip in lower right rear of chassis.
5. Release the two clamps at side of chassis holding upper chassis to base chassis.
6. Release spring catches on rear guides, and slide upper chassis slightly to front to disengage the two rear guides.
7. Lift upper chassis off base chassis, and place upper chassis on a flat surface.
8. Remove ac capacitor per paragraph 5.3.2.3.
9. If a card reader is attached, remove access cover on ferro cover over ferro terminal block (Diagram 8-1), and disconnect two wires leading from terminal block to connector on ferro cover by turning cam screw counterclockwise only. Note where leads were terminated (for later reinstallation).
10. Remove screw holding ferro cover and remove cover.
11. Disconnect the two wires leading from ferro terminal block to prime power box by turning cam screw counterclockwise only. Note where leads are terminated for later reinstallation.

12. Remove the two screws holding ferro to base chassis.
13. Slide transformer out of housing and clear of chassis.
14. Replace in reverse order. When connecting wires to terminal block, cam screw must be turned clockwise.

5.3.2.10 High-Voltage Power Supply

1. Disconnect anode lead from CRT.
2. Unplug input cable at lower edge of HV assembly. Note where leads are terminated (for later reconnection).
3. Remove mounting screw.
4. Lift power supply clear of machine.
5. Replace in reverse order. Ensure that anode lead is firmly seated in CRT bell.

5.3.2.11 Fuses

1. Determine which fuse is blown.
2. Replace blown fuse with another fuse of same value.
3. Turn power on.
4. Check that fuse does not blow again.

Note: The +8V, -12V, and 6.3V ac fuses are held in fuse clips located on the LV power supply printed-circuit board. Remove plastic shield over the LV power supply board on Model 2 display stations to replace these fuses. The ac line fuse is located in a screw-type fuse holder on the prime power box.

5.3.3 Analog Components

5.3.3.1 CRT

DANGER
All persons handling a CRT or who are in the vicinity of an exposed CRT under vacuum must wear safety glasses and long-sleeved garments.

1. (This step applies to Model 1 display stations only.) Remove mask/bezel assembly by detaching the two captive knurled head screws that hold assembly to frame.
2. Disconnect CRT anode lead.
3. Using an insulated jumper wire, momentarily ground CRT anode terminal to discharge static charge.
4. Disconnect CRT cable plug at CRT base.
5. Disconnect yoke cable connector plugged into analog card, and disconnect ground wire from yoke shield.

CAUTION
The next step in this procedure frees the CRT from its mounting. Protect and support the CRT from excessive pressures that could cause damage to the CRT itself or to other components.

6. Remove top two nuts that hold CRT to front frame.
7. Loosen bottom two holding nuts.
8. Connect lifting strap (PN 2565197) to the two upper CRT mounting ears. (On Model 1 display stations it may be necessary to slide CRT off threaded studs and tilt CRT forward to attach strap to mounting ears.)
9. Remove bottom two holding nuts.
10. Model 1. Slide CRT and yoke assembly toward front of display and clear of unit.

    Model 2. Slide CRT and yoke assembly toward rear of display and clear of unit.
11. Replace CRT and yoke assembly in reverse order.
12. Perform all display image adjustments (5.2.1 through 5.2.1.7).

5.3.3.2 Yoke

1. Disconnect CRT cable plug at CRT base.
2. Disconnect yoke cable from analog card, and disconnect ground wire from yoke shield.
3. Loosen screw on shield, rotate rear portion of shield, and remove.
4. Loosen yoke retainer clamp, and slide yoke assembly off neck of CRT and clear of unit.
5. Remove yoke from shield.
6. Replace in reverse order. Position yoke cable at bottom and the clamp screw on left side (as viewed from top-front).
7. Perform all display image adjustments (5.2.1.4 through 5.2.1.7).

5.3.3.3 Model 1 Analog Card

1. Unplug connectors at top of analog card.
2. Loosen the two captive screws passing through analog card and into wire form. (These two screws have large knurled heads and a spacer on them.)
3. Unplug bottom connector.
4. Remove analog card from machine.
5. Remove the two screws and spacers from old analog card.
6. Reassemble screws and spacers in new analog card.
7. Plug in bottom connector.
8. Replace analog card in machine.

Note: The two open slots in the rear edge of the analog card must fit into the slots in the rear leg of the wire form.

9. Tighten the two captive screws.
10. Plug in two top connectors.
11. Perform analog card adjustments (paragraphs 5.2.1.6 and 5.2.1.7) if a new card is installed or if the adjustments were disturbed.

5.3.3.4 Model 2 Analog Card

1. Open logic gate.
2. Remove the two upper screws supporting analog card shield, and lift off shield.
3. Unplug cables plugged into front of analog card.
4. Remove the two screws holding analog card to base chassis.
5. Remove analog card from support.
6. Unplug rear connector.
7. Replace in reverse order.
8. Perform analog card adjustments (paragraph 5.2.1.7) if a new card is installed or if the adjustments are disturbed.

5.3.3.5 Model 1 Brightness and Contrast Controls

The Brightness and Contrast controls are part of the prime power box on Model 1 display stations. Do not replace these controls; replace prime power box. See paragraph 5.3.2.4 for prime power box replacement procedure.

5.3.3.6 Model 2 Brightness and Contrast Controls

1. Unsolder the three leads on each of the two potentiometers. Note terminals from which wires are removed, for later reinstallation.
2. Pull the two knobs off concentric control shafts.
3. Remove rear-most C clip on slider bracket that retains slider bracket to potentiometer shaft.
4. Pull off large retaining clip that holds potentiometers to mounting bracket.
5. Lift assembly clear of unit from rear.
6. Assemble in reverse order.
7. Turn power on.
8. Check for proper operation of both controls.

5.3.3.7 Power Control Switch

The power control switch is part of the prime power box. If it is necessary to replace the switch, the prime power box must be replaced. See paragraph 5.3.2.4 for the Model 1 prime power box replacement procedure or paragraph 5.3.2.5 for the Model 2 prime power box replacement procedure.

5.3.4 Logic Components

5.3.4.1 Logic Card

1. Turn power off.
2. Pull out on the two handles on plastic card holder to disengage card from board.
3. Pull logic card from socket evenly and perpendicular to logic board.
4. If card is being changed, remove card holder from old card and install it on new card.
5. Place card in socket guides.
6. Push card on logic board pins. Do not bend pins. Make sure card seats firmly, with a snap, in socket.
7. Turn power on.

5.3.4.2 Logic Board

1. Turn power off.
2. Remove all cards from board to be replaced.
3. Remove decoupling capacitor from clip, and remove capacitor wires from the two board pins. Note where wires were terminated, for later reinstallation.
4. Remove all cables on pin side of board. Cables are labeled with their pin assignments.
5. Remove all socket-head screws that hold board to gate.
6. Remove board from machine while unplugging connectors plugged in card side of board.
7. Replace in reverse order. Be extremely careful to replace wires, cables, and connectors on correct board pins and to replace logic cards in proper sockets.

5.3.5 Keyboard Components

5.3.5.1 Keyboard Assembly from Display Station

1. Turn power off.
2. Remove display station front cover.
3. Disconnect keyboard cable ground strap from chassis.
4. Remove keyboard cable connector from its socket. On Model 2 display stations, I/O cable retainer must be unhooked to release keyboard connector. On Model 1 display stations, nylon cable clamp must be removed.
5. Replace in reverse order.
6. Ensure that all I/O cable connectors are firmly seated in sockets, and that ground straps are attached.

5.3.5.2 Keyboard Top Cover

1. Turn keyboard over.
2. Loosen the four captive screws in corners of keyboard bottom pan.
3. Place keyboard upright on a flat surface.
4. Lift top cover off keyboard.
5. Replace in reverse order.

5.3.5.3 Keyboard Assembly from Bottom Pan

1. Disconnect keyboard from display station. (See paragraph 5.3.5.1.)
2. Remove keyboard top cover. (See paragraph 5.3.5.2.)
3. Unplug cable connector from keyboard printed-circuit board.
4. Remove the four nuts and lockwashers from top of isolator mounting studs.
5. Remove grounding jumper from upper-left isolator stud.
6. Lift keyboard assembly off isolator studs.
7. Replace in reverse order.
8. Be sure to replace grounding jumper, and ensure that cable connector is firmly seated on printed-circuit board.

5.3.5.4 Audible Feedback Assembly

1. Disconnect keyboard from display station. (See paragraph 5.3.5.1.)
2. Remove keyboard top cover. (See paragraph 5.3.5.2.)

Note: The audible feedback device consists of two assemblies. The logic card is removed by pulling it out of its socket. To remove the audible feedback assembly, proceed with steps 3 and 4.

3. Disconnect the two leads from audible feedback assembly at connector positions 8 (white wire) and 9 (blue wire).
4. Remove the two screws that hold relay assembly to keyboard bottom pan.
5. Replace in reverse order.

5.3.5.5 Keybutton

A keybutton should be replaced when it deteriorates in appearance or when it fails to remain attached to the key module stem. Buttons are removed by pulling or prying upward, with a padded tool, on the bottom of the button.

5.3.5.6 Solid-State Switch (Except Spacebar Switch Module)

A. Switch Module Removal:

1. Record locations of keybuttons in area of the switch module (PN 5995542) being replaced. Remove keybutton from faulty module (and from as many others as needed to provide work space). A keybutton can be removed by pulling or prying upward, with a padded tool, on bottom of button.
2. Take the two small, flat, pointed tools from box containing new module, and slip one down the inside face of each D bracket (retainer) to force brackets away from locking channels on plastic case of old module (Diagram 5-1).

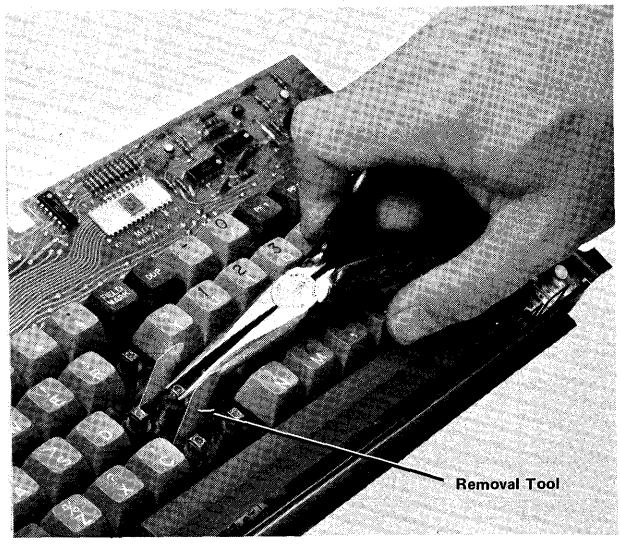


Diagram 5-1. Switch Module Removal

3. With flat tools in this position, grip shouldered portion of switch module plunger with pliers, and pull switch module straight out.

CAUTION
In the next step, do not apply the soldering iron for longer than necessary to flow the solder. IBM soldering iron PN 454332 or equivalent 15-watt iron is recommended.

4. The black plastic lead frame package is left behind when plunger assembly is removed. Using solder-wick (PN 5151439), unsolder and remove excess solder from the four terminal pads on printed circuit board (Diagram 5-2). Remove lead frame package from printed circuit board (Diagram 5-3).

Note: If the switch mounting frame becomes distorted during removal of the old module, form it back to its normal position. This can be done by squeezing the D brackets together until they will seat firmly against the sides of the new module housing.

B. Switch Module Replacement: Do not disassemble replacement module. Lead frame and plunger assemblies are matched during manufacture. Proceed as follows:

1. Check to see that return spring is firmly seated on spring boss on bottom of plunger of new switch module (Diagram 5-4). If it is not, invert switch module so that lead frame terminals are up. Place spring on boss. Compress and rotate spring until last coil expands around boss. When properly seated, spring should be parallel to long axis of switch module.

Note: When the plunger return spring is in place, check the lead frame terminals to see that they are not bent and that they are parallel to the long axis of the switch module.

2. Insert module into keyboard switch mounting frame, with orientation arrow on top of module pointed in the same direction as arrows on other modules (Diagram 5-5). As module is inserted, be sure plunger return spring seats on raised boss on bottom of mounting frame and that the four terminals extend through holes in printed-circuit board.

   Once new module is in place, check for the following conditions:
   a. Plunger moves freely.
   b. Top surface of module is even with those of other modules.
   c. D brackets on mounting frame lock module firmly in place.

Note: Should it be necessary to remove the new module to correct any of these conditions, be careful not to mar any portion of the plunger, since operation of the module and/or retention of the keybutton would be affected.

CAUTION
In the next step, do not apply soldering iron for longer than necessary to flow the solder. IBM soldering iron PN 454332, or equivalent 15-watt iron, is recommended.

3. Solder terminals of lead frame. Use a minimum amount of solder.
4. Reassemble keybuttons on switch modules. Check to see that correct keybuttons are returned to correct module positions.

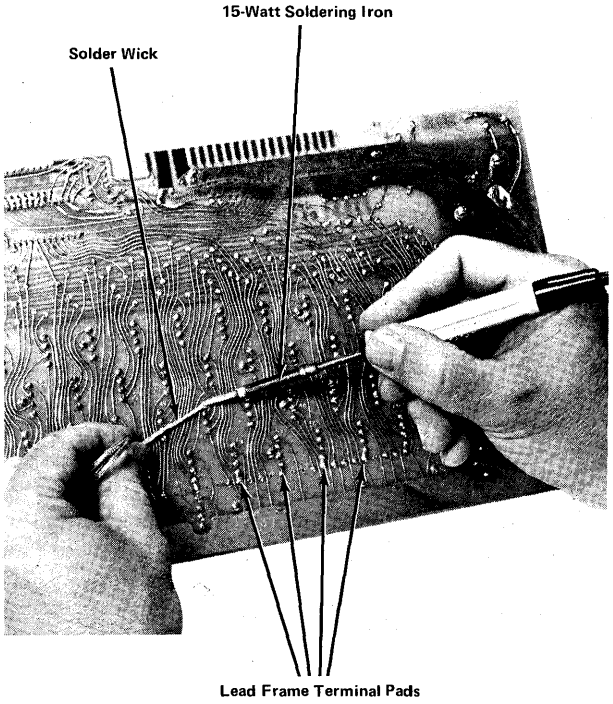


Diagram 5-2. Unsoldering Lead Frame Terminals

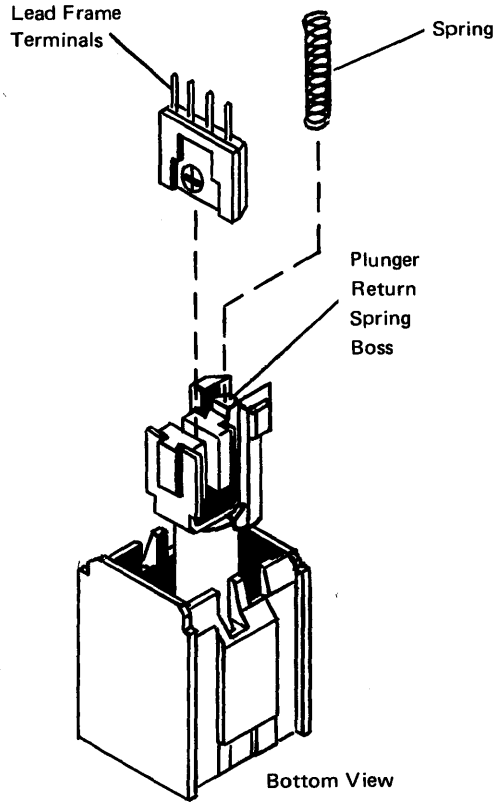


Diagram 5-4. Switch Plunger Return Spring Positioning

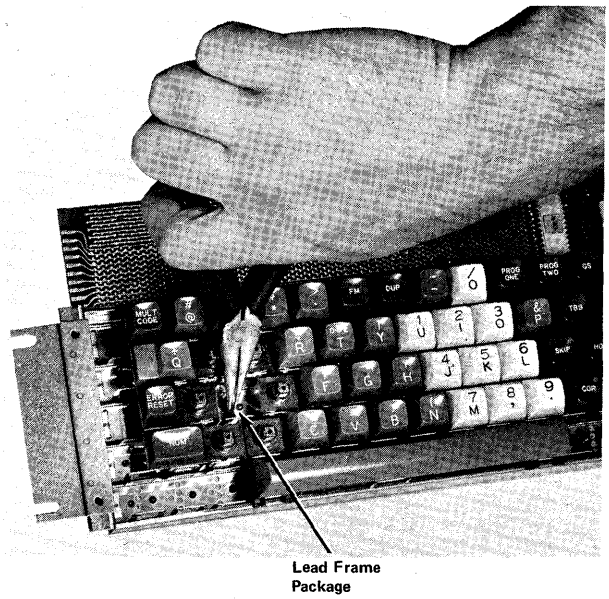


Diagram 5-3. Lead Frame Removal

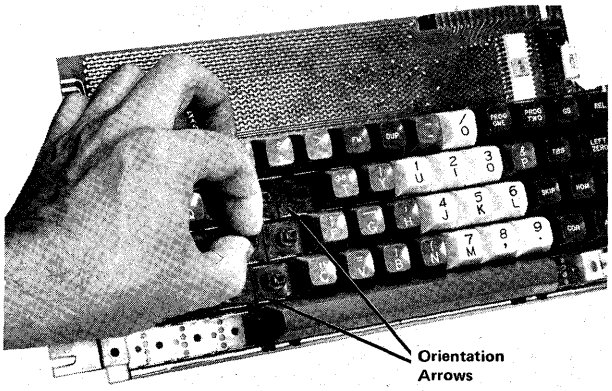


Diagram 5-5. Switch Module Orientation

5.3.5.7 Spacebar Assemblies

The spacebar assemblies consist of the spacebar group (PN 5995544) and the spacebar switch module (identical to other switch modules). The spacebar group comprises the spacebar, the torsion bar, and the two spacebar guide modules. Replacement of any spacebar part requires removal of the spacebar and torsion bar.

