TEK SERVICE MANUAL

Part No. 070-1933-01
Product Group 12

4662
INTERACTIVE DIGITAL PLOTTER

Tektronix®
COMMITTED TO EXCELLENCE

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Please Check for CHANGE INFORMATION at the Rear of This Manual

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WARNING

THE FOLLOWING SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID PERSONAL INJURY, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

MANUAL REVISION STATUS

PRODUCT: 4662 Interactive Digital Plotter

This manual supports the following versions of this product: Serial Numbers B010100 and up.

REV DATE	DESCRIPTION
JAN 1977	Original Issue
DEC 1981	Updated to 070-1933-01 to reflect rewrite (includes Option 31 support).
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SEP 1982	Added: page 2-32.
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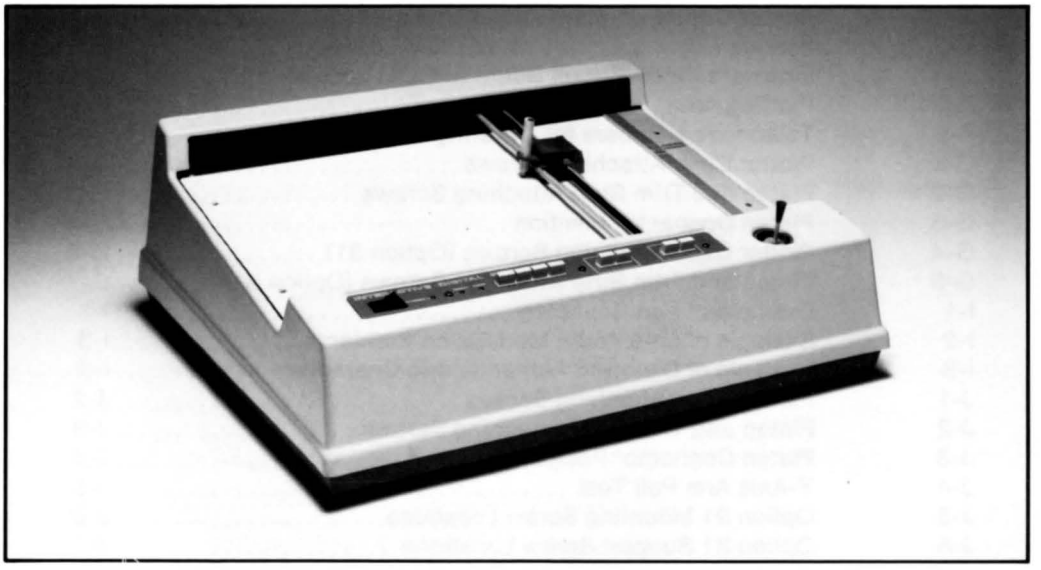
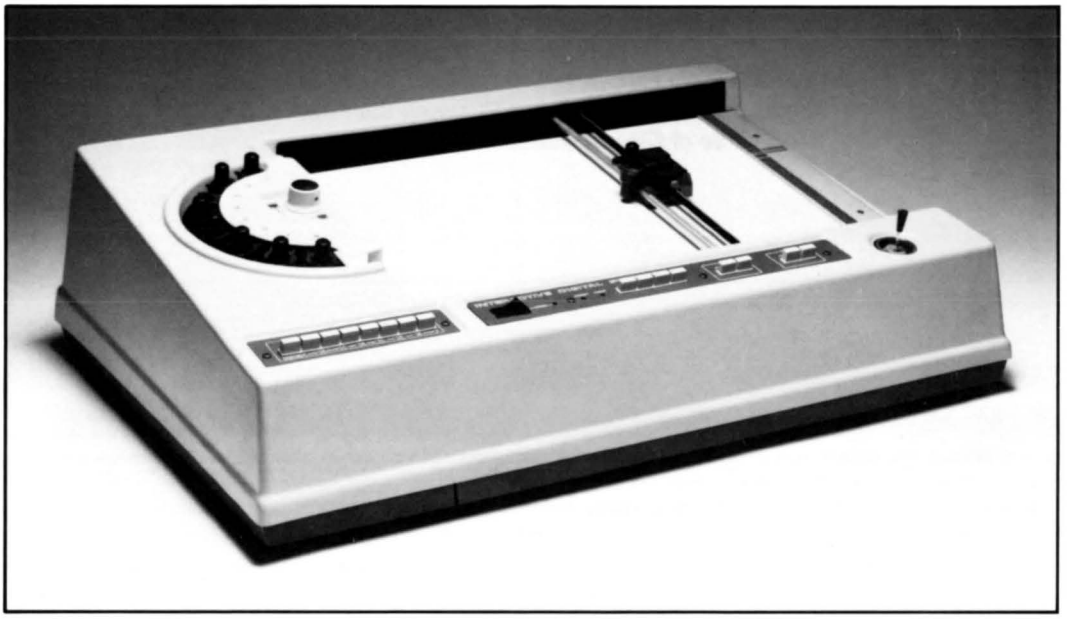


A. Standard 4662 Plotter.



B. 4662 Plotter Equipped with Option 31.

4165-1

Figure 1-1. 4662 Interactive Digital Plotter.

Section 1

INTRODUCTION

GENERAL DESCRIPTION

The 4662 Interactive Digital Plotter (shown in Figure 1-1) is an intelligent, B-sized flatbed plotter. Using an electrostatic paper hold-down system, the 4662 can draw or print on paper (or transparent film) that is as large as 11 x 17 inches (279 x 432 mm). The plotter is equipped with both RS-232-C and GPIB interfaces and is compatible with TEKTRONIX PLOT 10 and PLOT 50 Graphic Software. This means that the plotter can be used with controlling devices ranging from simple monochrome terminals to sophisticated computers.

Since the plotter is digital, it converts external commands from a host into appropriate vector movements. A 6800 microprocessor oversees this conversion. AC motors control pen carriage movement in the X- and Y-axis directions through a system of cables and pulleys. To optimize data transfer from the host computer, data input to the plotter is internally buffered (the amount of buffer is 2K bytes and is expandable to 8K bytes with Option 20).

The 4662 also has an internal character generator that produces the full uppercase and lowercase ASCII character set as well as variations for several foreign languages and graphic symbols. The plotter has the ability to scale characters (to print them with any width or height) or to rotate them.

The plotter also has the capability to digitize the location of the pen. That is, the plotter can convert a drawing, a picture, or a graph into a computer-usable language. This function and the built-in joystick, which moves the pen, makes the plotter an efficient digitizer.

The 4662 can also be equipped with the multiple-pen option, Option 31. With this option, either the operator or the host can choose one of eight different pens (or colors) to produce elaborate multi-colored plots.

SERVICE DOCUMENTATION

The service documentation for the 4662 Interactive Digital Plotter consists of three manuals.

- The 4662 Service Manual (this manual) contains:
  - preventive maintenance and adjustment procedures
  - assembly/disassembly procedures for replacing parts
  - interconnecting cable diagrams
  - circuit desriptions
  - signal descriptions
  - electrical and mechanical parts lists
  - schematics
  - strapping tables
  - instrument and option installation procedures
  - diagrams of circuit board component locations and troubleshooting procedures.
- The 4662 Diagnostic Test Fixture Instruction Manual (070-2564-00) describes how the Diagnostic Test Fixture (067-0831-00 and 067-0831-01) is used with the System Test Fixture (067-0746-00) to test and troubleshoot the 4662 Interactive Digital Plotter.
- The 4662 Test Tape Operator's Manual (070-2366-01) describes how to use the 4662 Test Tape package (067-0829-00 and 067-0829-01) in testing the 4662 Plotter operation.

4662 OPTIONS

The following options are available for the 4662 Plotter.

OPTION 01 GPIB INTERFACE CABLE

This option deletes the standard RS-232-C cable and adds the GPIB cable. This option does not affect the interfaces; both GPIB and RS-232-C interface capabilities are provided in the 4662 Plotter.

OPTION 20 8K BYTE INPUT BUFFER

This option increases the input storage capacity of the plotter from 2K to 8K bytes. This allows more information to be sent to the plotter without overflowing the input data buffer.

OPTION 31 MULTIPLE PENS

This option adds operator/host-controlled pen changing capability to the 4662 Plotter. Felt-tip, plastic hard-nib, or wet-ink pens in several colors can be interchanged to produce elaborate plots. Option 31, which is retro-fittable to all existing 4662 Plotters, also adds these features:

- DC1/DC3 ASCII character flagging to control the data transmission from the host.
- Pause and Resume capability to interrupt the plotting process.
- Host controlled programmable plotting speeds.

OPTION 48 220 VOLT OPERATION

This option internally rewires the plotter's power supply to allow it to operate on 220 volt, 50 Hz line voltages.

Section 2

PREVENTIVE MAINTENANCE AND ADJUSTMENT

INTRODUCTION

Because the plotter is an electromechanical device, periodic care and adjustment is necessary for proper performance. The period between adjustments depends on the amount of use that the plotter receives. (Semi-annual or annual adjustments may be required.) It is recommended, however, that the two pen drive cables be adjusted after at least every 500 hours of plotter operation.

Plotter adjustment should be preceded by a thorough cleaning and inspection for loose, damaged, or worn parts. It is especially important to check the entire length of the two pen drive cables for broken strands, worn spots, etc.

After inspecting and cleaning the plotter, a 30-minute warmup period must precede the adjustment procedure, which should be performed in a 68 to 86° F (+ 20 to + 30° C) environment.

PREVENTIVE MAINTENANCE

GENERAL

Preventive maintenance consists of cleaning the case and platen, visual inspection, and lubrication. Performed on a regular basis, preventive maintenance may improve the reliability of this instrument. The frequency and severity of the plotter's use will determine the required maintenance interval. Table 2-1 shows a recommended preventive maintenance schedule. It is, however, recommended that the plotter's two pen drive cables be checked and adjusted at least every 500 hours of plotter operation. After each cable check, you may want to perform preventive maintenance checks and adjustments on the plotter. A convenient time to perform preventive maintenance is preceding the adjustments.

Procedures for each service task follow in this section.

Table 2-1

PREVENTIVE MAINTENANCE SCHEDULE

Interval			
500 hrs	**1 yr**	**4 to 5 yrs**	**Service Procedure (Task)**
X[a]			Clean the platen and case
X[a]			Replace pen caps (Option 31 only)
	X		Lubricate the X-axis shafts, pen solenoid shaft, and Option 31 mechanism (if installed)
X[a]			Pen drive cable checks (check for both wear and tension)
	X		Perform adjustment procedure
		X	Option 31 major overhaul (see Appendix H)

[a]More often if needed and/or each time the plotter is serviced.

A complete checklist follows of all preventive maintenance tasks for the standard or Option 31 equipped plotter.

Standard Plotter:

- ☐ Cleaning platen and case
- ☐ Lubricate X-axis shafts and pen solenoid shafts
- ☐ Y-axis arm pull test
- ☐ Pen drive cable checks for wear
- ☐ Pen carriage slide tension adjustment
- ☐ X-axis pen drive cable tension adjustment
- ☐ Y-axis pen drive cable tension adjustment
- ☐ X-axis symmetry control
- ☐ Y-axis symmetry control
- ☐ Joystick electrical center adjustment
- ☐ Pen actuator adjustment
- ☐ Pen pressure adjustment
- ☐ Aligning the X-axis, platen, and orthogonality
- ☐ Limit switch adjustment

Option 31 Equipped Plotter

Preventive maintenance tasks for the Option 31 Equipped Plotter consist of the same preventive maintenance tasks for the standard plotter plus the following:

- ☐ Lubricate
- ☐ Set lower bushing clearance
- ☐ Set knob clearance
- ☐ Motor belt tension
- ☐ Rotary pen turret height adjustment
- ☐ Pen sense switch adjustment
- ☐ Set rotary pen turret exchange point
- ☐ Adjust X-axis pen exchange position
- ☐ Replace pen caps
- ☐ Pen cap alignment

CLEANING THE PLATEN AND CASE

Occasional cleaning preserves the appearance of the plotter. The need for cleaning varies with the plotter's environment. Use the following procedure to clean the plotter:

1. **Turn** the plotter's power on and allow the plotter to initialize (approximately 5 to 10 seconds).
2. **Press** and lock down the LOAD switch. This causes the pen carriage to move to the upper right corner and out of the way.
3. **Turn** off the power to the plotter and unplug the line cord.
4. **Remove** any paper present on the platen.

CAUTION

Abrasive and strong chemical cleaners can scratch or remove layers of the thin insulating film on the platen's electrostatic surface. You must also avoid conductive cleaners. These include products containing ammonia, oils, liniments, or scents that leave an electrically conductive film if not entirely removed. The film's conductivity may cause the electrostatic paper hold-down to fail. You can use isopropyl alcohol to remove this film, provided you remove the isopropyl film with a cloth moistened with water.

5. **Clean** the platen with isopropyl alcohol or an alcohol pad (TEKTRONIX P/N 006-2398-00).

NOTE

Part number 006-2398-00 is for one pad only. A box of 50 can be ordered by using a quantity of 50.

6. **Wipe** the platen with a soft cloth moistened with water to remove the thin alcohol residue on the platen surface (from Step 5). Turn the cloth frequently to prevent smearing the residue.
7. **Dry** with a clean, dry cloth.

CAUTION

The four rear panel switches are very sensitive to solvents. These switches should not be put through any cleaning process where water or solvents (or their vapor) will reach the interior of the switch.

8. **Clean** the plotter case with a cloth lightly dampened with a mild detergent solution.
9. **Connect** the power cord to the power source. The plotter may again be operated.

LUBRICATION INFORMATION

The only lubrication required in the standard 4662 Plotter is of the two X-axis shafts, the ends of the pen actuator bar, the pivot points on the pen holder, and the pen solenoid shaft. These should be lubricated at a minimumn of once yearly. Lubrication must occur more often if the lubricant begins to dry or solidify, or if it becomes contaminated with dust and foreign particles.

The pen drive cable pulleys turn on bearings that are permanently lubricated and require no periodic lubrication. In addition, the Y-axis shafts are supported, stressed, and coated such that lubrication is not necessary. The surfaces of these shafts should, however, be kept clean.

The two motors and pen solenoid do not require any lubrication.

Option 31 equipped plotters require the same lubrication as standard plotters, plus one component, which is also lubricated once yearly (see Lubrication Procedure). However, at the 4- to 5- year major overhaul, lightly grease the following locations as the Option 31 mechanism is rebuilt and installed (refer to Figure 4, *Replaceable Mechanical Parts*):

- Spring Guide - on the two surfaces that mate together.
- Shaft - in the middle of the pen stable bracket.
- Pen Stable Bracket - run Q-tip with grease through brass bushing.
- Optic Interrupter Bracket - around shaft.
- Optic Interrupter Bracket Bushing - top.
- Cam Shaft - both pins, about one inch either side of cam on shaft.

NOTE

Be sure there is no grease on the point at which the cam and the pen capping plate meet. Also apply no grease to the black portion of the cam.

- Tall metal post in capping plate - on post, sides and top.

Lubrication Procedure

1. **Remove** the platen and plotter case. Refer to Appendix G for the procedure.
2. **Clean** the old lubricant and contaminants from the two X-axis shafts with paper tissue or cloth. These are the two shafts (approximately 0.5 inch in diameter) along which the Y-axis shafts/pen carriage assembly slide horizontally. One of these shafts is near the front of the plotter and the other is just below the rear trim strip (see Figure 2-1A).
3. **Clean** the old lubricant from the length of the Pen Solenoid Shaft in a similar manner to Step 2 (see Figure 2-1A).
4. **Lubricate** the full length of the three shafts (the two X-axis shafts and the Pen Solenoid Shaft) lightly but evenly with Zeniplex ® #2 or the equivalent (TEKTRONIX Part Number 006-3684-01).
5. **Lubricate** the ends of the Pen Actuator Bar (see Figure 2-1A) with the same lubricant.
6. **Lubricate** the two pivot points on the pen holder (see Figure 2-1A).
7. **Lubricate** the lower tip of the main rotary pen turret shaft where it contacts the ground clip if the plotter is equipped with Option 31 (Multiple Pens) (see Figure 2-1B).
8. **Reassemble** the plotter case and platen unless the plotter is to undergo further cable checks and instrument calibration (procedures following). Refer to Appendix G for the reassembly procedure.

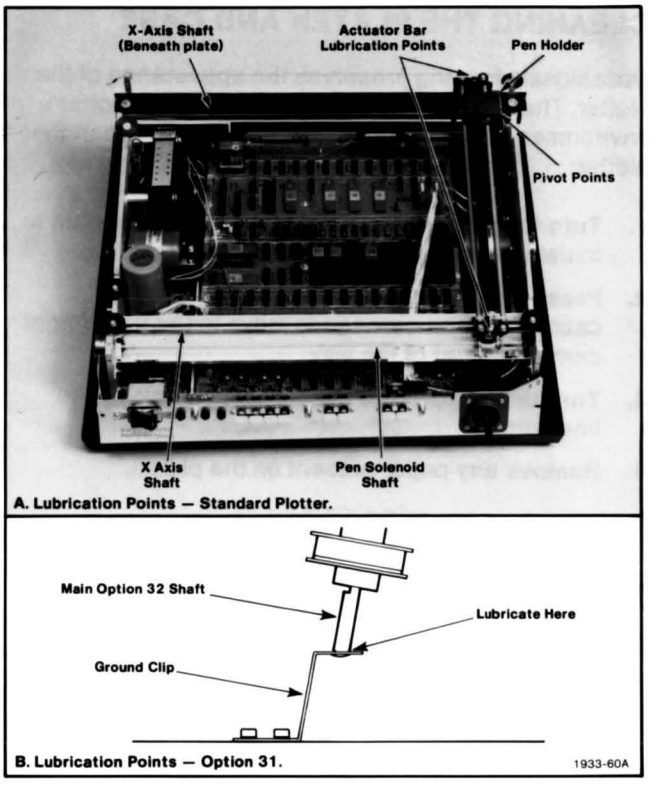


Figure 2-1. Lubrication Points.

ADJUSTMENT PROCEDURES

INTRODUCTION

A thorough cleaning, inspection for loose, damaged, or worn parts, and lubrication should precede any adjustments. It is especially important to check the two pen drive cables for broken strands, worn spots, etc., at this time. After a 30-minute warm-up period, perform the adjustment procedures in a + 68 to + 86° F (+ 20 to + 30° C) environment.

PRELIMINARY PROCEDURE

1. **Remove** the plotter's platen and case (refer to Appendix G for instructions). It is not necessary to use the digitizing crosshair and the two pieces of paper with the dot taped to the platen in that procedure since the platen will be aligned in the following adjustment procedure.

WARNING

Potential lethal voltages exist within the plotter. To avoid injury disconnect the line cord.

2. **Ensure** that the plotter's power is off and the line cord is disconnected.

EQUIPMENT REQUIRED

Allen Wrenches
.050" Standard Allen Wrench Driver
Phillips Screwdriver (or Pozidriv ®)
3/16" Nutdriver
Push-Pull Scale (fish-weighing scale)(003-0762-00)
¼" Open-End Wrench
Needle-Nose Pliers
Pen Turret Height Gauge (003-1238-00)
.004" Feeler Gauge (003-1291-00)
.040" Feeler Gauge
Digitizing Reticle
  214-2409-01 for standard 4662 Plotter
  119-1432-01 for Option 31 equipped plotters
Calibration Overlay (334-4717-00)
IC Puller
Thread Adhesive (such as Loctite ® #222, 006-2517-00)
Front Panel Extender Cable (198-3848-00) Platen Shims
  .005" (361-0855-00)
  .010" (361-0857-00)
  .020" (361-0856-00)
Lubricant (such as Zeniplex ® #2)(006-3684-01)
Pen Caps (Option 31 only)(200-2630-00)
Pen Cap Alignment Tool (003-1237-00)

Y-AXIS ARM PULL TEST

NOTE

The force required to move the Y-axis arm back and forth across the platen may indicate the condition of several components. The force required may indicate the effectiveness of the lubrication, drive motors, bearings, cable condition, pulleys, and the linear bearing.

1. **Hook** the push-pull scale (or fish-weighing scale) over the Pen Actuator Bar as shown in Figure 2-2. Use the push-pull scale to pull the Y-axis arm back and forth across the platen. If the force required to move the Y-axis arm in either direction is greater than 24 ounces (1.5 lbs or 681 grams), it may be necessary to lubricate the X-axis shafts and the pen solenoid shaft and/or to replace some of the components listed in the preceding note.

PEN DRIVE CABLE CHECKS

The plotter uses a system of two cables, each driven by a separate motor, to move the pen carriage. Although the cables are coated with plastic and made of multiple strands of steel wire, they may eventually become worn and break, especially when the plotter is used for a long time without adjustment. Periodically (at least every 500 hours), the entire length of the two cables should be checked for broken wire strands, kinks, worn spots, or other failures. If any of these conditions are found, replace the cable (the procedure is found in the Assembly/Dissassembly procedures in Section 3). Then, adjust the cable tension. This procedure is covered in the adjustment procedures later in this section.

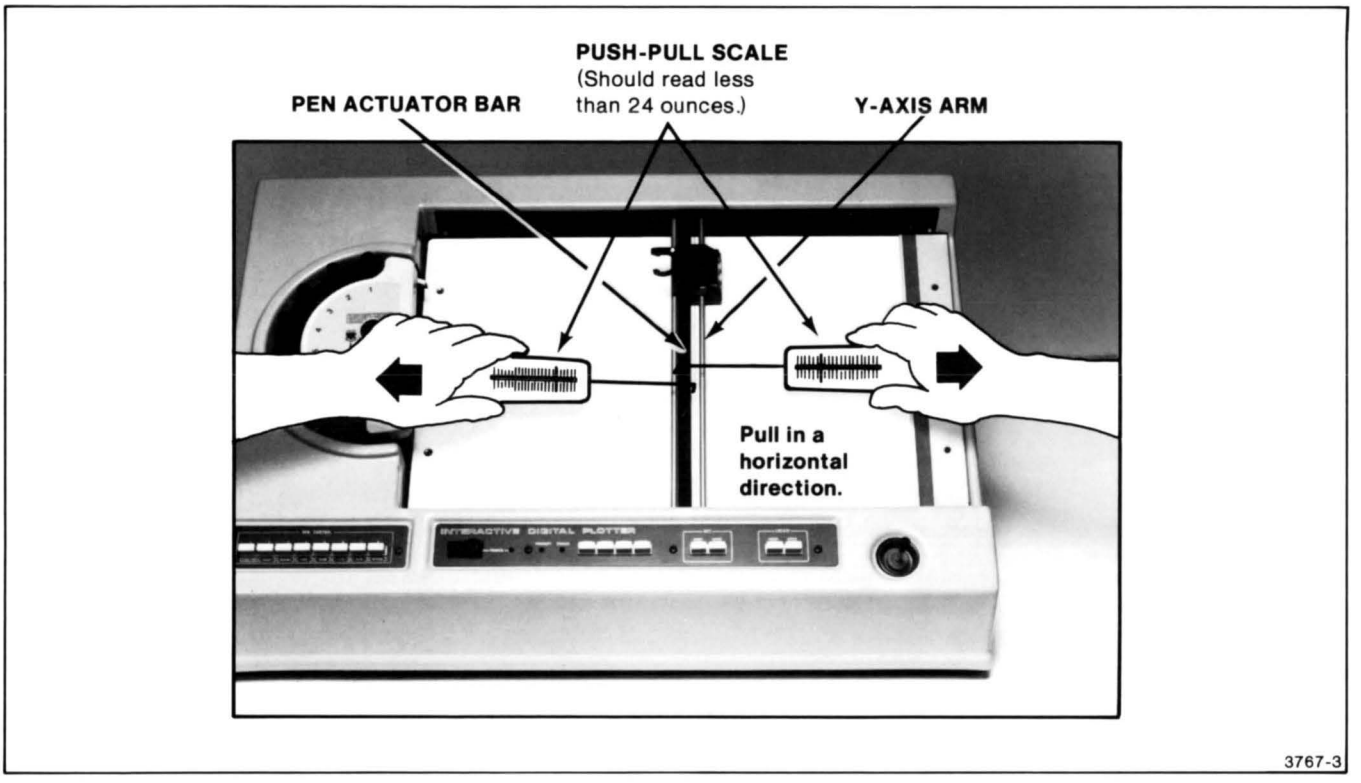


Figure 2-2. Y-Axis Arm Pull Test.

PEN CARRIAGE SLIDE TENSION ADJUSTMENT

The Pen Carriage Slide Tension Adjustment removes pen carriage play around the Y-axis shafts. There are three rollers inside the pen carriage that grip the Y-axis arm. One of these rollers is used for adjusting the tension of the pen carriage. When you grip the pen carriage and gently try to rotate it clockwise or counterclockwise, if the pen carriage has **any** noticeable movement or play around the Y-axis shaft, follow this adjustment procedure.

1. **Loosen** slightly (but do not remove) the 3/16" hex-nut that fastens to the tension adjustment screw shown in Figure 2-3. This nut is on the underside of the pen carriage.
2. **Turn** the tension adjustment screw counterclockwise only until all noticeable pen carriage play around the Y-axis arm is gone. Do not "over-adjust"; the pen carriage should slide freely along the Y-axis arm without binding.
3. **Tighten** the hex-nut on the tension screw to ensure that the tension adjustment does not change. Secure with thread adhesive.

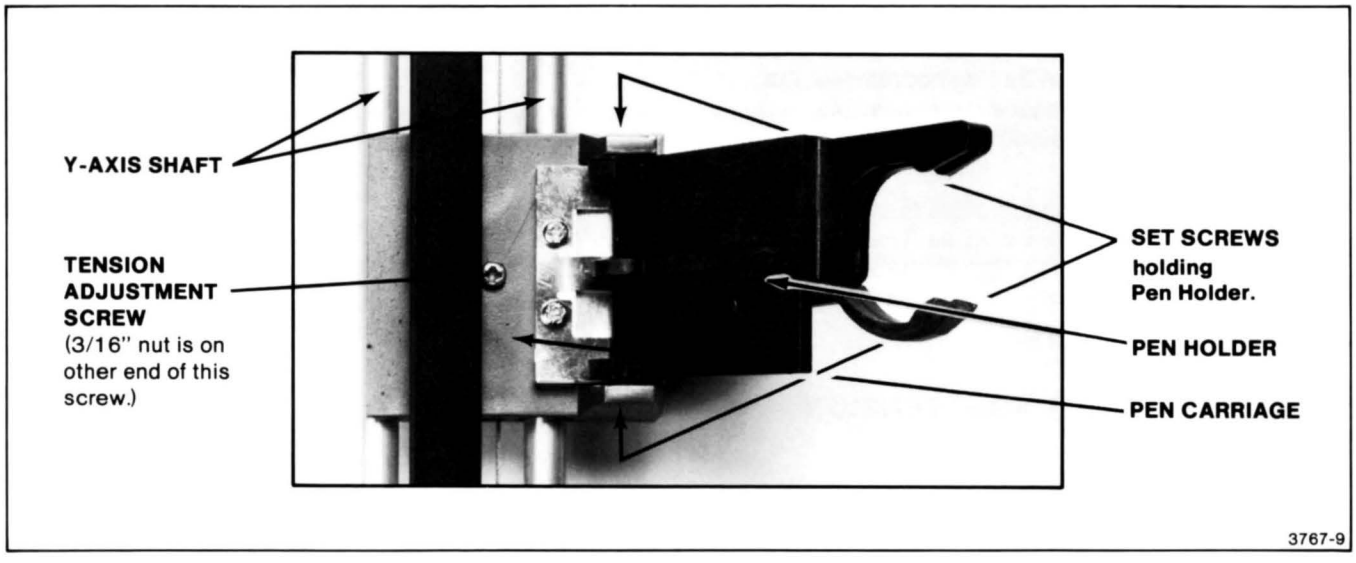


Figure 2-3. Pen Carriage Slide Tension Adjustment.

Y-AXIS PEN DRIVE CABLE TENSION ADJUSTMENT

1. **Check** to see that all of the pen drive cables are in the grooves of the pulleys.
2. **Move** the Y-axis arm all the way to the left.
3. **Attach** the push-pull scale to the looped end of the Y-axis cable (see Figure 2-4). This cable has a smaller diameter than the X-axis cable and its loop is usually located in the left-rear corner as viewed from the front of the plotter. If the cable does not have a loop, simply tie a knot (such as a bowline knot) in the cable to provide a loop.
4. **Pull** a spring tension of five pounds on the Y-axis drive cable and loosen (but do not remove) the securing screw holding the cable near the loop. It is not necessary to touch the other end of the Y-axis cable.
5. **Reduce** the tension on the cable to 2.25 pounds after the securing screw is loose. Then, while maintaining that tension, tighten the securing screw holding the cable.
6. **Remove** the push-pull scale.

X-AXIS PEN DRIVE CABLE TENSION ADJUSTMENT

1. **Move** the Y-axis arm to the right edge of the plotter (as viewed from the front of the plotter).
2. **Loosen** (but do not remove) the hex-socket cap screw (use a 5/64" allen wrench) that holds the X-axis cable to the front end of the Y-axis arm (see Figure 2-5). This screw is accessible by looking under the front panel and moving the Y-axis arm past either end of the Front Panel circuit board (for example, just to the left of the joystick).
3. **Feed** the looped end of the X-axis cable between the top portion of the right side frame and the trim strip so that you can obtain a straight pull (see Figure 2-6).
4. **Attach** a push-pull scale to the looped end of the X-axis cable (see Figure 2-6). This cable is larger in diameter than the Y-axis cable tensioned earlier and is attached to the rear end of the Y-axis arm. If the cable does not have a loop, simply tie a knot (such as a bowline knot) in the cable to provide a loop.
5. **Pull** a tension of eight pounds on the X-axis pen drive cable and loosen (but do not remove) the securing screw holding the end of the cable **with the loop.** Do not touch the nearby securing screw holding the other end of the X-axis cable that does not have a loop.
6. **Reduce** the tension on the cable to 5.25 pounds after the securing screw is loose. Then, while maintaining that tension, tighten the securing screw holding the cable.
7. **Remove** the scale and return the looped end of the X-axis cable to its normal (or original) position so that it does not interfere with the pen carriage/Y-axis arm movement.
8. **Move** the front of the Y-axis arm so that it is parallel to the plotter's sides (estimate this setting; it will be corrected later by the orthogonality adjustment).
9. **Ensure** that the X-axis cable passes between the washer on the cable securing screw and the Y-axis arm end casting (see Figure 2-5). Then, lightly tighten the cable securing screw. This screw will be loosened again in a later step.