A. Spacebar Removal:

1. Grasp torsion bar near one end with thumb and forefinger (Diagram 5-6), and flex it upward, snapping it forward out of retaining lugs on spacebar guide module.

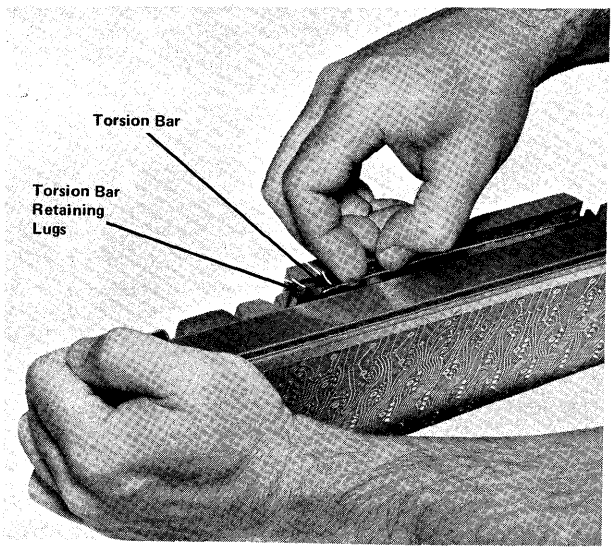


Diagram 5-6. Torsion Bar Removal

2. Swing loose end of torsion bar upward, and disengage it from other spacebar guide module.
3. Lift spacebar straight up out of spacebar guide modules. This exposes spacebar guide modules and spacebar switch module.
4. If spacebar group is to be replaced, remove spacebar guide modules as explained in paragraph 5.3.5.6A, step 2. (See Diagram 5-7.) Lift module straight out with thumb and forefinger.
5. If spacebar switch module is to be replaced, remove switch module as described in paragraph 5.3.5.6A, steps 2 through 4.

B. Spacebar Replacement:

1. If spacebar switch module is to be replaced, use procedure described in paragraph 5.3.5.6B, steps 1 through 3.
2. If spacebar group is to be replaced, insert new spacebar guide modules into mounting frame; be careful to have torsion bar retaining lugs positioned to the front. Be sure that D brackets lock guide modules firmly in place.
3. Insert spacebar guides in spacebar guide modules, and drop spacebar in place.
4. Holding torsion bar at a suitable angle and position, insert end of torsion bar in the hole in one spacebar guide (Diagram 5-7). At the same time, engage torsion bar with retaining lugs on guide module. Lower torsion bar to horizontal. Flex it as during removal, and insert other end simultaneously into hole in other spacebar guide and into retaining lugs on other guide module.
5. Operate spacebar to see that switch module operates freely and that torsion bar and spacebar guides do not bind.

5.3.5.8 Keybutton Support Modules

The longer keybuttons, 1-3/4 and 2-3/4 units long, utilize support modules PN 5995543 and PN 5995547, respectively.

Support Module Removal:

1. Remove keybutton(s) to provide adequate work space.
2. Take the two small, flat, pointed tools from box containing new module, and slip one down inside face of each D bracket (retainer) to force brackets away from locking channels on plastic case of old module.
3. With flat tools in this position, grip shouldered portion of support module plunger with pliers, and pull old module straight out.

Support Module Replacement:

1. Check that return spring is firmly seated on spring boss on bottom of plunger of new support module. If it is not, invert module, place spring on boss, and compress and rotate spring until last coil expands around boss.

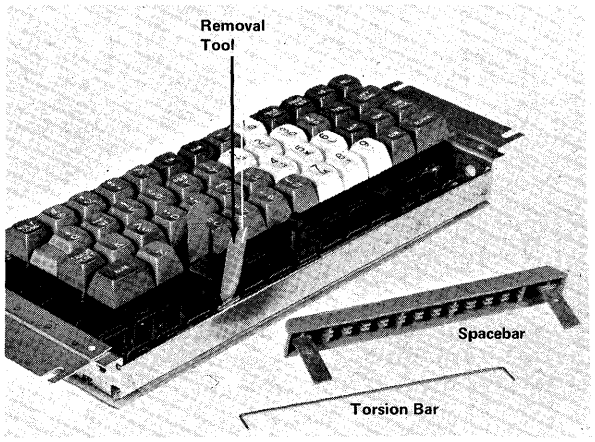


Diagram 5-7. Spacebar Guide Module Removal

2. Insert new module into keyboard switch mounting frame, with orientation arrow on top of module housing pointed in same direction as arrows on other modules. As module is inserted, be sure plunger return spring seats on raised boss on bottom of mounting frame.

   Once new module is in place, check that plunger moves freely, that top surface of module does not extend above other modules, and that D brackets on mounting frame have locked module firmly in place.
3. Reassemble keybuttons on switch modules. Check that correct keybuttons are returned to correct module positions.

5.3.6 Audible Alarm (Optional Feature)

The audible alarm device circuitry is packaged in a small metal box mounted on the base chassis beneath the CRT, inside the front cover. The audible alarm box is mounted vertically on Model 1 display stations and horizontally on Model 2 display stations.

1. Remove front cover.
2. Remove audible alarm box from chassis. Box can be removed from snap fasteners by rocking metal box while pulling away from chassis.
3. Remove circuit board from the metal box.
4. Remove cable wires from audible alarm circuit board with long-nosed pliers or small blade screwdriver.
5. Replace in reverse order. Circuit board is etched with color code of wires to be replaced.

5.3.7 Security Keylock (Optional Feature)

5.3.7.1 Model 1

1. Remove screws that hold keylock assembly to frame.
2. Release cable clamps that route switch assembly cable to logic board.
3. Remove cable leads from connector at socket A1Z3. Note positions from which wires are removed (for later reconnection).
4. Lift switch cable assembly free of machine.
5. Reassemble in reverse order. Make sure that leads removed in step 3 are replaced in proper connector positions and that keylock assembly is aligned with hole in right side cover.

5.3.7.2 Model 2

1. Remove screws that hold keylock assembly to frame.
2. Remove keylock assembly cover.
3. Remove cable leads from switch with pliers or small screwdriver. Note terminals from which leads are removed (for later connection).
4. Remove cable strain relief from hole in switch assembly.
5. Remove cable from keylock assembly.
6. Reassemble in reverse order. Make sure to align keylock assembly with hole in right side cover.

5.3.8 Selector Light-Pen (Optional Feature)

5.3.8.1 Model 1

1. Remove screws from base of selector light pen holder; remove cable.
2. Unplug feature cable from logic board cable socket Y4.
3. Unscrew nylon cable clamp screw that holds cable to center rear of board assembly.
4. Remove screw and retainer that clamps routing cable and ground wire to rear of chassis.
5. Slip cable out of slotted hole at center rear of chassis.
6. Replace in reverse order. Make sure that ground wire is reconnected to chassis, and that cable is positioned in slot so that extra insulation on cable acts as a grommet.
7. Position light-pen cable in pen holder so that distance from holder to cable end of pen is about 30 inches.

5.3.8.2 Model 2

1. Remove screws from base of selector light pen holder; remove cable.
2. Unplug feature cable from logic board cable socket Y4.
3. Release cable from cable clamps that route cable to bottom of chassis.
4. Disconnect ground wire from frame.
5. Slip cable out of slotted hole at bottom, right, rear of chassis.
6. Replace in reverse order. Make sure cable is positioned in cable clamps so that extra insulation on cable acts as a grommet where cable passes through hole in chassis. Make sure that ground wire is reconnected to frame.
7. Position light pen cable in pen holder so that distance from holder to cable end of pen is approximately 30 inches.

5.3.9 Operator Identification Card Reader (Optional Feature)

1. Disconnect card reader cable ground strap from chassis.
2. Remove card reader cable connector from its socket. On Model 1 display stations, nylon cable clamp must be removed. On Model 2 display stations, the I/O cable retainer must be unhooked to release cable connector.
3. Replace in reverse order.
4. Ensure that all I/O cable connectors are firmly seated in sockets and that all ground straps are attached to chassis ground terminal.

This section contains miscellaneous reference information that can be helpful in maintaining IBM 3277 Display Stations.

6.1 CONTROLS

Controls are divided into two categories: external and internal. External controls are those that are accessible without removing covers. Internal controls are those that are under covers and are accessible to maintenance personnel only. The audible alarm volume control, although located under the front cover, is considered an external control because the display station operator can adjust the volume.

6.1.1 External Controls (Diagram 6-1)

6.1.1.1 OFF-PUSH (Power, Brightness, and Contrast)

The OFF-PUSH switch is a triple-function control that adjusts the display image brightness and contrast. It also controls display station power. Pulling the switch out toward the operator turns display station power on. The overall displayed image is made brighter by rotating the Brightness control (outer knob) clockwise; the image is made dimmer by rotating the knob counterclockwise. The Contrast control (inner knob) is on a concentric shaft with the Brightness control. Rotating the Contrast control clockwise reduces the difference in contrast between high and normal intensity characters; rotating the control counterclockwise increases the difference in contrast.

6.1.1.2 Security Keylock (Optional Feature)

This operator control is a key-operated switch lock. The key must be inserted in the lock and turned on (horizontal position) to enable the display station for operation. The key must remain in the On position to keep the display station enabled. The key cannot be removed from the lock unless it is returned to the Off position.

6.1.1.3 Selector Light-Pen Tip Switch (Optional Feature)

The selector light-pen contains a spring-loaded switch in its tip. The switch is used to select detectable fields on the

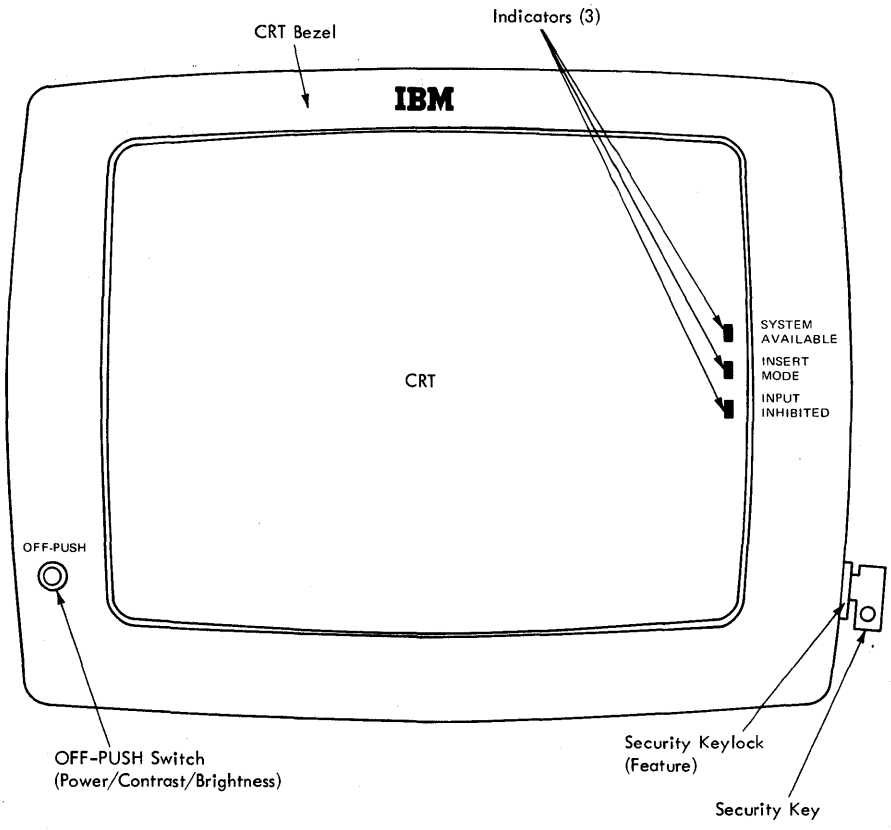


Diagram 6-1. External Controls and Indicators

screen by placing the point of the pen on the desired data field and pushing the barrel of the pen toward the screen. Removing the tip from the screen turns the switch off automatically.

6.1.1.4 Audible Alarm Volume (Optional Feature)

The loudness of the audible tone can be adjusted by the display station operator by turning the audible alarm volume control. The front cover must be lowered for access to the control. On Model 1 display stations, the control protrudes downward from the audible alarm box on the right side of the base chassis. On Model 2 display stations the control protrudes frontward from the audible alarm box on the left side of the upper chassis.

6.1.1.5 Keyboard Audible Response

A lever in the back of the keyboard cover adjusts the volume of the keyboard audible response device. Volume can be adjusted from off (no click when a key is depressed) to maximum loudness by moving the lever from side to side.

6.1.2 Internal Controls

6.1.2.1 INTEN CRT

This momentary-contact switch is located on the display station analog card. The switch overrides intensity and blanking pulses generated by control logic and causes a complete raster of scan lines to be displayed when pressed.

6.1.2.2 Focus

This control is a screwdriver-adjustable potentiometer located on the HV power supply. Turning the control varies the sharpness of the dots that form the characters on the screen.

6.1.2.3 WIDTH

The WIDTH control is a screwdriver-adjustable potentiometer located on the analog card. Turning this control varies the horizontal dot-to-dot spacing, which alters the total width of the displayed image.

6.1.2.4 CHAR HEIGHT

This control is a screwdriver-adjustable potentiometer located on the analog card. Turning the control varies vertical dot-to-dot spacing of the displayed image. On the Model 1 display station, it determines the overall height of the displayed image.

6.1.2.5 ROW SPACING (Model 2 Display Stations Only)

This control is a screwdriver-adjustable potentiometer located on the analog card. Turning the control varies spacing between character rows and, thus, determines the overall height of the displayed image. The ROW SPACING control is not used in Model 1 display stations.

6.1.2.6 TOP MARGIN

This control is a screwdriver-adjustable potentiometer located on the analog card. The control sets the top reference line on the CRT, from which all other vertical image adjustments are made. Once the control is set, the reference line remains stationary during other vertical character and image adjustments.

6.1.2.7 Image Tilt

The deflection yoke, mounted on the CRT neck, is used to tilt the entire displayed image. Rotating the yoke adjusts the image for squareness with the edges of the CRT bezel.

6.1.2.8 Magnetic Centering Rings

The magnetic centering rings are mounted on the CRT neck, directly behind the deflection yoke. The centering rings are rotated to position the displayed image about the geometric center of the CRT.

6.1.2.9 Data Sample

This screwdriver-adjustable control is located on logic card 01A-A1G2. It is a singleshot timing pulse adjustment. Turning the control varies the duration of the 'data sample' pulse used to demodulate data signals received from the control unit. The adjustable potentiometer is preset during manufacture and is sealed. Field-adjustment of this control is not necessary or advisable.

6.1.2.10 -12V Supply

This control is a screwdriver-adjustable potentiometer located on the -12V regulator card. Turning the control sets the voltage output of the -12V power supply.

6.2 INDICATORS

Display indicators, like controls, are divided into two categories: external and internal. External indicators are those that can be seen without removing any machine covers. To observe internal indicators, covers must be removed. Internal indicators are accessible only to maintenance personnel.

6.2.1 External Indicators (Diagram 6-1)

The three external indicators on 3277 Display Stations are displayed as small boxes (blips) generated by analog circuitry. They are displayed at the right edge of the CRT. Each indicator has its function identified by a label on the

CRT bezel, adjacent to the indicator. The brightness of the indicators is controlled by the Brightness control.

6.2.1.1 SYSTEM AVAILABLE Indicator

This indicator is displayed at character row 4 on Model 1 display stations and at character row 10 on Model 2 display stations. In remote system configurations, the indicator signifies that the carrier is on and that the transmission control unit (TCU) is online when lighted. In local system configurations, the indicator being on signifies that the channel 'operational out' tag line is active.

6.2.1.2 INSERT MODE Indicator

This indicator is displayed at character row 6 on Model 1 display stations and at character row 12 on Model 2 display stations. The indicator lights when the INSERT MODE key on the keyboard is pressed. It signifies that the display station is in the Insert mode of operation. The indicator remains on, and the display station remains in Insert mode until the RESET key is pressed.

6.2.1.3 INPUT INHIBITED Indicator

This indicator is displayed at character row 8 on Model 1 display stations and at character row 14 on Model 2 display stations. The lighted indicator signifies that manual input to the display station from the keyboard, selector light pen, and Operator Identification Card Reader is blocked. The indicator is extinguished by program control or by pressing the RESET key. When the security keylock is off, this indicator lights.

6.2.2 Internal Indicator (SWEEP INDIC)

The SWEEP INDIC indicator is a neon bulb mounted on the display station analog card. The lighted indicator signifies that the horizontal deflection circuits and counters are operating.

6.2.3 Arc-Suppression Neon

The arc-suppression neon is located on the arc-suppression board in Model 1 display stations and on the voltage distribution board in Model 2 display stations. It is not an indicator and will never be seen lighted. The two elements of the neon bulb are connected between dc ground (RET) and the display station frame ground. The neon acts as a momentary short circuit whenever the difference in potential between its two elements would have exceeded approximately 90V. The difference in potential is occasionally generated by the inherent characteristic of a cathode-ray tube to arc. Arcing causes transients in the return path of the tube. Restricting potentials to 90V to ground protects display station circuitry from possible damage.

6.3 KEYBOARDS (Optional Feature)

Three keyboards are used with 3277 Display Stations. Keyboards of the same type are interchangeable among display stations having keyboard adapter circuitry installed. EBCDIC is the basic code used on all keyboards.

6.3.1 Types of Keyboards

6.3.1.1 Typewriter Keyboard

The typewriter keyboard uses a standard typewriter key layout of 66 keys. An additional 12 Program Function keys may be incorporated in the standard typewriter keyboard. Diagram 6-2 illustrates the typewriter keyboard.

6.3.1.2 Data Entry Keyboard

The data entry keyboard uses a 66-key layout similar to IBM 029 Keypunches. Diagram 6-3 illustrates the data entry keyboard.

6.3.1.3 Operator Console Keyboard

The operator console keyboard uses an IBM 1052-7 type key layout with an additional 12 Program Function keys. Diagram 6-4 illustrates the operator console keyboard.

6.3.2 EBCDIC Keyboard Codes

The EBCDIC code is the standard code used with all 3270 system keyboards. Diagram 6-5 shows the keyboard codes for the typewriter and operator console keyboards. Characters (and functions) are shown in the Graphics column as they appear on typewriter keyboard keytops. The operator console keyboard key layout is similar. Diagram 6-6 shows the EBCDIC code arrangement used on the data entry keyboard.

6.4 ASCII* OPTIONS

ASCII character generator and keyboard options may be present on 3277 Display Stations. The following paragraphs describe the characteristics of these options.

6.4.1 ASCII Character Generators (Optional Features)

Two ASCII character generator options allow the ASCII code set to be displayed. The ASCII code set includes the symbols [,] , \ , and ^ which are not used in the 3277 EBCDIC code set. ASCII option A uses the symbols | and ¬, while option B substitutes the symbols ! and ^ respectively. Each option requires a different character

*ASCII American National Standard Code for Information Interchange, X3.4-1968.

generator logic card in location K2. Maintenance of the display station is not affected by the presence of the ASCII option; however, if logic card K2 must be changed, the same type number card must be used.

6.4.2 ASCII Keyboards (Optional Features)

Two ASCII typewriter keyboards can be attached to the 3277 Display Station. They are similar to EBCDIC typewriter keyboards described in paragraph 6.3.1.1, except unique ASCII characters are included on some keytops. PF keys 1–12 are included in the 78-key version. ASCII keyboards are serviced like EBCDIC keyboards, and operationally they are the same. Unique logic cards are not used, but ASCII character generator option A or B must be installed to enter and display the unique ASCII characters. Option A provides the 64 ASCII character set including the symbols | (logical or) and ¬ (logical not). Option B provides the 64 ASCII character set but substitutes ! (exclamation point) for logical or and ^ (circumflex) for logical not.

6.5 REFERENCE DIAGRAMS

Diagrams 6-7 through 6-14 contain reference data that can be helpful in maintaining IBM 3277 Display Stations. Display station data flow is shown in Diagram 6-7, a foldout page located at the back of this manual. Diagram 6-8 lists all logic cards used in the display station and describes the function of each card. All logic card I/O pins used as probe points in the troubleshooting diagrams (Section 4) are listed in Diagram 6-9. ALD references are also listed. Logic board jumpering data for the various keyboard feature options is included in Diagram 6-10. Diagram 6-11 shows how characters are encoded in the keyboard assembly. Diagrams 6-12 and 6-13 show logic card plugging for the one-half and two-thirds boards, respectively. Logic board pin identification data is given in Diagram 6-14.

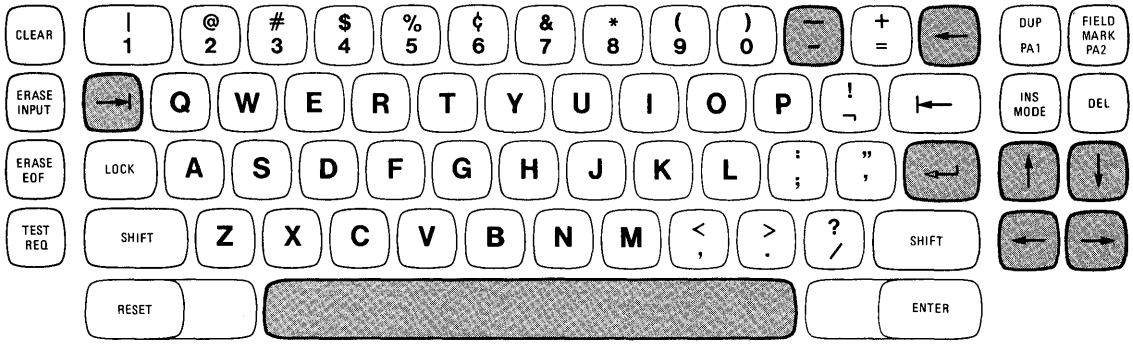


Diagram 6-2. Typewriter Keyboard

Diagram 6-3. Data Entry Keyboard

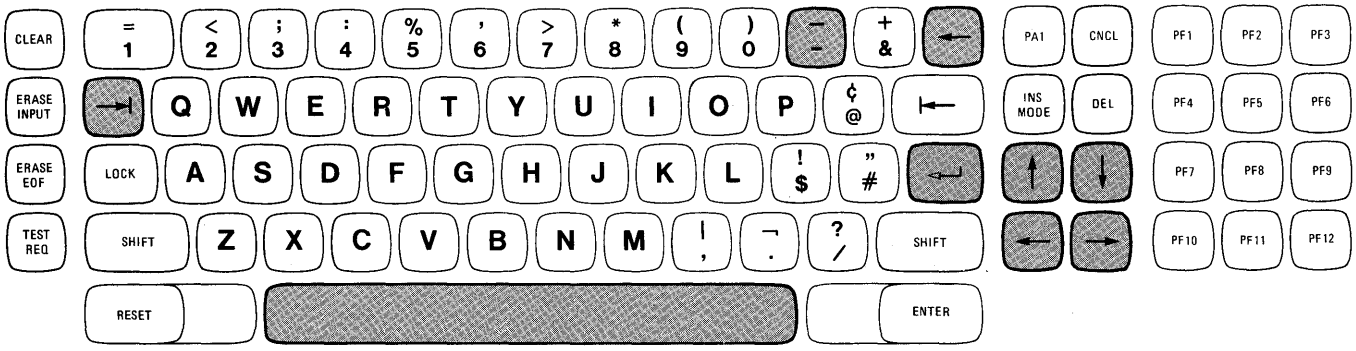


Diagram 6-4. Operator Console Keyboard

Typamatic Keys

Numeric Keys

Graphic U	Graphic L	Upper Shift 0 1 2 3 4 5 6 7 P *	Lower Shift 0 1 2 3 4 5 6 7 P *
ERASE INPUT		0 0 0 1 0 1 1 1 1	0 0 0 1 0 1 1 1 1
ERASE EOF		0 0 0 1 0 1 1 0 0	0 0 0 1 0 1 1 0 0
RESET			
DUP	PA1	1 0 0 1 1 1 0 0 1	0 0 1 0 1 1 0 0 0
CLEAR		0 0 1 0 1 1 0 1 1	0 0 1 0 1 1 0 1 1
INS MODE		0 0 0 1 0 0 0 1 1	0 0 0 1 0 0 0 1 1
DEL		0 0 0 1 0 0 0 0 0	0 0 0 1 0 0 0 0 0
TEST REQ		0 0 1 1 0 0 0 0 1	0 0 1 1 0 0 0 0 1
FIELD MARK	PA2	1 0 0 1 1 1 1 0 0	0 0 1 0 1 1 1 0 1
ENTER		0 0 1 1 1 1 0 1 0	0 0 1 1 1 1 0 1 0
Space		0 1 0 0 0 0 0 0 0 *	0 1 0 0 0 0 0 0 0 *
↵		0 0 0 1 0 1 0 1 0 *	0 0 0 1 0 1 0 1 0 *
↑		0 0 0 1 1 0 0 0 1 *	0 0 0 1 1 0 0 0 1 *
↓		0 0 0 1 1 0 0 1 0 *	0 0 0 1 1 0 0 1 0 *
→		0 0 0 1 1 0 1 0 0 *	0 0 0 1 1 0 1 0 0 *
← (2 Keys)		0 0 0 1 1 0 1 1 1 *	0 0 0 1 1 0 1 1 1 *
⇥		0 0 0 1 0 0 1 1 0 *	0 0 0 1 0 0 1 1 0 *
⇤		0 0 0 1 0 1 0 0 1	0 0 0 1 0 1 0 0 1
|	1	0 1 0 0 1 1 1 1 0	1 1 1 1 0 0 0 1 0
@	2	0 1 1 1 1 1 0 0 0	1 1 1 1 0 0 1 0 0
#	3	0 1 1 1 1 0 1 1 1	1 1 1 1 0 0 1 1 1
$	4	0 1 0 1 1 0 1 1 0	1 1 1 1 0 1 0 0 0
%	5	0 1 1 0 1 1 0 0 1	1 1 1 1 0 1 0 1 1
¢	6	0 1 0 0 1 0 1 0 0	1 1 1 1 0 1 1 0 1
&	7	0 1 0 1 0 0 0 0 1	1 1 1 1 0 1 1 1 0
*	8	0 1 0 1 1 1 0 0 1	1 1 1 1 1 0 0 0 0
(	9	0 1 0 0 1 1 0 1 1	1 1 1 1 1 0 0 1 1
)	0	0 1 0 1 1 1 0 1 0	1 1 1 1 0 0 0 0 1
–	-	0 1 1 0 1 1 0 1 0 *	0 1 1 0 0 0 0 0 1 *
+	=	0 1 0 0 1 1 1 0 1	0 1 1 1 1 1 1 0 1
Q	Q	1 1 0 1 1 0 0 0 1	1 0 0 1 1 0 0 0 0
W	W	1 1 1 0 0 1 1 0 0	1 0 1 0 0 1 1 0 1
E	E	1 1 0 0 0 1 0 1 1	1 0 0 0 0 1 0 1 0
R	R	1 1 0 1 1 0 0 1 0	1 0 0 1 1 0 0 1 1
T	T	1 1 1 0 0 0 1 1 0	1 0 1 0 0 0 1 1 1
Y	Y	1 1 1 0 1 0 0 0 1	1 0 1 0 1 0 0 0 0
U	U	1 1 1 0 0 1 0 0 1	1 0 1 0 0 1 0 0 0
I	I	1 1 0 0 1 0 0 1 1	1 0 0 0 1 0 0 1 0
O	O	1 1 0 1 0 1 1 0 0	1 0 0 1 0 1 1 0 1
P	P	1 1 0 1 0 1 1 1 1	1 0 0 1 0 1 1 1 0
!	¬	0 1 0 1 1 0 1 0 1	0 1 0 1 1 1 1 1 1
A	A	1 1 0 0 0 0 0 1 0	1 0 0 0 0 0 0 1 1
S	S	1 1 1 0 0 0 1 0 1	1 0 1 0 0 0 1 0 0
D	D	1 1 0 0 0 1 0 0 0	1 0 0 0 0 1 0 0 1
F	F	1 1 0 0 0 1 1 0 1	1 0 0 0 0 1 1 0 0
G	G	1 1 0 0 0 1 1 1 0	1 0 0 0 0 1 1 1 1
H	H	1 1 0 0 1 0 0 0 0	1 0 0 0 1 0 0 0 1
J	J	1 1 0 1 0 0 0 1 1	1 0 0 1 0 0 0 1 0
K	K	1 1 0 1 0 0 1 0 1	1 0 0 1 0 0 1 0 0
L	L	1 1 0 1 0 0 1 1 0	1 0 0 1 0 0 1 1 1
:	;	0 1 1 1 1 0 1 0 0	0 1 0 1 1 1 1 0 0
"	'	0 1 1 1 1 1 1 1 0	0 1 1 1 1 1 0 1 1
Z	Z	1 1 1 0 1 0 0 1 0	1 0 1 0 1 0 0 1 1
X	X	1 1 1 0 0 1 1 1 1	1 0 1 0 0 1 1 1 0
C	C	1 1 0 0 0 0 1 1 1	1 0 0 0 0 0 1 1 0
V	V	1 1 1 0 0 1 0 1 0	1 0 1 0 0 1 0 1 1
B	B	1 1 0 0 0 0 1 0 0	1 0 0 0 0 0 1 0 1
N	N	1 1 0 1 0 1 0 1 0	1 0 0 1 0 1 0 1 1
M	M	1 1 0 1 0 1 0 0 1	1 0 0 1 0 1 0 0 0
<	,	0 1 0 0 1 1 0 0 1	0 1 1 0 1 0 1 1 0
>	.	0 1 1 0 1 1 1 0 0	0 1 0 0 1 0 1 1 1
?	/	0 1 1 0 1 1 1 1 1	0 1 1 0 0 0 0 1 0
PF1		0 0 1 1 0 0 0 1 0	0 0 1 1 0 0 0 1 0
PF2		0 0 1 1 0 0 1 0 0	0 0 1 1 0 0 1 0 0
PF3		0 0 1 1 0 0 1 1 1	0 0 1 1 0 0 1 1 1
PF4		0 0 1 1 0 1 0 0 0	0 0 1 1 0 1 0 0 0
PF5		0 0 1 1 0 1 0 1 1	0 0 1 1 0 1 0 1 1
PF6		0 0 1 1 0 1 1 0 1	0 0 1 1 0 1 1 0 1
PF7		0 0 1 1 0 1 1 1 0	0 0 1 1 0 1 1 1 0
PF8		0 0 1 1 1 0 0 0 0	0 0 1 1 1 0 0 0 0
PF9		0 0 1 1 1 0 0 1 1	0 0 1 1 1 0 0 1 1
PF10		0 0 1 1 1 0 1 0 1	0 0 1 1 1 0 1 0 1
PF11		0 0 1 1 1 0 1 1 0	0 0 1 1 1 0 1 1 0
PF12		0 0 1 1 1 1 0 0 1	0 0 1 1 1 1 0 0 1

*Typamatic Key

Note: Typewriter Keyboard button layout used. Character codes are same on both keyboards.