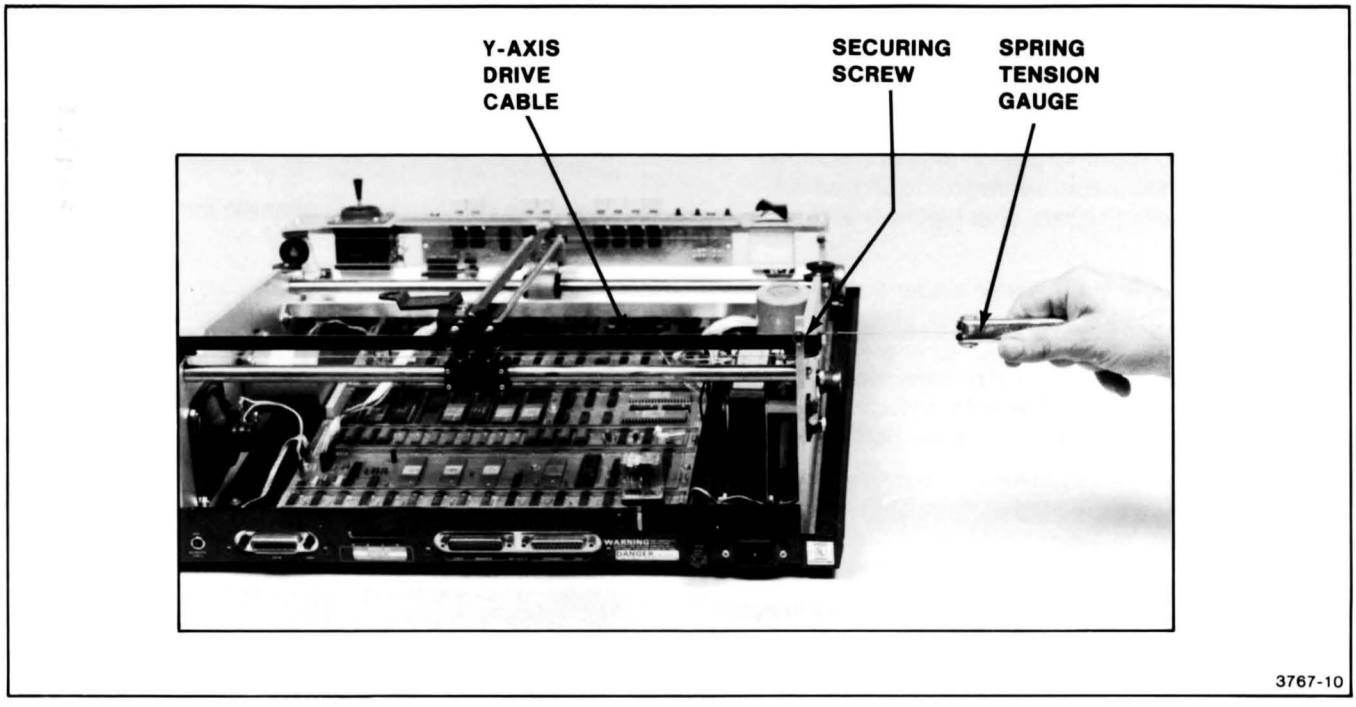


Figure 2-4. Y-Axis Pen Drive Cable Tension Adjustment.

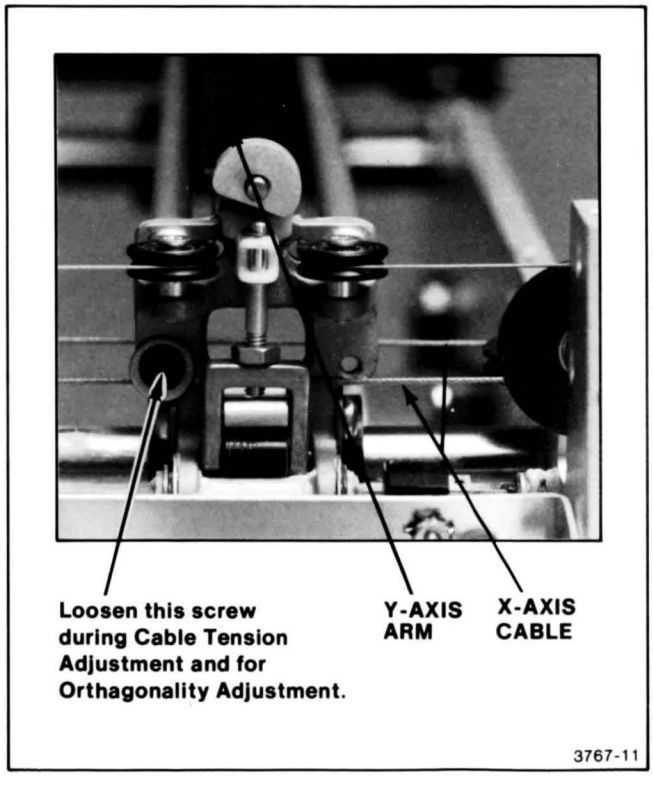


Figure 2-5. X-Axis Securing Screw.

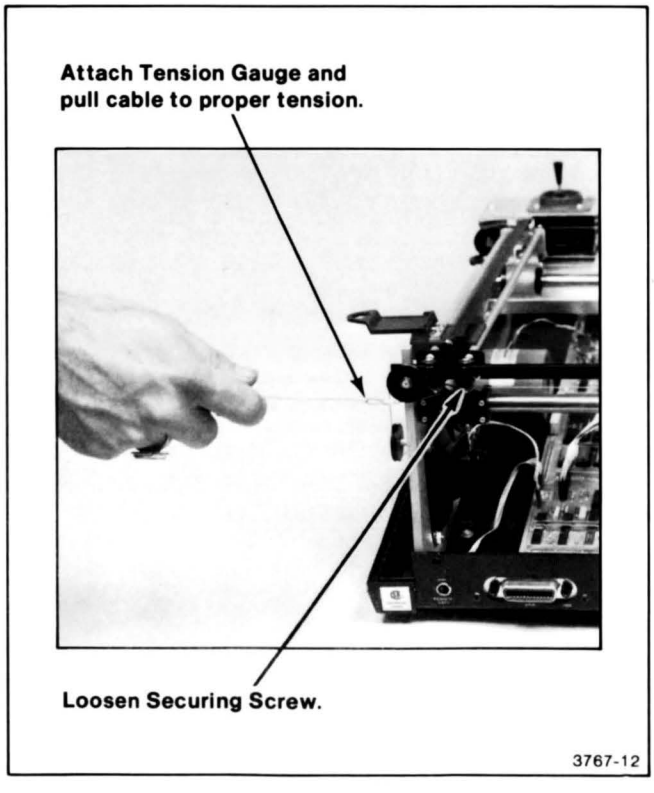


Figure 2-6. X-Axis Pen Drive Cable Tension Adjustment.

PLATEN INSTALLATION (PRELIMINARY FOR ALIGNMENT)

1. **Replace** any platen shims removed earlier in their original locations.
2. **Move** the Y-axis arm to the left side of the plotter and connect the platen connector to J61 on the main Plotter circuit board (see Figure G-2 of Appendix G).
3. **Slide** the left end of the platen under the Y-axis arm and onto the frame (or shims). Make certain that the wires to the platen do not interfere with the pen drive cables and are not pinched between the frame and the platen. Be sure that the front paper guide strip and the X-axis cable are not tangled.
4. **Verify** that the insulation strip is in place over the wire connection on the top surface of the platen and place the trim strip in position at the right edge of the platen (see Appendix G).
5. **Install** (but do not tighten) the four hex-socket cap screws. Notice that the two longer screws go through the trim strip and the platen's right side and that the short screws go on the left side (see Appendix G).

X-AXIS SYMMETRY CONTROL

1. **Plug** in the plotter's line cord and turn on the plotter's POWER switch. Allow the plotter to initialize (approximately 10 seconds). Then, allow the plotter to warm up for approximately 30 minutes to permit complete stabilization of components.
2. **Move** the pen carriage to near the center of the platen using the joystick.

NOTE

The following steps will not work if the pen carriage is against the platen boundary. Therefore, the pen carriage must be positioned such that any joystick movement can produce a corresponding pen carriage movement.

3. **Connect** channel 1 of a dual trace oscilloscope to the 1REF test point in the X-Axis Drive (see Figure 2-7). Attach the oscilloscope's ground lead to C592 as shown in Figure 2-7. Use the side that faces Q591. Set channel 1 to 1 V/div and sweep to 1 ms/div.

NOTE

Shakey or unstable oscilloscope traces may occur if the joystick is not moved exactly along the desired axis (i.e., the joystick is pulled or pushed in a manner that there is deflection along both the X- and Y-axes). The same unstable oscilloscope trace may also indicate that the ground lead is not attached to C592.

4. **Deflect** the joystick to full right (+ X-Axis). Adjust the scope triggering for a stable display, and note the waveform (period duration).
5. **Deflect** the joystick to full left (—X-Axis) and note the waveform's period duration.

6. **Check** for symmetry between waveforms obtained in Steps 4 and 5. If the waveforms are not symmetrical, adjust R492 (XSYM) until symmetry is achieved (see Figure 2-8).

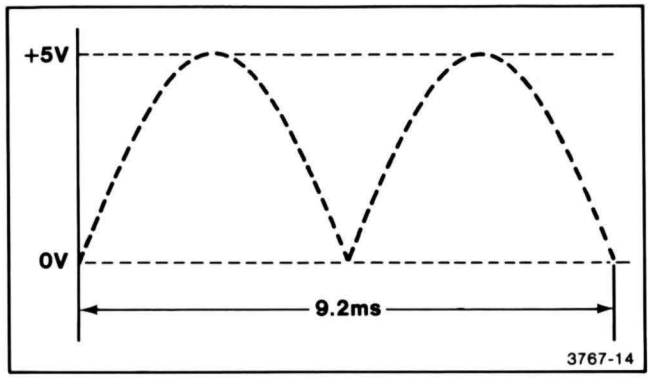


Figure 2-8. Symmetry Waveform.

Y-AXIS SYMMETRY CONTROL

1. **Move** the channel 1 scope probe to the 1REF test point in the Y-Axis Drive (see Figure 2-7). Do not move the oscilloscope ground lead.
2. **Deflect** the joystick to full up (+ Y-Axis) and note the waveform (period duration). See the preceding note.
3. **Deflect** the joystick to full down (—Y-Axis) and note the waveform's period duration.
4. **Check** for symmetry between the waveforms obtained in Steps 2 and 3. If the waveforms are not symmetrical, adjust R491 (YSYM) until symmetry is achieved (see Figure 2-8).

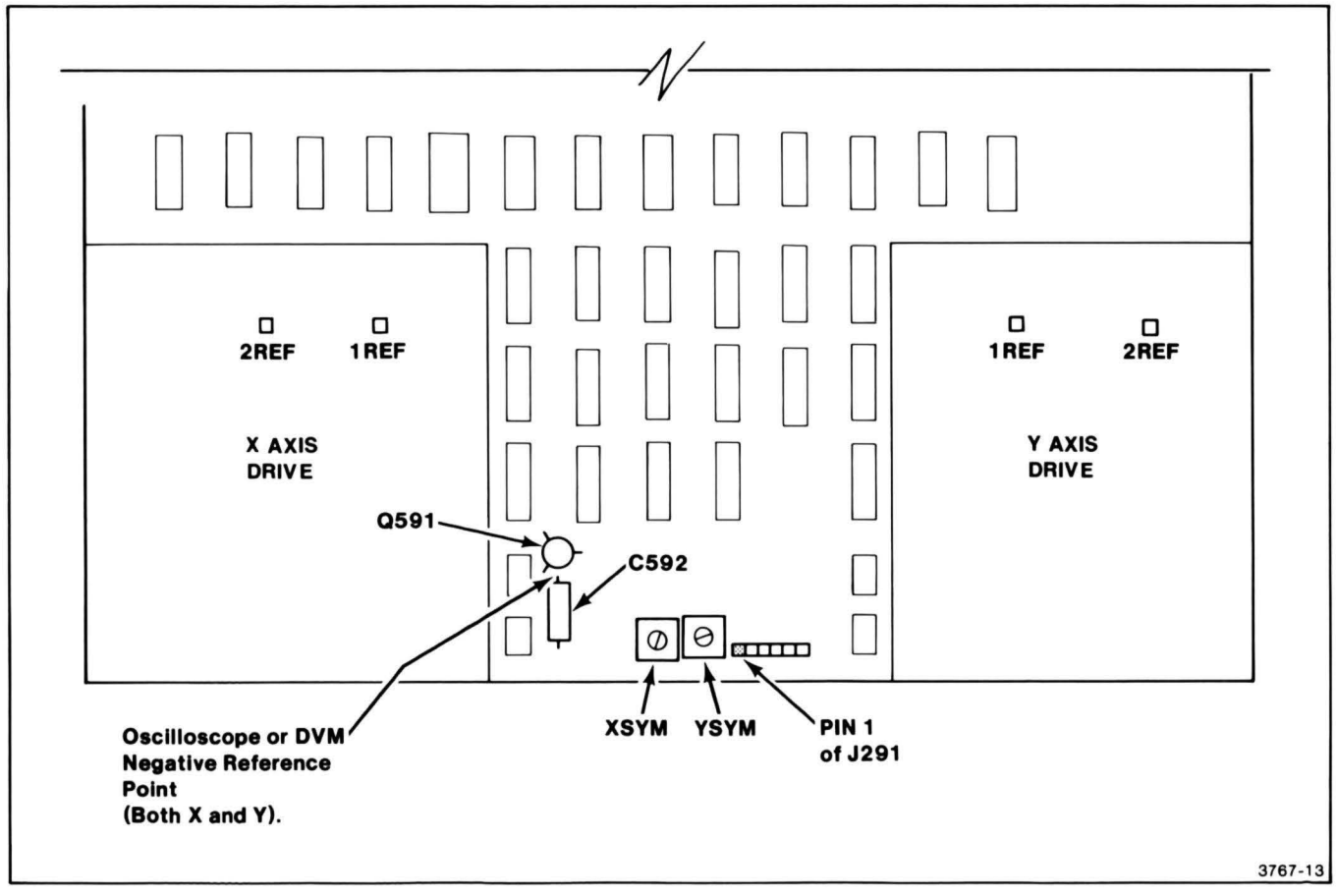


Figure 2-7. X and Y Symmetry Control and Test Point Locations.

JOYSTICK ELECTRICAL CENTER ADJUSTMENT

1. **Move** the pen carriage to the lower-left corner of the platen using the joystick. Turn the plotter's POWER off.
2. **Remove** the two screws that hold the front panel switch panel to the side rails and tilt the panel forward to gain access to the underside of the front panel assembly.
3. **Remove** the large 20-pin connector cable from the Front Panel circuit board (J181).
4. **Install** the 198-3848-00 extender cable between the cable just removed and the connector on the Front Panel circuit board.
5. **Turn** the front panel on its side to gain access to the joystick adjusting screws in later steps.

CAUTION

Failure to activate the Y-axis limit switch in the next step will cause the pen carriage to repeatedly jam against the lower Y-axis boundary when power is applied.

6. **Press** and hold the actuating lever on the Y-axis limit switch (the microswitch connected to the front panel assembly) while turning on the plotter's POWER switch. Then, release the actuating lever.
7. **Attach** the negative lead of either a digital voltmeter (DVM) or an oscilloscope to the side of C592 that faces Q591 (see Figure 2-7).
8. **Attach** the positive lead of the DVM (or scope) to the green wire connecting J291 to the joystick.
9. **Check** the Joystick Dead Band Differential. To do this, deflect the joystick handle slowly to the right until the pen carriage just starts to move. (Hint: it may be helpful to place your hand on the pen carriage to feel the vibration when the motor begins to step). Record the reading at the point when the pen carriage just starts to creep.
10. **Repeat** Step 9, except deflect the joystick handle to the left (-X-axis). Record the reading when the pen carriage just starts to creep. The difference between the readings in Steps 9 and 10 is the X differential.

11. **Adjust** the X-axis adjustment on the joystick using a 5/16" Allen wrench (see Figure 2-9) so that the X differential will be zero. Repeat Steps 9 and 10 until the difference is as close to zero as possible.
12. **Move** the positive lead of the DVM (or scope) to the red wire that connects J291 to the joystick.
13. **Repeat** Steps 9, 10, and 11 for the Y-axis (see Figure 2-9 for the adjustment location). Move the joystick handle forward and back).
14. **Remove** the DVM leads.
15. **Observe** the pen carriage to be sure that there is no visible drifting (no matter how slight) in any direction. If the pen carriage drifts, repeat Steps 8 through 14.
16. **Turn** the plotter's power off.
17. **Reinstall** the front panel assembly **with the extender cable still connected.** The cable will be removed later.

NOTE

The Y-axis limit switch adjustment has been altered by this procedure.

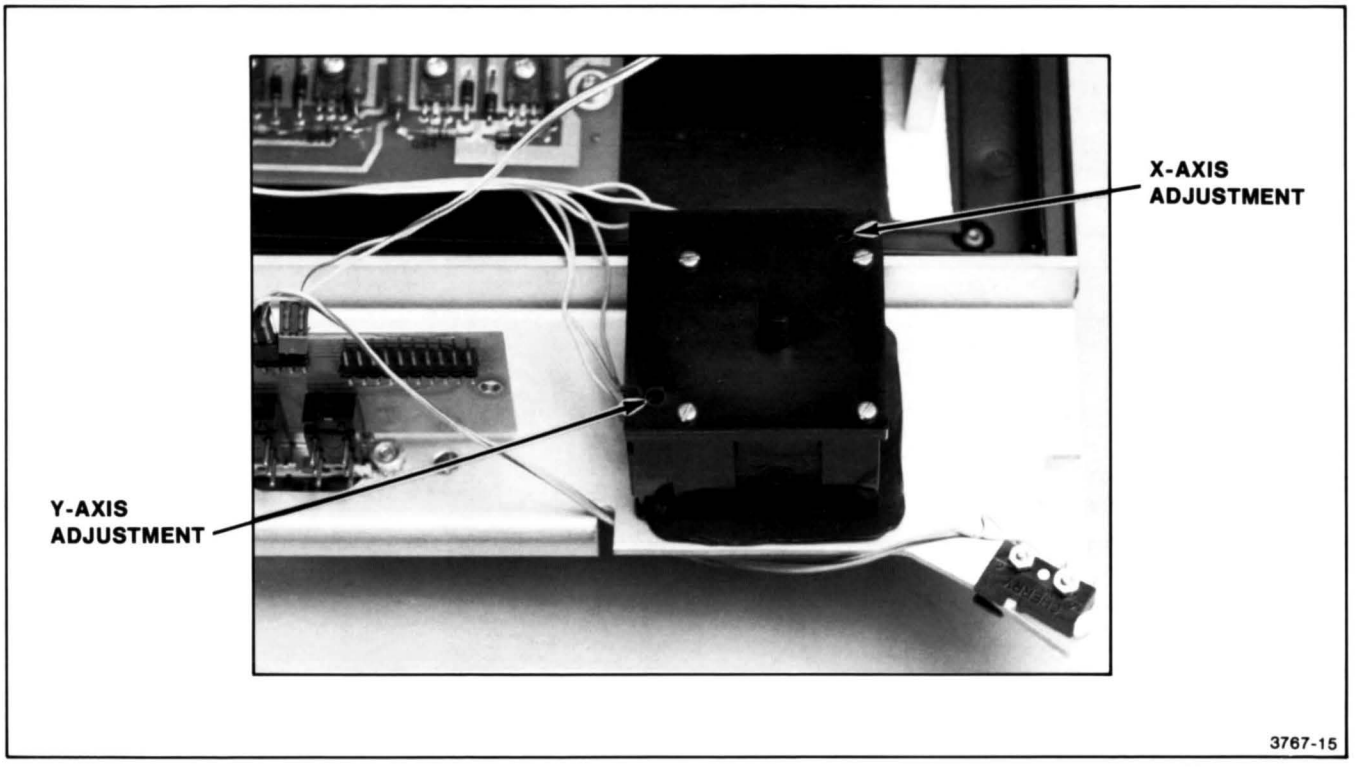


Figure 2-9. Joystick Electrical Center Locations.

PEN ACTUATOR ADJUSTMENTS

1. **Plug** in the plotter's line cord and turn on the plotter's POWER switch. Allow the plotter to initialize (approximately 10 seconds).
2. **Thread** a pen into a pen adapter until the pen is firmly seated.
3. **Install** the pen adapter into the pen holder located on the pen carriage.
4. **Move** the pen carriage near the left side of the platen using the joystick. The pen tip should be close to .030 inch above the platen surface with the pen up. Use a feeler gauge to measure this. If the height needs to be changed; (1) loosen the two hex-screws in the Pen Actuation Cam, (2) while holding the right side of the Pen Actuation Cam against the Pen Actuation Plunger, turn the Pen Bar to raise or lower the pen tip to achieve the .030 inch space, and (3) tighten the two hex-screws on the Pen Actuation Cam (see Figure 2-10).
5. **Move** the pen carriage to the other three corners of the platen and to the center using the joystick. Repeat the measurement until the distance between the tip of the pen and the platen is between .020 and .055 inch. If the space is greater than .055 inch at any location, add shims under the platen until all four corners and the center of the platen are between .020 and .055 inch below the pen tip.
6. **Repeat** Steps 4 and 5 until the space is between .020 and .055 inch in each of the four corners and the center of the platen.
7. **Press** the LOAD switch to the locked-down position and load a sheet of paper on the platen. Then, press the LOAD switch again to release it from its locked-down position.
8. **Move** the pen over all areas of the platen using the joystick. The pen should not write anywhere on the paper. If it does, repeat Steps 4 and 5.

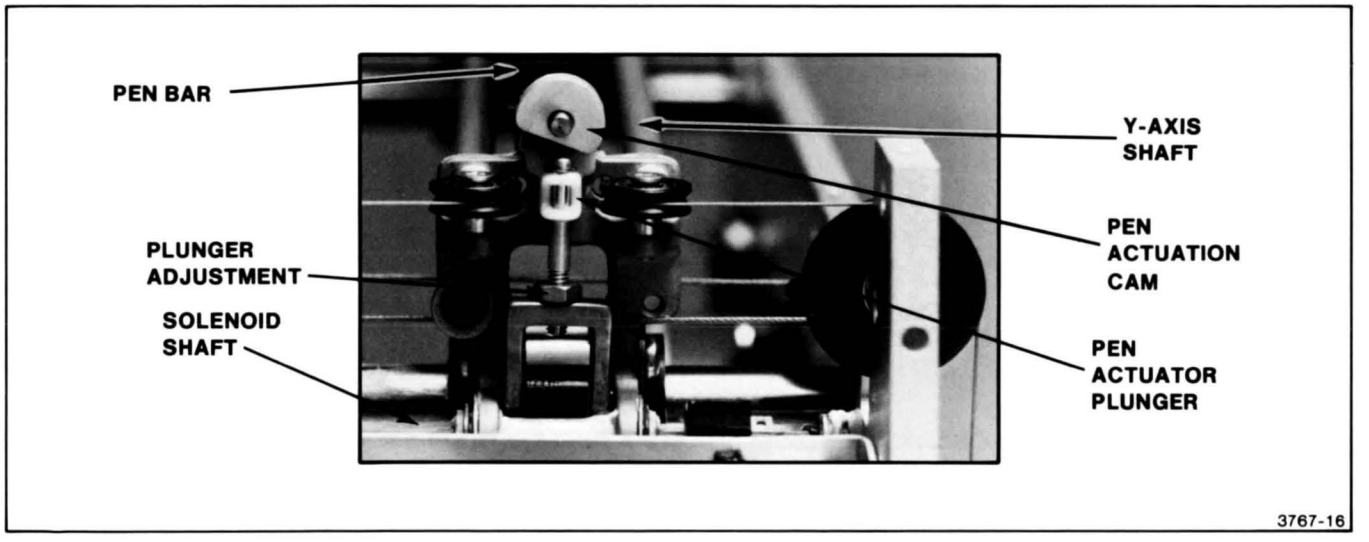


Figure 2-10. Pen Actuator Adjustment.

9. **Press** the PEN switch to lower the pen to the paper.
10. **Move** the pen over all areas of the paper using the joystick. The pen should write without skipping over any area of the platen. There should be a visible gap (approximately 1/32 inch) between the pen actuating bar and the underside of the pen holder, regardless of the pen carriage's location on the platen (see Figure 2-11). If the pen skips or there is no visible gap between the pen actuating bar and the underside of the pen holder, repeat Steps 4 and 5. If it is impossible to achieve good performance, try removing or adding shims under the platen. If the performance is still not satisfactory, the platen may be defective and should be replaced.
11. **Press** the PEN switch again to raise the pen.

PEN PRESSURE ADJUSTMENTS

Pen skipping or mashed tips can be caused by incorrect pen pressure. Adjust the pen pressure by (1) loosening the two Allen set screws that connect the pen holder to the pen carriage, (2) removing the pen holder and bending the pen actuator spring up (for more pressure) or down (for less pressure). For standard fiber tip pens, the pressure should be between 7 and 9.5 grams. A phonograph stylus pressure gauge can be used to verify pen pressure. When replacing the pen holder, be sure it is centered in the pen carriage and that the Allen set screws are not so tight as to cause excessive friction. To adjust this properly, loosen both Allen screws holding the pen holder and then tighten them until they just start to become snug, or until the pen carriage begins to spread. Back off the screws slightly. The pen holder should not be loose, but at the same time, it should not be binding or tight.

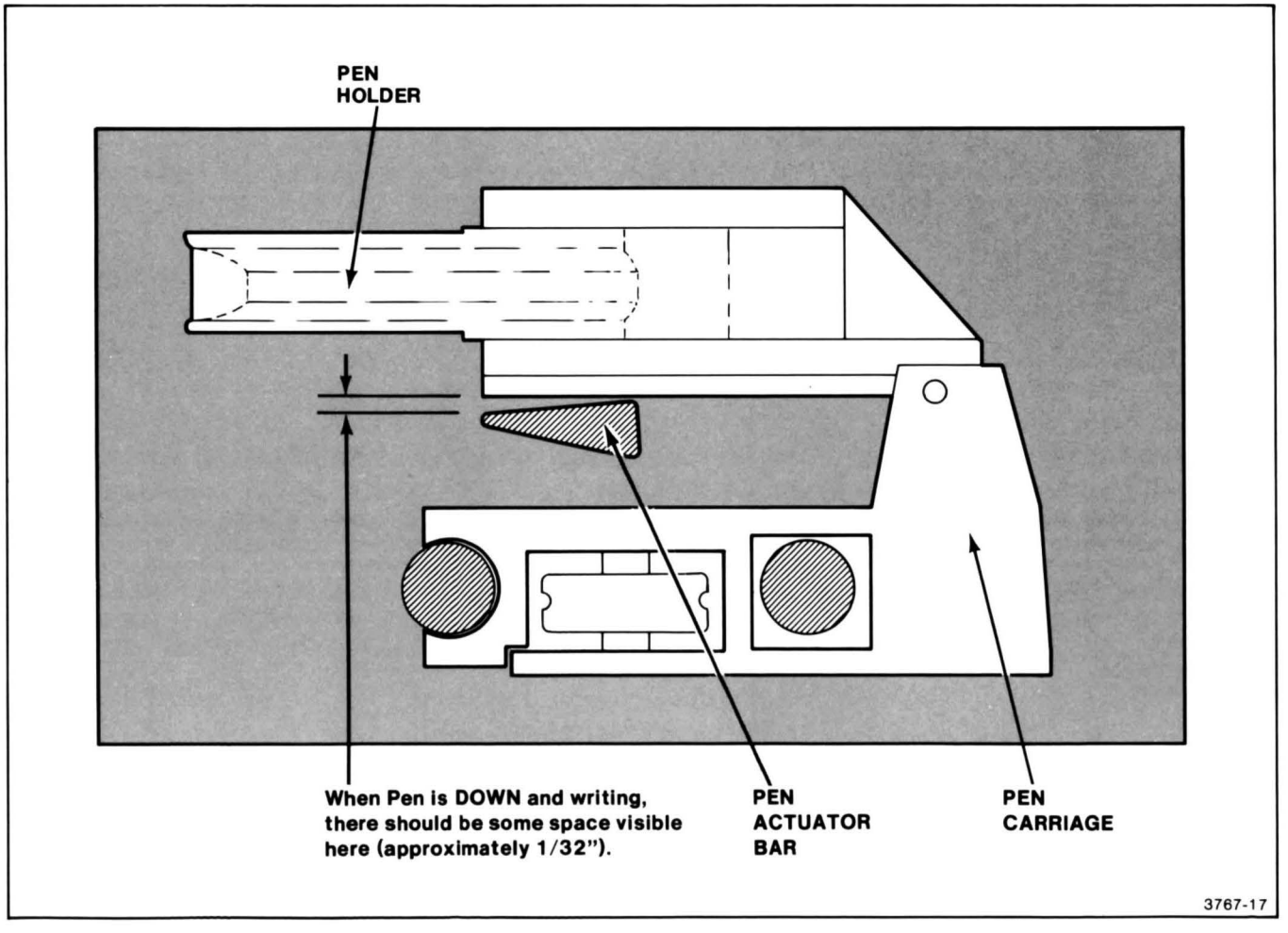


Figure 2-11. Gap Between Pen Actuating Bar and Pen Holder.

ALIGNING THE X-AXIS, PLATEN, AND ORTHOGONALITY

This procedure aligns the plotter's internal X- and Y-axes with the platen.

1. **Turn** off the plotter's power.
2. **Connect** the plotter to a RS-232-C terminal or host. Alternatively, connect a TEKTRONIX 4051 to the GPIB interface.
3. **Set** the plotter's four rear panel switches to 0-2-2-1 (300 baud) or 0-2-2-3 (1200 baud). If using a 4051 with GPIB, set the plotter's rear panel switches to 5-0-0-1.
4. **Power** up the terminal and the plotter and press the plotter's LOAD switch down.
5. **Place** the plotter calibration overlay (334-4717-00) on the platen. Position the calibration overlay so that (1) the left-most vertical line on the overlay is directly over the left edge of the platen and (2) the bottom edge of the overlay touches the paper guide along its entire length (see Figure 2-12).
6. **Press** the LOAD switch to release it from its locked-down position.
7. **If using a RS-232 terminal** to communicate with the plotter, press the LOCAL switch to its locked-down position.
8. **Place** the digitizing reticle in the pen carriage pen holder.

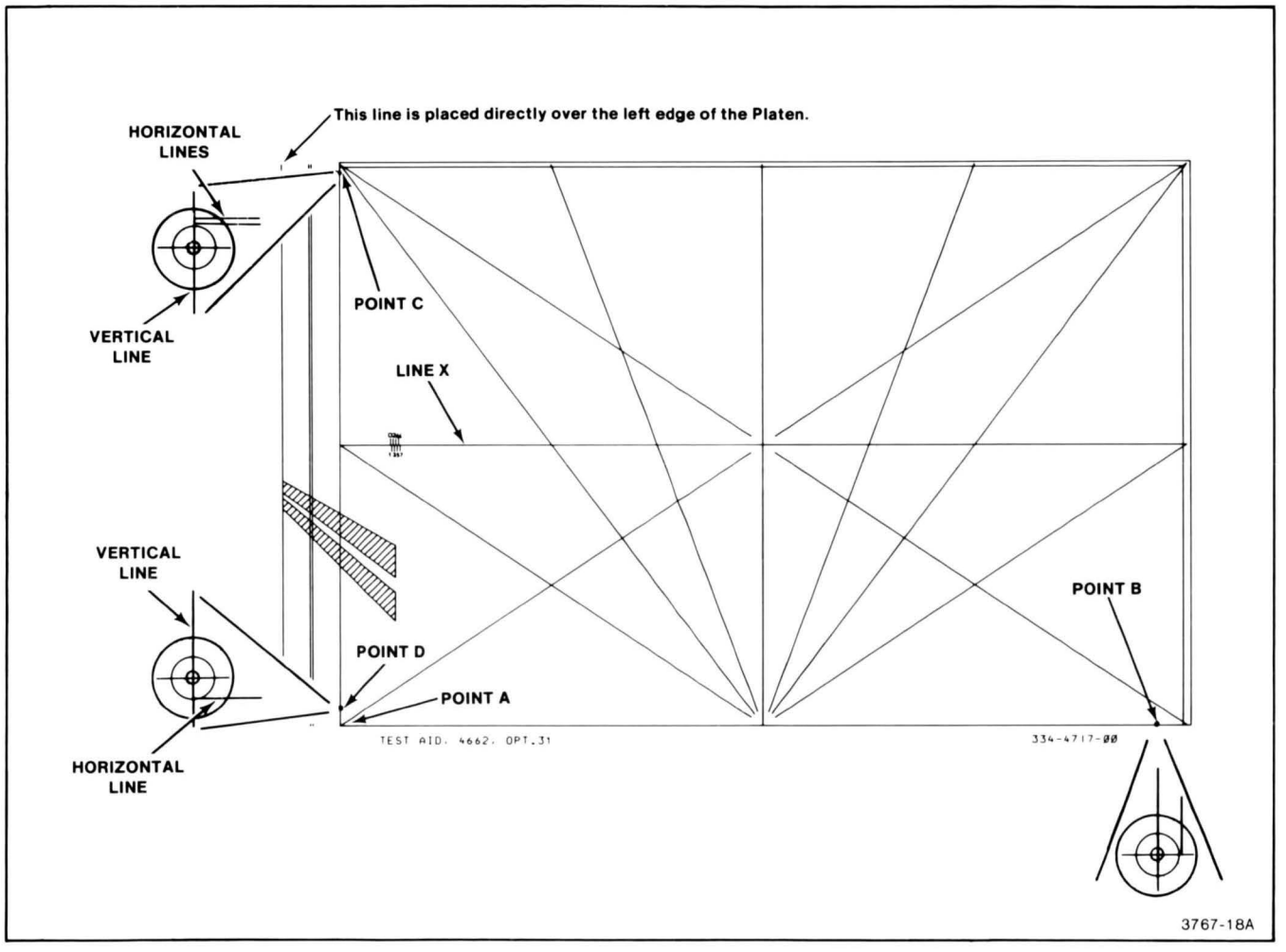


Figure 2-12. Calibration Overlay Locations.