Diagram 6-5. Typewriter and Operator Console Keyboard Codes

Graphic U	Graphic L	Upper Shift 0 1 2 3 4 5 6 7 P *	Lower Shift 0 1 2 3 4 5 6 7 P *
ERASE INPUT		0 0 0 1 0 1 1 1 1	0 0 0 1 0 1 1 1 1
ERASE EOF		0 0 0 1 0 1 1 0 0	0 0 0 1 0 1 1 0 0
RESET			
PA1		0 0 1 0 1 1 0 0 0	0 0 1 0 1 1 0 0 0
CLEAR		0 0 1 0 1 1 0 1 1	0 0 1 0 1 1 0 1 1
INS MODE		0 0 0 1 0 0 0 1 1	0 0 0 1 0 0 0 1 1
DEL		0 0 0 1 0 0 0 0 0	0 0 0 1 0 0 0 0 0
TEST REQ		0 0 1 1 0 0 0 0 1	0 0 1 1 0 0 0 0 1
PA2		0 0 1 0 1 1 1 0 1	0 0 1 0 1 1 1 0 1
ENTER		0 0 1 1 1 1 0 1 0	0 0 1 1 1 1 0 1 0
Space		0 1 0 0 0 0 0 0 0 *	0 1 0 0 0 0 0 0 0 *
SKIP		0 0 0 1 0 0 1 1 0 *	0 0 0 1 0 0 1 1 0 *
DUP		1 0 0 1 1 1 0 0 1	1 0 0 1 1 1 0 0 1
↵		0 0 0 1 0 1 0 1 0 *	0 0 0 1 0 1 0 1 0 *
↑		0 0 0 1 1 0 0 0 1 *	0 0 0 1 1 0 0 0 1 *
↓		0 0 0 1 1 0 0 1 0 *	0 0 0 1 1 0 0 1 0 *
→		0 0 0 1 1 0 1 0 0 *	0 0 0 1 1 0 1 0 0 *
← (2 Keys)		0 0 0 1 1 0 1 1 1 *	0 0 0 1 1 0 1 1 1 *
⇥		0 0 0 1 0 0 1 1 0 *	0 0 0 1 0 0 1 1 0 *
⇤		0 0 0 1 0 1 0 0 1	0 0 0 1 0 1 0 0 1
PA3		0 0 1 0 1 0 1 1 1	0 0 1 0 1 0 1 1 1
	@	0 1 0 0 0 0 0 0 0	0 1 1 1 1 1 0 0 0
	#	0 1 0 0 0 0 0 0 0	0 1 1 1 1 0 1 1 1
,	*	0 1 1 0 1 0 1 1 0	0 1 0 1 1 1 0 0 1
.	$	0 1 0 0 1 0 1 1 1	0 1 0 1 1 0 1 1 0
0	/	1 1 1 1 0 0 0 0 1	0 1 1 0 0 0 0 1 0
+	Q	0 1 0 0 1 1 1 0 1	1 1 0 1 1 0 0 0 1
–	W	0 1 1 0 1 1 0 1 0	1 1 1 0 0 1 1 0 0
!	E	0 1 0 1 1 0 1 0 1	1 1 0 0 0 1 0 1 1
:	R	0 1 1 1 1 0 1 0 0	1 1 0 1 1 0 0 1 0
;	T	0 1 0 1 1 1 1 0 0	1 1 1 0 0 0 1 1 0
=	Y	0 1 1 1 1 1 1 0 1	1 1 1 0 1 0 0 0 1
1	U	1 1 1 1 0 0 0 1 0	1 1 1 0 0 1 0 0 1
2	I	1 1 1 1 0 0 1 0 0	1 1 0 0 1 0 0 1 1
3	O	1 1 1 1 0 0 1 1 1	1 1 0 1 0 1 1 0 0
&	P	0 1 0 1 0 0 0 0 1	1 1 0 1 0 1 1 1 1
<	A	0 1 0 0 1 1 0 0 0	1 1 0 0 0 0 0 1 0
>	S	0 1 1 0 1 1 1 0 0	1 1 1 0 0 0 1 0 1
	D	0 1 0 0 0 0 0 0 0	1 1 0 0 0 1 0 0 0
|	F	0 1 0 0 1 1 1 1 0	1 1 0 0 0 1 1 0 1
¬	G	0 1 0 1 1 1 1 1 1	1 1 0 0 0 1 1 1 0
¢	H	0 1 0 0 1 0 1 0 0	1 1 0 0 1 0 0 0 0
4	J	1 1 1 1 0 1 0 0 0	1 1 0 1 0 0 0 1 1
5	K	1 1 1 1 0 1 0 1 1	1 1 0 1 0 0 1 0 1
6	L	1 1 1 1 0 1 1 0 1	1 1 0 1 0 0 1 1 0
%	Z	0 1 1 0 1 1 0 0 1	1 1 1 0 1 0 0 1 0
?	X	0 1 1 0 1 1 1 1 1	1 1 1 0 0 1 1 1 1
'	C	0 1 1 1 1 1 1 0 1	1 1 0 0 0 0 1 1 1
"	V	0 1 1 1 1 1 1 1 0	1 1 1 0 0 1 0 1 0
(	B	0 1 0 0 1 1 0 1 1	1 1 0 0 0 0 1 0 0
)	N	0 1 0 1 1 1 0 1 0	1 1 0 1 0 1 0 1 0
7	M	1 1 1 1 0 1 1 1 0	1 1 0 1 0 1 0 0 1
8	,	1 1 1 1 1 0 0 0 0	0 1 1 0 1 0 1 1 0
9	.	1 1 1 1 1 0 0 1 1	0 1 0 0 1 0 1 1 1
.	.	0 1 0 0 1 0 1 1 1	0 1 0 0 1 0 1 1 1
-	-	0 1 1 0 0 0 0 0 1	0 1 1 0 0 0 0 0 1
PF1		0 0 1 1 0 0 0 1 0	0 0 1 1 0 0 0 1 0
PF2		0 0 1 1 0 0 1 0 0	0 0 1 1 0 0 1 0 0
PF3		0 0 1 1 0 0 1 1 1	0 0 1 1 0 0 1 1 1
PF4		0 0 1 1 0 1 0 0 0	0 0 1 1 0 1 0 0 0
PF5		0 0 1 1 0 1 0 1 1	0 0 1 1 0 1 0 1 1
FIELD MARK		1 0 0 1 1 1 1 0 0	1 0 0 1 1 1 1 0 0

*Typamatic key

Diagram 6-6. Data Entry Keyboard Codes

Location and Name	Type	Logic Page Reference	Function or Major Units	Significant I/O Signals Input	Output
*A2 Keyboard Controls – 2	9072	KM111–161	Tests for modified characters and protected data. Contains keyboard operation latches, control latches, and MDT latch.	Keybd Strobe; Keybd Reset; CU Busy; Index; I/O Unlock Keybd; Allow Char Load.	KB lock; FF Enable; Ld KB to Fets; Char Rdy Decode; MDT Load Bit 7.
*B2 Keyboard Controls – 1	9069	KM011–071	Contains KB decoder, Tab controls, Cursor Controls, and Insert/Delete Controls.	KB Bits 1–7, and P; Alpha Shift; Numeric Shift; KB Strobe.	KB Op Decoder outputs; Char Edit; Csr Edit; Op Complete; Insert Bit 9; Csr Move; Keybd Bits 1–7.
C2 I/O Gating and Parity	9066	MG011–061	Contains message buffer register and parity check circuits, late register, attribute register, and gating circuitry for line buffer and message buffer.	CR Bits 0–9; SR Bits 3–11; KB Bits 1–7; Fets Out Bits 0–9; Load I/O Data; Load Message Buffer.	FQ Ser in Bits 0–9; Mesg Bfr Bits 1–9; Attb Reg Bits 2–6; P Chk Bfr.
D2 (Model 1) 480 Storage and Gate	9057	MB011–061	Model 1 – Contains 480-character message buffer and gates.	FQ Ser in Bits 0–9; Serial Shift Gt; Shift Fets.	Fets Out Bits 0–9.
D2 (Model 2) 960 Storage and Gate	9065	MB011–061	Model 2 - Contains 960-character message buffer and gates.		TQ Ser in Bits 0–9.
E2 SERDES and Special Circuits	L514	KA111–121	Contains line driver and line receiver, I/O serializer/ deserializer (SERDES) and gates, oscillator, and 5V relay switch.	Data to Control Unit; Data to Driver Receiver; Mesg Bfr Bits 1–9; Keyb bits 3–7; Data.	Data to Control Unit; Data from Driver Receiver; SR Bits 1–12; Osc.
F2 960 Storage and Gate	9065	MB111–161	Model 1 – Not used. Model 2 – Contains 960 character message buffer and gates.	Third Quarter Serial in Bits 0–9 (from card D2); Shift Fets.	Fets Out Bits 0–9.
G2 I/O Control	9068	KA011–081	Contains operation decoder, I/O gating controls, status register, SERDES controls, and cursor positioning controls.	Osc, End Screen; Fets Out Bit 7–8; SR Bits 1–12; Data from Driver Receiver; Attention inputs.	Stop Clock; Index; Sound Alarm; Write Latch; System Ready Latch; Control Word 1 and 2; Clock; Data; Input Data; Device Busy; Read Sync; Xmit Check; Read Out Shift; Data to Driver Receiver; CU Busy; Input Inhibited; Load I/O Data; Protected Bfr.

*Optional feature cards

Diagram 6-8. Logic Card Data (Sheet 1 of 2)

Location and Name	Type	Logic Page Reference	Function or Major Units	Significant I/O Signals Input	Output
H2 Clock and Step Control	9071	KF011–071	Contains dot counter, character counter, buffer shifting controls, and buffer attribute register.	Osc; Read Out Shift; Set I/O Fast Shift; Load Late Reg; Last Line.	Interface Op Step Retrace Ctr; Dot 1–8; Char 0; Next to Last Char; Last Char; Char Ctr All Ones; Fast Shift Latch; Unformatted Display; Normal Gates; High Intensity, Non Disp Blank; Unprotected Char; Numeric Field.
J2 Display Control	9067	KF111–181	Contains retrace counter, line counter, row counter, analog controls, and controls to display indicators.	Step Retrace Ctr; Retrace Blank; Lines 0–9; Csr Line; Input Inhibited; System Ready; Insert Mode.	Set Blank for Retrace; First 9 Lines; Ld LB Gates; Shift Line Buff; Ld Atb Reg from Fets; Step Row Ctr; Horiz Sync; Blank CRT at Video Output; Row 0; Row 1; Last Row; End Screen; Unblank; Shift Fets; Vertical Retrace; Bump Display; Serial Shift GT.
K2 Line Buffer and Character Generator	9058 (M1) 9070 (M2)	MC011–091	Contains gates to line buffer, ROS register, line buffer, ROS character generator, and data serializer for analog.	Fets Out Bits 2–9; Shift Line Buff; Blank CRT at Video Output; Unblank Ind; Lines 0–8.	Pre ROS Bits 2, 3, and 7; Bits 4, 5, 6, and 8 from Line Buffer; Non Display or Hi Inten; Video Data Out.
L2 (Not Used)					
*M2 LP Control	9088	KT011–061	Contains selector light-pen interface and control circuitry.	I/O Busy; Bits 4, 5, 6, and 8 from Line Buffer; Pre ROS bits 2, 3, and 7.	Bit 7 and LB and MB; LP Busy; LP Aid Bits 3, 4, 5, and 6.
*N2 Card Reader	2229	KR011–071	Contains magnetic card reader interface and control circuitry.	CR Data; Keybd Bits 0–7; Keybd Parity Bit.	Strobe; Bits 0–7; Pty; Gate Keyboard.

*Optional feature cards

Diagram 6-8. Logic Card Data (Sheet 2 of 2)

Card	Pin	ALD	Signal Name
A-A2	B04	KM141	+ DE Up Shift
	G04	KM111	- Ld KB to Fets
	*M10	KM141	- Keybd Strobe
	P05	KM131	- Load Late Reg Gt
	S03	KM141	- Keybd Lock
	*S09	KM141	- Keybd Reset
	U04	KM141	+ FF Enable
	U06	KM121	- Insert Mode
A-B2	G03	KM041	- Fill Hole
	G09	KM021	- KB Attn Lock KB
	J10	KM041	- Clr Norm Gt Lth
	M03	KM031	+ Erase Fld 6
	*M10	KM031	+ Keybd Bit 5
	*M11	KM031	+ Keybd Bit 7
	P06	KM031	- Set EAU Lth 7
	*S02	KM031	+ Keybd Bit 3
	*S05	KM031	+ Keybd Bit 0
	*S08	KM031	+ Keybd Bit 1
	*S09	KM031	+ Keybd Bit 2
	*S13	KM021	+ Keybd Parity Bit
	*U05	KM031	+ Keybd Bit 4
	*U09	KM031	+ Keybd Bit 6
	U13	KM011	- Insert Csr Bit 9
A-C2	P04	MG051	+ POR
	*S02	MG051	- POR
	S03	MG041	+ P Chk Bfr
A-E2	*B02	KA111	+ Relay Coil
	B09	KA111	+ Switched 5V
	B12	KA121	+ 2.385 MHz Osc
	J13	KA121	+ 4.770 MHz Osc
A-F2	M02	MB141	+ Fets Out Bit 9
A-G2	B09	KA081	+ Insert Null
	*D07	KA061	- Security Key
	G04	KA081	+ Delete Csr Bit 9
	G07	KA071	- Protected Bfr
	G09	KA061	- Device Busy Status Dot
	J05	KA081	- Insert Cursor Norm
	J13	KA071	- Set I/O Fast Shift
	M06	KA061	+ CU Busy
	P02	KA021	+ Index
	S04	KA031	- Delete MDT Bit 7
	S06	KA031	- Syst Rdy Lth Set
	S10	KA061	- Input Inhibit

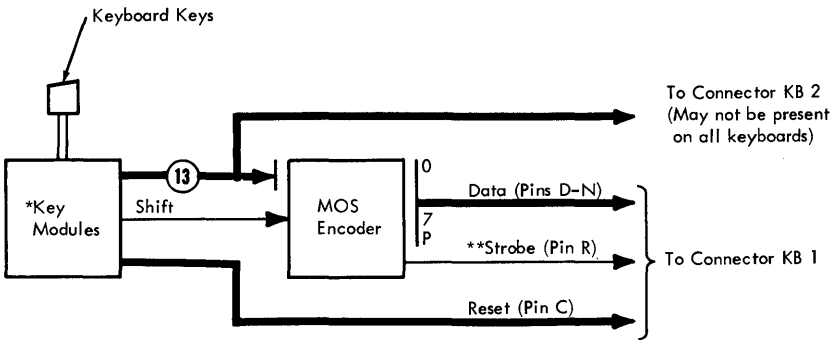
Card	Pin	ALD	Signal Name
A-H2	B03	KF071	+ Null Bet Cur and End
	D06	KF071	+ Numeric Field
	D13	KF021	- Dot 6
	G03	KF071	+ Unprotected Char
	G11	KF041	- Shift Fets
	G13	KF061	+ High Intensity
	J02	KF051	+ Unformatted Disp Lth
	J09	KF051	+ Normal Gates
	M09	KF051	+ Fast Shift Latch
	M13	KF031	- Char All Ones
	P06	KF031	- Next To Last Char
	P10	KF021	+ Blank For First Frame
	U06	KF021	- Late Reg Strobe
A-J2	B04	KF131	- Cond Fets Bit 8
	B10	KF131	+ Ld LB Gates
	G08	KF161	- Unblank Ind
	M08	KF151	- End Screen
	P04	KF181	+ Up Line
	S02	KF151	+ Last Row
	S05	KF141	+ Blank CRT at Video Output
	S09	KF141	- Force Unblank Line
	S12	KF171	- Bump Display
	S13	KF171	+ Vertical Retrace
	U02	KF141	+ Dev Check
	U10	KF141	+ Horiz Sync
A-K2	P11	MC081	+ Non Dis Or Hi Inten
	S09	MC091	+ Video Data Out
A-M2	*D04	KT041	- LP Strike
	P09	KT051	- Draw Bars
	*U06	KT051	- LP Sw Closed

*Input pins

Diagram 6-9. Probe Pin Data

Feature Name	Feature Number	Feature B/M	Jumper
Typewriter Keyboard	4630, 4632, 4633, 4634, 4635, 2955	2621364, 65, 67, 68, 69, 71, 72, 77, 78, 83, 84 5922871, 88, 89	Add wire: A2B06 to A2D08
Data Entry Keyboard	4631, 2971	2621366, 73, 79, 85 5922870, 90	Remove wire: A2B06 to A2D08
Keyboard Numeric Lock (USA and United Kingdom)	4690	2568694	Add wire: B4B12 to B4D08
Keyboard Numeric Lock (French, German, and Italian)	4690	2568696	Add wires: B4B12 to B4D08 B5B03 to B5D08

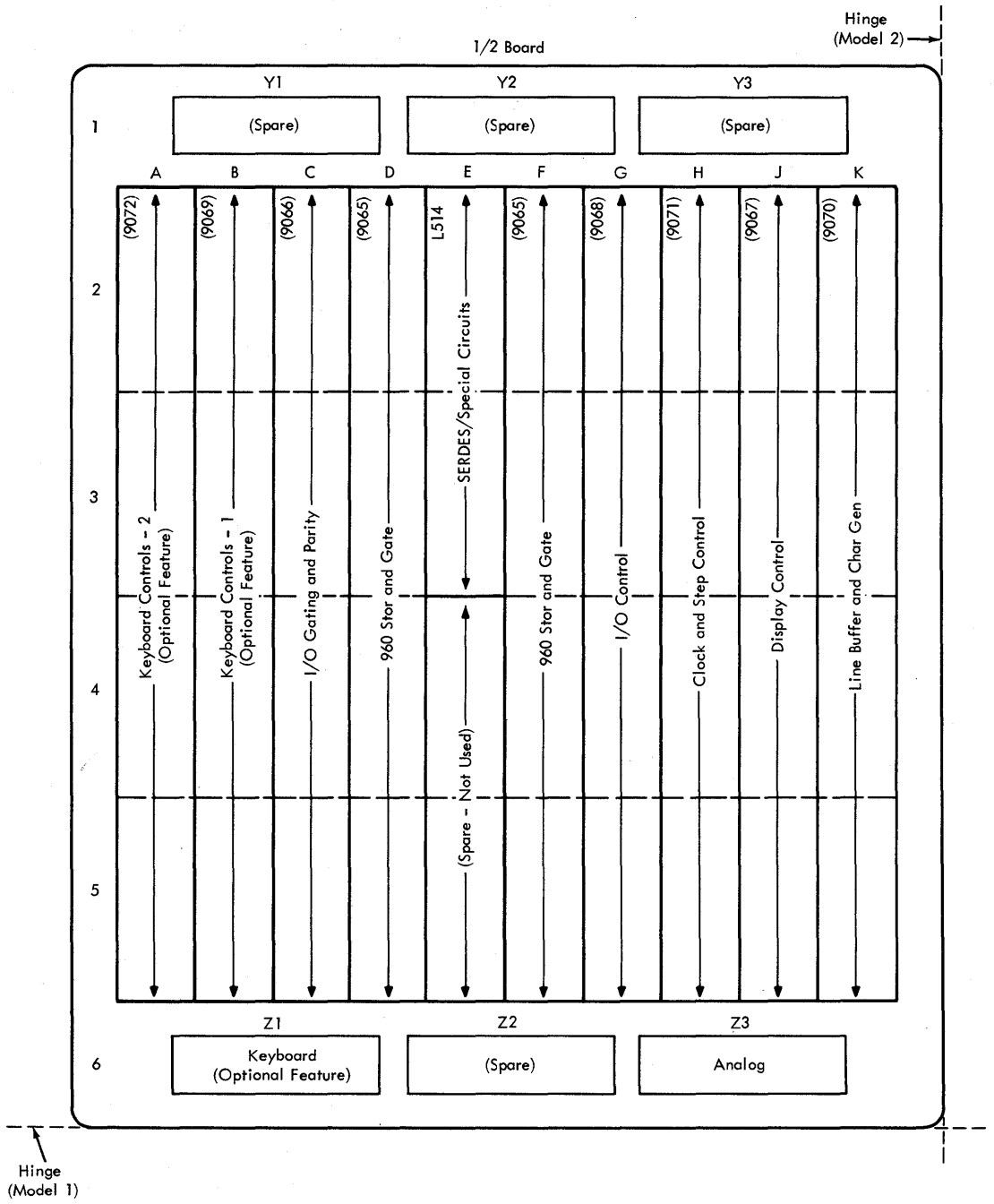
Diagram 6-10. Keyboard Feature Jumpers



*Each key module (except RESET and the shift keys) generates two active inputs to the encoder.

**The strobe signal is active when two and only two active inputs are present at the encoder.

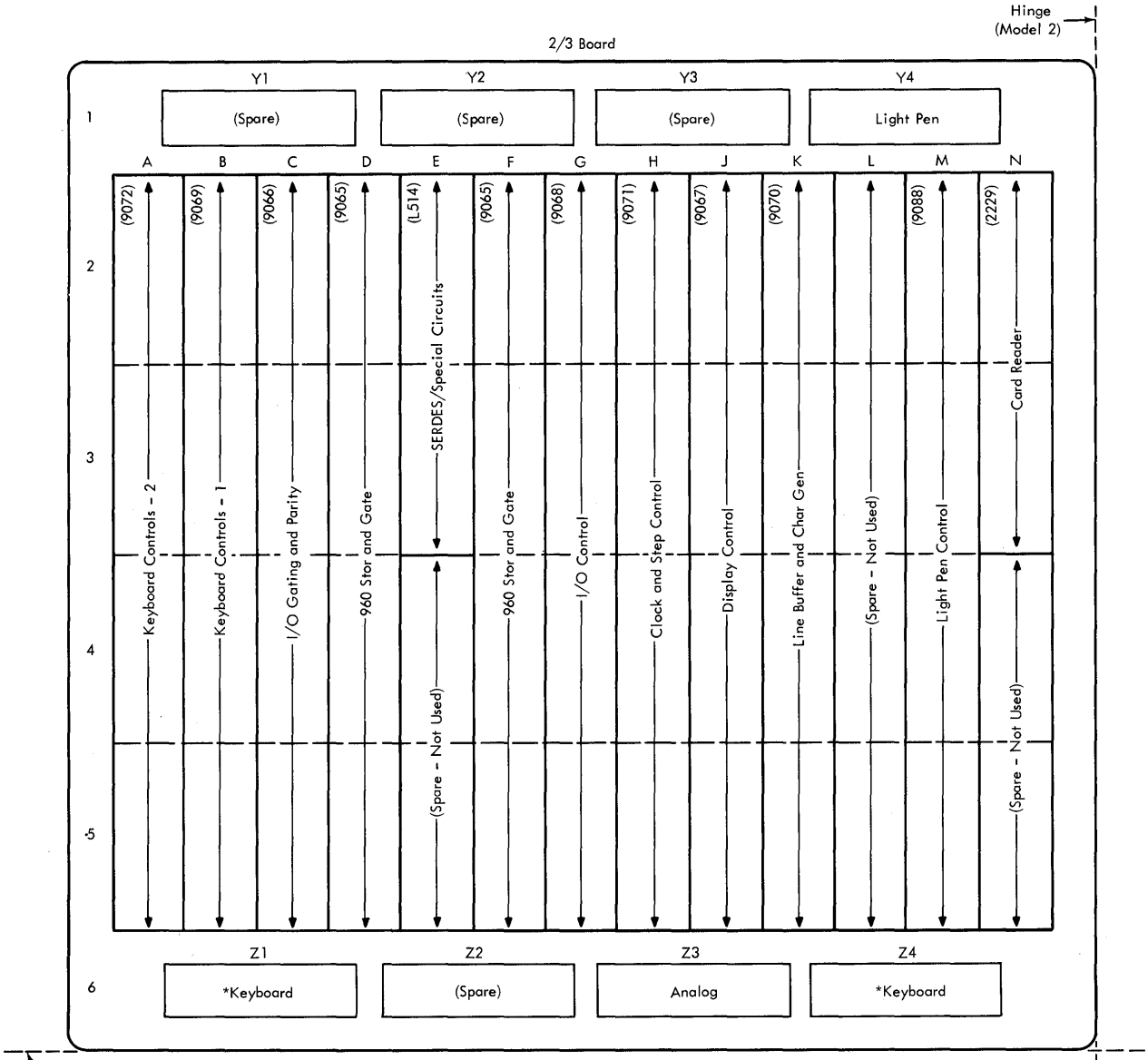
Diagram 6-11. Keyboard Encoding



Model 1 Differences (Model 2 Cards Shown)

- D2 - 480 Stor and Gate (9057, Two-wide Card)
- F2 - Spare (Not Used)
- K2 - Line Buffer and Char Gen (9058)

Diagram 6-12. Board Layout by Card Function — Without Features (Card Side View)

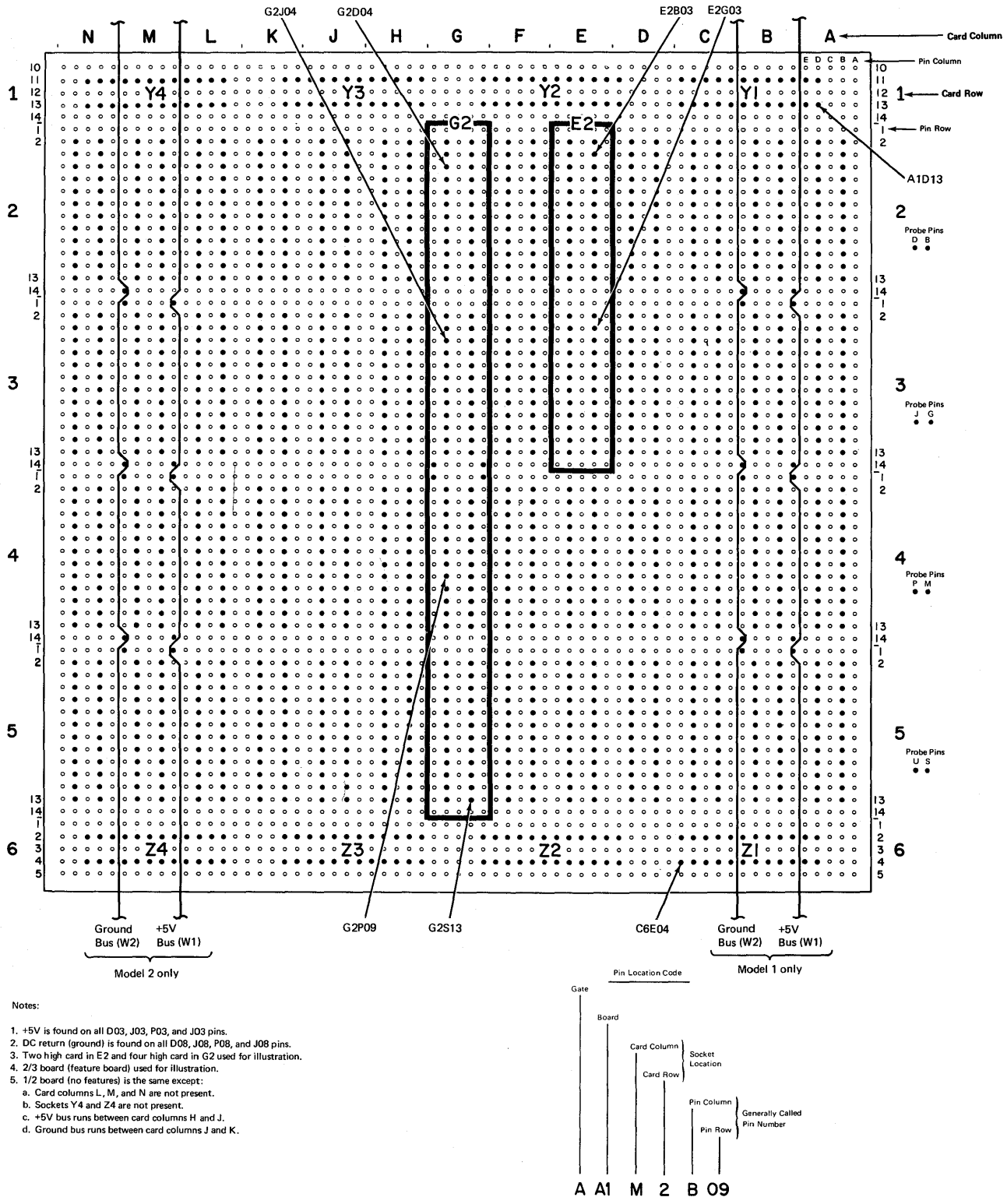


*Z1 - Keyboard socket without operator identification card reader feature.
Z4 - Keyboard socket with operator identification card reader feature.

Model 1 Differences (Model 2 Cards Shown)

- D2 - 480 Stor and Gate (9057, Two-wide Card)
- F2 - Spare (Not Used)
- K2 - Line Buffer and Char Gen (9058)

Diagram 6-13. Board Layout by Card Function — With Features (Card Side View)



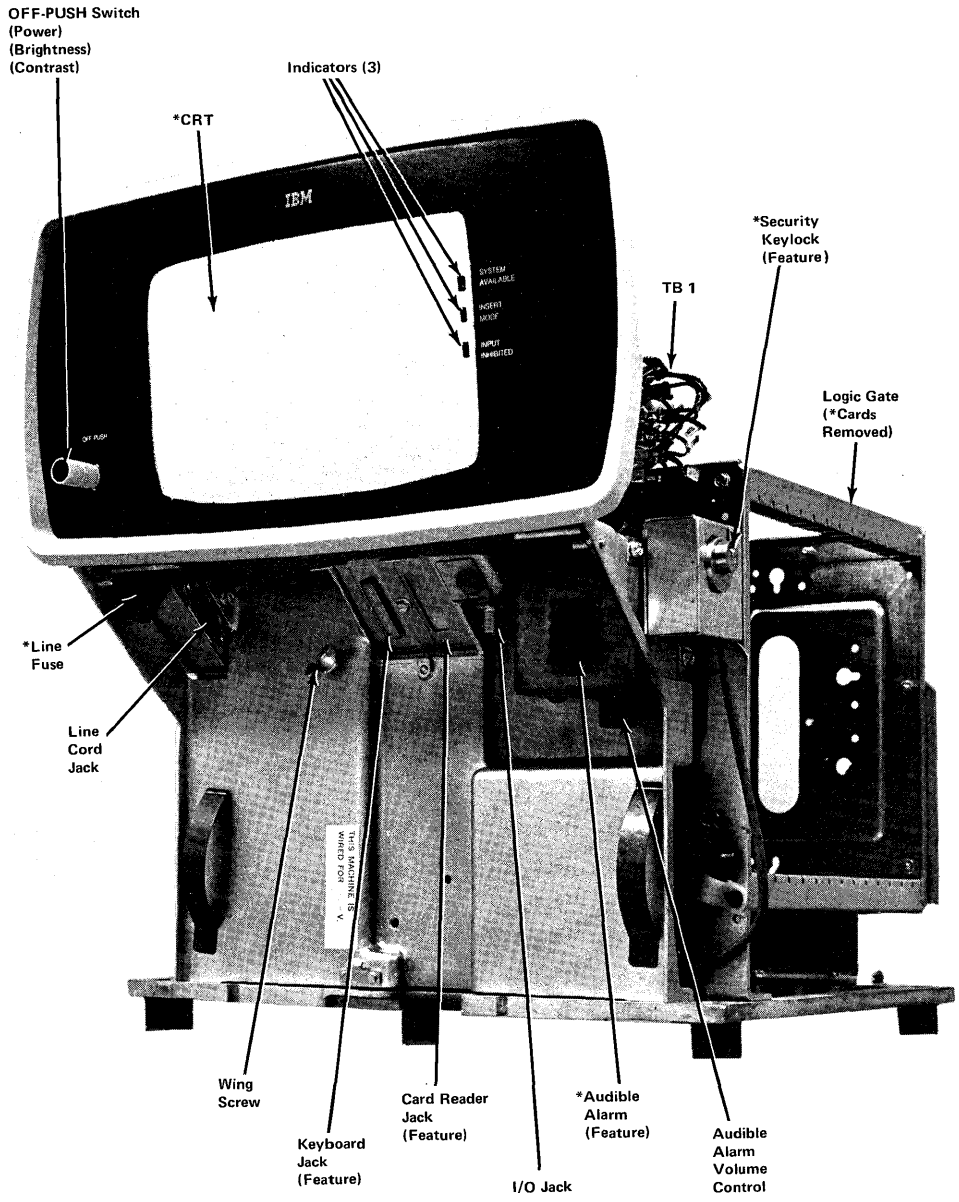
Notes:

1. +5V is found on all D03, J03, P03, and J03 pins.
2. DC return (ground) is found on all D08, J08, P08, and J08 pins.
3. Two high card in E2 and four high card in G2 used for illustration.
4. 2/3 board (feature board) used for illustration.
5. 1/2 board (no features) is the same except:
   a. Card columns L, M, and N are not present.
   b. Sockets Y4 and Z4 are not present.
   c. +5V bus runs between card columns H and J.
   d. Ground bus runs between card columns J and K.

Diagram 6-14. Board Layout Pin Identification Data (Pin Side View)

Photographs and drawings are provided in this section to aid in locating field-replaceable units, adjustable components, and voltage measurement points.

Diagrams 7-1 through 7-6 show Model 1 and Model 2 component locations. Keyboard locations are shown in Diagrams 7-7 and 7-8. Voltage component locations and test points are shown in Diagrams 7-9 through 7-15.