NOTE

For all subsequent procedures, when you are viewing locations on the calibration overlay through the digitizing reticle, the pen must be DOWN. If the pen does not lower after each terminal-generated move command, press the PEN switch. Even if the PEN switch is pressed prior to a move, the pen may automatically lift up off the paper after the completion of the move.

9. **If using a RS-232-C terminal** to communicate with the plotter, transmit the following ASCII string to turn the plotter logically on, to turn on the PROMPT indicator, and to disable the automatic pen lift feature. This forces the first coordinate pair to be a Draw rather than a Move.

   <ESC>AE<ESC>AK<GS><BEL>

   On some terminals, <ESC> is <CONTROL-SHIFT>K, <GS> is <CONTROL-SHIFT>M, and <BEL> is <CONTROL>G.

   If using a 4051 GPIB, type the following:

```
PRINT @1,26:1<CR>
WINDOW0,150,0,100<CR>
VIEWPORT0,150,0,100<CR>
1 SET KEY<CR>
2 STOP<CR>
4 DRAW @1:1,0<CR>
5 RETURN<CR>
8 DRAW @1:149,0<CR>
9 RETURN<CR>
12 DRAW @1:150,99<CR>
13 RETURN<CR>
16 DRAW @1:150,1<CR>
17 RETURN<CR>
RUN
```

This program turns on the plotter's PROMPT indicator, disables the automatic pen lift feature, and configures the 4051 to handle X-axis coordinates greater than 130. This program will aid the technician during the remaining adjustments. When a 4051 step is called out in the procedure, you need only press the specified USER-DEFINED key.

10. **If using an RS-232-C terminal,** transmit the following ASCII string:

    <SPACE>a` <SPACE>G

    to cause the digitizing reticle to move near the lower-left corner of the plotting area.

    If using the 4051 program, press the USER-DEFINED #1 key.

NOTE

The center location of the digitizing reticle may not be directly over the lower-left corner of the overlay (point A in Figure 2-12). This is due to probable misalignment of the X- and Y-limit switches (that will be adjusted later) and the program that positions the pen carriage to a point just inside the corners.

11. **Position** (using the joystick) the digitizing reticle's center over the overlay's horizontal line at Point A in Figure 2-12.

12. **Press** and hold down the plotter's front panel SET LOWER LEFT switch until the plotter's bell sounds (approximately one second). This establishes this point initially as 0,0.

NOTE

Steps 13 through 16 establish the bottom of the platen parallel with the plotter's X-axis line.

13. **If using a RS-232-C terminal,** transmit the following ASCII string:

    <SPACE>a` ?X

    to move the digitizing reticle near the lower-right corner of the page boundary.

    If using the 4051 program, press the USER-DEFINED #2 key.

14. **If** the center of the digitizing reticle is not over the horizontal line at Point B (as shown in Figure 2-12), carefully move the platen so that the horizontal line is centered directly under the digitizing reticle. Be careful not to disturb the lower-left corner of the platen.

15. **Repeat** Steps 10 through 14 until the horizontal line at positions A and B (see Figure 2-12) is exactly centered under the digitizing reticle. Then, tighten the four platen screws.

16. **Repeat** Steps 10 through 14 to verify that the horizontal line in both corners is centered under the digitizing reticle.

17. **Center** the digitizing reticle (using the joystick) directly over the overlay's vertical line at Point C in Figure 2-12.

18. **Press** and hold the SET UPPER RIGHT switch until the plotter's bell sounds (approximately one second). This point is now established as the upper-right corner of the page.

19. **If using a RS-232-C terminal,** transmit the following ASCII string:

    <SPACE>cg?-

    The hexadecimal equivalency of these five ASCII characters is: 20, 63, 67, 3F, and 5F. This moves the digitizing reticle down near the lower-right corner of the page boundary (lower-left corner of the platen).

    If using the 4051 program, press the USER-DEFINED #4 key.

20. **If** the digitizing reticle is not centered directly over the overlay's vertical line at Point D (see Figure 2-12), move the front end of the Y-axis arm either to the left or right to center the reticle. To do this, (1) loosen the X-axis cable securing screw on the front end of the Y-axis arm (see Figure 2-5), (2) move the front end of the Y-axis arm so that the digitizing reticle is centered directly over the overlay's vertical line at Point D (Figure 2-12), and (3) tighten the X-axis securing screw.

21. **If using the RS-232-C terminal,** send the following ASCII string:

    5cc?-

    The hexadecimal equivalency of these five ASCII characters is: 35, 63, 63, 3F, and 5F. This moves the digitizing reticle to near the upper-right corner of the page, which is physically the upper-left corner of the platen.

    If using the 4051 program, press the USER-DEFINED #3 key.

22. **If** the digitizing reticle is centered directly over the overlay's verticle line at Point C, repeat Steps 19 and 20 to verify proper alignment.

23. **If necessary,** repeat Steps 17 through 22 until the vertical line remains centered under the digitizing reticle at Points D and C (Figure 2-12).

LIMIT SWITCH ADJUSTMENT

The X- and Y-axis limit switches (shown in Figure 2-13) control the mechanical position of the power-up origin point and therefore control the relationship of the plotting area to the plotting surface. The switches should be adjusted so that when the pen is sent to the coordinates X= 0, Y= 0, the pen moves to the lower-left corner of the overlay's page boundary. Follow these procedures to set the limit switches.

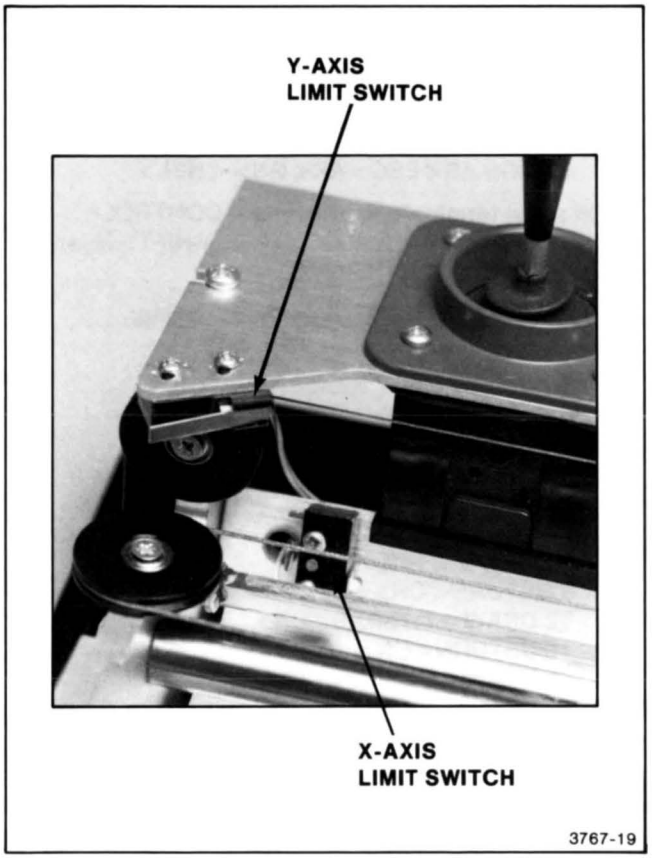


Figure 2-13. Limit Switch Locations.

1. **Turn** the plotter's POWER off.
2. **Turn** the plotter's POWER back on and allow the plotter to initialize (about 10 seconds). This establishes the default page boundaries.
3. **Ensure** that the calibration overlay is properly positioned (see the procedure under Aligning the X-Axis and Platen).
4. **Press** the LOCATE LOWER LEFT switch to send the digitizing reticle to the lower-left corner.
5. **Press** the PEN switch to lower the digitizing reticle.
6. **Locate** the center of the digitizing reticle within ± .010 inch of the lower-left corner of the overlay grid (marked Point A in Figure 2-12). (As a guide, the width of the cross-hair lines in the digitizing reticle are .010 inch. If the X and Y portion of the crosshair lines are not over the lower-left corner of the overlay in either the X or Y direction, adjust either or both of the limit switches.

NOTE

Because movement of the X-axis affects the Y-axis limit, but not vice-versa, adjust the X-axis limit switch first.

7. **If** you need to adjust the X-axis limit switch, first note how far the center of the digitizing reticle is from Point A (Figure 2-12).

a. Turn off the plotter's POWER switch.

b. Remove the front panel's left mounting screw and loosen (but do not remove) the right mounting screw.

c. Move the Y-axis arm to the right so that the actuator stop (see Figure 2-14) on the front of the Y-axis arm is visible through a cutout in the debris tray (there are three connector plugs located here).

d. Loosen the locking nut on the actuator stop (see Figure 2-14).

e. Thread the actuator in or out to the distance noted in Step 7. If the digitizing reticle needs to move to the right, thread it in; if the digitizing reticle needs to move to the left, thread it out. Then, tighten the locking nut.

f. Press and hold the actuating lever on the Y-axis limit switch (located on right end of the front panel). Turn on the plotter's POWER switch and allow the plotter to initialize. When the pen carriage is at the right and starts to move to the top of the platen, release the limit switch.

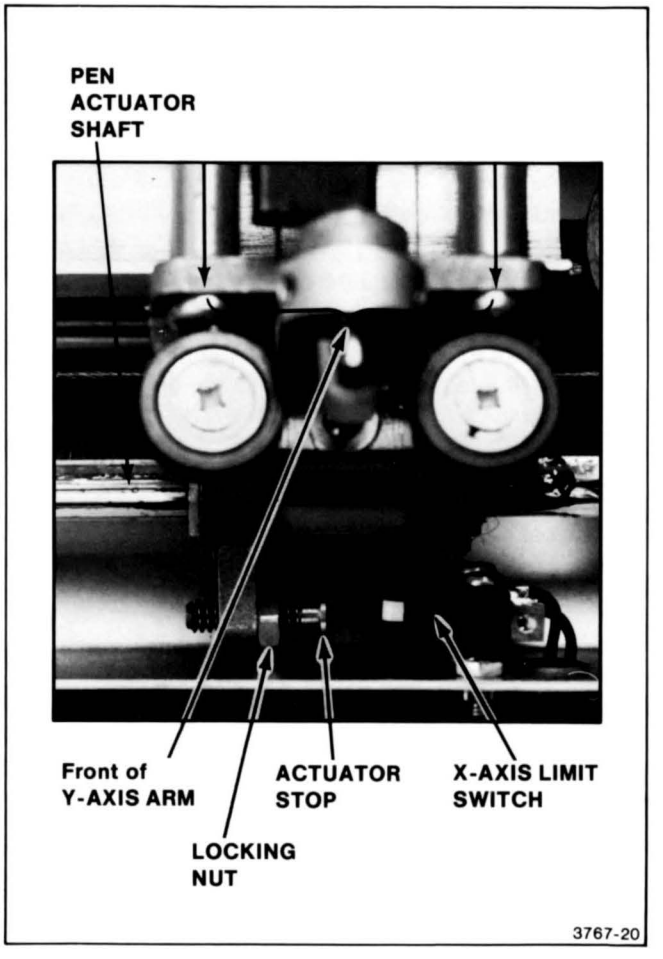


Figure 2-14. Actuator Stop Detail.

g. Repeat Steps 6 through 7f until the X-axis limit switch is properly set.

h. Turn the plotter's POWER switch off.

i. Remove the extender cable that was temporarily installed between the Front Panel circuit board and the 20-pin cable connecting the Plotter circuit board. Then, reconnect the 20-pin cable to the Front Panel circuit board at J181.

j. Install the front panel and secure it with the two screws.

k. Turn the plotter's POWER switch on and allow the plotter to initialize.

l. Press the LOCATE LOWER LEFT switch to position the digitizing reticle over the lower-left corner.

m. Press the PEN switch to lower the digitizing reticle.

8. **If** you need to adjust the Y-axis limit switch, note how far vertically the center of the digitizing reticle is from Point A (Figure 2-12).

a. Turn off the plotter's POWER switch.

b. Loosen the screws holding the Y-axis limit switch and slide the switch up or down in the slotted holes. If it is necessary to move the digitizing reticle up, slide the switch up; if it is necessary to move the digitizing reticle down, slide the switch down. Then, tighten the Y-axis limit switch securing screws.

c. Turn the plotter's POWER switch back on and allow the plotter to initialize.

d. Press the LOCATE LOWER LEFT switch to position the digitizing reticle over the lower-left corner.

e. Press the PEN switch to lower the digitizing reticle.

f. Repeat Steps 8a to 8e until the Y-axis limit switch is properly adjusted.

This completes the calibration of the standard 4662 plotter. If the plotter is also equipped with Option 31 (Multiple Pens), proceed to the Option 31 adjustments following. Otherwise, turn the plotter's POWER switch off and refer to Appendix G for instructions for replacing the plotter's case.

OPTION 31 (MULTIPLE PENS) ADJUSTMENTS

The following adjustments are intended to be performed on 4662 Plotters that are equipped with Option 31. These adjustments must be performed only after completing the adjustments for the standard 4662 Plotter.

Lubrication

Refer to the Lubrication Procedure earlier for instructions on lubricating the Option 31 mechanism.

Set Lower Bushing Clearance

This sets the clearance between the lower bushing and the optical interruptor lever (bracket) at .004 inch.

1. **Loosen** (but do not remove) the set screw in the large sprocket wheel. This sprocket wheel also acts as a belt pulley since the belt from the motor passes around it.
2. **Insert** the .004 inch feeler gauge between the bushing and the optical interruptor lever (see Figure 2-15).
3. **Push** the large sprocket wheel tight against the feeler gauge and tighten the set screw in the large sprocket wheel.
4. **Remove** the feeler gauge.

Set Knob Clearance

This sets the clearance between the rotary pen turret knob and the pen holder assembly cover at .004 inch.

1. **Loosen** (but do not remove) the set screw in the rotary pen turret knob.
2. **Slide** the .004 inch feeler gauge between the underside of the knob and the top of the pen holder assembly cover. The large opening in the feeler gauge surrounds the small ridge around the main shaft opening (see Figure 2-15).
3. **Press** the knob firmly down onto the feeler gauge and tighten the set screw in the knob.
4. **Remove** the feeler gauge.

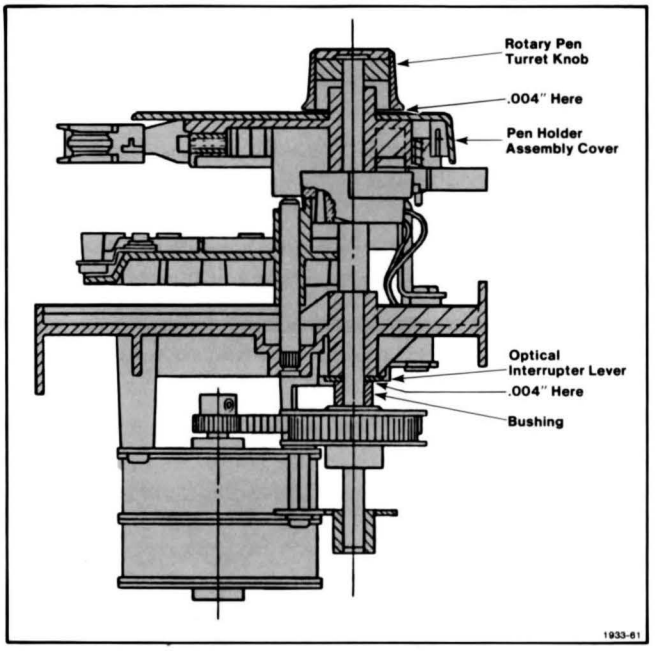


Figure 2-15. Setting Lower Bushing and Knob Clearances.

Set Motor Belt Tension

This adjustment places a force of three pounds on the Option 31 motor belt.

1. **Loosen** (but do not remove) the four mounting screws holding the motor to the Option 31 mechanism.
2. **Hook** a push-pull scale (like a fish weighing scale) over the motor shaft as shown in Figure 2-16 and pull a steady force of three pounds (1.4 kg).
3. **Tighten** the four motor mounting screws while holding a steady force of three pounds.
4. **Remove** the push-pull scale.

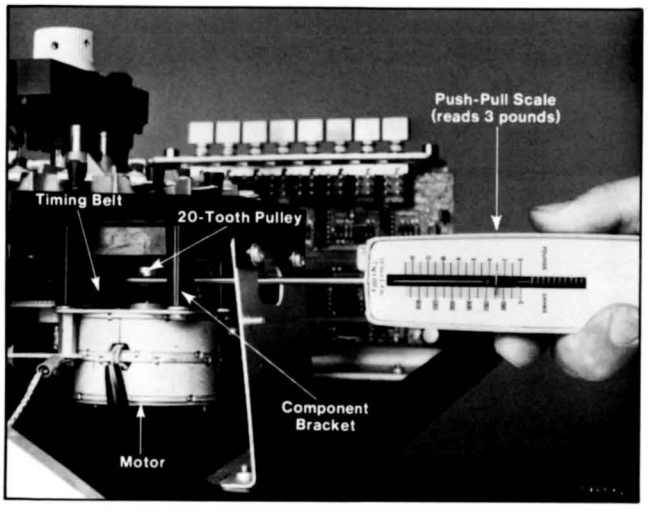


Figure 2-16. Setting Motor Belt Tension.

Rotary Pen Turret Height Adjustment

1. **Turn** off the plotter's power and unplug the line cord.
2. **Remove** the rotary pen turret knob. It is held with one set screw.
3. **Lift** off the rotary pen turret cover.
4. **Remove** any pens stored in the rotary pen turret.
5. **Remove** the calibration overlay from the platen.
6. **Loosen** the four screws holding the rotary pen turret to the plotter (see Figure 2-17).
7. **Attach** the rotary pen turret height gauge (003-1238-00) to the rotary pen turret shaft as shown in Figure 2-17. Make sure that the gauge sits level on the top of the rotary pen turret by squeezing the gauge and the pen turret together while tightening the gauge's set screw.
8. **Move** the rotary pen turret with the gauge attached until both sides of the bottom of the gauge rest on the platen (as shown in Figure 2-17). Then, tighten the four screws holding the rotary pen turret.
9. **Verify** that the rotary pen turret is level and at the correct height after tightening the screws. Verification can be made by performing the following steps.
   - Check the clearance between the pens in the turret and the platen at point A (Figure 2-17A). Clearance should be a minimum of .055 inch. If the clearance is less than .055 inch, loosen the screw below point A which secures the turret assembly to the 4662 side frame. Push the corner of the turret assembly up until the clearance is .055 inch, tighten the screw.
   - Perform the same procedure at point B.
   - Move the turret to point C. Each of the pens should clear the platen by a minimum of .040 inch. Also the pen holder should first contact the ramp of the pen keeper at a point at least 1/3 of the way up the ramp (Figure 2-17A).
   - If either of the conditions specified in the preceding step is not met, loosen the two screws securing the turret assembly to its bracket (Figure 2-17), and adjust the turret assembly tilt until the conditions are met.
10. **Remove** the rotary pen turret height gauge.
11. **Replace** the rotary pen turret cover, making sure that the index tabs on the underside of the cover seat in holes on the top of the rotary pen turret. Replace the knob, but do not tighten the set screw.
12. **Place** the .004 inch feeler gauge on top of the rotary pen turret cover and under the rotary pen turret knob, locating the rotary pen turret shaft in the notch of the feeler gauge.
13. **Tighten** the rotary pen turret knob set screw while maintaining reasonably firm downward pressure on the knob itself.
14. **Remove** the feeler gauge.

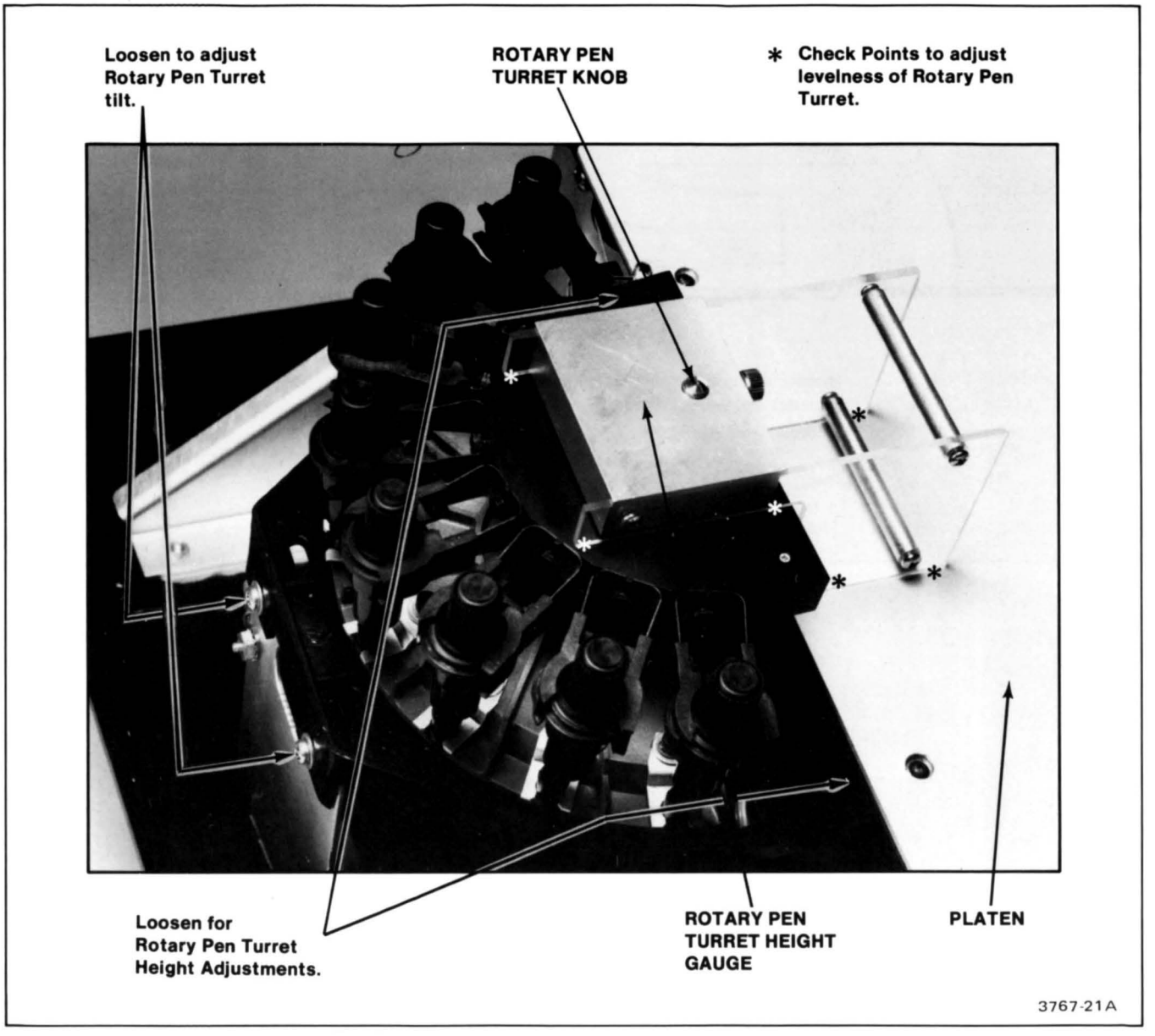


Figure 2-17. Rotary Pen Turret Height Adjustments.

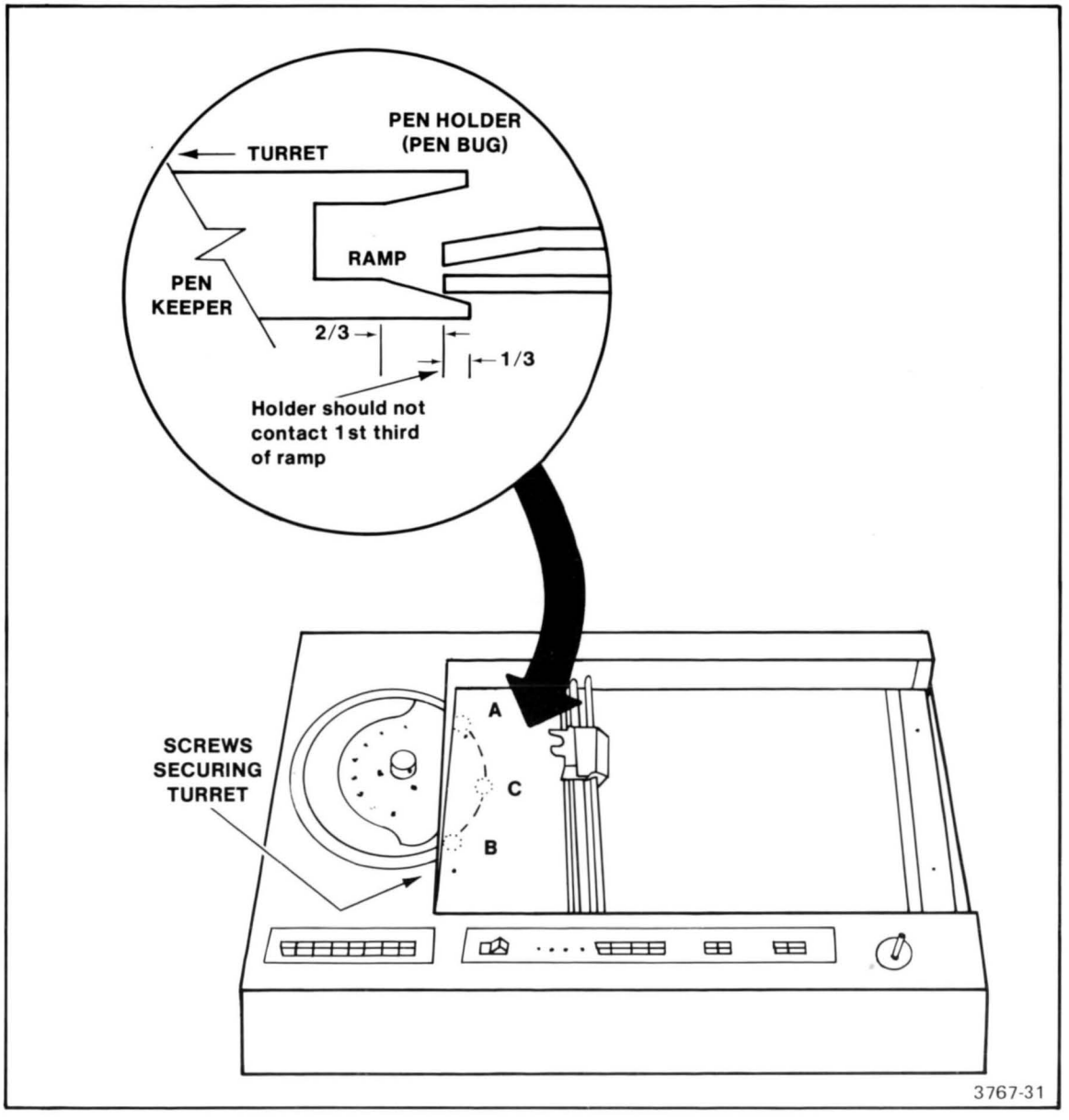


Figure 2-17A. Relationship of the Pen Holder to the Keeper.

Pen Sense Switch Adjustment

1. **Turn** the rotary pen turret knob to UNCAP.
2. **Remove** the rubber pen cap from its holder in Pen Position 1.
3. **Load** a pen in Pen Position 6 of the rotary pen turret and load the digitizing reticle in Pen Position 1.
4. **Position** the calibration overlay (see Step 5 of Aligning the X-Axis, Platen, and Orthogonality).
5. **Turn** the plotter's power on and allow it to initialize.
6. **Turn** the rotary pen turret knob clockwise manually until the digitizing reticle passes over the area on the Calibration Overlay labeled tolerance zone #1 (see Figure 2-18). The pen sense switch indicator LED (see Figure 2-19B) should turn off while the center of the digitizing reticle is over tolerance zone #1. When the digitizing reticle passes over tolerance zone #2, the pen sense switch indicator LED should turn back on because Pen 6 is triggering the pen sense switch. The Pen Sense Switch Indicator should be off while the digitizing reticle is between the two tolerance zones.

   If the pen sense switch indicator LED does not behave as described above, adjust the bracket that holds the pen sense switch. To do this, first loosen (but do not remove) the two screws holding the bracket to the rotary pen turret mounting bracket (see Figure 2-19A). Second, make small adjustments (for example, 1/8 to 1/4 of the length or width of the screw slots) using the following four hints as a guide:

   - To move the switch range (tolerance zones) down, rotate the pen sense switch bracket clockwise.
   - To move the switch range (tolerance zones) up, rotate the pen sense switch bracket counterclockwise.
   - To spread the switch range tolerance zones, move the pen sense switch bracket towards the rear of the plotter.
   - To narrow the switch range tolerance zones, move the pen sense switch bracket towards the front of the plotter.

   Experiment with these settings to properly set this bracket. And finally, when the test is successful, firmly tighten the two screws holding the pen sense switch bracket.
7. **Repeat** Step 6 to verify that the adjustment is still valid after tightening the screws.

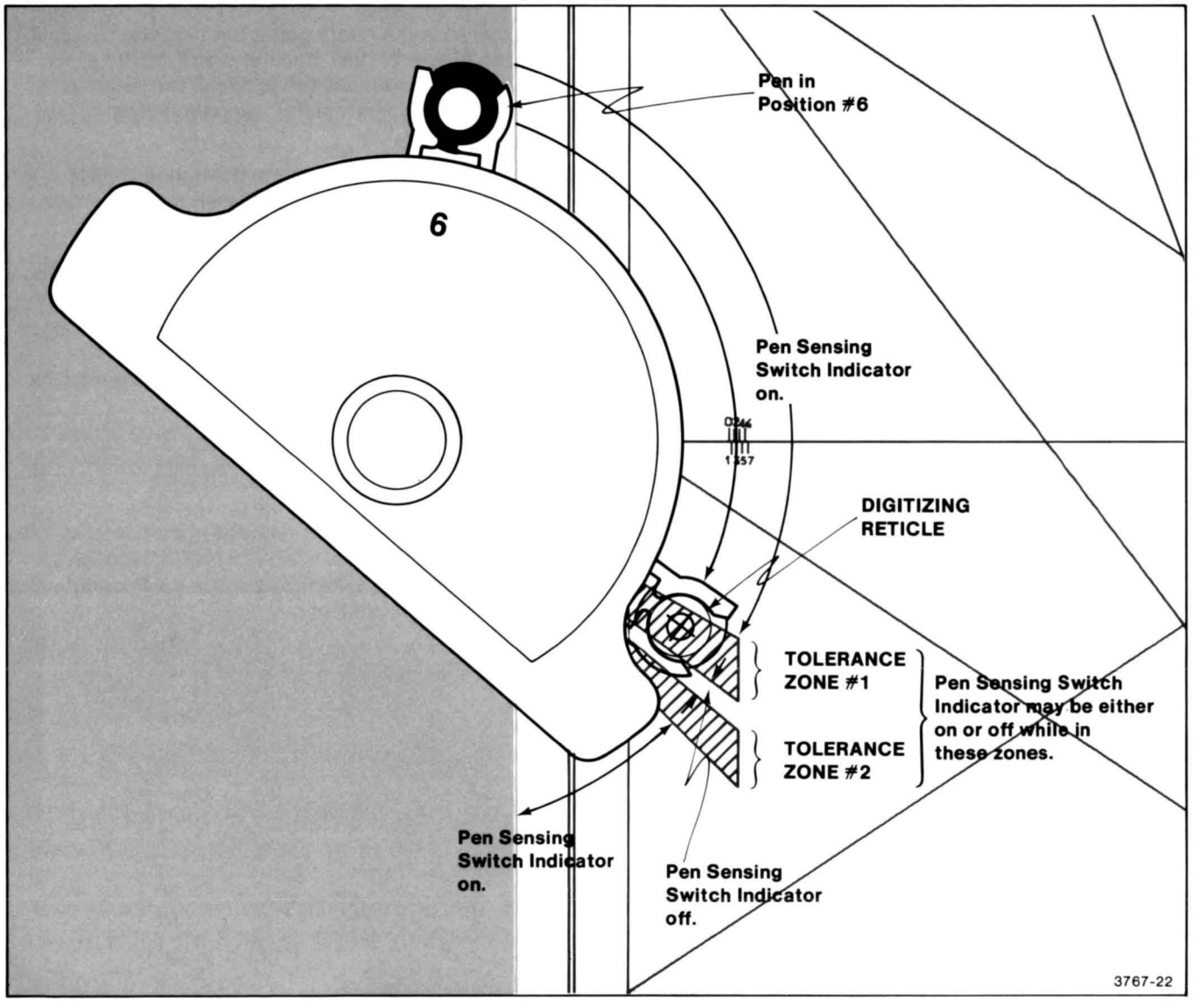
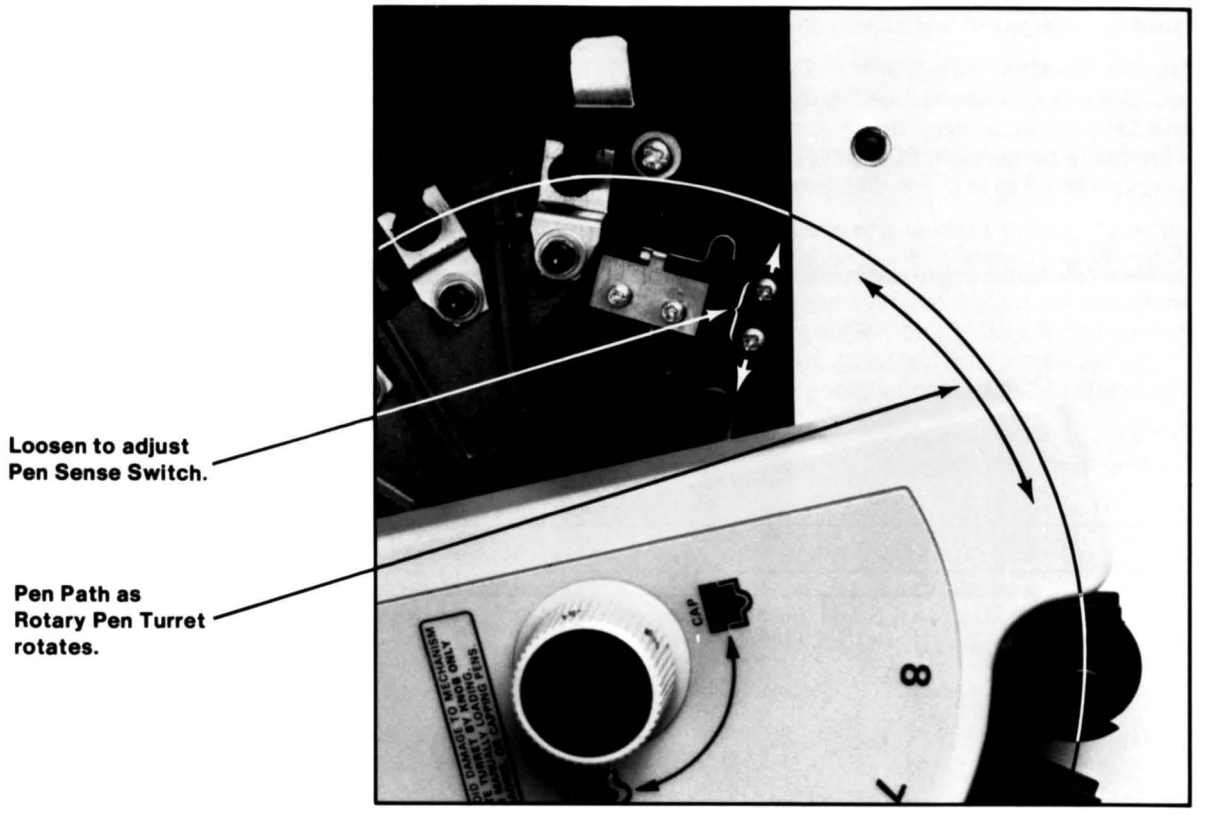
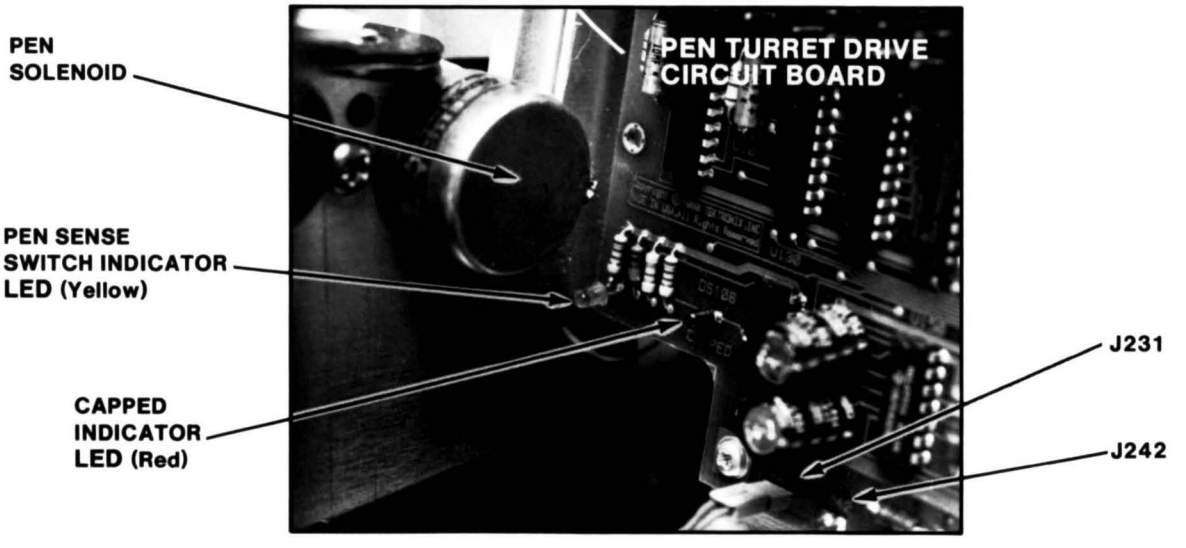


Figure 2-18. Pen Sense Switch Activation Details.



A. Pen Sense Switch.



B. Pen Sense Indicator LED.

3767-23

Figure 2-19. Pen Sense Switch and Indicator LED.

Setting Rotary Pen Turret Exchange Point

1. **Ensure** that the plotter's power is off.
2. **Move** the J95 strap from NORM to CAL on the Pen Turret Drive circuit board (see Figure 2-20). Refer to the description of this strap in Appendix D for the functions of the eight PEN CONTROL switches when the J95 strap is in the CAL position.
3. **Turn** on the plotter's power and allow the plotter to initialize (approximately 10 seconds).
4. **Ensure** that the Calibration Overlay is properly positioned on the platen (left guide mark is even with the left edge of the platen and the bottom edge of the overlay is against the paper guide.
5. **Ensure** that the digitizing reticle is in Pen Position #1 of the rotary pen turret.
6. **Rotate** the rotary pen turret knob until (1) the digitizing reticle points straight to the right across the platen and (2) the crosshair cursor is directly over the center horizontal line (marked Line X in Figure 2-12).
7. **Loosen** the belt pulley on the rotary pen turret motor shaft with a .050 inch Allen wrench. There are two set screws.
8. **Press** the PEN CONTROL 1 switch, which moves the motor to its closest detent and places a "hold voltage" on the motor to prevent it from turning easily.
9. **Tighten** the two set screws on the motor belt pulley while holding the center of the digitizing reticle directly over the horizontal line.
10. **Press** the PEN CONTROL 2 switch momentarily to rotate the pen turret back to the stored position.

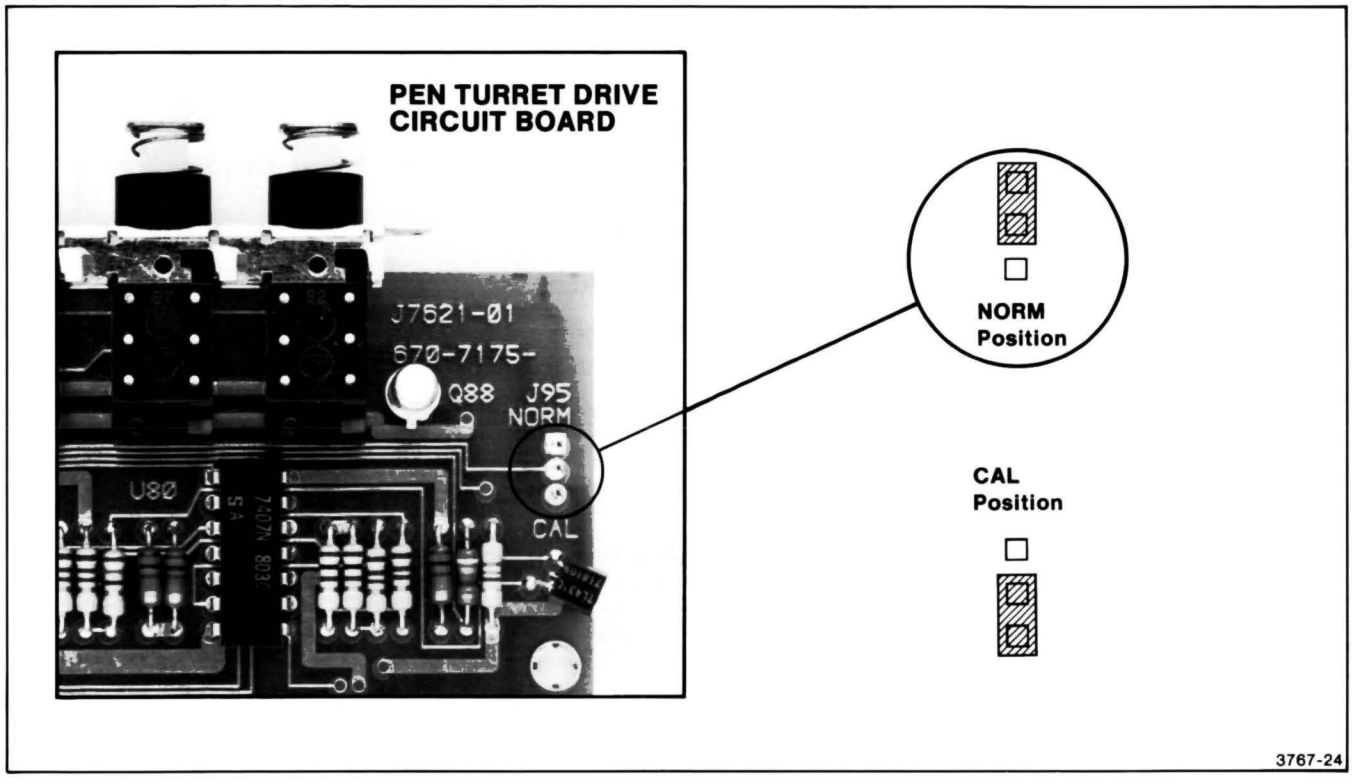


Figure 2-20. Pen Turret Drive Circuit Board NORM-CAL Strap Location.

11. **Loosen** the screw holding the optical interrupter lever (shown in Figure 2-21).
12. **Position** the optical interrupter lever until the CAPPED LED (see Figure 2-19B) just turns on.
13. **Move** the optical interrupter lever back until the CAPPED LED just turns off. Position this lever right at this transition point (the CAPPED LED is between on and off).
14. **Tighten** the screw that holds the optical interrupter lever.
15. **Press** the PEN CONTROL 3 switch, which deenergizes the rotary pen turret motor.
16. **Rotate** the rotary pen turret knob manually to the fully counterclockwise position (CAP).
17. **Press** the PEN CONTROL 5 switch, which will rotate the digitizing reticle to the pen exchange position (straight out to the right). Look straight down through the digitizing reticle and note the distance between the horizontal line (marked Line X in Figure 2-12) and the center of digitizing circle. This distance should be less than 1/4 of the radius of the large digitizing circle (less than .025 inch).

    If the distance is over 1/4 of the circle radius from the center of the digitizing reticle, press PEN CONTROL 3 switch and repeat this procedure starting at Step 4.

NOTE

When looking straight down through the digitizing reticle, all of the digitizing reticle crosshair pattern should be visible. If you see only portions of the pattern, you are not looking straight down through the digitizing reticle.

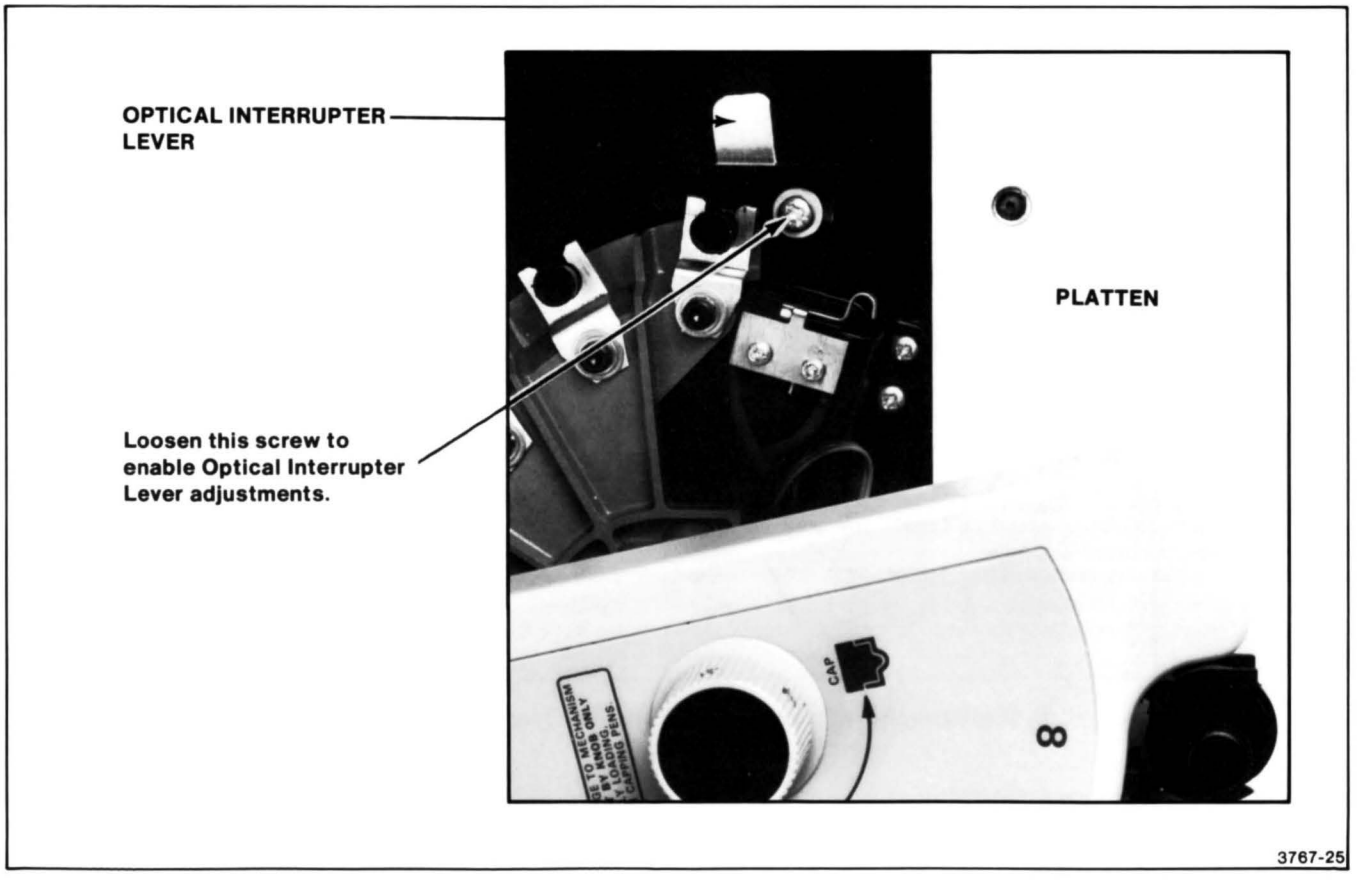
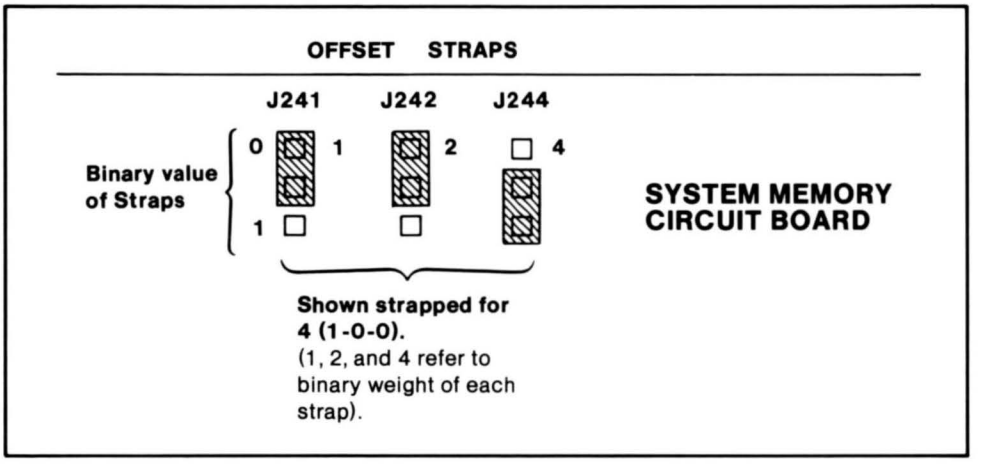


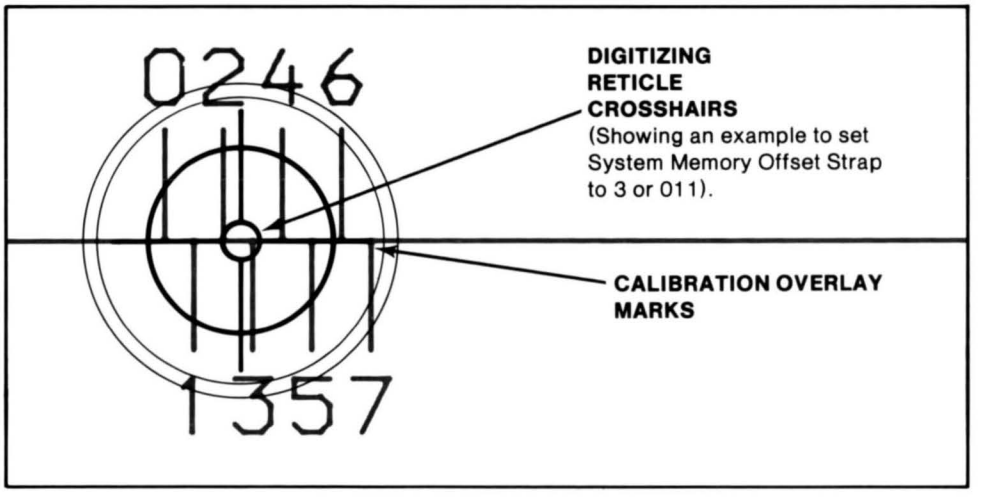
Figure 2-21. Optical Interruptor Lever Securing Screw Location.

Adjust X-Axis Pen Exchange Position

Three straps (labeled OFFSET) on the System Memory circuit board (see Figure 2-22A) electronically shift the platen's X-axis **during pen exchanges only.** These three straps can be set to any binary number from zero to seven. Each progressive binary number causes the X-axis of the pen exchange point to shift by 0.020 inches to the right. Factory-aligned plotter straps are set for a binary number of four (1-0-0). However, due to tolerances in the plotter's assembly, it may be necessary to change the X position of the pen exchange



A. System Memory Circuit Board OFFSET Straps.



B. Digitizing Reticle and the Calibration Overlay Offset Marks.

3767-26

Figure 2-22. X-Axis Pen Exchange Position Straps.

NOTE

The electrical X-axis locations are not affected by these strap settings during normal plotting.

1. **Center** the digitizing reticle over the center horizontal line (marked Line X in Figure 2-12). Look straight down (see the note under Setting Rotary Pen Turret Exchange Point) through the digitizing reticle to the marks on the Calibration Overlay (see Figure 2-22B). Ideally, the digitizing reticle should be between the marks labeled 3 and 4. For this reason, the System Memory circuit board OFFSET straps are set at 1-0-0 on plotters shipped from the factory. If the digitizing reticle is between any other marks, change the OFFSET straps on the System Memory circuit board to reflect the actual location of the center of the digitizing reticle crosshair. Continue this procedure to change the OFFSET straps. If no change is necessary, skip to Final Checks and Cover Replacement.
2. **Turn** off the plotter's POWER switch and unplug the line cord.

NOTE

The plotter MUST be turned off during this procedure because the processor only reads these straps one time when the plotter is turned on.

3. **Change** the System Memory circuit board OFFSET straps to reflect the label of the overlay mark closest to the center of the digitizing reticle. Use Table 2-2 as a guide for setting the OFFSET straps. If the center of the digitizing reticle is centered between two marks, set the straps according to the higher of the two marks.
4. **Plug** in the plotter's line cord and turn on the plotter's POWER switch. Allow the plotter to initialize.

Table 2-2

OFFSET STRAP SETTINGS

Calibration Overlay Marks	Strap Setting		
	J244	J242	J241
0	0	0	0
1	0	0	1
2	0	1	0
3	0	1	1
4	1	0	0
5	1	0	1
6	1	1	0
7	1	1	1

Pen Cap Replacement

After every 500 hours or so, it may be necessary to replace the rubber pen caps on the pen capping plate. It may be necessary to change the pen caps more often if they become worn, deformed, or filled with ink (especially different colored ink, which may contaminate the pen tips), or if the bottom vent hole becomes plugged.

Refer to Section 3 for the Pen Cap Replacement procedure.

Pen Cap Alignment

Each pen cap under the rotary pen turret should be directly below the associated pen tip in order to ensure proper capping of the pens between uses. A bracket that is secured by a hex-socket cap screw holds these pen caps and allows some positioning of the pen caps.

1. **Turn** the rotary pen turret knob to UNCAP.
2. **Remove** the eight rubber pen caps.

3. **Place** the pen cap gauge in the pen holder (claw) of Pen Position #1. When the top of this gauge is lifted and then released, the tip of this gauge should drop into the hole on the pen cap bracket formerly occupied by the rubber pen cap (see Figure 2-23). If the gauge does not drop into the bracket, loosen the hex-socket cap screw that holds the bracket and position the bracket so that the tip of the gauge just drops into the bracket.
4. **Repeat** Step 3 for the other seven pen positions, 2 through 8.
5. **Replace** the eight rubber pen caps.

Final Checks and Cover Replacement

1. **Press** PEN CONTROL 3, which deenergizes the rotary pen turret motor.
2. **Remove** the digitizing reticle and replace the pen cap in the rotary pen turret's Pen Position 1.
3. **Thread** seven pens into the pen adapters (an eighth pen was previously threaded). Firmly seat the pens into the adapters.
4. **Load** all eight pens manually (in adapters) into the rotary pen turret.
5. **Rotate** the rotary pen turret knob fully counter-clockwise (CAP).
6. **Ensure** that no pen is located in the pen carriage.
7. **Remove** the Calibration Overlay from the platen.
8. **Press** the PEN CONTROL 7 switch, which causes the plotter to sequentially exchange each pen starting with Pen 1. After Pen 8 has been exchanged, the cycle starts over with Pen 1. Permit this process to cycle three or four times.
9. **Press** the PEN CONTROL 8 switch to stop the automatic pen exchange cycle. Because the plotter stores several commands before executing them, there may be several more pen exchanges after pressing PEN CONTROL 8.
10. **Press** in and lock down the plotter's LOAD switch.
11. **Press** the plotter's LOAD again to release it to the up position.
12. **Make sure** there is a pen in the pen carriage.
13. **Press** the PEN CONTROL 7 SWITCH. When the cycle starts, the pen in the pen carriage should be stored in the empty position in the rotary pen turret. If not, the pen sense switch needs adjusting (refer to the Pen Sense Switch Adjustment).
14. **Press** the PEN CONTROL 8 switch to stop the automatic exchange cycle.
15. **Turn** off the plotter's power.
16. **Move** the Pen Turret Drive circuit board strap from CAL to NORM.
17. **Place** the plotter case on the frame.
18. **Position** the two front panel label strips in position on the plotter case.
19. **Install** the eight hex-socket cap screws holding the plotter case to the frame (see Appendix G).

This completes the adjustments for the Option 31 equipped 4662 Plotter.

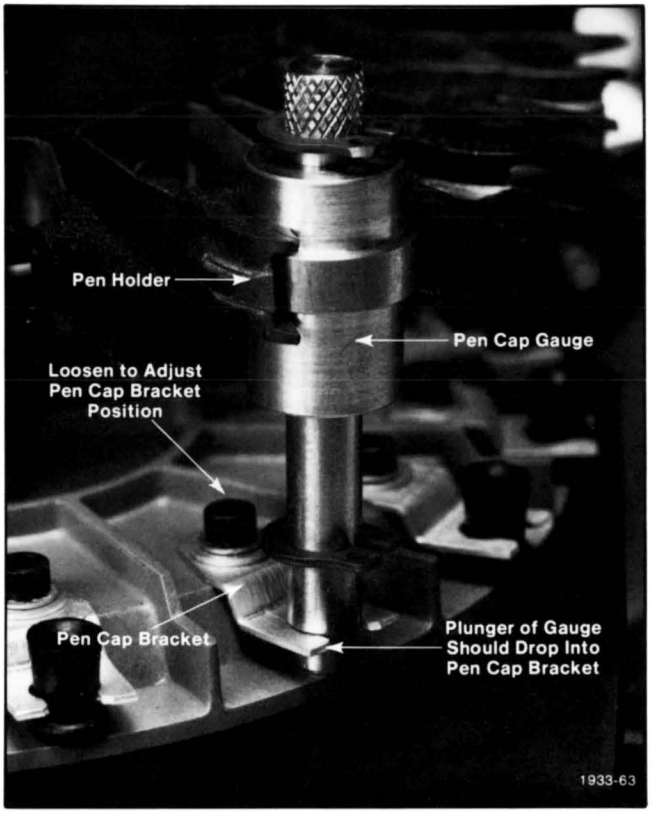


Figure 2-23. Pen Cap Alignment.

Section 3

ASSEMBLY/DISASSEMBLY

ABOUT THIS SECTION

This section describes the procedures for removing and replacing most parts, circuit boards, or mechanical assemblies. This section also contains the procedures for stringing the pen drive cables.

The contents at the beginning of this manual list the removal and replacement instructions which are included in this section. Refer to the mechanical exploded views in Section 8 when performing these removal and replacement procedures.

NOTE

In most instances, the procedures assume that the service technician has removed the plotter case and platen. The procedures for removing the plotter case and platen are located in Appendix G. Refer to these procedures as requested in the following instructions.

NOTE

Removal/replacement of many plotter parts or assemblies will require that a plotter adjustment (or a portion of the adjustment procedure) be performed. Table 3-1 shows which adjustments are required for each assembly removed/replaced. All other parts removed and replaced do not require any plotter adjustment. Refer to Section 2 for the adjustment procedures.

Table 3-1

REPLACED ASSEMBLIES REQUIRING ADJUSTMENT

Replaced Part/Assembly	Adjustment Required
X or Y-Axis Pen Drive Cables	• Both X- and Y-Pen Drive Cable Tension Adjustments • Setting Rotary Pen Turret Exchange Point (Option 31) • (X-axis cable also requires Aligning the X-Axis, Platen, and Orthogonality)
X or Y-Axis Cable Drive Motor	• Both X- and Y-Pen Drive Cable Tension Adjustments • Aligning the X-Axis, Platen, and Orthogonality • Setting Rotary Pen Turret Exchange Point (Option 31) • (X-axis motor also requires Rotary Pen Turret Height Adjustment)
Joystick	• Joystick Electrical Center Adjustment
Pen Carriage	• Both X- and Y- Pen Drive Cable Tension Adjustments • Pen Actuator Adjustments • Pen Pressure Adjustments
Pen Actuating Solenoid	• Pen Actuator Adjustments
Linear Bearing	• Both X- and Y- Pen Drive Cable Tension Adjustments • Aligning the X-Axis, Platen, and Orthogonality • Limit Switch Adjustment • Setting Rotary Pen Turret Exchange Point (Option 31) • Adjusting X-Axis Pen Exchange Position (Option 31)
Platen	• Pen Actuator Adjustments • Aligning the X-Axis, Platen, and Orthogonality • Limit Switch Adjustment • Setting Rotary Pen Turret Exchange Point (Option 31) • Adjusting X-Axis Pen Exchange Position (Option 31)

Replaced Part/Assembly	Adjustment Required
Entire Option 31 Mechanism	• Set Motor Belt Tension • Rotary Pen Turret Height Adjustment • Pen Sense Switch Adjustment • Setting Rotary Pen Turret Exchange Point • Adjusting X-Axis Pen Exchange Position • Pen Cap Alignment
Rotary Pen Turret Drive Motor and/or Belt	• Set Motor Belt Tension • Rotary Pen Turret Height Adjustment • Setting Rotary Pen Turret Exchange Point
Optical Interruptor	• Set Lower Bushing Clearance • Set Motor Belt Tension • Rotary Pen Turret Height Adjustment • Setting Rotary Pen Turret Exchange Point
Pen Capping Plate	• Set Lower Bushing Clearance • Set Motor Belt Tension • Rotary Pen Turret Height Adjustment • Setting Rotary Pen Turret Exchange Point • Pen Cap Alignment
Pen Holder Hub/Pen Holder (claw)	• Rotary Pen Turret Height Adjustment • Pen Sense Switch Adjustment • Adjusting X-Axis Pen Exchange Position
Pen Sense Switch	• Pen Sense Switch Adjustment
Pen Cap Holders	• Pen Cap Alignment

CABLE STRINGING

The 4662 plotter uses two separate motor and cable assemblies to move the Y-axis arm and pen carriage. One assembly moves the Y-axis arm back and forth along the X-coordinate and the other moves the pen carriage back and forth along the Y-axis arm in the Y-coordinate.