*Field Replaceable Unit

Diagram 7-1. Model 1 Locations, Front View

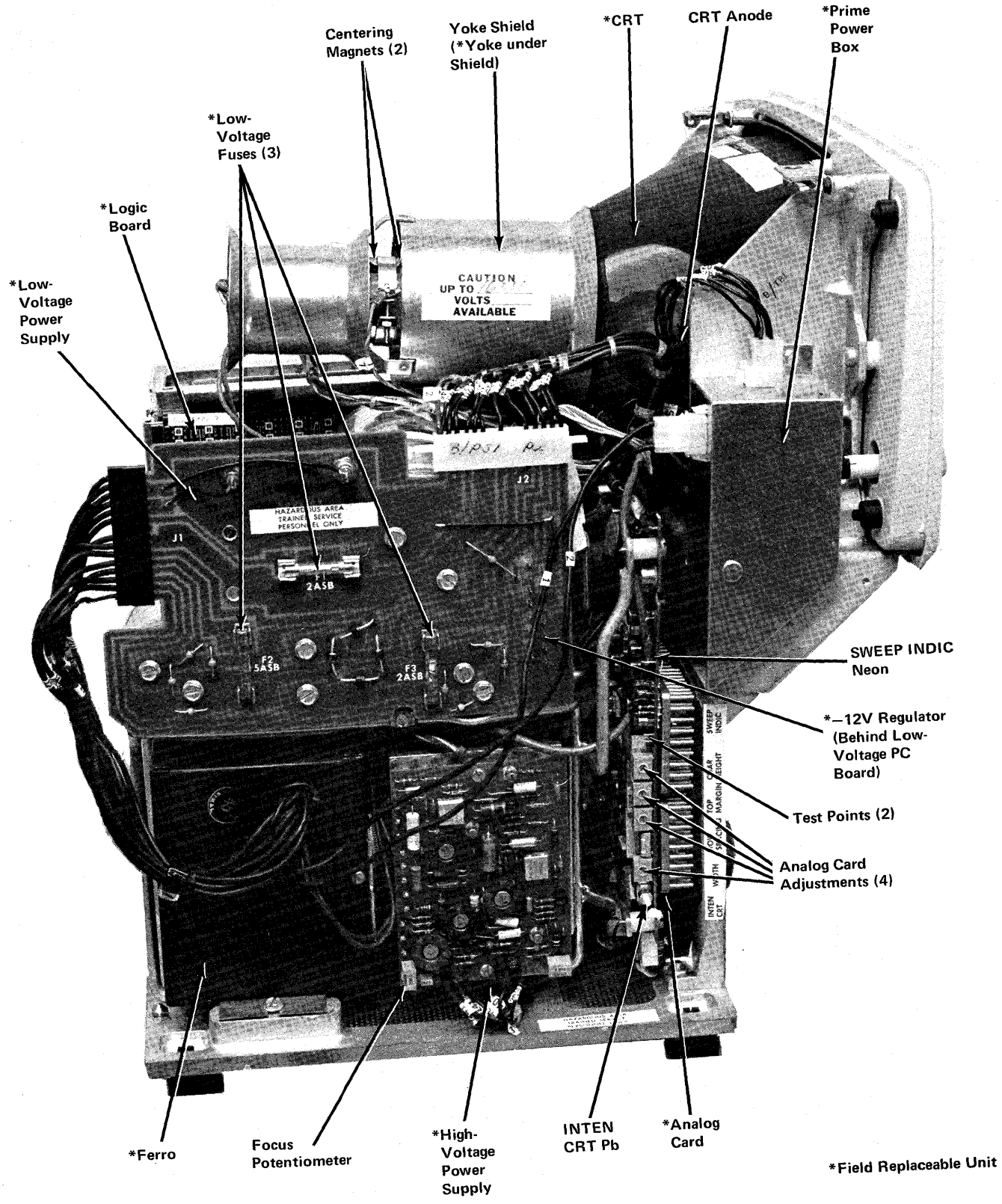


Diagram 7-2. Model 1 Locations, Left-Side View

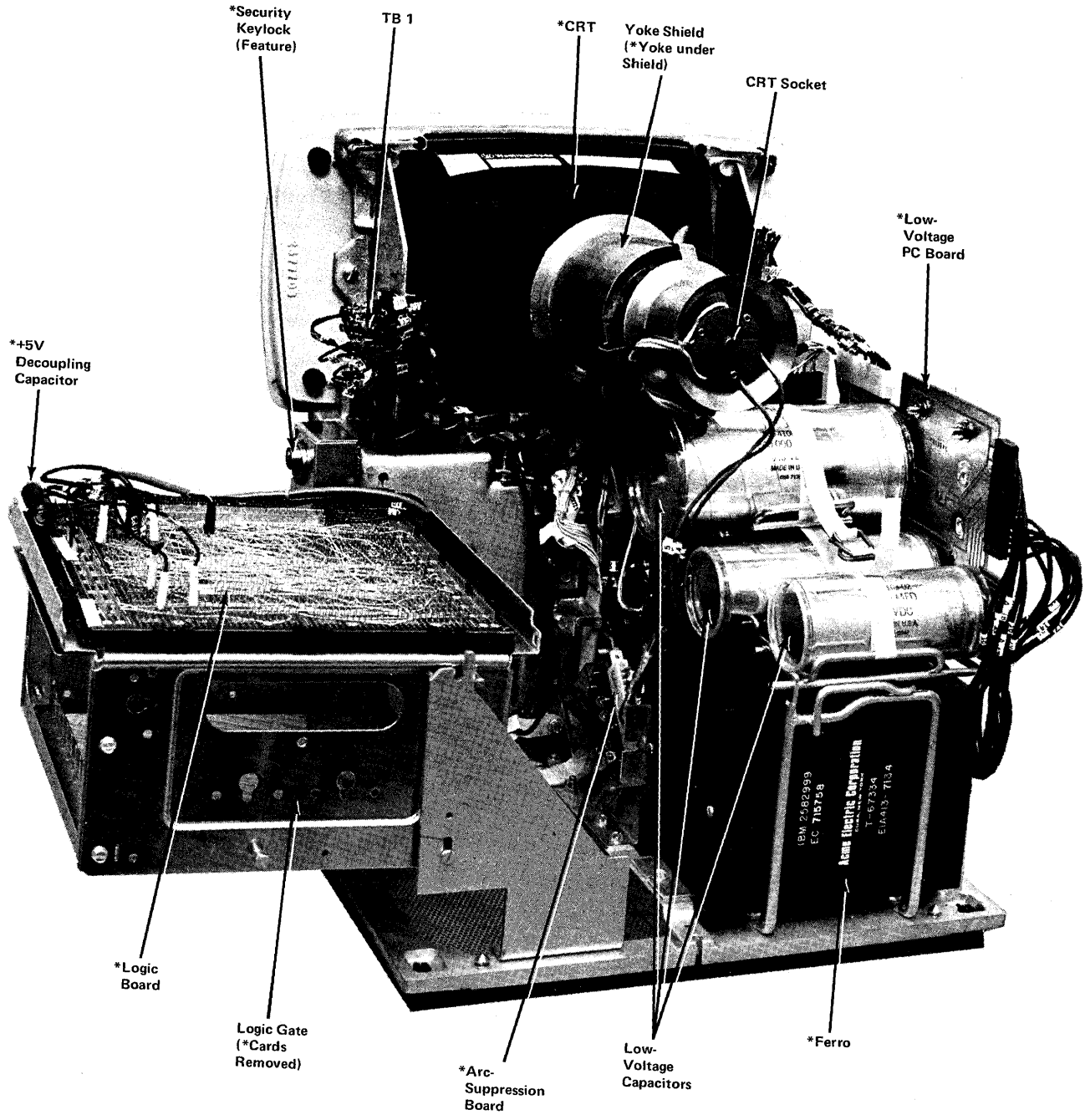
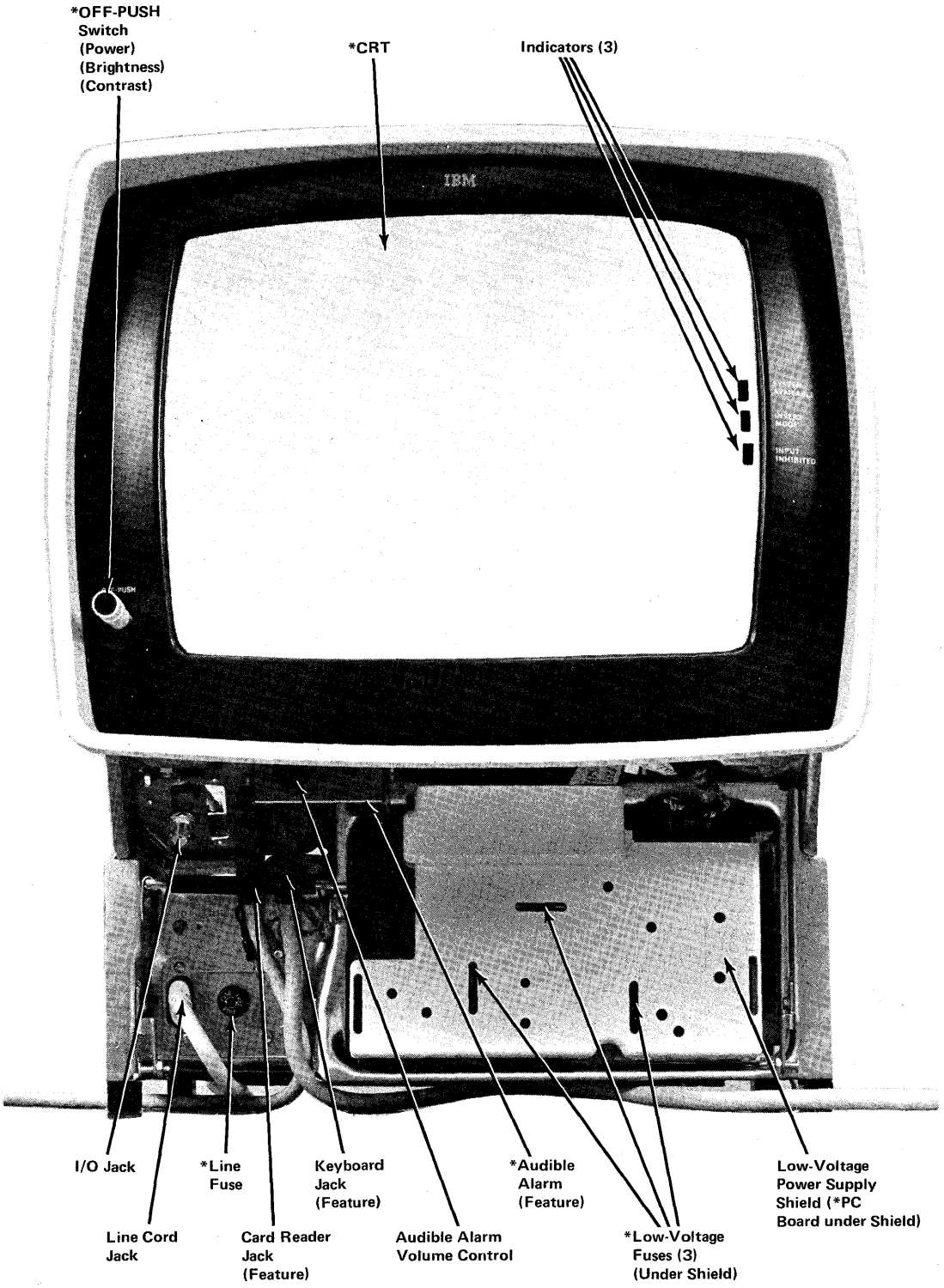