The X-axis motor is located on the left side of the plotter (when viewed from the front of the plotter), while the Y-axis motor is located on the right side of the plotter.

The cables, which are plastic-coated, operate through a network of pulleys. If a cable should break, if the plastic coating becomes worn or cracked, if some of the steel strands break and poke through the plastic coating, or if the cable has to be removed during a mechanical disassembly procedure, it will be necessary to install new cables using the following procedures.

Pen Drive Cables Required:

- X-axis cable, 11 feet, size .034 inch diameter (TEKTRONIX Part Number 214-2002-00).
- Y-axis cable, 11 feet, size .018 inch diameter (TEKTRONIX Part Number 214-2001-00).

NOTE

Throughout these procedures, all references to the right or left sides are made assuming that the service technician is viewing the front of the plotter.

PRELIMINARY PROCEDURE

1. **Remove** the plotter case and platen following the instructions in Appendix G.
2. **Remove** the front switch panel that is held by two screws (one at each end of the panel). The plotter should appear as in Figure 3-1.
3. **Ensure** that the Y-axis drive pulley (the largest one) is mounted on the right stepping motor. Align the inner pulley flange flush with the outer surface of the plotter chassis (see Figure 3-2).

CAUTION

Exercise care when handling the pen drive cables because the plastic coating can easily be scraped off, especially when passing the cables near edges of the chassis or through the holes in the drive pulleys.

NOTE

When wrapping the cables, it is critical that each wrap be tight and even. No wraps should be on top of previous wraps. A little extra effort will eliminate having to restring the cables later. You can use masking tape to hold the cable on the pulleys during the stringing process.

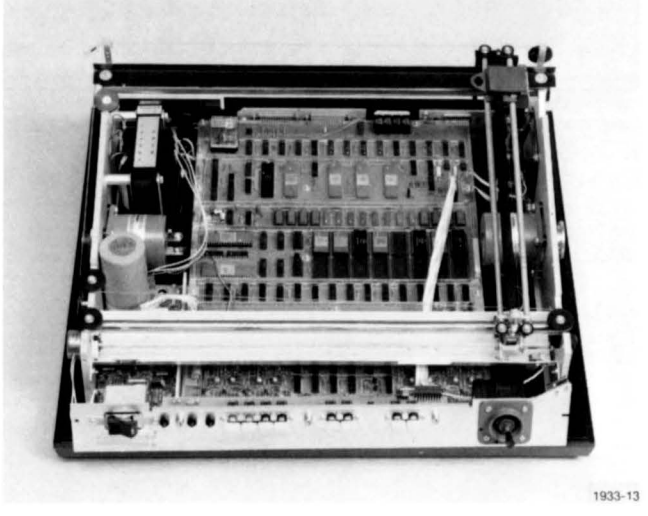


Figure 3-1. Plotter Ready for Cable Stringing.

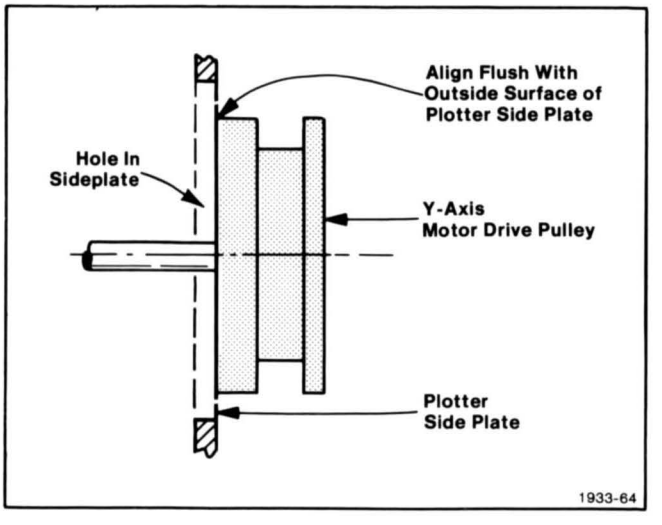


Figure 3-2. Y-Axis Motor Pulley Positioning.

X-AXIS CABLE STRINGING PROCEDURE

1. **Move** the Y-axis arm to the extreme right side.
2. **Remove** the X-axis drive pulley from the stepper motor on the plotter's left side. This pulley is held with two set screws.

CAUTION

Insert your thumb into the X-axis pulley to help guide the cable through the holes and prevent the plastic coating from being scraped off. If the cable's coating is scraped off, the cable must be replaced.

3. **Thread** about four feet of the .034-inch diameter cable down through the front (B) hole and up through the rear (A) hole (see Figure 3-3). If the cable has a loop on one end, arrange it so that the long end has the loop.
4. **Replace** the X-axis pulley on the X-axis motor shaft. The **INSIDE** edge of the pulley flange should be even with the outside surface of the plotter chassis (see Figure 3-4).
5. **Refer** to Figure 3-5. With the X-axis drive pulley cable holes pointing to the front of the plotter, wrap the long end of the cable (about seven feet long) clockwise under the pulley to the rear and up over the pulley to the front.
6. **Feed** the cable clockwise over Pulley A, counter-clockwise around Pulley B, through the front of the Y-axis arm (between the slide carriage casting and the pen actuator link assembly), around the front of pulley C, around the front of pulley D, and clock-wise around pulley E.
7. **Fasten** the cable with the securing screw on the left-rear of the Y-axis arm.
8. **Check** to be sure the drive cable lies in the grooves of the appropriate pulleys.
9. **Attach** the cable to the front of the Y-axis arm with the cable securing screw located there. Tighten only tight enough to hold the cable. This screw will be tightened in the orthogonality adjustment later.

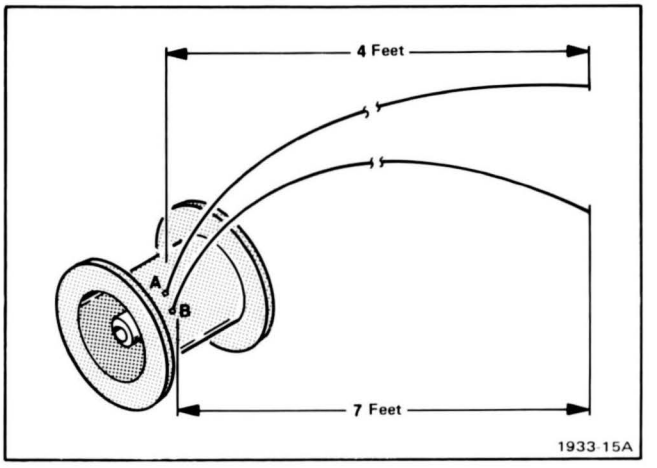


Figure 3-3. X-Axis Pulley Cable Threading.

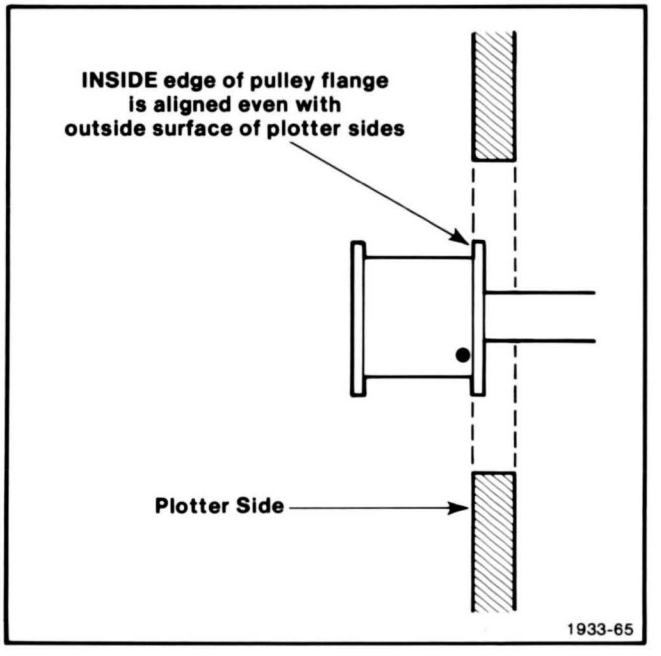


Figure 3-4. X-Axis Pulley Adjustment.

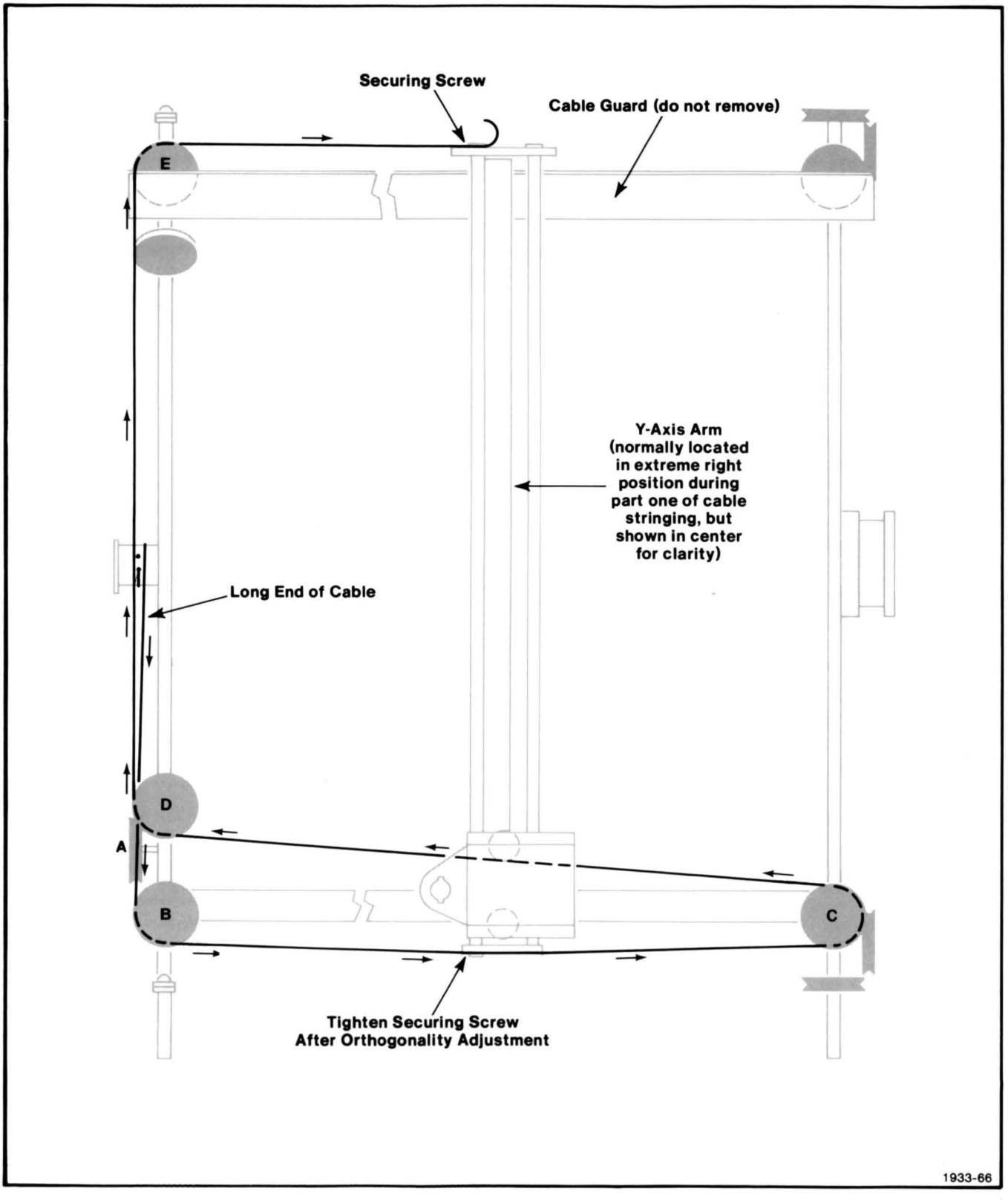


Figure 3-5. Part 1 of the X-Axis Cable Stringing Procedure.

10. **Wind** the cable onto the X-axis drive pulley by turning the pulley (not the cable) counterclockwise until the Y-axis arm moves to the stop at the left edge of the chassis. The cable windings should lie in a smooth, neat row toward the inner edge of the pulley. It may help to place some drag on the Y-axis arm as it moves to the left to ensure tight cable wraps on the X-axis drive pulley. Also, ensure that the cable wraps on the X-axis drive pulley are tight and even, and the wraps on each end do not touch the flanges of the pulley. A plastic tool can be used to guide the cable wraps as the pulley turns.
11. **Loop** the short end of the cable counterclockwise from under the drive pulley and across the top.
12. **Refer** to Figure 3-6 and feed the short end of the cable around the back of Pulley F, around Pulley G counterclockwise, and fasten the cable with the securing screw on the right-rear of the pen carriage; leave no slack and do not allow the X-axis drive pulley to rotate.
13. **Check** that the drive cable lies in the grooves of the appropriate pulleys.
14. **Adjust** the cable tension using the procedure in Section 2 (Preventive Maintenance and Adjustment).

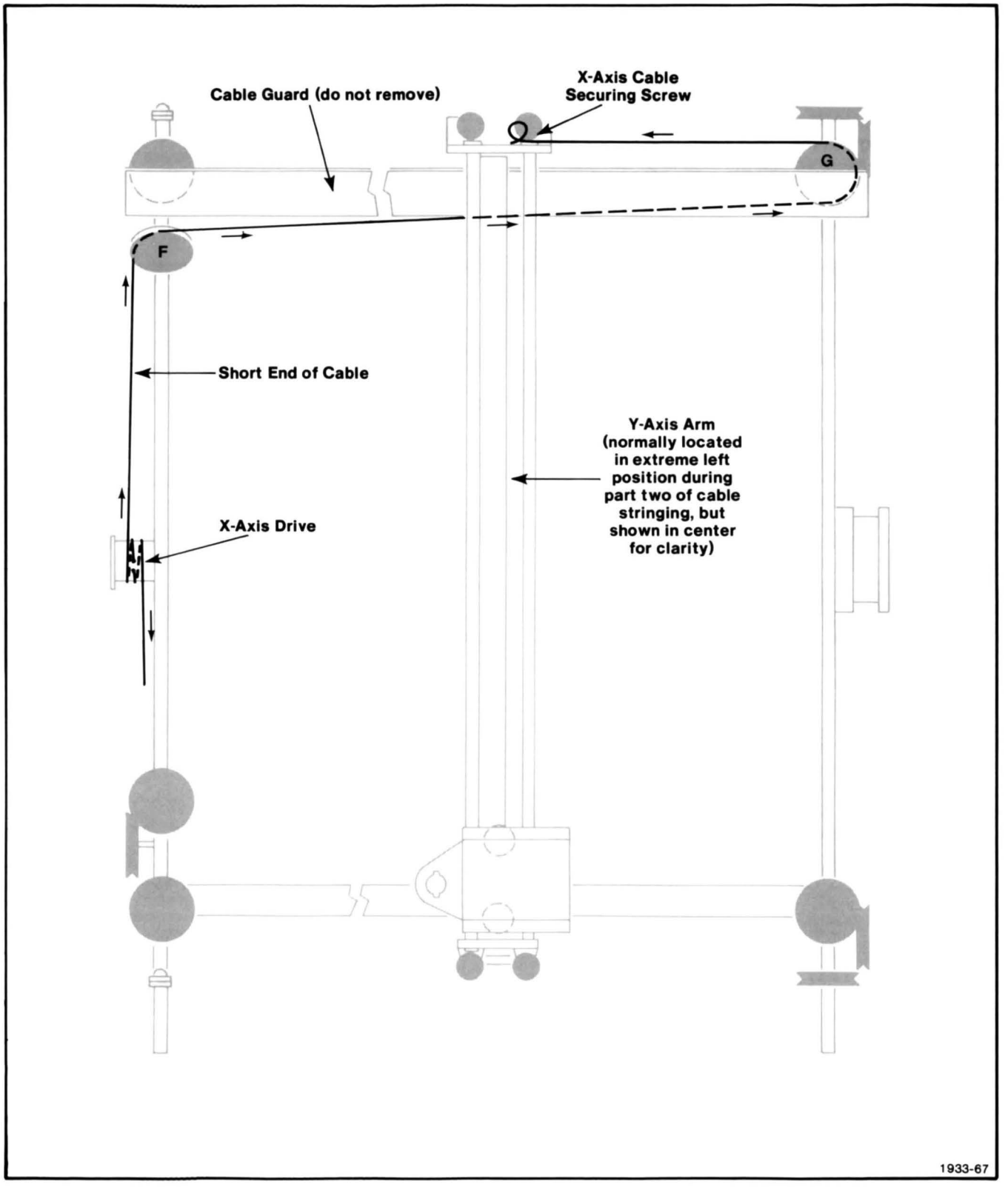


Figure 3-6. Part 2 of the X-Axis Cable Stringing Procedure.

Y-AXIS CABLE STRINGING PROCEDURE

1. **Thread** one end of the 11-foot, .018 inch diameter cable down through one hole in the Y-axis drive pulley (right side of the plotter) and back out the adjacent hole so that both ends of the cable are equal in length. If the cable has a loop on one end, arrange the cable so that the loop is on the end emerging from the left hole of the pulley (with the pulley holes facing straight up and the pulley is viewed from the right side of the plotter).
2. **Move** the Y-axis arm manually to the far right edge of the platen area and the pen carriage to the extreme front position (Y= 0).
3. **Position** the Y-axis drive pulley so that both holes and the cable ends point straight up.
4. **Take** the front cable and loop it under the Y-axis drive pulley toward the back of the plotter. Feed this cable under Pulley H, over Pulley I, through the back pulley assembly of the pen carriage and secure the cable to the chassis post at the left-rear corner of the platen (see Figure 3-7). The pen carriage pulleys are designed so that if the cable is inserted on one side of the rear pulley, it will circle around and exit from the opposite side.
5. **Wind** the cable just strung onto the Y-axis drive pulley by turning the pulley (not the cable) clockwise until the pen carriage moves to the stop at the back of the chassis. The cable windings should lie in a smooth, neat row toward the inner edge of the pulley. It may help to place some drag on the pen carriage as it moves to the rear to ensure tight cable wraps on the Y-axis drive pulley. Also, ensure that the cable wraps on the Y-axis drive pulley are tight and even, and that the wraps on each end do not touch the flanges of the pulley. A plastic tool can be used to guide the cable wraps as the pulley turns.
6. **Loop** the other end of the cable clockwise around and under the Y-axis drive pulley.
7. **Refer** to Figure 3-7 and feed the cable under Pulley J, over Pulley K, through the front pulley assembly in the pen carriage, and secure the cable to the plotter chassis left of the front panel POWER switch. The pen carriage pulleys are designed so that if the cable is inserted on one side of the front pulley, it will circle around and exit from the opposite side.

CAUTION

If the plotter has Option 31 installed, be sure to trim off any excess cable to prevent the cable from contacting the pen turret drive board and creating a short circuit.

8. **Check** that the drive cable lies in the grooves of the appropriate pulleys.
9. **Adjust** the cable tension using the procedure in Section 2 (Preventive Maintenance and Adjustment).
10. **Replace** the front switch panel (removed in the Preliminary procedure).

The X-axis and platen will need to be aligned and an orthogonality adjustment made (refer to Section 2 — Preventive Maintenance and Adjustment).

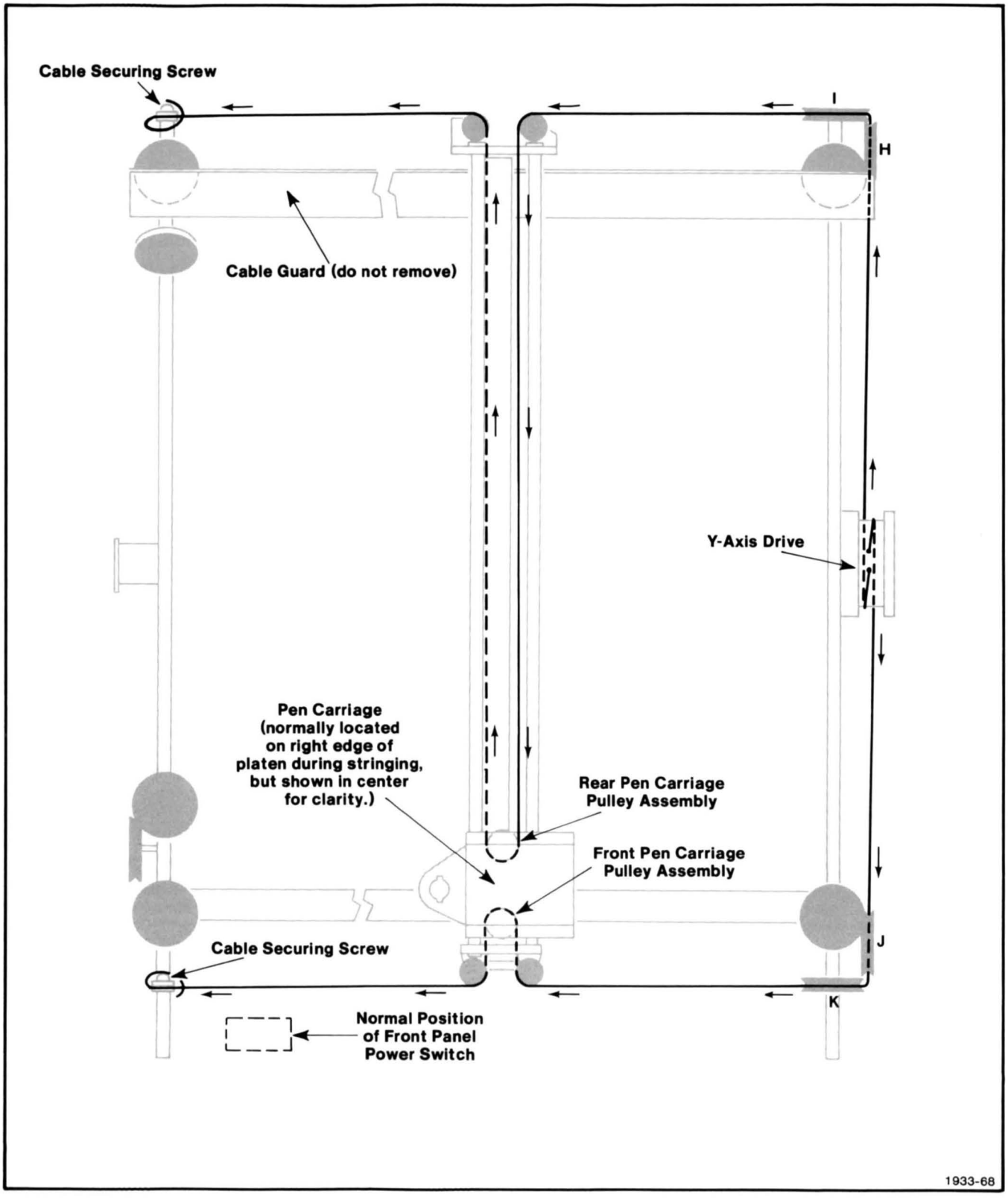


Figure 3-7. Y-Axis Cable Stringing Diagram.

CIRCUIT BOARD REPLACEMENT

Figure 3-8 shows the location of the circuit boards in the plotter.

Refer to Section 4 (Interconnecting Wiring) while reconnecting cables to and from circuit boards.

FIRMWARE PATCH CIRCUIT BOARD

Some early model plotters were shipped with a Firmware Patch circuit board (670-5120-00, 01, 02 . . .).

1. **Remove** the plotter case and platen following the instructions in Appendix G.
2. **Remove** the flat ribbon-cables from J41 and J51 of the Firmware Patch circuit board.
3. **Disconnect** connector J105 on the Firmware Patch circuit board.
4. **Remove** the two screws holding the Firmware Patch circuit board to spacer posts near connectors J41 and J51. It is not necessary to remove the two screws on the left side of the Firmware Patch circuit board.
5. **Remove** the Firmware Patch circuit board.
6. **Reverse** this procedure to replace the circuit board (see Section 4 for diagrams of interconnecting cables).

SYSTEM MEMORY CIRCUIT BOARD

Early model plotters not equipped with Option 31 (multiple pens) may not contain the System Memory circuit board (670-7176-00, 01, 02 . . .).

1. **Remove** the plotter case and platen following the instructions in Appendix G.
2. **Remove** the flat ribbon-cable from J41 and J51 of the System Memory circuit board.
3. **Remove** the flat ribbon-cable from J190 of the System Memory circuit board.
4. **Remove** the cable from J105 of the System Memory circuit board.
5. **Remove** the four screws holding the System Memory circuit board to spacer posts underneath.
6. **Lift** the System Memory circuit board from the plotter.
7. **Reverse** this procedure to replace the circuit board (see Section 4 for diagrams of interconnecting cables).

ATN/DAV HOLDOFF CIRCUIT BOARD

Some modes of plotters are not equipped with this circuit board (670-7787-00, 01, 02,...).

1. **Remove** the plotter case (it is not necessary to remove the platen) following the instructions in Appendix G.
2. **Remove** connector J1.
3. **Remove** the screw holding the ATN/DAV Holdoff circuit board to the spacer post that is located near rear panel switch A. It is not necessary to remove the two screws holding the ATN/DAV Holdoff circuit to the two spacers on the edge (side) of the main Plotter circuit board.
4. **Remove** the ATN/DAV Holdoff circuit board.
5. **Reverse** this procedure to replace the circuit board.

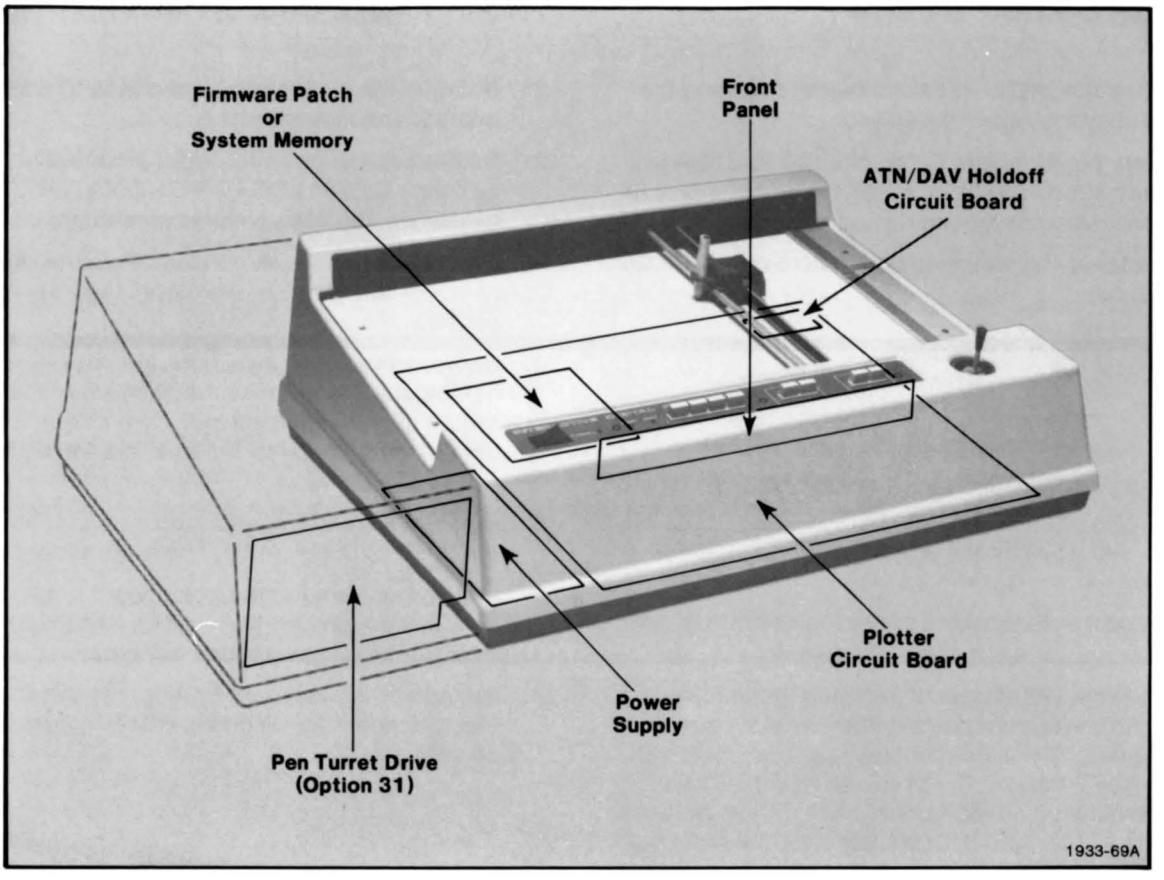


Figure 3-8. Plotter Circuit Board Locations.

PLOTTER CIRCUIT BOARD

1. **Remove** the plotter case and platen following the instructions in Appendix G.
2. **Remove** the Firmware Patch circuit board, System Memory circuit board, or ATN/DAV circuit board (if present). Use the preceding instructions.
3. **Disconnect** the following connectors on the Plotter circuit board:

J21	J71
J31	J105
J35	J291
J41	J765
J61	J871

4. **Remove** the four hex-socket cap screws (5/64-inch Allen wrench required) surrounding J102, J103, and J104 on the plotter's rear panel (see Figure 3-9).
5. **Remove** the front switch panel that is held by two screws (one at each end of the panel).
6. **Remove** the 12 screws holding the Plotter circuit board to the spacer posts underneath the board (see Figure 3-10). If the plotter was equipped with either the Firmware Patch circuit board or the System Memory circuit board, two or three of these screws will be spacer posts that must be removed.
7. **Lift** the Plotter circuit board out of the rear of the plotter.
8. **Reverse** this procedure to replace the circuit board (see Section 4 for diagrams of interconnecting cables).

FRONT PANEL CIRCUIT BOARD

1. **Remove** the plotter case and platen following the instructions in Appendix G.
2. **Remove** the caps on the eight push-button switches (LOAD, LOCAL, PEN, CALL, SET, AND LOCATE). The caps simply pull straight up and off.
3. **Disconnect** the three connectors to the right end of the circuit board (viewed from the front of the plotter).
4. **Remove** the six screws, nuts, and lockwashers holding the Front Panel circuit board to the front switch panel. These screws are immediately adjacent to the eight push-buttons that were uncapped in Step 2.
5. **Remove** the black plastic ring from around each of the three LED indicators. The rings simply lift off.
6. **Lower** the Front Panel circuit board until it is free, carefully guiding the three LEDs and the eight push-buttons through the front panel.
7. **Reverse** this procedure to replace the circuit board (see Section 4 for diagrams of interconnecting cables).

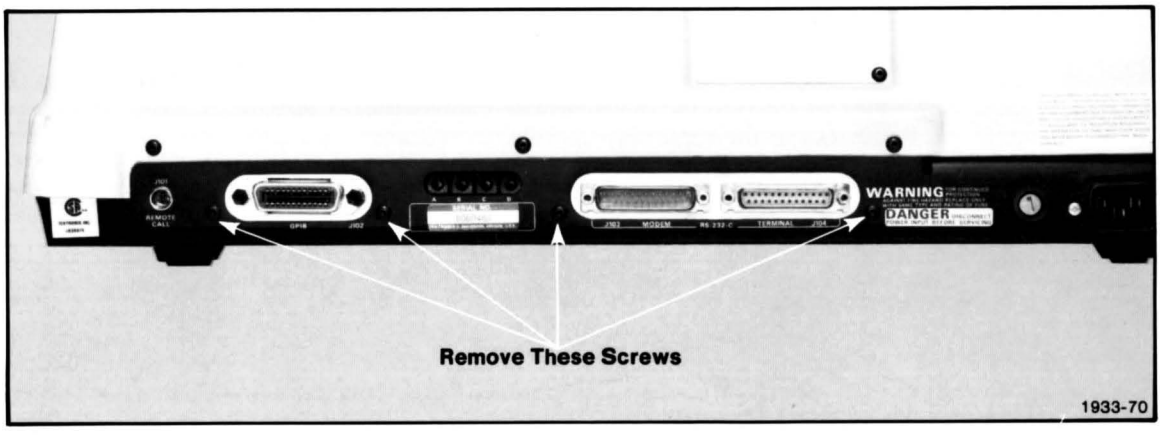


Figure 3-9. Rear Panel Circuit Board Screw Locations.

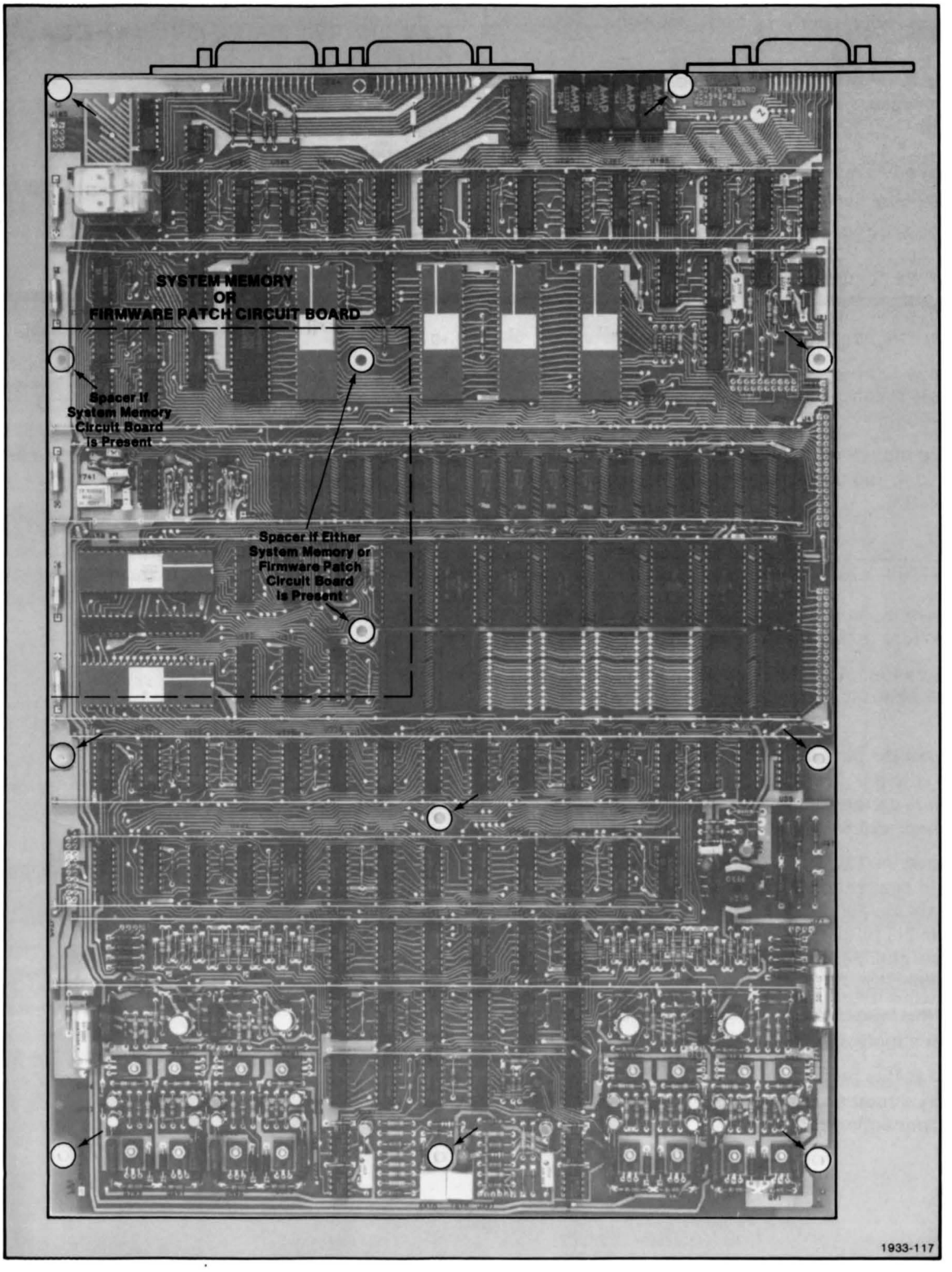


Figure 3-10. Plotter Circuit Board Screw Locations.

POWER SUPPLY

To remove the Power Supply circuit board, first remove the power supply assembly from the plotter using this procedure:

1. **Remove** the plotter case and platen following the instructions in Appendix G.
2. **Disconnect** connectors J10, J11 (unmarked), and J12 from the Power Supply circuit board. J11 is the two wires going to the pen actuating solenoid.
3. **Remove** the four screws on the bottom of the plotter that hold the power supply assembly.
4. **Remove** the two screws on the plotter's left side chassis that hold the debris catcher (protective circuit board cover).
5. **Lift** up the left end of the debris catcher loosened in Step 4, and lift the power supply assembly out of the plotter.

Remove the Power Supply circuit board from the power supply assembly as follows:

1. **Remove** the screws holding the four heatsinked transistors to the power supply assembly chassis.
2. **Remove** the four screws holding the Power Supply circuit board to spacer posts underneath the board.
3. **Remove** the screw holding the heatsinked rectifier (CR51) to the power supply assembly chassis. This screw is on the underside of the power supply assembly chassis near J12.
4. **Remove** the two screws holding the large capacitor (C1) to spacer posts on the power supply assembly chassis. Do not remove the two screws nearby that are visible through holes in the chassis. These screws connect the positive and negative leads to the capacitor.
5. **Free** the Power Supply circuit board from the power supply assembly chassis.
6. **Reverse** this procedure to replace the Power Supply circuit board (see Section 4 for diagrams of interconnecting cables).

PEN TURRET DRIVE CIRCUIT BOARD (OPTION 31)

To remove the Pen Turret Drive circuit board, first remove the pen turret drive assembly from the Option 31 equipped plotter. Use this procedure:

1. **Remove** the plotter case and platen following the instructions in Appendix G.
2. **Disconnect** connectors J190, J231, J242, J253, and J274.
3. **Remove** the screw holding the pen turret drive assembly to the plotter's left side chassis.
4. **Remove** the two screws underneath the plotter that hold the pen turret drive assembly to the plotter's bottom chassis.

Remove the Pen Turret Drive circuit board from the pen turret drive assembly as follows:

1. **Remove** the caps on the eight push-button switches. The caps simply pull straight up and off.
2. **Remove** the two screws immediately adjacent to the left and right ends of the eight push-button switches.
3. **Remove** the two screws holding the Pen Turret Drive circuit board to spacer posts on the pen turret drive assembly chassis. These screws are located on each side of connectors J231, J242, J253, and J274.
4. **Free** the Pen Turret Drive circuit board from the pen turret drive assembly chassis.
5. **Reverse** this procedure to replace the Pen Turret Drive circuit board (see Section 4 for diagrams of interconnecting cables).

CABLE DRIVE MOTOR REPLACEMENT

Use the following procedure to replace either axis drive motor. It may help to refer to the exploded parts diagram in Section 8 when performing this procedure.

It is possible to change the cable drive motor without unstringing the drive cable if you exercise care and have handy a 1/4-inch rod approximately 12 inches long.

1. **Remove** the plotter case and platen following the instructions in Appendix G.
2. **Loosen** (but do not remove) the two set screws holding the cable drive pulley on the motor shaft. For the X-axis, it may be necessary to move the Y-axis arm to the right to expose the two set screws. For Option 31 equipped plotters, you might find it helpful to remove the rear triangular-shaped brace plate. It is held with three screws (two underneath the plotter and one attaching the plate to the plotter's left side chassis).
3. **Unplug** the electrical cable connector that connects the motor to the Plotter circuit board (J871 for the X-axis and J71 for the Y-axis).
4. **Remove** the four screws, eight motor mounts, and four sleeve-nuts holding the motor to the plotter's side chassis.
5. **Work** the motor shaft out of the drive pulley gently and at the same time insert a 1/4-inch rod (approximately 12 inches long) in the drive pulley. If this rod is held in about the same position as the motor shaft, it will not be necessary to remove the cable and the drive pulley should remain neatly wound.
6. **Reverse** this procedure to replace the motor (see Section 4 for diagrams of the interconnecting cables).

JOYSTICK REPLACEMENT

To remove the joystick from the plotter, use the following procedure (refer to Figure 3-11):

1. **Remove** the plotter case and platen following the instructions in Appendix G.
2. **Disconnect** the six-wire joystick cable connector from J291 of the Plotter circuit board.
3. **Remove** the four screws holding the joystick to the front switch panel.
4. **Lift** the plastic molding retaining plate from the top of the front switch panel.
5. **Remove** the screw holding the right end of the front switch panel. Loosen (but do not remove) the screw holding the left end.
6. **Pull** the right end of the front switch panel gently toward the front of the plotter. Lower the joystick assembly past the debris catcher (circuit board protective cover).
7. **Pull** the plastic handle off the joystick control lever. The handle simply slides straight up and off.
8. **Lift** the joystick boot seal gently from the joystick.
9. **Unsolder** the cables from the joystick if the cables are needed on the replacement joystick.

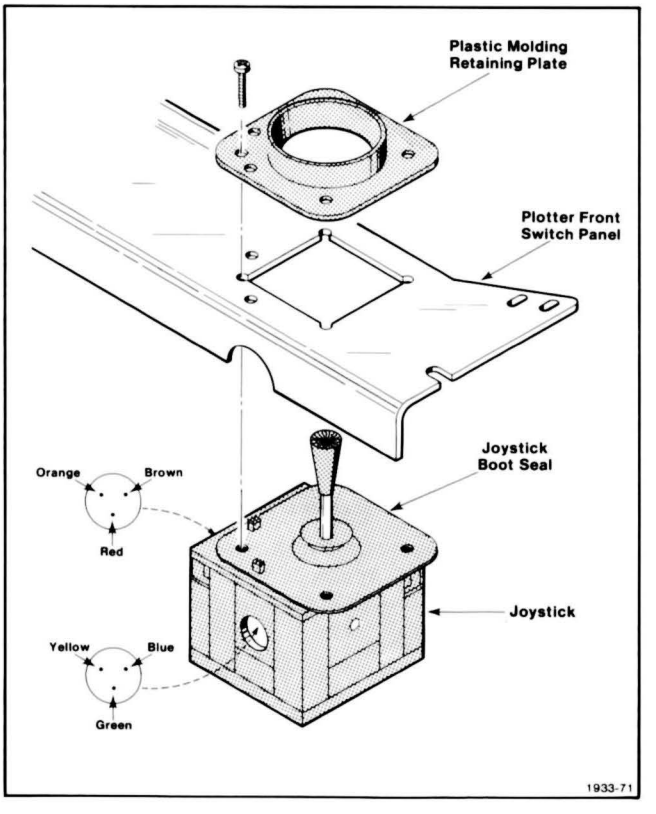


Figure 3-11. Joystick Assembly.

To replace the joystick, use the following procedure (refer to Figure 3-11):

1. **Ensure** that both joystick trim adjustments are moved toward the corner as shown in Figure 3-11.
2. **Solder** the six-wire cable to the solder contacts as shown in Figure 3-11.
3. **Slide** the plastic handle off the joystick control lever, and place the joystick boot seal over the top of the joystick assembly. Make certain that the boot seal is arranged as shown in Figure 3-11 so that the two trim adjustments protrude through two holes in the seal. Then, replace the plastic handle.
4. **Hold** the joystick to the underside of the front switch panel so that the yellow, blue and green wires point to the front of the plotter and the orange, brown, and red wires point to the left. Place the plastic molding retaining plate on top of the front switch panel over the joystick assembly. Arrange the retaining plate so that the group of three holes point to the left-front corner of the plotter as shown in Figure 3-11. Be sure that the rubber boot seal is in place and that the two joystick trim adjustments are visible through the two holes on the plastic molding retainer.

CAUTION

Do not overtighten the four screws in the following step because the joystick assembly is plastic and may break or you may strip the threads.

5. **Attach** the joystick assembly and the plastic molding retainer to the front switch panel with four screws.
6. **Move** the right end of the front switch panel into place and replace the screw holding the right end. Then tighten the screw holding the left end of the front switch panel.
7. **Attach** the six-wire cable connector to J291 of the Plotter circuit board.
8. **Install** the plotter case and platen using the instructions in Appendix G to restore the plotter to operation.

It is necessary to adjust the plotter after installing the joystick and moving front switch panel. It is especially important to perform the Joystick Electrical Center Adjustment.

FUSES

The plotter has one ac line overcurrent fuse on the rear panel and several overcurrent fuses on the Power Supply circuit board.

The replacement procedures follow.

LINE FUSE

The line fuse is located in a fuseholder on the rear panel immediately to the left of the power cord connector.

WARNING

Be sure that the power is turned off and that the power cord is disconnected. Serious injury could result from touching line voltage present in the fuseholder circuits.

After disconnecting the line cord from the power source, remove the fuse by turning the fuseholder cap 1/4-turn counterclockwise (CCW) with a small screw driver. Be sure that the replacement fuse has exactly the same rating as the fuse removed. The fuse should match one of the ratings listed below:

1 Ampere Slo-Blo for 105 to 116 volt operation.
0.5 Ampere Slo-Blo for 210 to 232 volt operation.

POWER SUPPLY FUSES

The power supply fuses are small axial-lead variety and the leads simply insert into holes on the circuit board.

NOTE

Do not solder these leads to the circuit board.

Figure 3-12 shows the locations of the power supply fuses and Table 3-2 lists their values.

Table 3-2

POWER SUPPLY FUSES

Fuse	Circuit	Value
F351	+ 28 volt circuit	1.5 A
F352	−5 volt circuit	1.5 A
F431	+ 12 volt circuit	1.5 A
F551	-12 volt circuit	0.25 A
F353	Switching Transistors Q301 and Q40	5.0 A[a]

[a]This fuse is not present on early model plotters.

Use the following procedure to replace the Power Supply circuit board fuses:

1. **Remove** the plotter case and platen following the instructions in Appendix G.
2. **Remove** the Power Supply circuit board if necessary. Most of the power supply fuses can be changed without removing the Power Supply circuit board if you exercise care. If removal of the Power Supply circuit board is necessary, refer to Circuit Board Removal — Power Supply (located earlier in this section).
3. **Grasp** the fuses gently with needle-nose pliers (use care — the fuse body is thin glass) and pull straight up.
4. **Insert** the axial leads of the replacement fuse into the holes on the Power Supply circuit board.
5. **Install** the plotter case and platen following the instructions in Appendix G.

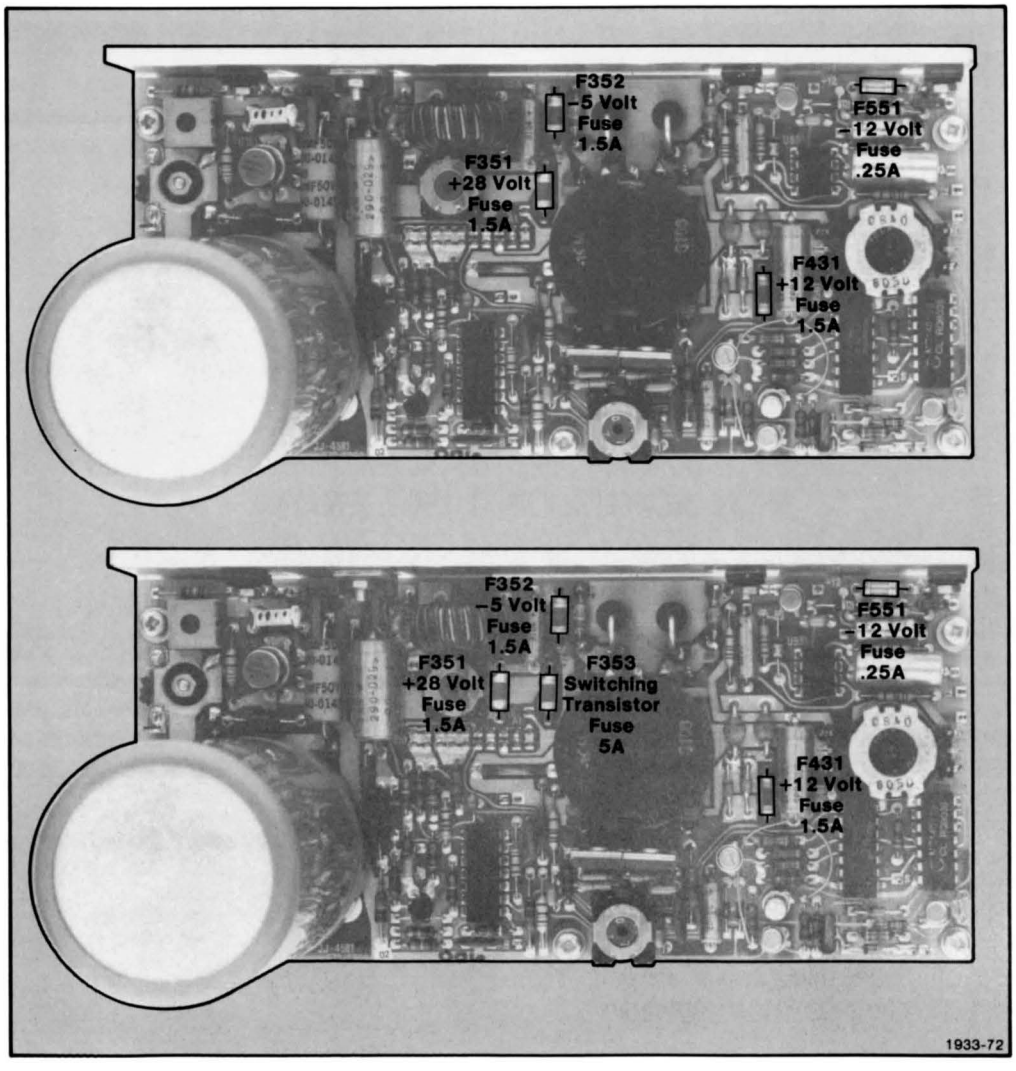


Figure 3-12. Power Supply Fuses.

PEN CARRIAGE REMOVAL/INSTALLATION

1. **Remove** the plotter case and platen following the instructions in Appendix G.

NOTE

The next step requires the removal of the Y-axis cable. Exercise care and tape the cable on the Y-axis drive pulley and pulleys H, I, J, and K (see Figure 3-7) to save much of the restringing later.

2. **Loosen** (but do not remove) the two Y-axis cable securing screws shown in Figure 3-7. Then remove both ends of the cable from the pen carriage back to pulleys H, I, J, and K (see Figure 3-7).
3. **Remove** the two Y-axis cable pulleys on the top and back of the Y-axis arm (the cable was removed in the previous step).
4. **Remove** the two screws holding the Y-axis arm rear-end carriage mounting plate to the two Y-axis slide rods.

NOTE

Carefully remove the spring mounted on the rear end of the pen actuating bar during the next step.

5. **Separate** the Y-axis arm rear-end carriage mounting plate from the pen actuating bar. To allow some slack in the X-axis cable, briefly loosen (but do not remove) the X-axis cable securing screw **with the looped end of the cable** on the rear-end of the Y-axis arm.
6. **Slide** the pen carriage off the back of the Y-axis arm.

To open up the pen carriage:

1. **Remove** the pen holder. It is held with one set screw (.050 inch) on each side.
2. **Remove** the two screws holding the pen holder spring. These screws are on the top of the pen carriage. Lift the spring off the pen carriage.
3. **Remove** the three screws and nuts holding the top and bottom halves of the pen carriage together. The center screw also holds the pressure pad spring under the pen carriage. Three rollers and two cable pulleys are inside the pen carriage.

Reverse these procedures to install the pen carriage. Refer to the exploded parts diagram in Section 8 for more information.

If you have removed and replaced the pen carriage, you must adjust the plotter for proper operation.

PEN ACTUATING SOLENOID

1. **Remove** the plotter case and platen following the instructions in Appendix G.
2. **Disconnect** the two-wire connector from J11 of the Power Supply circuit board.
3. **Remove** the two slotted round nuts holding the pen solenoid to the plotter's left side chassis. Use a screwdriver.

NOTE

In the next step, after sliding the solenoid assembly to the left two or three inches, it is necessary to remove the bushing from the right end of the square solenoid rod. This is necessary to allow the square rod to slide through the pen actuator assembly.

4. **Push** forward gently on the pin that is in the coupling that joins the solenoid to the square rod. This allows the entire solenoid assembly (including the pin) to slide to the left and out of the plotter. After sliding the solenoid assembly to the left two or three inches, remove the bushing on the right end of the square pen solenoid rod. The bushing simply slides off.
5. **Reverse** this procedure to replace the solenoid.

LINEAR BEARING REPLACEMENT

The linear bearing is the sleeve of the pen actuator assembly (front of the Y-axis arm) that slides along the front X-axis shaft. (This X-axis shaft is not the square pen solenoid shaft.) See Figure 3-13.

1. **Remove** the plotter case and platen following the instructions in Appendix G.
2. **Remove** both the X and Y-axis drive cables.
3. **Remove** the pen solenoid (instructions immediately precede these).
4. **Remove** the two Y-axis cable pulleys on the top and front end of the Y-axis arm (pen actuator assembly).
5. **Remove** the two screws holding the front X-axis shaft (one screw on each end) to the plotter sides.
6. **Loosen** the two set screws holding the pen bar cam to the end of the pen actuating bar. Remove the pen bar cam.
7. **Remove** the two screws holding the pen actuator assembly to the two Y-axis slide rods.
8. **Slide** the pen actuator assembly off the front X-axis shaft.
9. **Loosen** the three adjustment screws (see Figure 3-13).
10. **Remove** the two bearing retainers. They are held with screws.
11. **Slide** the linear bearing out of the pen actuator assembly.
12. **Install** the replacement linear bearing in the pen actuator assembly.

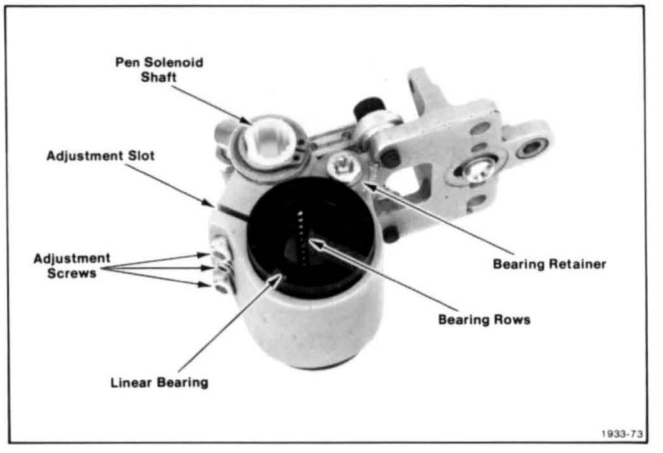


Figure 3-13. Linear Bearing Assembly.

13. **Rotate** the linear bearing in the pen actuator assembly to align the adjustment slot (Figure 3-12) so that it is over one of the casting seams on the linear bearing (see Figure 3-13).
14. **Insert** the front X-axis shaft through the linear bearing.
15. **Hold** the X-axis shaft and pen actuator assembly at approximately a 45° angle. Tighten the outer two of the three adjustment screws. Tighten the screws equally until the pen actuator assembly slides freely along the shaft without binding.
16. **Continue** to hold the X-axis shaft at approximately a 45° angle, position the pen actuator assembly to the high end of the shaft, and release it. It should not move until it is tapped gently with a finger and then it should slide freely down the shaft. Adjust both outside adjustment screws equally to achieve this.
17. **Reverse** the shaft position (with the other end of the shaft pointing up at a 45° angle) and repeat Step 16. Adjust if necessary. Then, tighten the center set screw and secure the setting with thread adhesive.
18. **Install** the two bearing retainers (see Figure 3-13).
19. **Reverse** Steps 1-7 to install the pen actuator assembly in the plotter.

PLATEN REPLACEMENT

See Appendix G.

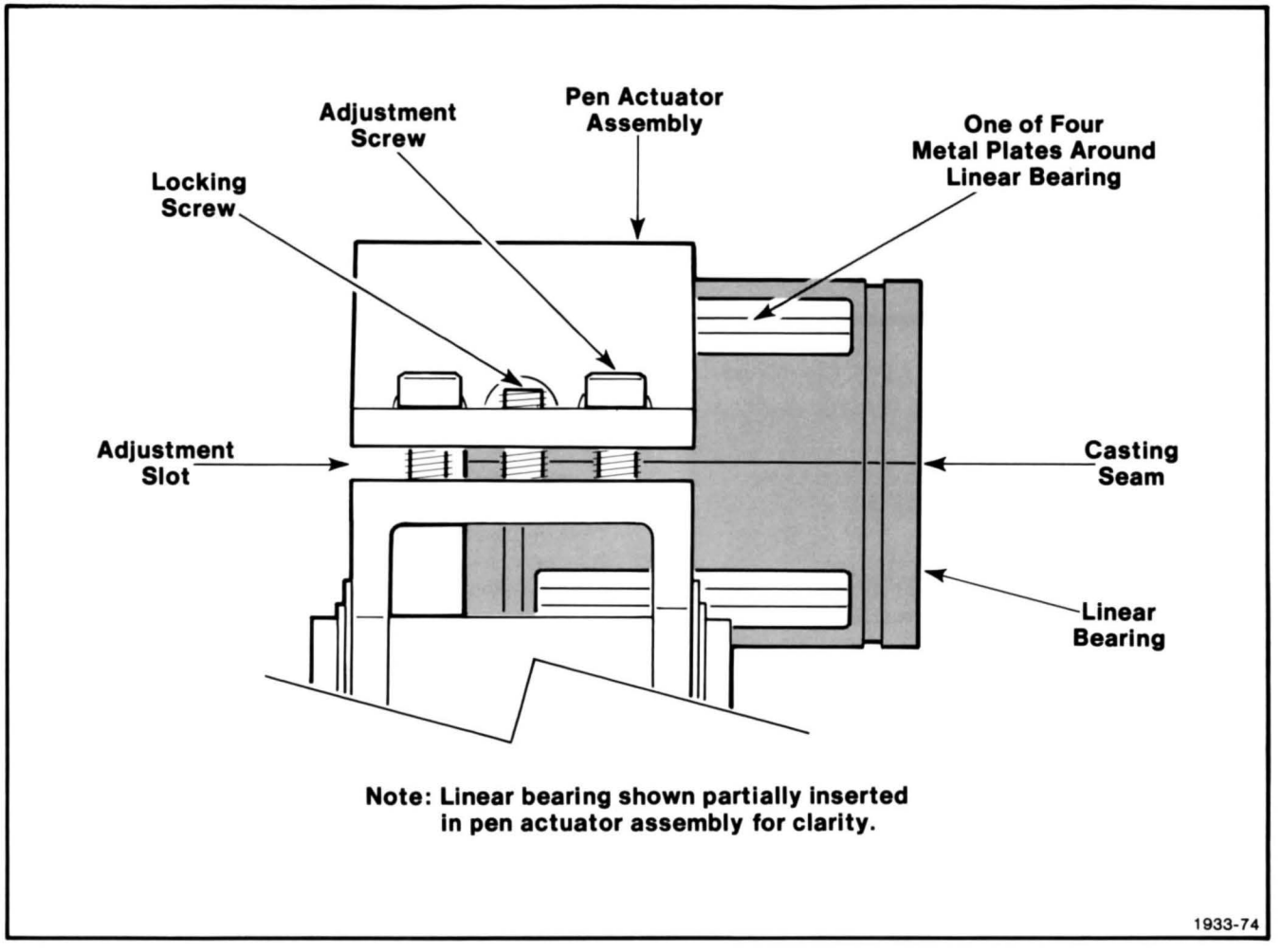


Figure 3-14. Linear Bearing Positioning.

OPTION 31 MECHANISM (MULTIPLE PENS)

To replace most parts of the Option 31 mechanism, it is usually easier to first remove the entire Option 31 mechanism from the plotter. Then you can easily remove and replace the desired part of the Option 31 mechanism. The following procedure describes how to remove the entire Option 31 mechanism and is referred to in several of the Option 31 parts assembly/disassembly procedures.

NOTE

Refer to the Mechanical Parts List in Section 8 for exploded parts diagrams while performing these procedures.

REMOVAL OF THE OPTION 31 MECHANISM

Use this procedure if the Option 31 parts assembly/disassembly procedures call for the removal of the entire Option 31 mechanism.

1. **Remove** the plotter case, but not the platen, following the instructions in Appendix G.
2. **Disconnect** the three electrical wire connectors at J231, J243, and J274 of the Pen Turret circuit board.
3. **Loosen** (but do not remove) the four screws holding the Option 31 mechanism to the plotter (see Figure 3-15).
4. **Lift** the entire Option 31 mechanism out of the plotter. Individual parts may be removed or added to the Option 31 mechanism as called for in the following procedures.

The Option 31 mechanism is replaced by reversing the above procedure. See Table 3-1 for the adjustments required for each part replaced.

ROTARY PEN TURRET DRIVE MOTOR AND/OR BELT

1. **Remove** the Option 31 mechanism from the plotter using the procedure "Removal of the Option 31 Mechanism."
2. **Remove** the four screws and washers holding the rotary pen turret drive motor to the Option 31 mechanism.
3. **Lift** the motor from the Option 31 mechanism. Leave the drive belt in place (around the large sprocket wheel) unless the belt is being changed.

Reverse this procedure to install the motor. However, orient the motor so that its electrical wires point to the rear of the plotter. Leave the mounting screws loose and perform the Option 31 Rotary Pen Turret Motor Belt Tension Adjustment in Section 2. Then, refer to Table 3-1 for other adjustments that may be required.

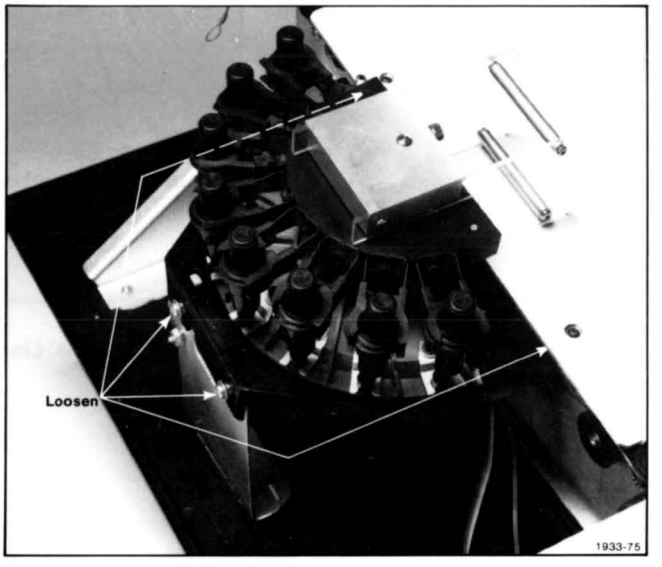


Figure 3-15. Option 31 Mechanism Securing Screw Locations.