Diagram 7-3. Model 1 Locations, Rear View

*Field Replaceable Unit



*Field Replaceable Unit

Diagram 7-4. Model 2 Locations, Front View

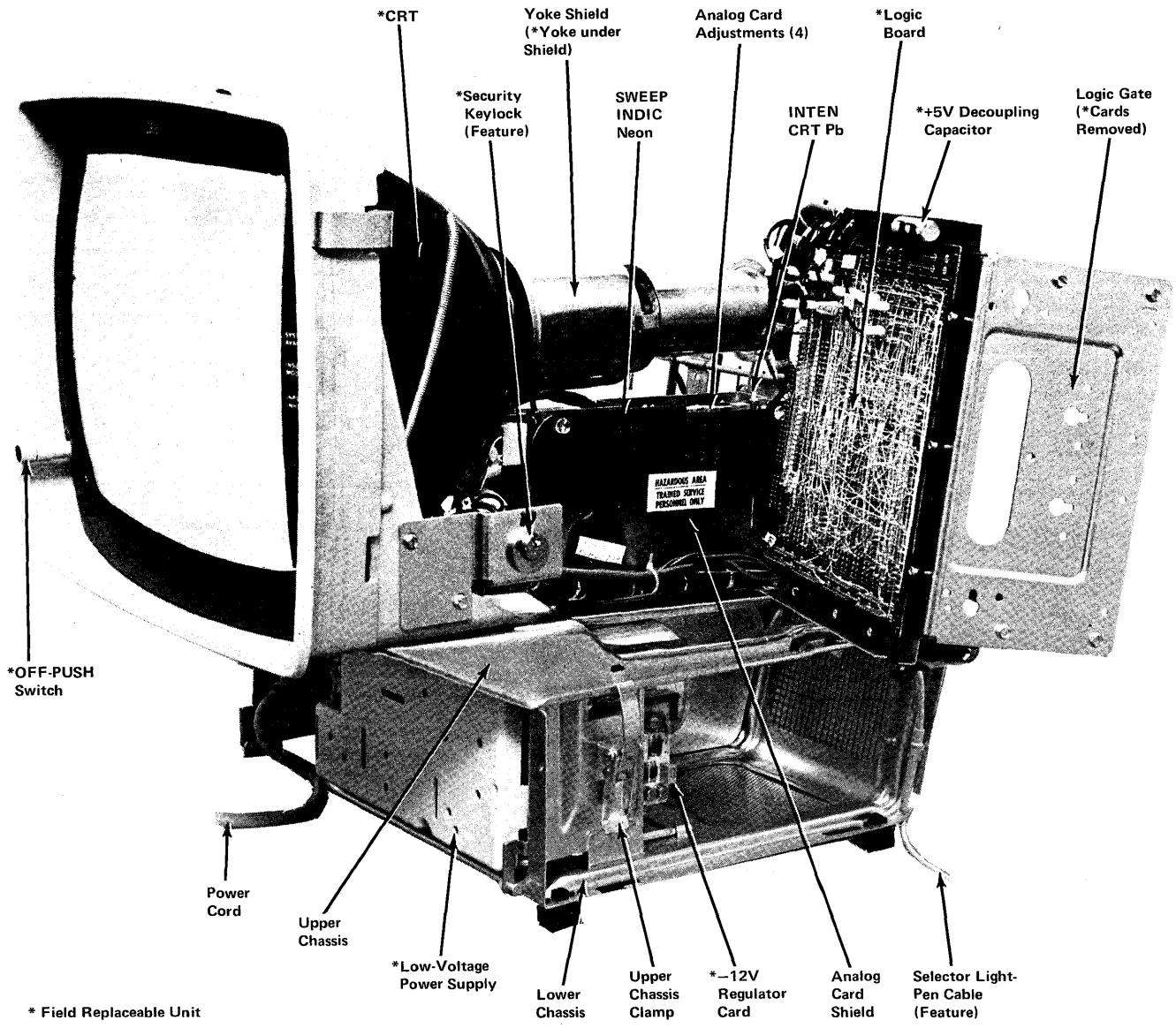


Diagram 7-5. Model 2 Locations, Right-Side View

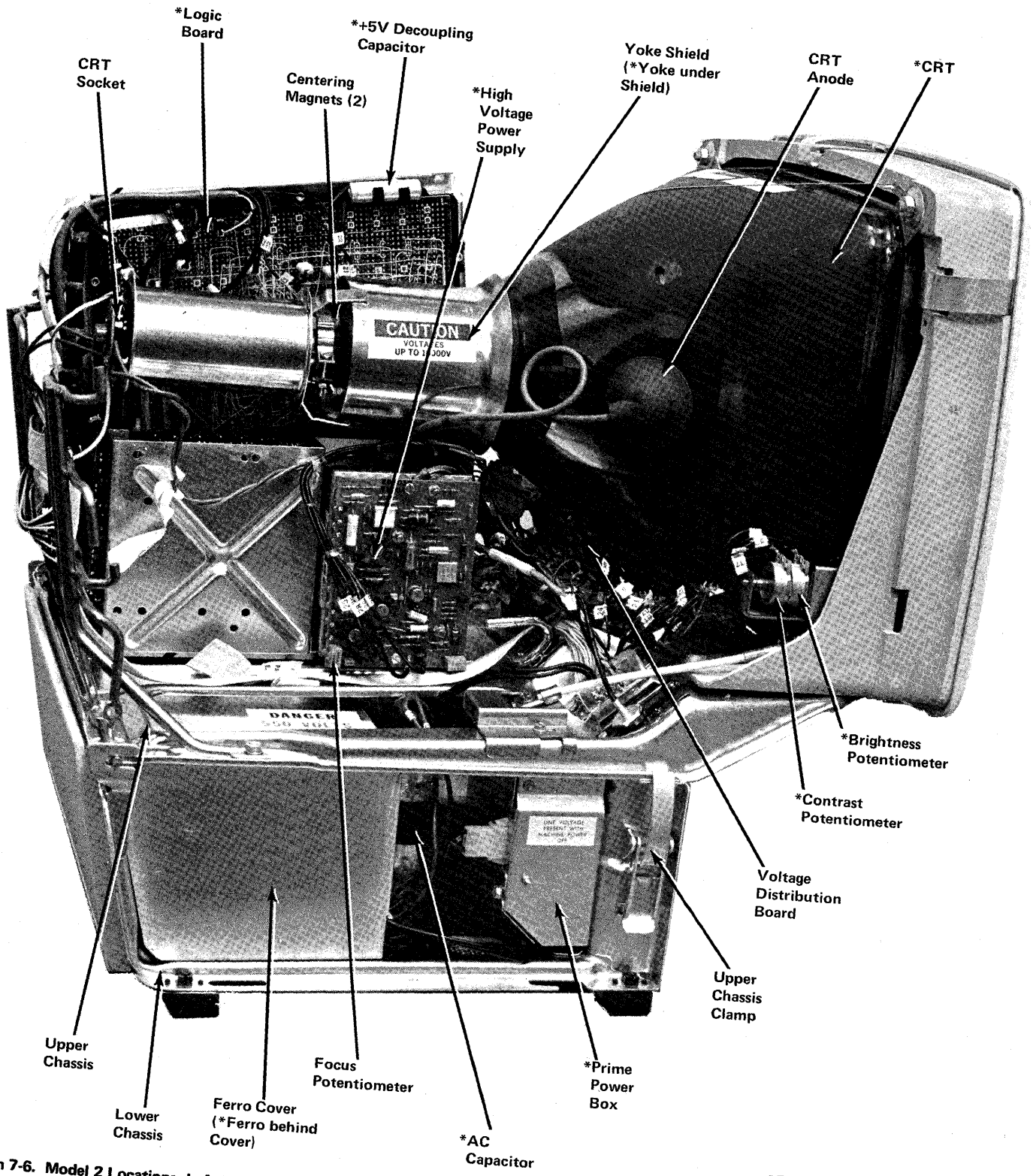


Diagram 7-6. Model 2 Locations, Left-Side View

*Field Replaceable Unit

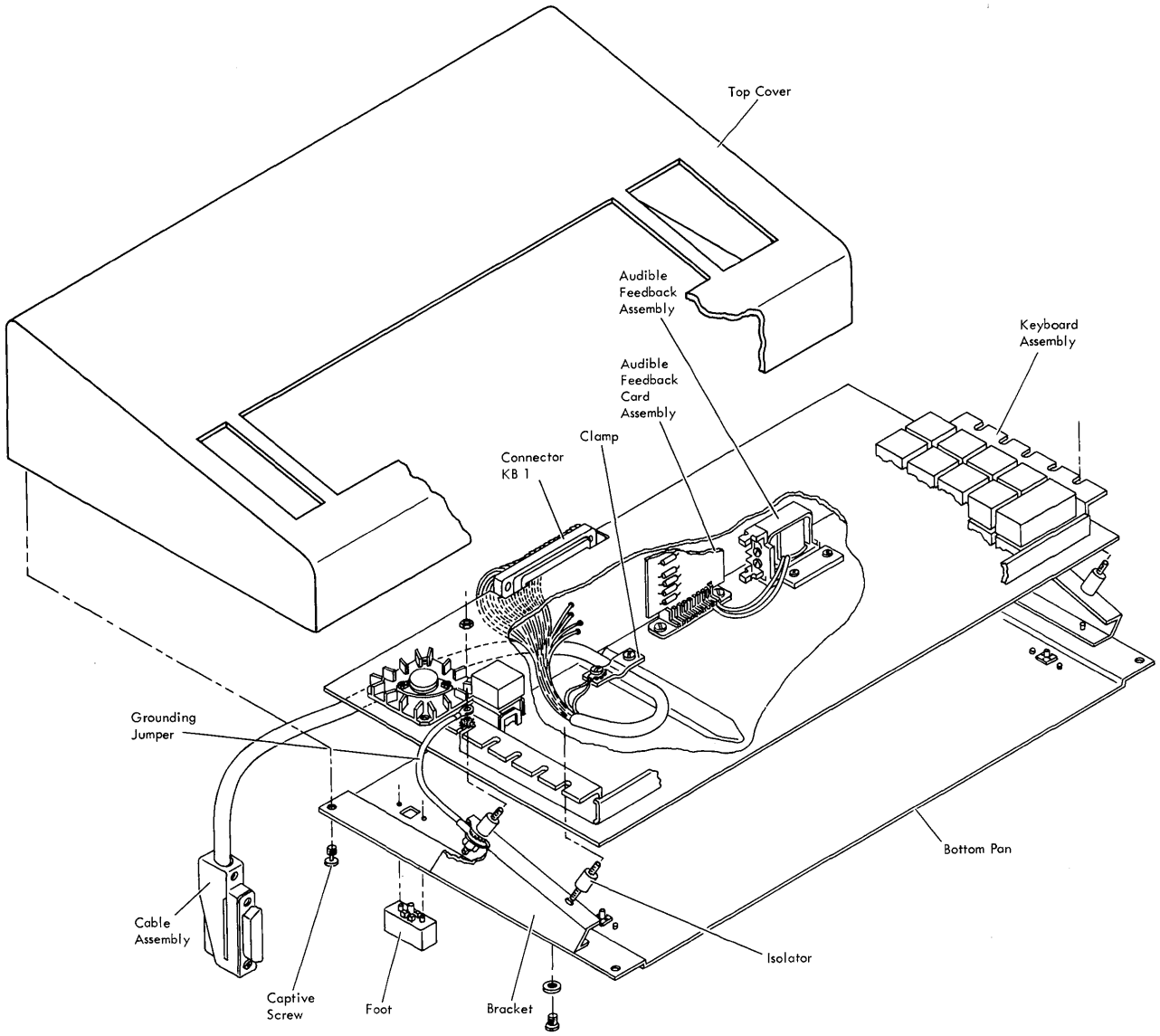
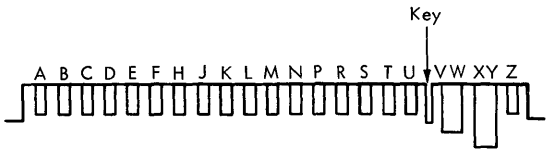


Diagram 7-7. Keyboard Locations

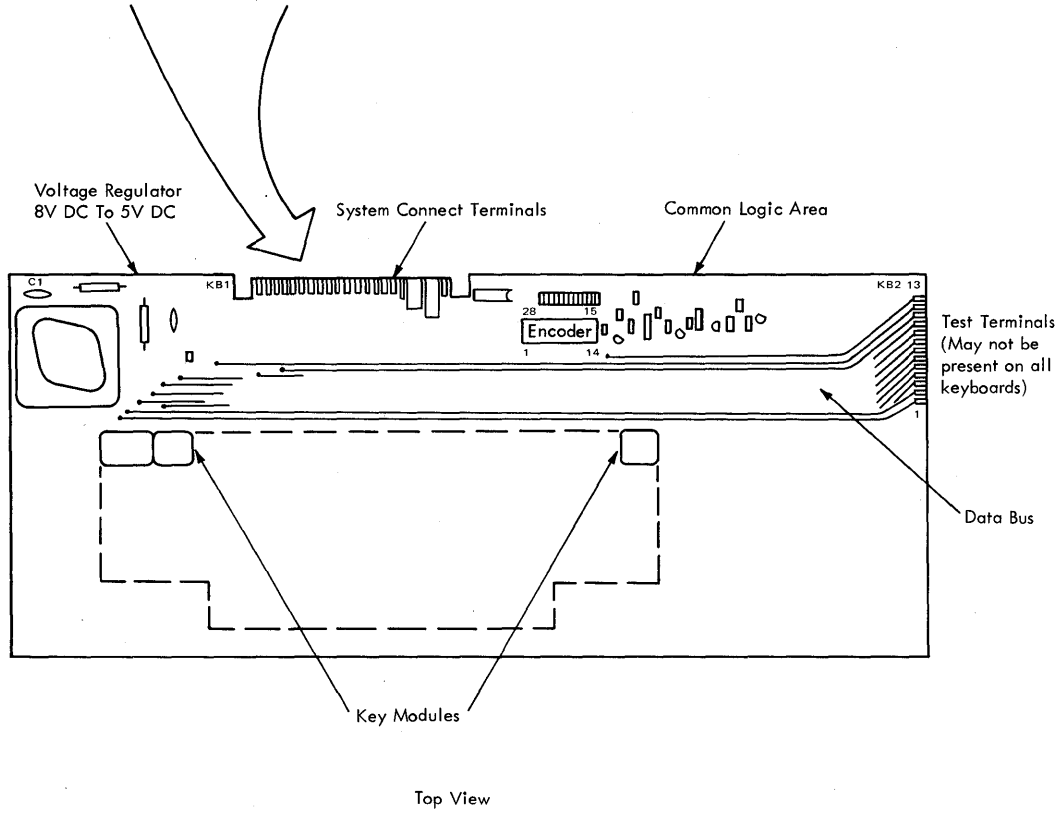
Blowup of KB1



KB1 Signals

Pin	Signal
A	Spare
B	Spare
C	Reset
D	Bit 0
E	Bit 1
F	Bit 2
H	Bit 3
J	Bit 4
K	Bit 5
L	Bit 6
M	Bit 7

Pin	Signal
N	Parity Bit
P	Flip-Flop Enable
R	Strobe
S	Numeric Shift
T	Alpha Shift
U	Up Shift
V	+8V DC
W	+8V DC
X	Gnd (0V DC)
Y	Gnd (0V DC)
Z	12V DC