OPTICAL INTERRUPTOR

1. **Remove** the Option 31 mechanism from the plotter using the procedure "Removal of the Option 31 Mechanism."
2. **Turn** the Option 31 mechanism upside down for the remainder of these instructions and follow the procedure for removing the "Rotary Pen Turret Drive Motor and/or Belt."

CAUTION

A large spring between the rotary pen turret mounting bracket and the pen cap plate may cause the remainder of the Option 31 mechanism to separate unexpectedly during the next step. Use care so that small parts are not dropped, lost, or damaged.

3. **Remove** the large sprocket wheel and attached cam (and belt) from the main rotary pen turret shaft. The shaft is held with two set screws.
4. **Remove** the bushing from the main rotary pen turret shaft. This bushing is between the large sprocket wheel (just removed) and the optical interruptor lever (see Figure 3-16).
5. **Remove** the optical interruptor lever adjustment lock screw and washer (see Figure 3-16).
6. **Remove** the two screws holding the optical interruptor (light source/phototransistor) to the optical interruptor lever (see Figure 3-16).
7. **Lift** the optical interruptor from its lever while threading the four-wire ribbon cable through the Optical 31 mechanism.

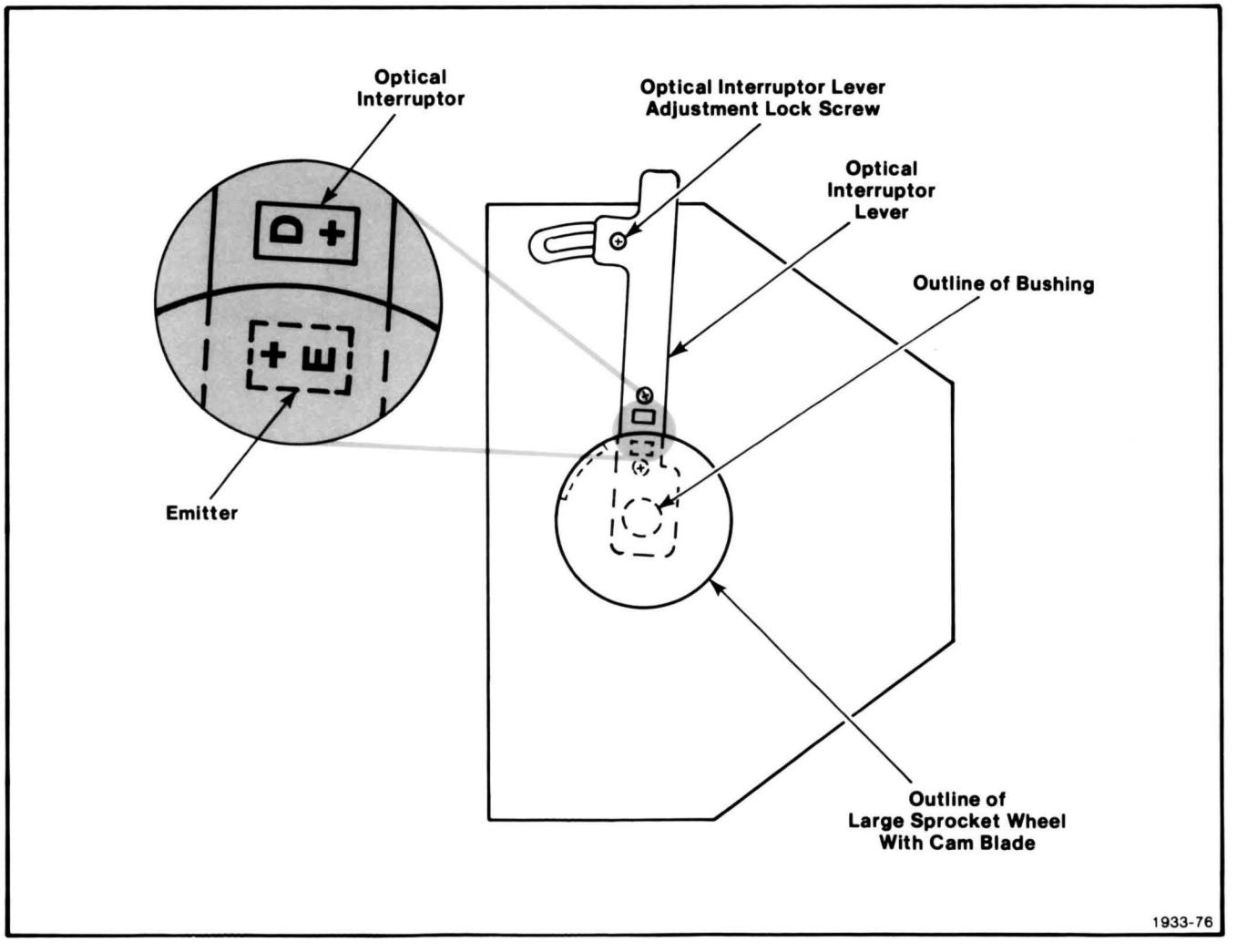


Figure 3-16. Optical Interruptor Lever Assembly.

The optical interruptor (light source/phototransistor) is replaced in the reverse manner, except that the optical interruptor is oriented with the emitter (marked E+) closest to the main rotary pen turret shaft (as shown in Figure 3-16). In addition, the sprocket wheel is oriented so that when the rotary pen turret knob index points to CAP, the sprocket wheel's cam blade is located between the optical interruptor's light source and its phototransistor.

Refer to Table 3-1 for the adjustments required after completing this assembly/disassembly.

PEN CAPPING PLATE

1. **Remove** the Option 31 mechanism from the plotter using the procedure "Removal of the Option 31 Mechanism."
2. **Remove** the rotary pen turret knob. It is held with one set screw.
3. **Remove** the rotary pen holder (turret) cover. It simply lifts straight up.
4. **Place** the rotary pen turret knob back on the shaft, but do not tighten its set screw.
5. **Refer** to Figure 3-17 and insert a .035-inch wire (a straightened paper clip, for example) through a hole in the pen holder hub and into a small hole through the spring (below) and its spring guide. Make sure that the wire goes clear through the spring and spring guide. It may take some turning of the rotary pen turret knob to align the top and bottom holes of the spring guide and to allow the wire to pass through. The wire holds the spring in a position to aid in its installation later. Then, remove the rotary pen turret knob.
6. **Lift** the pen holder hub off the shaft along with the spring and spring guide underneath.
7. **Turn** the Option 31 mechanism upside down.
8. **Follow** the procedure for removing the "Rotary Pen Turret Drive Motor and/or Belt."

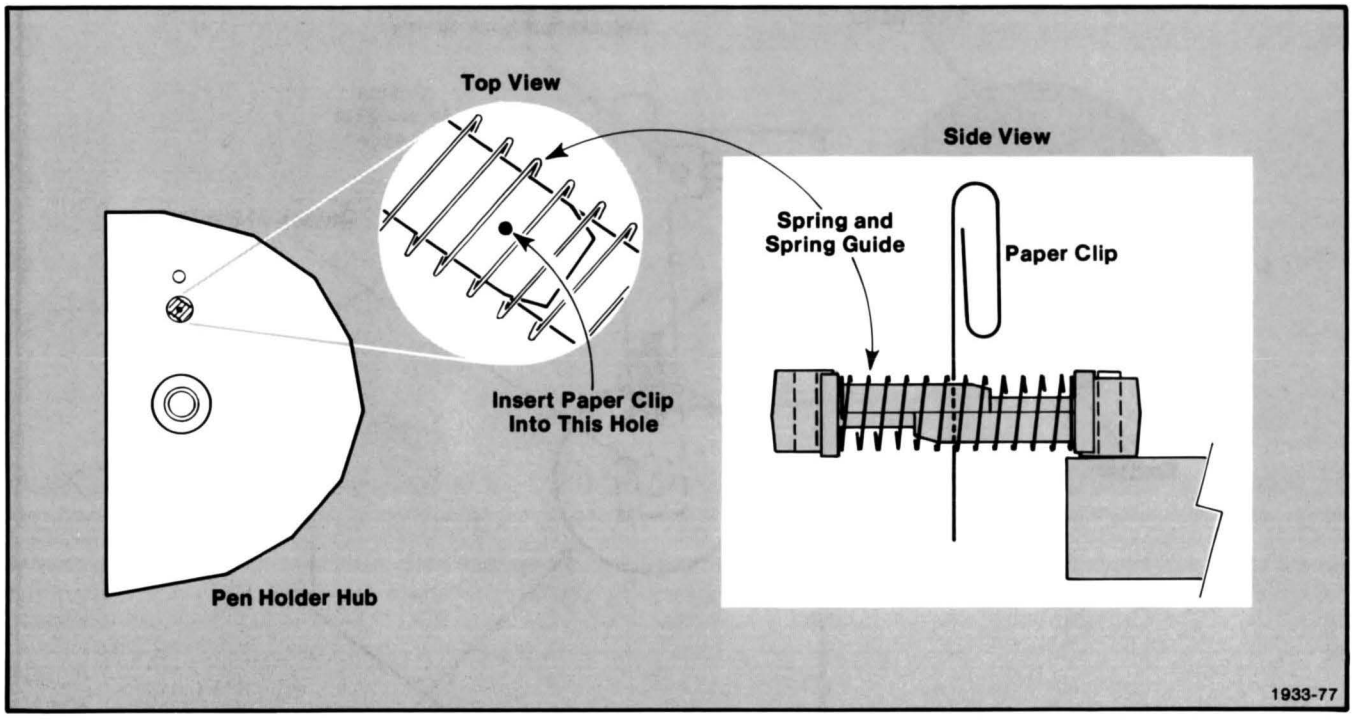


Figure 3-17. Pen Holder Hub Spring and Spring Guide Details.

NOTE

A large spring separates the Option 31 mounting bracket and the pen capping plate, which may cause the remainder of the Option 31 mechanism to separate unexpectedly during the next step. Use care so that small parts are not dropped, lost, or damaged.

9. **Remove** the large sprocket wheel and attached cam from the main rotary pen turret shaft. The shaft is held with two set screws.
10. **Remove** the bushing from the main rotary pen turret shaft. This bushing is between the large sprocket wheel (just removed) and the optical interruptor lever (see Figure 3-16).
11. **Separate** the pen capping plate from the Option 31 mounting bracket. The main shaft and attached cam join these two pieces and simply slide out of each piece.

Reverse this procedure to replace the pen capping plate. The pin on the lobed side of the cam (attached to the main shaft) goes into the spring guide (the part of the pen holder hub held with the paper clip). The sprocket wheel is oriented so that when the rotary pen turret knob index points to CAP, the sprocket wheel's cam blade is located between the optical interruptor's light source and its phototransistor.

Finally, refer to Table 3-1 for the adjustments required after completing this assembly/disassembly.

PEN HOLDER HUB/PEN HOLDER (CLAW)

1. **Remove** the Option 31 mechanism from the plotter using the procedure "Removal of the Option 31 Mechanism."
2. **Remove** the rotary pen turret knob. It is held with one set screw.
3. **Remove** the rotary pen holder (turret) cover. It simply lifts straight up.
4. **Place** the rotary pen turret knob back on the shaft, but do not tighten its set screw.
5. **Refer** to Figure 3-17 and insert a .035-inch wire (a straightened paper clip, for example) through a hole in the pen holder hub and into a small hole through the spring (below) and its spring guide. Make sure that the wire goes clear through the spring and spring guide. It may take some turning of the rotary pen turret knob to align the top and bottom holes of the spring guide and to allow the wire to pass through. The wire holds the spring in a position to aid in its installation later. Then, remove the rotary pen turret knob.
6. **Lift** the pen holder hub off the shaft along with the spring and spring guide underneath.

To remove/install a pen holder (claw), use the following procedure:

1. **Remove** the pen holder from the pen holder hub. It is held by a hex-socket cap screw.
2. **Install** the replacement pen holder in the pen holder hub, ensuring that the top surface of the hub is even with the top surface of the pen holder spring (see Figure 3-18).

Reverse this procedure to replace the pen holder hub. The pin on the lobed side of the cam (attached to the main rotary pen turret shaft) goes into the spring guide (the part of the pen holder hub held with the paper clip).

Finally, refer to Table 3-1 for the adjustments required after completing this assembly/disassembly.

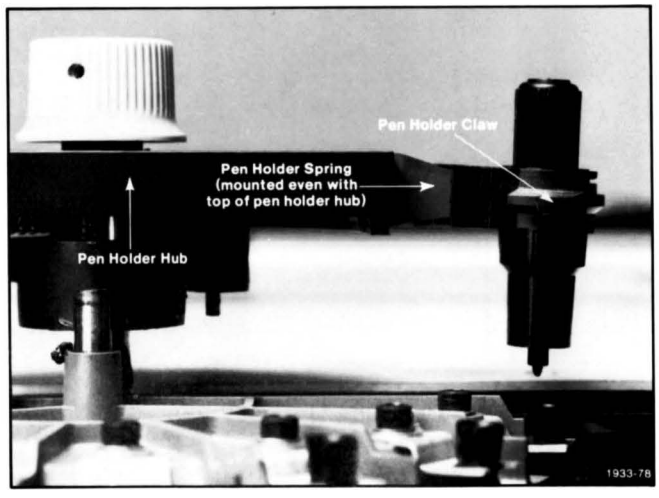


Figure 3-18. Pen Holder Hub and Pen Keeper Detail.

PEN SENSE SWITCH

1. **Turn** the rotary pen knob fully clockwise to expose the pen sense switch (see Figure 3-19).
2. **Disconnect** the connector from J231 of the Pen Turret Drive circuit board.
3. **Remove** the two screws holding the pen sense switch to the bracket.
4. **Lift** the pen sense switch out of the Option 31 mechanism while guiding the two-wire cable through the mechanism.

Reverse this procedure to replace the pen sense switch.

Finally, refer to Table 3-1 for the adjustments required after completing this assembly/disassembly.

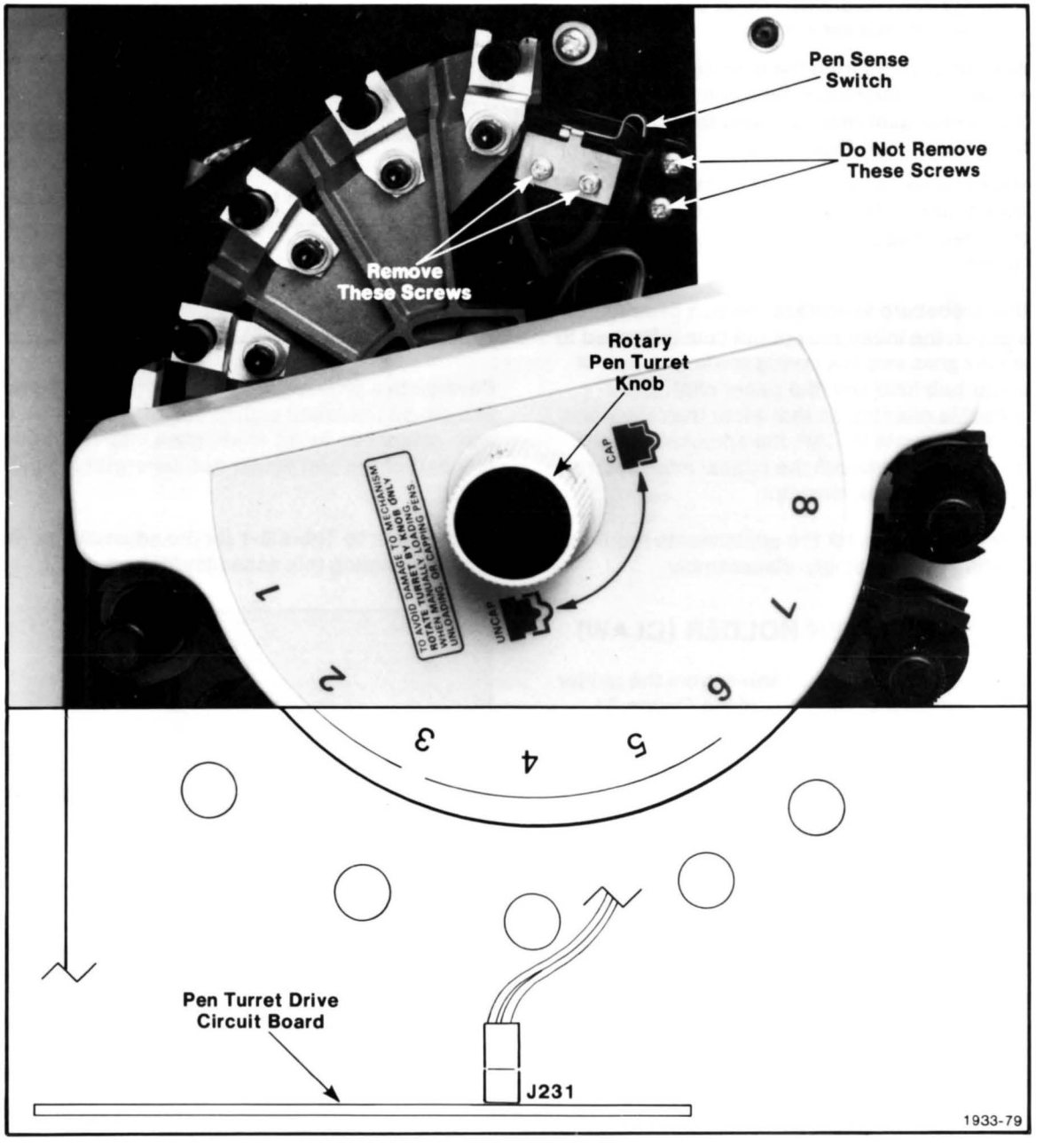


Figure 3-19. Pen Sense Switch Mounting Detail.

PEN CAPS

It may be necessary to replace the rubber pen caps on the pen capping plate after every 500 hours or so of plotter operation. It may even be necessary to replace these more often if they become worn, deformed, or filled with ink (especially with different colors of ink, which may contaminate the present pen tip), or if the bottom vent hole becomes plugged.

1. **Turn** the rotary pen turret knob clockwise until the rubber pen caps below the rotary pen turret become visible.
2. **Use** your fingers to slide the rubber pen caps out of their brackets (see Figure 3-20).
3. **Use** your fingers to slide the replacement rubber pen caps into their brackets.

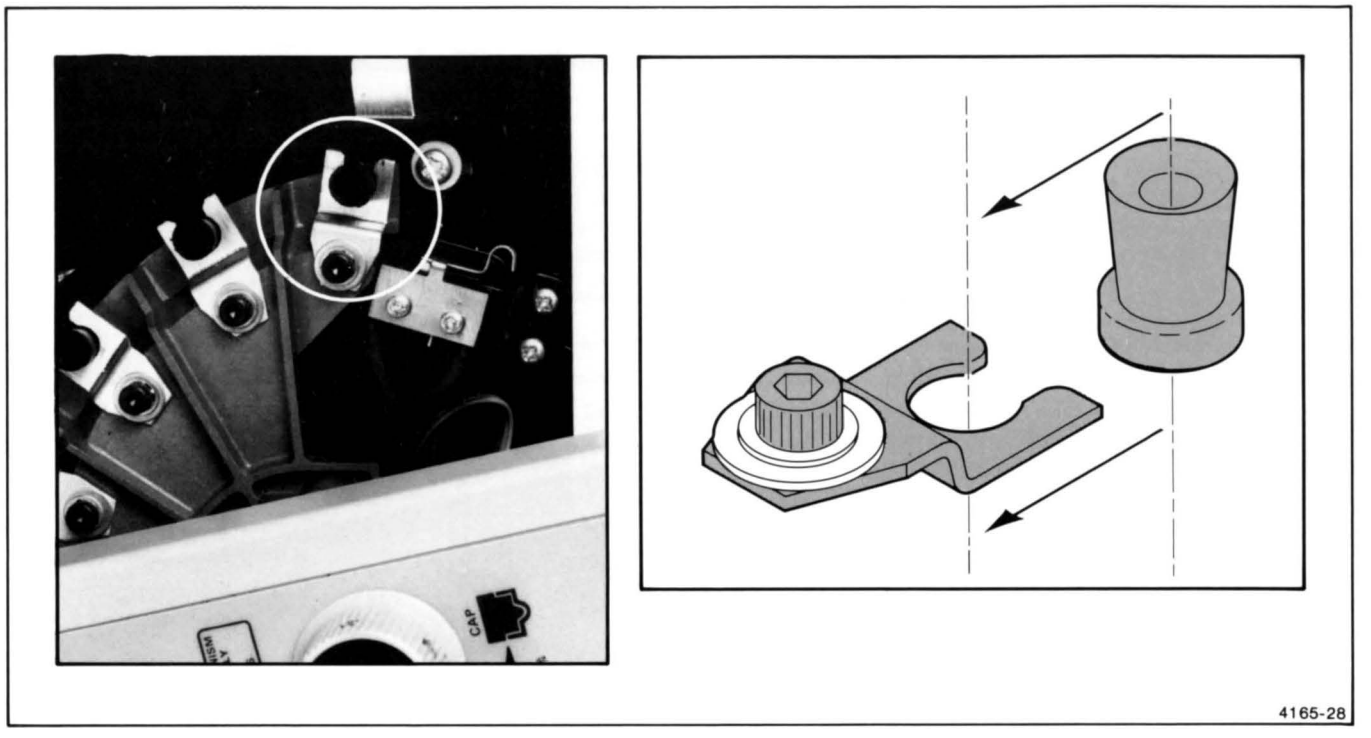


Figure 3-20. Replacing Pen Caps (Option 31 Only).

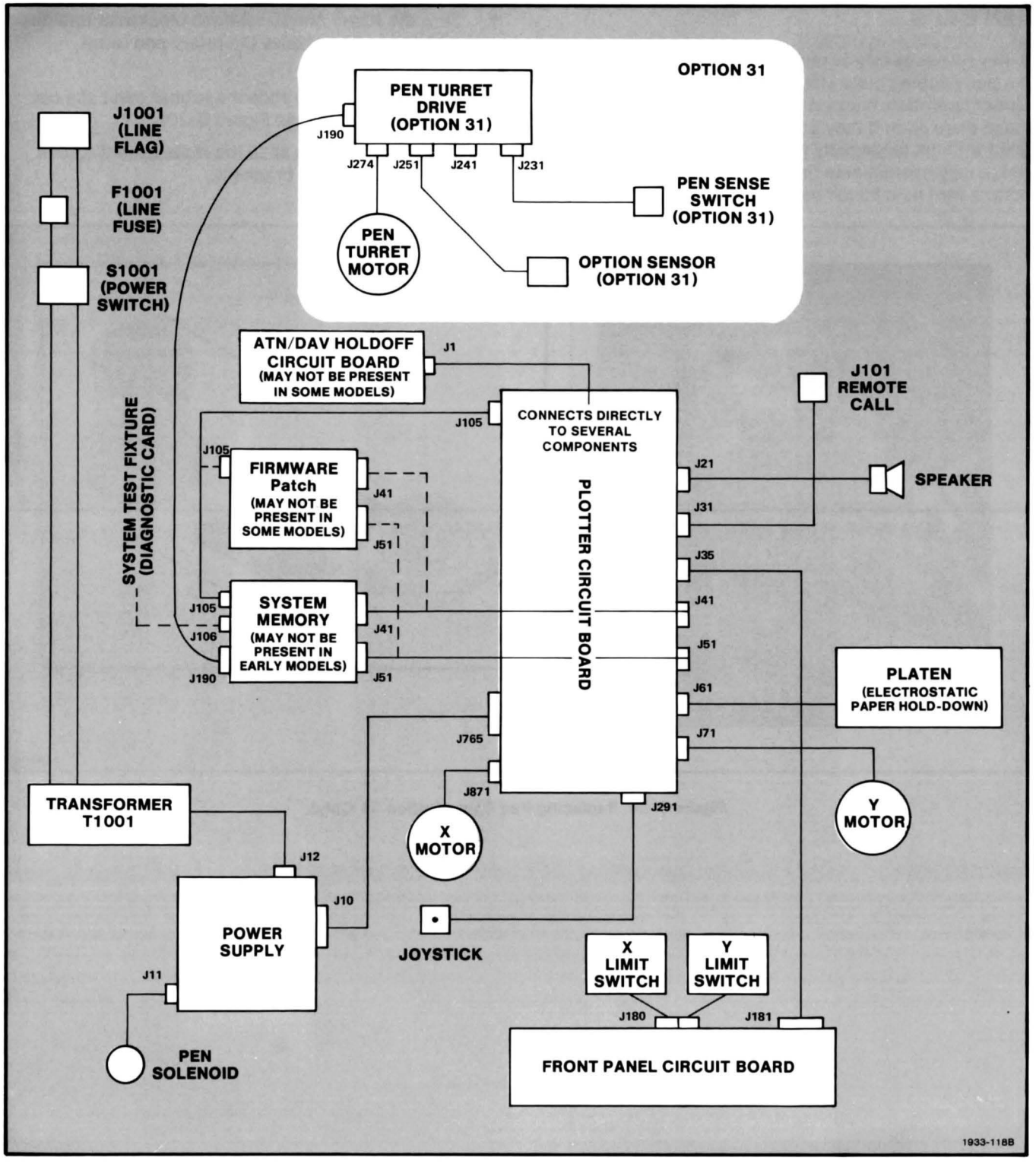


Figure 4-1. Interconnecting Cables and Cable Connectors Diagram.

Section 4

INTERCONNECTING WIRING

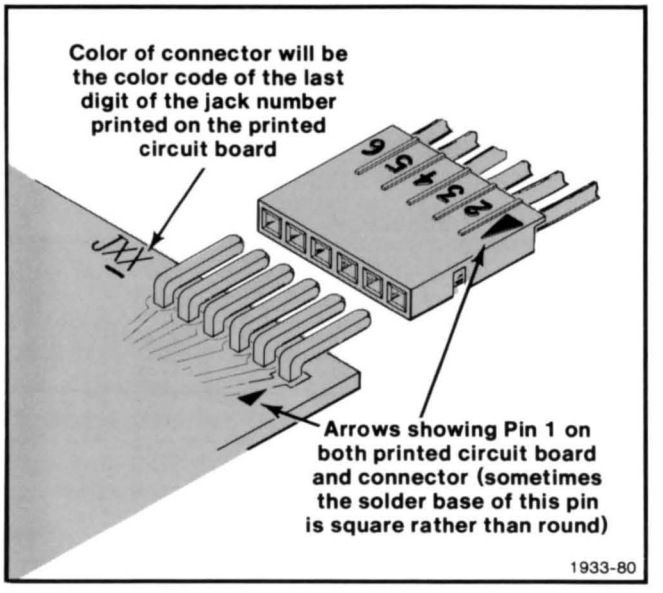
INTRODUCTION

This section contains an interconnecting cable diagram and tables that describe the interconnecting cables and the connectors.

Figure 4-1 shows a diagram of all the interconnecting cables within the plotter and the associated cable connector numbers. Jack (or plug) numbers for multi-pin cable connectors appear on the circuit board next to the connection. A small arrow indicates Pin 1 on both the printed circuit board and connector (see Figure 4-2). (In some cases, the solder base for the number one square-pin is square rather than round.) Furthermore, the cable connectors are color-coded from 0 to 9 to match the last digit of the jack number to which the plug is connected. For example, a yellow connector (color code of four) connects to a jack with a number ending in four, for example, J34. The color codes are listed below:

0 Black	5 Green
1 Brown	6 Blue
2 Red	7 Violet
3 Orange	8 Grey
4 Yellow	9 White

Tables 4-1 through 4-5 list the signals on the pins of these connectors, while Appendix A provides a functional description of each major signal in the plotter.



PLOTTER CIRCUIT BOARD

The connector locations on the Plotter circuit board are shown in Figure 4-3. Table 4-1 describes the signals on each pin of the Plotter circuit board's cable connectors.

Table 4-1

PLOTTER CIRCUIT BOARD CONNECTORS

Connector	Pin	Signal Name	Source or Destination
J21	1	from U211D	Speaker
	2	+ 5 Volts	Speaker
J31	1	Spare 1-0	J101 REMOTE CALL
	2	CALL-0	J101 REMOTE CALL
	3	+ 12 Volts	J101 REMOTE CALL
	4	GND	J101 REMOTE CALL
J35	A1	LOWLFT-0	Front Panel Switches
	A2	GND	circuit board J181
	A3	ERROR	
	A4	PROMPT	
	A5	YLIM-0	
	A6	+ 5 Volts	
	A7	XLIM-0	
	A8	GND	
	A9	LOCATE-0	
	A10	GND	
	B1	GND	
	B2	LOAD-0	
	B3	GND	
	B4	LOCAL-0	
	B5	GND	
	B6	PEN-0	
	B7	GND	
	B8	CALL-0	
	B9	GND	
	B10	SET-0	
[a]Pin 8, U205		GND	J1 ATN/DAV
Pin 7, U205		NRFD-0	Holdoff
Pin 16, U205		+ 5 Volts	Circuit Board
Pin 10, U101		ATN	
Pin 9, U201		ENABLE	

[a]J1 of ATN/DAV Holdoff circuit board attaches directly to several Plotter circuit board components.