Top View

Diagram 7-8. Keyboard Pin and Terminal Locations

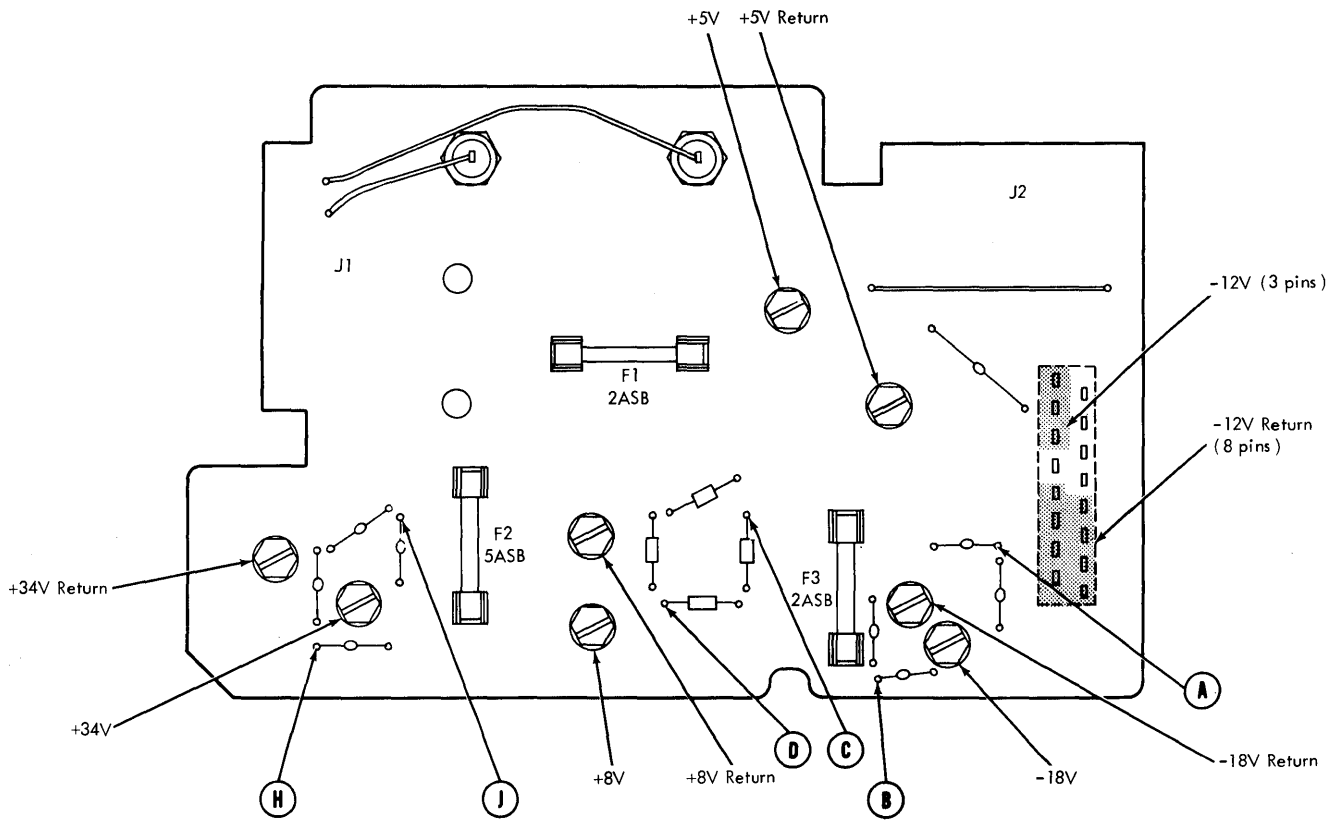


Diagram 7-9. Low-Voltage Printed Circuit Board

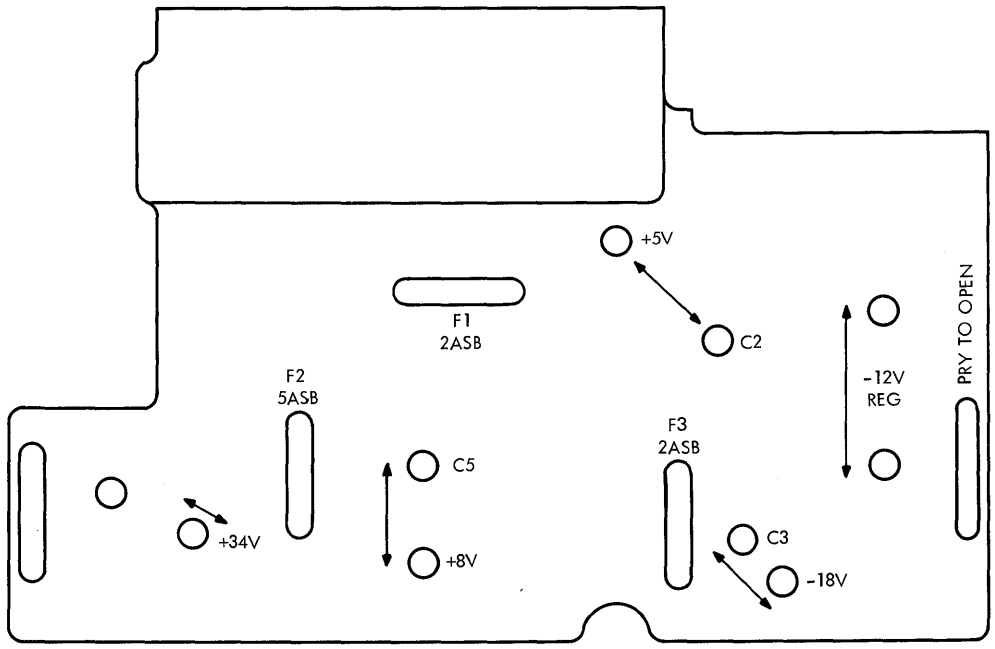


Diagram 7-10. Low-Voltage Printed Circuit Board Shield

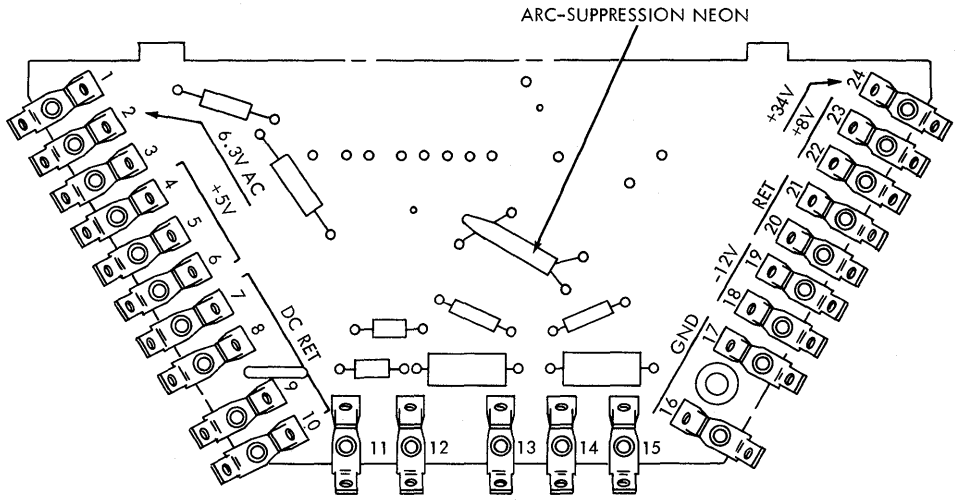


Diagram 7-11. Model 2 Voltage Distribution Board

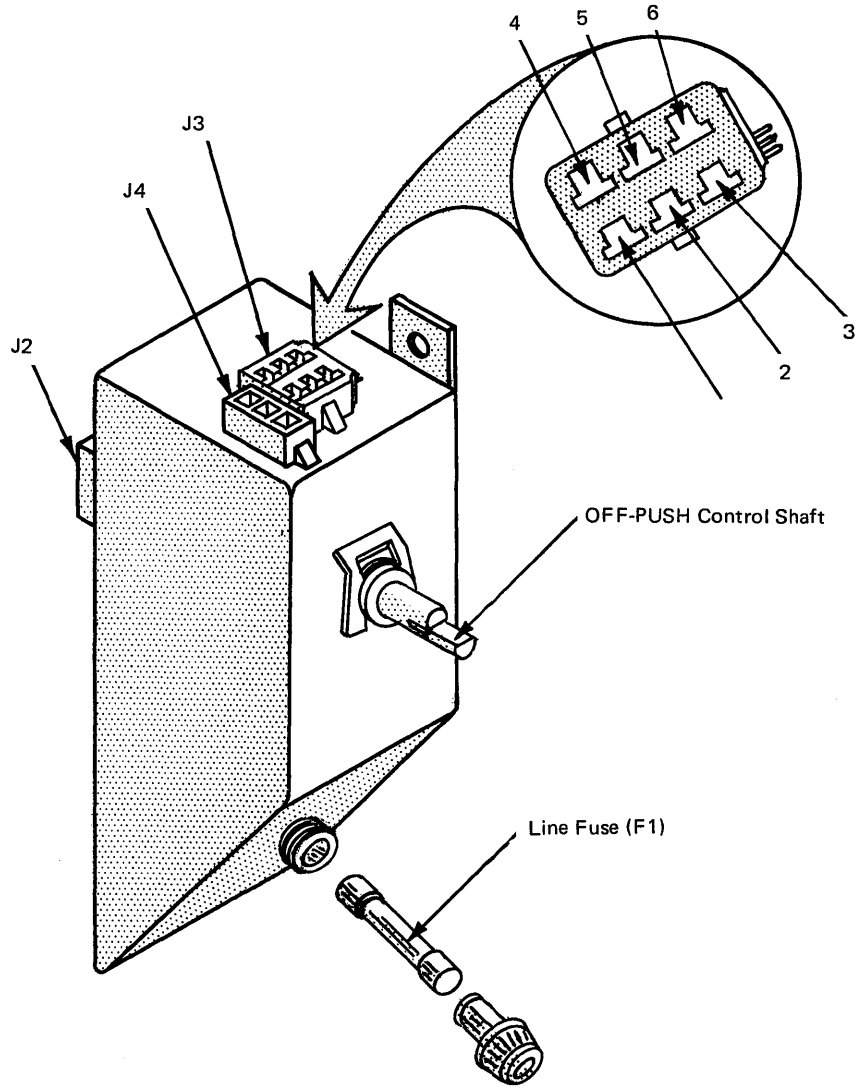


Diagram 7-12. Model 1 Prime Power Box

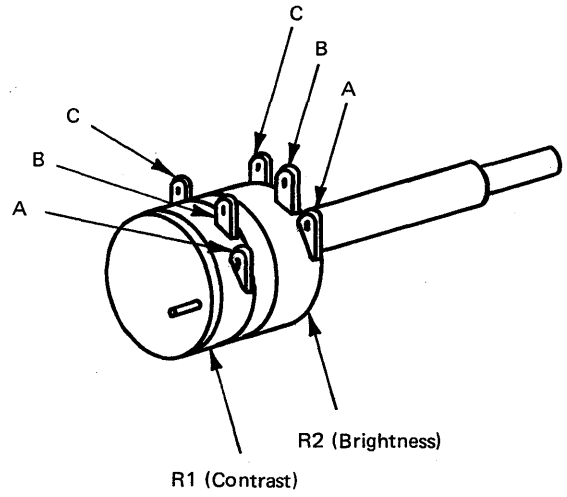


Diagram 7-13. Brightness and Contrast Control Terminals

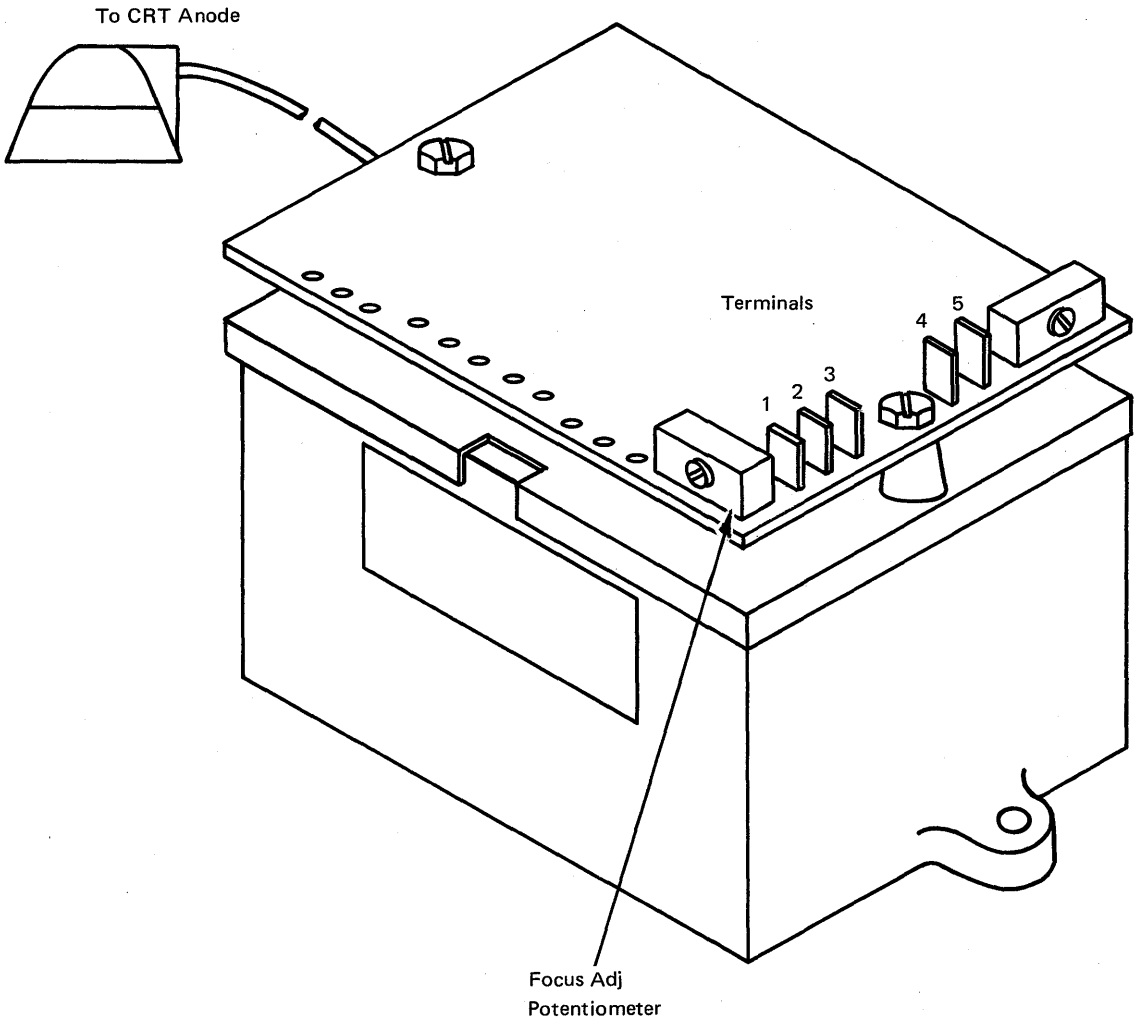
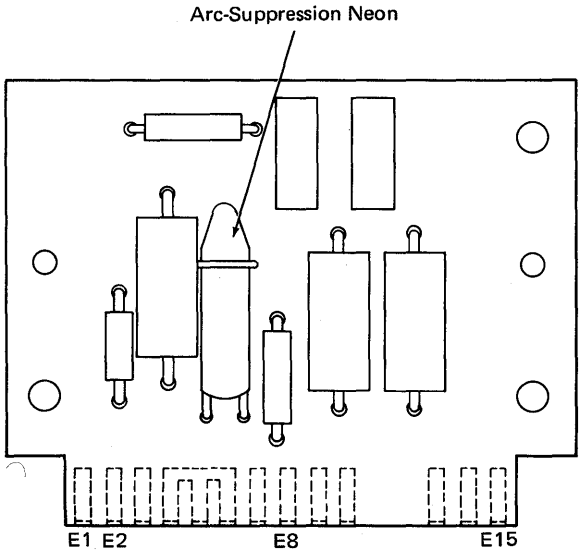


Diagram 7-14. High-Voltage Power Supply



Note: Connector pins on reverse side of board.

Diagram 7-15. Model 1 Arc-Suppression Board

8.1 GENERAL

Carefully inspect the display station for any obvious damage as soon as it arrives on site. Check that all items listed in the bills of material are received. It is extremely important that power-source line voltage is correct and that primary power connections in the display station are correct before power is applied to the unit. Do not turn power on until the following checks are performed.

8.2 INSTALLATION

Check with the customer, and place display station in the location designated by him. If it is necessary to move a display station, observe good safety procedures.

DANGER
The 3277 Model 2 Display Station weighs about 90 pounds. Two men should be used to move this unit. Separate the upper chassis from the lower chassis before trying to move the Model 2 display station alone. (See paragraph 5.3.2.8, steps 1–7, to separate the two chassis.)

8.2.1 Line Voltage Check

Domestic (USA) models use 115V ac (±10%), 60-Hz, single-phase line voltage. No internal adjustments are required for domestic display stations.

World Trade models use 100, 110, 123.5, 220, 235V ac, 50-Hz, single-phase, or 100V ac, 60-Hz single-phase line voltage. Check that the connections on the ferro terminal block, TB1, agree with the line voltage provided. Diagram 8-1 shows the 50-Hz TB1.

8.2.2 Feature Installation

Connect all features supplied with the display station. Proceed to paragraph 8.2.3 if no features are to be attached.

8.2.2.1 Keyboard Installation

1. Remove front cover.
2. Plug keyboard cable connector into keyboard jack. Diagrams 7-1 and 7-4 show location of cable jacks for Model 1 and Model 2 display stations, respectively.
3. Secure cable by attaching Model 1 nylon cable clamp or by hooking Model 2 I/O cable retainer. (Model 2 cable

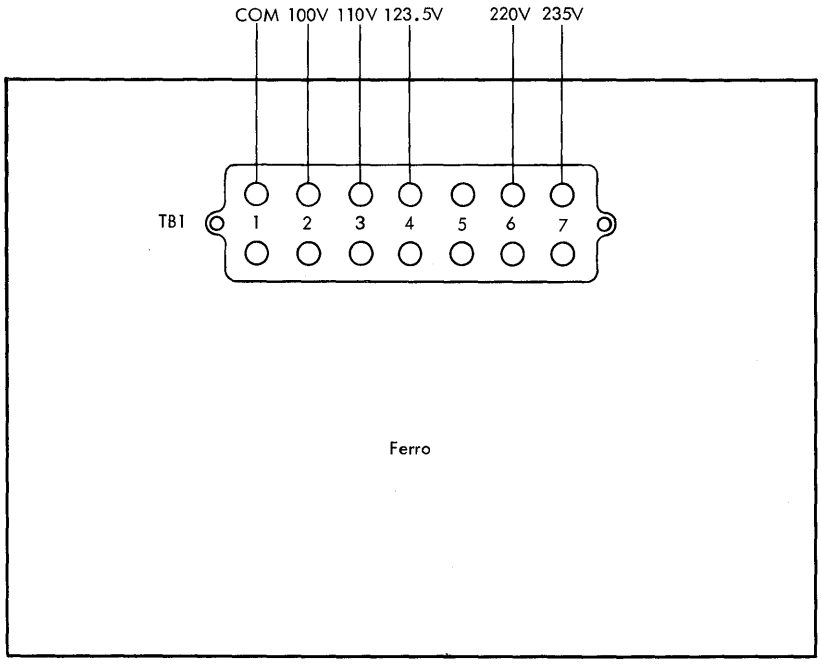


Diagram 8-1. 50-Hz Ferro TB-1

retainer may have to be repositioned to maintain a snug connector fit.)
4. Connect cable ground strap to the chassis.

8.2.2.2 Selector Light-Pen Installation

1. Place pen holder next to display station.
2. Insert pen in pen holder.

8.2.2.3 Operator Identification Card Reader Installation

1. Remove front cover.
2. Plug reader cable connector into reader jack. (Diagrams 7-1 and 7-4 show cable socket locations for Model 1 and Model 2 display stations, respectively.)
3. Secure cable by attaching nylon cable clamp (Model 1) or by hooking the cable retainer (Model 2).
4. Connect cable ground strap to chassis.

8.2.3 Prepower-On Checks

1. Remove front cover if it was not previously removed to install feature(s).
2. Plug line cord into display station chassis jack.
3. Open side covers.
4. Inspect for loose cords in logic gate and for loose cable connections.

8.2.4 Power-On Checks

1. Plug line cord into power source, and pull out OFF-PUSH switch.
2. Perform the display station operational test described in paragraph 5.1.2, beginning at step 3.
3. Refer to Section 3 (Symptom Index) if a malfunction occurs during power-on check procedure.
4. Refer to paragraph 5.2 if any adjustments are required during power-on check.
5. Connect control unit signal cable.
6. Replace all covers previously removed except front cover.

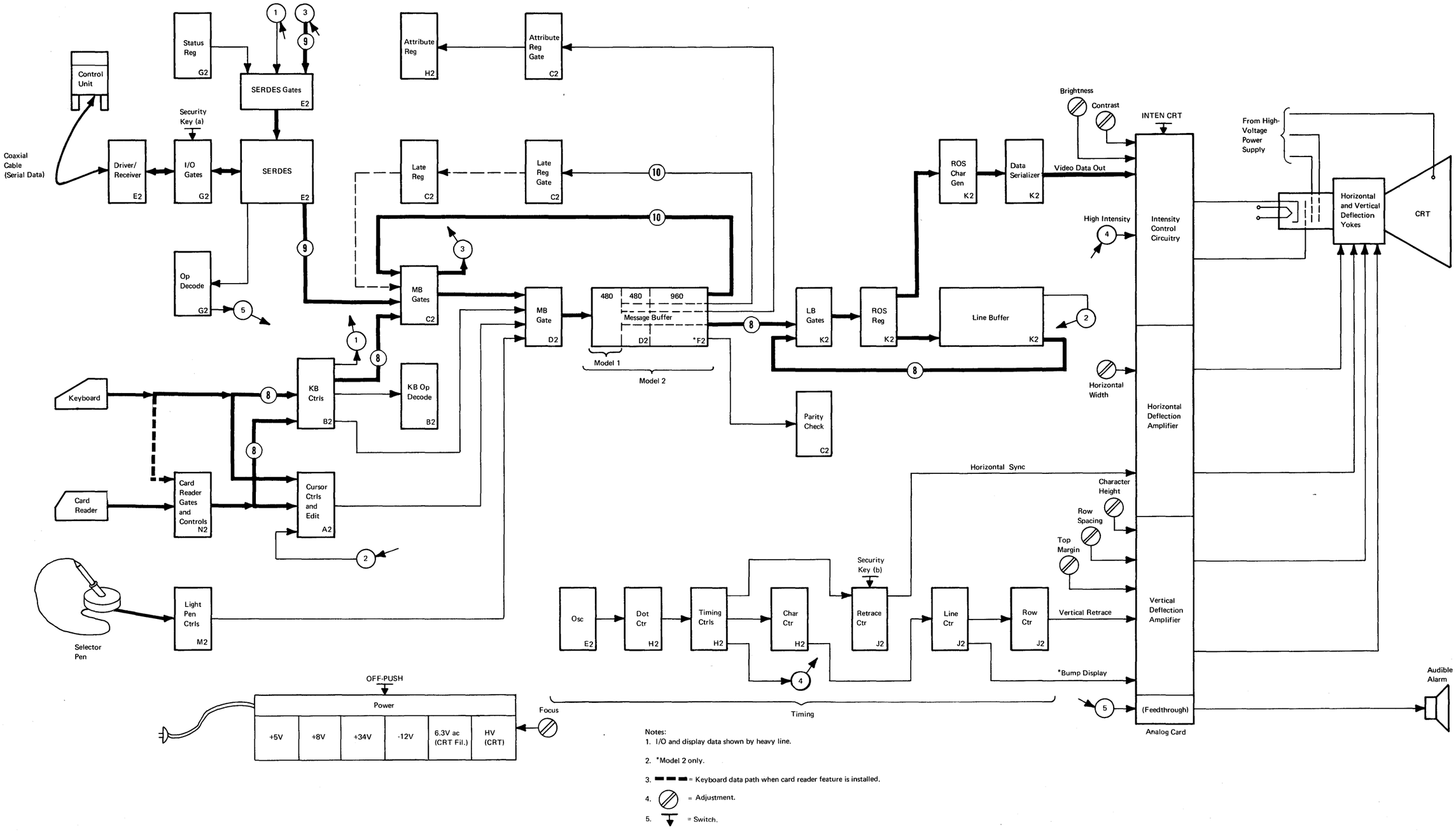
8.2.5 Hexadecimal Address Label

1. On front cover, locate a point 3 inches up from bottom edge and 1/2 inch in from left edge.
2. Attach label to cover, parallel to bottom edge, with lower-left corner of label on the point located in step 1.
3. Replace front cover.

8.2.6 Installation Report Form

Kingston Field Engineering Technical Operations provides an FE Installation Report form with all 3270 system units. When installation is completed, fill out the form completely and return it to the address shown below.

IBM Corporation
Attention:
Dept. 020/Bldg. 057-1
Neighborhood Road
Kingston, New York 12401



Notes:
1. I/O and display data shown by heavy line.
2. *Model 2 only.
3. ▬ ▬ ▬ = Keyboard data path when card reader feature is installed.
4. ⊘ = Adjustment.
5. ⊤ = Switch.

Diagram 6-7. Data Flow

3277 Display Station Models 1 and 2
Troubleshooting Guide

Order No. SY27-2314-0

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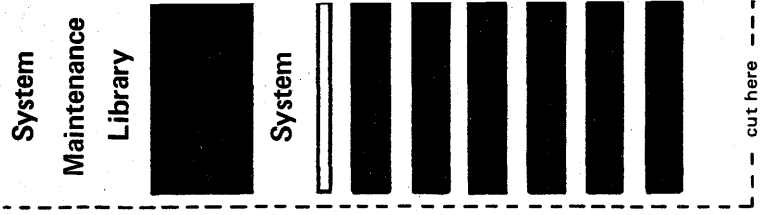

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