Table 4-1 (cont)

PLOTTER CIRCUIT BOARD CONNECTORS

Connector	Pin	Signal Name	Source or Destination
J41	A1	PHASE 2-1	J41 of either System
	A2		Memory or Firmware
	A3	PIACS2-0	Patch circuit board
	A4	BR-1/W-0	
	A5		
	A6		
	A7	RST-0	
	A8	ROM ENABLE-1	
	A9	IRQ-0	
	A10		
	A11	BA15-1	
	A12	BA14-1	
	A13	BA12-1	
	A14	BA13-1	
	A15	BA11-1	
	A16	BA10-1	
	A17	BA9-1	
	B1 to		
	B17	GND	
J51	A1	BA8-1	J51 of either System
	A2	BA7-1	Memory or Firmware
	A3	BA6-1	Patch circuit board
	A4	BA5-1	
	A5	BA4-1	
	A6	BA3-1	
	A7	BA2-1	
	A8	BA1-1	
	A9	BA0-1	
	A10	BD0-1	
	A11	BD1-1	
	A12	BD2-1	
	A13	BD3-1	
	A14	BD4-1	
	A15	BD5-1	
	A16	BD6-1	
	A17	BD7-1	
	B1 to		
	B17	GND	
J61	1	RETURN	Platen
	2	+ 880 Volts	Platen
J71	1	0A Motor Winding	Y-Axis Motor
	2	0A Motor Winding	Y-Axis Motor
	3	0B Motor Winding	Y-Axis Motor
	4	0B Motor Winding	Y-Axis Motor

(continued)

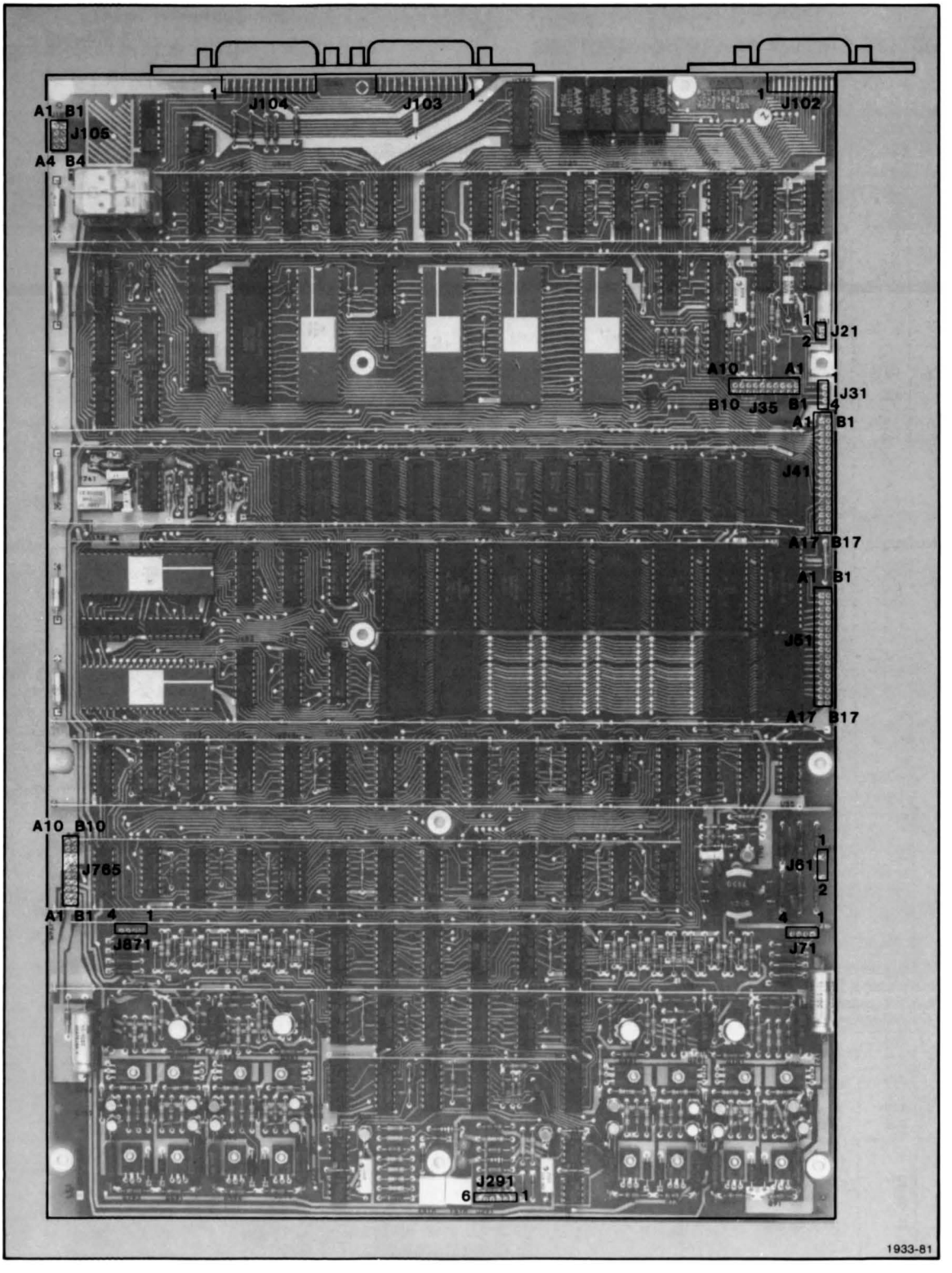


Figure 4-3. Plotter Circuit Board Connectors.

Table 4-1 (cont)

PLOTTER CIRCUIT BOARD CONNECTORS

Connector	Pin	Signal Name	Source or Destination
J102	1	DIO1-0	GPIB Connector (see Figure 4-4)
	2	DIO2-0	
	3	DIO3-0	
	4	DIO4-0	
	5	EOI-0	
	6	DAV-0	
	7	NRFD-0	
	8	NDAC-0	
	9	IFC-0	
	10	SRQ-0	
	11	ATN-0	
	12	Shield GND	
	13	DIO5-0	
	14	DIO6-0	
	15	DIO7-0	
	16	DIO8-0	
	17	REN-0	
	18	Interface GND	
	19	Interface GND	
	20	Interface GND	
	21	Interface GND	
	22	Interface GND	
	23	Interface GND	
	24	Interface GND	
J103	1		Connects to J104-1
	2	MODEM TDATA	RS-232-C Connector to MODEM
	3	MODEM RDATA	
	4 to 25		Connects to J104-4 to J104-25
J104	1		Connects to J103-1
	2	TERM TDATA	RS-232-C Connector to TERMINAL
	3	TERM RDATA	
	4 to 25		Connects to J103-4 to J103-25
J105	A1	GND	J105 of either System Memory or Firmware Patch circuit board
	A2	+ 5 Volts	
	A3	+ 12 Volts	
	A4	−12 Volts	
	B1	GND	
	B2	+ 5 Volts	
	B3	+ 12 Volts	
	B4	−12 Volts	
J291	1	+ 12 Volts	Joystick
	2	YJOY	
	3	−12 Volts	
	4	+ 12 Volts	
	5	XJOY	
	6	−12 Volts	

Table 4-1 (cont)

PLOTTER CIRCUIT BOARD CONNECTORS

Connector	Pin	Signal Name	Source or Destination
J765	A1	+ 28 Volts	Power Supply circuit board J10
	A2	Power GND (motors)	
	A3	−12 Volts	
	A4	+ 12 Volts	
	A5	RST-1	
	A6	GND	
	A7	GND	
	A8	GND	
	A9	+ 5 Volts	
	A10	+ 5 Volts	
	B1	+ 28 Volts	
	B2	Power GND (motors)	
	B3	−5 Volts	
	B4	+ 12 Volts	
	B5	PEN DOWN-0	
	B6	ANALOG GND	
	B7	GND	
	B8	GND	
	B9	+ 5 Volts	
	B10	+ 5 Volts	
J871	1	0A Motor Winding	X-Axis Motor
	2	0A Motor Winding	X-Axis Motor
	3	0B Motor Winding	X-Axis Motor
	4	0B Motor Winding	X-Axis Motor

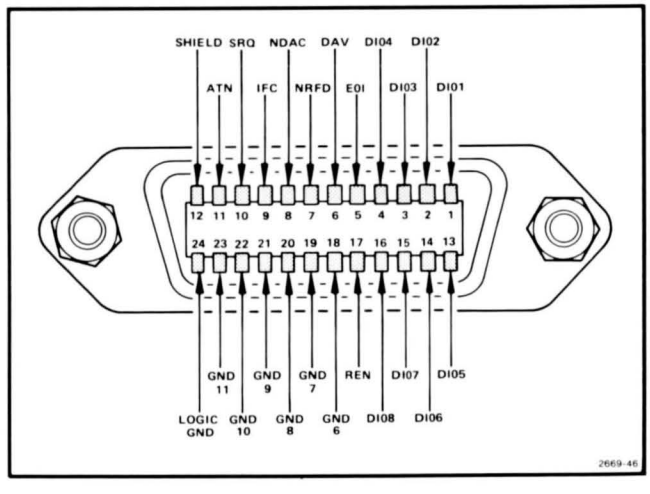


Figure 4-4. The GPIB Connector.

SYSTEM MEMORY CIRCUIT BOARD

The connectors on the System Memory circuit board are shown in Figure 4-5. Table 4-2 describes the signals on each pin of the System Memory circuit board's cable connectors.

Table 4-2

SYSTEM MEMORY CIRCUIT BOARD CONNECTORS

Connector	Pin	Signal Name	Source or Destination
J41[a]	--	--	--
J51[b]	--	--	--
J105[c]	--	--	--
J106	1	GND	System Test Fixture (Maintenance Troubleshooting Only)
	2	+ 5 Volts	
	3	+ 12 Volts	
	4	−12 Volts	
J190	A1	GND	Pen Turret Drive circuit board J190 (Option 31)
	A2	CAPPED-0	
	A3	SENSE B-1	
	A4	SELECT 0-1	
	A5	ENABLE A-0	
	A6	POLARITY A-1	
	A7	PULSE A-0	
	A8	GND (spare)	
	A9	GND	
	A10	GND	
	B1	GND	
	B2	SENSE A-1	
	B3	SENSE C-1	
	B4	SELECT 1-1	
	B5	ENABLE B-0	
	B6	POLARITY B-1	
	B7	PULSE B-0	
	B8	+ 5 Volts	
	B9	+ 5 Volts	
	B10	+ 12 Volts	

[a] This connector is the same as J41 of the Plotter circuit board.
[b] This connector is the same as J51 of the Plotter circuit board.
[c] This connector is the same as J105 of the Plotter circuit board.

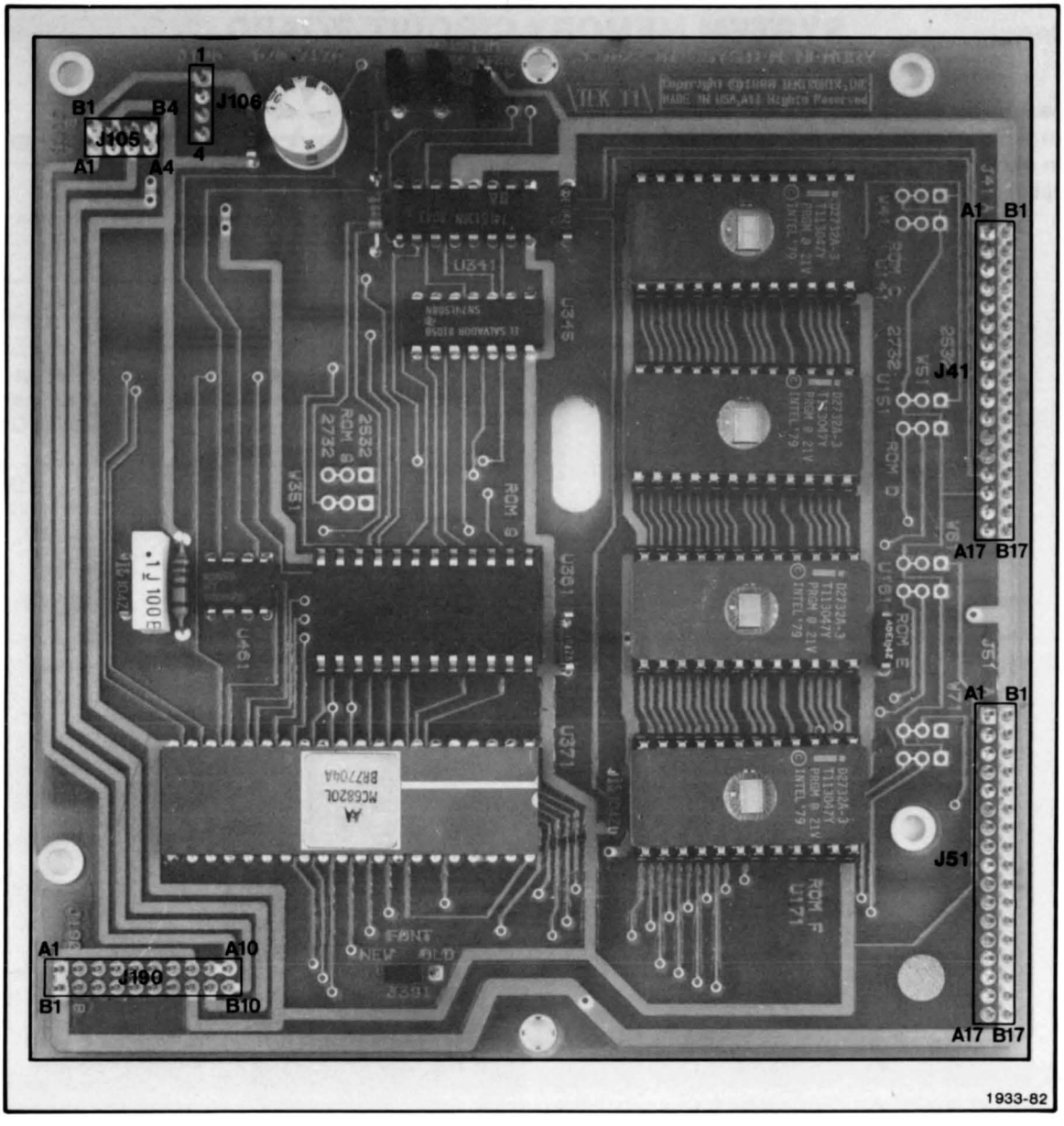


Figure 4-5. System Memory Circuit Board Connectors.

FIRMWARE PATCH CIRCUIT BOARD

The connectors on the Firmware Patch circuit board are shown in Figure 4-6. The J41, J51, and J105 connectors are the same as the corresponding connectors on the Plotter circuit board.

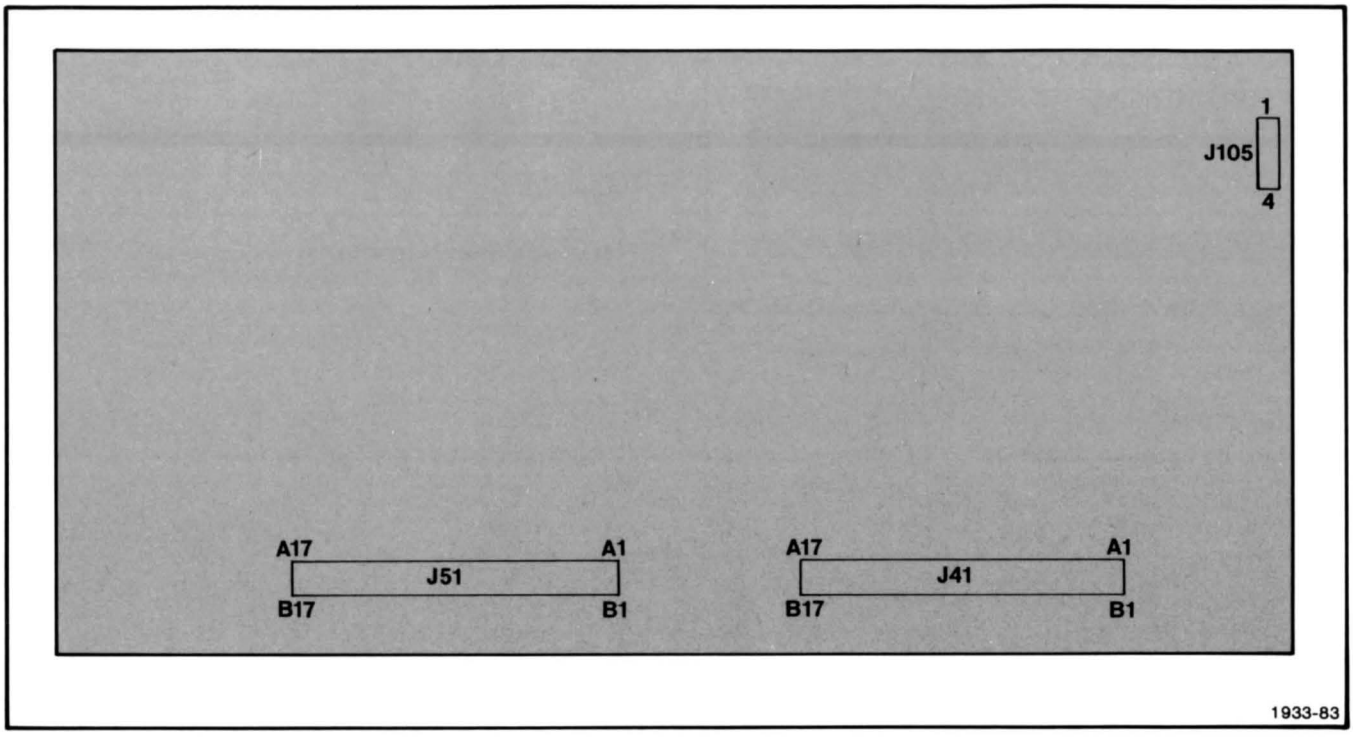


Figure 4-6. Firmware Patch Circuit Board Connectors.

FRONT PANEL CIRCUIT BOARD

The connectors on the Front Panel circuit board are shown in Figure 4-7. Table 4-3 describes the signals on each pin of the Front Panel circuit board's cable connectors.

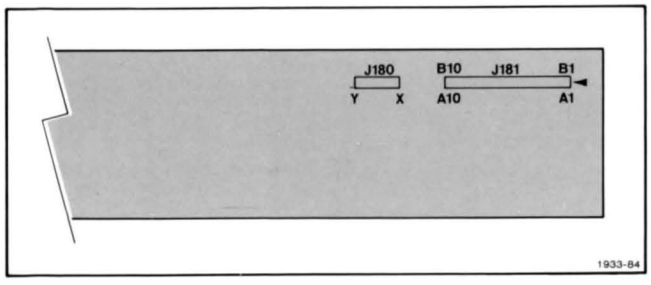


Figure 4-7. Front Panel Circuit Board Connectors.

Table 4-3

FRONT PANEL CIRCUIT BOARD CONNECTORS

Connector	Pin	Signal Name	Source or Destination
J180	1	XLIM-0	X-Axis Limit Switch
	2	GND	
	3	GND	Y-Axis Limit Switch
	4	YLIM-0	
J181[a]	--	--	--

[a]This connector is the same as J35 of the Plotter circuit board.

POWER SUPPLY CIRCUIT BOARD

The connectors on the Power Supply circuit board are shown in Figure 4-8. Table 4-4 describes the signals on each pin of the Power Supply circuit board's cable connectors.

Table 4-4

POWER SUPPLY CIRCUIT BOARD CONNECTORS

Connector	Pin	Signal Name	Source or Destination
J10[a]	--	--	--
J11	1	PEN SOLENOID	Pen Solenoid (L1005)
	2	−13.5 Volts	
J12	1	Secondary Winding AC	
	2	Center Tap	Power Transformer (T1001)
	3	Secondary Winding AC	

[a]This connector is the same as J765 of the Plotter circuit board.

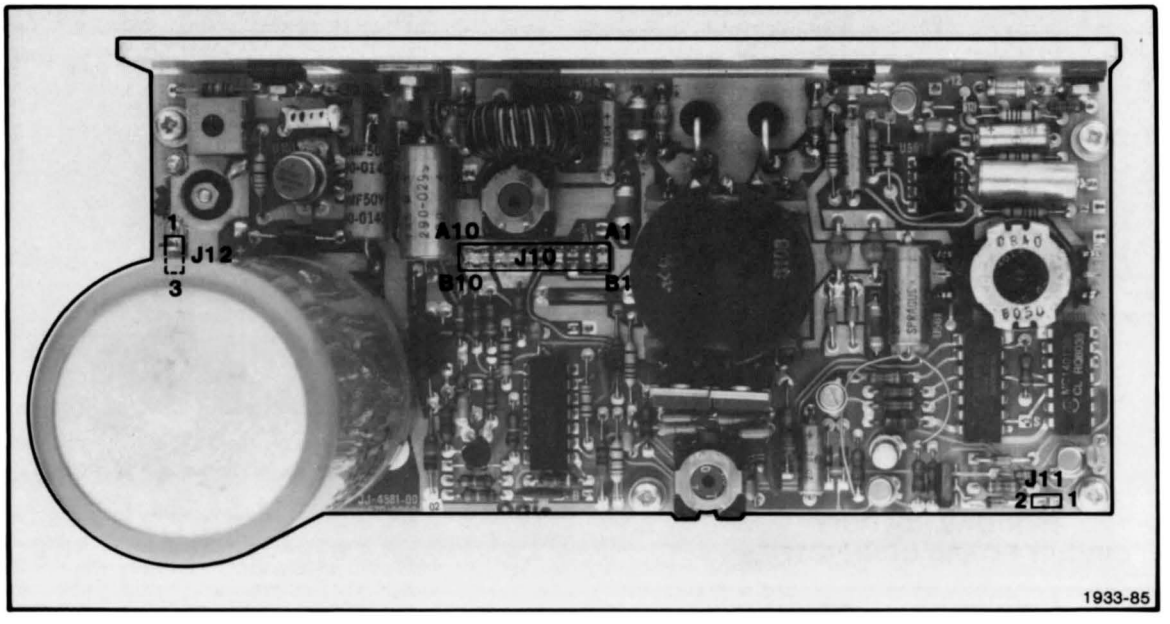


Figure 4-8. Power Supply Circuit Board Connectors.

PEN TURRET DRIVE CIRCUIT BOARD (OPTION 31)

The connectors on the Pen Turret Drive circuit board are shown in Figure 4-9. Table 4-5 describes the signals on each pin of the Pen Turret Drive circuit board.

Table 4-5

PEN TURRET DRIVE CIRCUIT BOARD CONNECTORS

Connector	Pin	Signal Name	Source or Destination
J190[a]	--	--	--
J231	1	PEN PRESENCE	Pen Presence Switch
	2	GND	
J243	1		Collector of Cam Sense Optical Switch
	2		Emitter of Cam Sense Optical Switch (GND)
	3		Anode of Cam Sense Optical Switch
	4		Cathode of Cam Sense Optical Switch
J274	1	Coil A (red lead)	
	2	Coil A (grey lead)	Pen Turret Drive
Motor	3	Coil B (yellow)	
	4	Coil B (brown)	

[a]This connector is the same as J190 of the System Memory circuit board.

ATN/DAV HOLDOFF CIRCUIT BOARD

Table 4-6

ATN/DAV HOLDOFF CIRCUIT BOARD CONNECTORS

Connector	Pin	Signal Name	Source or Destination[a]
J1	1	GND	U205, Pin 8
	2	NRFD-0	U205, Pin 7
	3	+ 5 Volts	U205, Pin 16
	4	ATN	U101, Pin 10
	5	ENABLE	U201, Pin 9

[a]U205, 201, and 101 are located on the main Plotter circuit board.

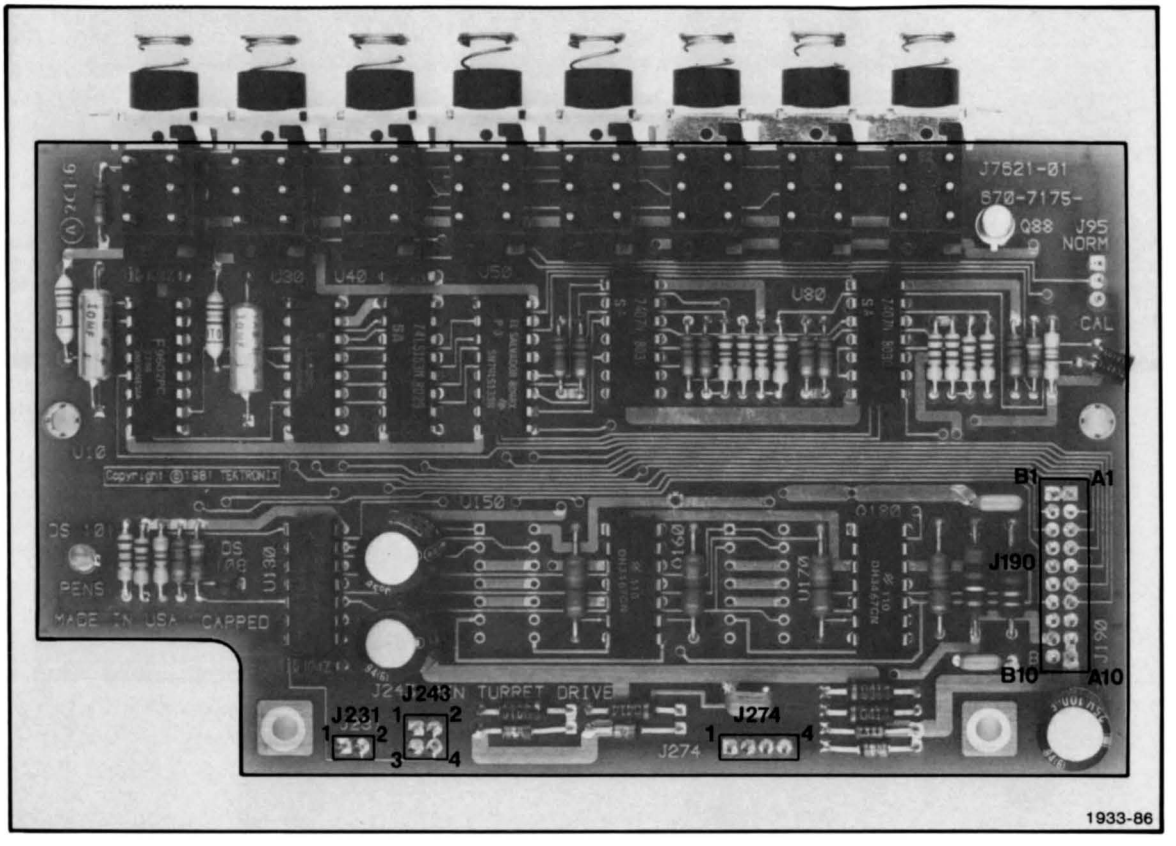


Figure 4-9. Pen Turret Drive Circuit Board Connectors.

Section 5

CIRCUIT DESCRIPTIONS

SYSTEM ARCHITECTURE

The basic electronics structure of the 4662 Plotter is composed of functional blocks residing on a central bus. A diagram of this structure is shown in Figure 5-1. Since a large part of the plotter's circuitry resides on the Plotter circuit board, most of these functional blocks refer to a group of components on that board. Most of these functional blocks electrically connect directly to the central bus through a PIA (Peripheral Interface Adapter). There are a few exceptions, however, where functional blocks do not connect directly to the bus. First, the Front Panel, the Joystick Rate Generator, and the Pen Turret Drive (Option 31) "piggy-back" onto other functional blocks which, in turn, are connected to the central bus. Second, the X and Y Motor Drive and the High Voltage Platen Power Supply are functionally connected to the Vector Generator and the Front Panel respectively. This is because the X and Y Motor Drive communicates primarily with the Vector Generator and the High Voltage Platen Supply receives its enable from the Front Panel. Physically, however, both of these functional blocks are located on the Plotter board. Figure 5-1 shows the functional piggy-back relationships.

The 4662 contains a microprocessor. All operational control of the plotter is directed by this 6800 microprocessor. Hereafter, the 6800 microprocessor will be referred to as the "processor." The processor is controlled by the program or "firmware" stored in Read-Only Memory (ROM). In some cases EPROM may be used. The firmware resides on a separate System Memory circuit board (except for early model plotters, which have the ROM firmware residing on the Plotter board). The plotter is electrically organized such that the processor views all other functional blocks as peripheral devices. Each functional block has a specific purpose; the block is activated by the processor when the processor requires that function. The individual blocks, in turn, can also request action by the processor through interrupts. The highest priority interrupt is the Non-Maskable Interrupt (NMI); it is reserved for the vector generation circuitry. The basic functional blocks (shown in Figure 5-1) that communicate with the Processor are as follows:

- RS-232 Interface
- GPIB Interface
- Processor and Clock
- Memory (includes Memory circuit board)
- Vector Generator
- Miscellaneous Interface (front- and rear-panel switches, LEDs, etc.)
- Pen Turret Drive (Option 31)

The following circuit descriptions discuss what each functional block does and how it operates. In the descriptions, each functional block is further broken down into smaller circuit blocks as necessary. The smaller circuit blocks are also then described. The functional blocks correspond to the schematic sheets in Section 7. The circuit blocks are shown on the schematics by grey tint blocks around the circuit block.

For additional information, refer to the component location photographs (also in Section 7 — Schematics) and the signal descriptions in Appendix A.

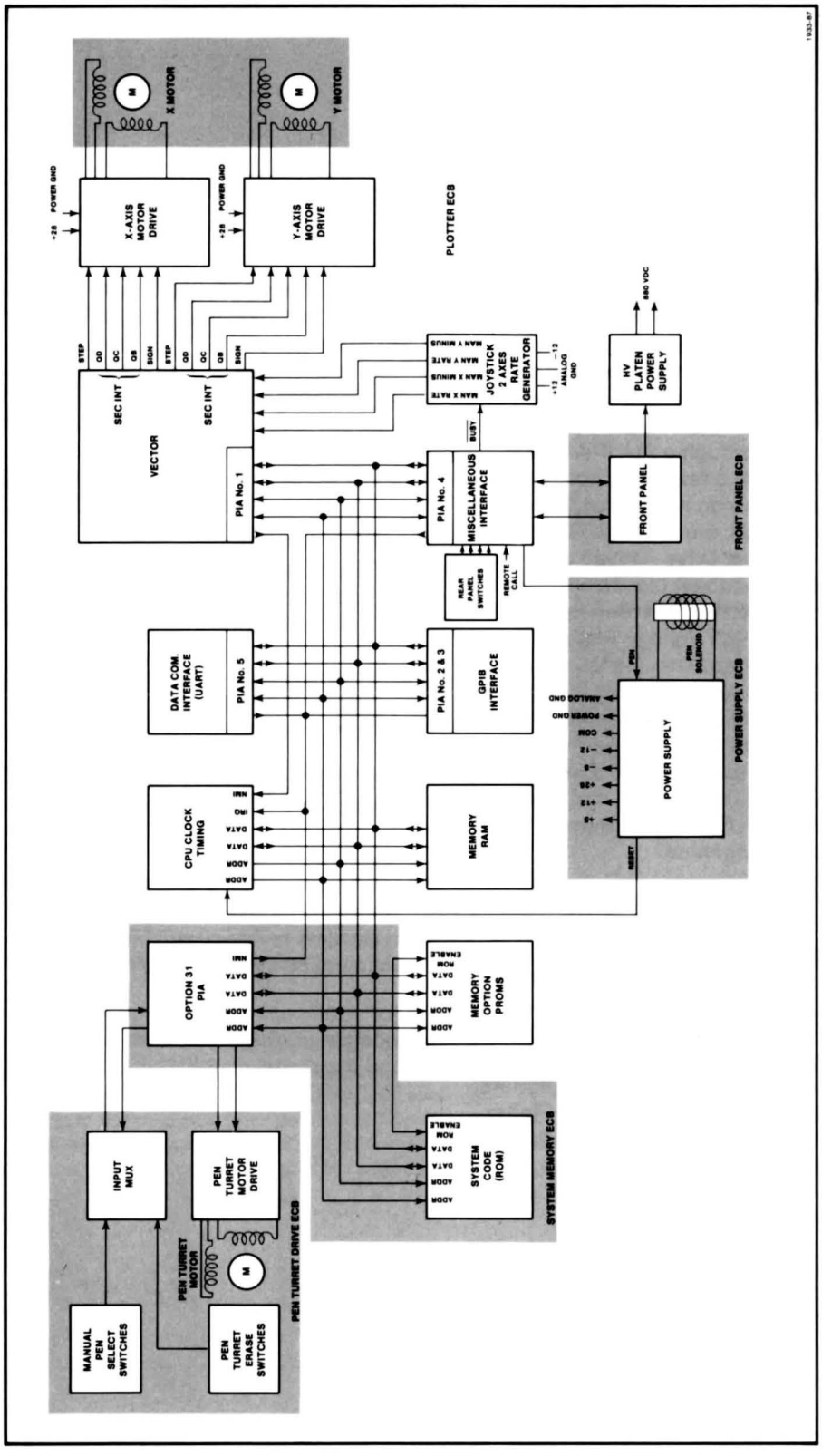


Figure 5-1. 4662 Functional Block Diagram.

INTERFUNCTIONAL BLOCK COMMUNICATIONS PROTOCOL

The processor, when idle, is always waiting for an instruction or command. The instructions or commands can come through either the RS-232 or GPIB interface or from front or rear panel switches. (Note that the hex rear-panel switches are only checked during initial power-up.)

When a command has been received by an interface, it is first converted to a data byte in typical 6800 format. Then, the interface (through its PIA) issues an interrupt to the processor. When interrupted, the processor completes its present task, if any, and turns to the ROM memory for instructions for servicing that interrupt. If the received command changes an operating parameter or requests information from the plotter, ROM may instruct the processor to refer to a RAM memory location where operating parameters (such as block size or alpha size) have been stored.

If the received command is an alphanumeric print instruction, the processor must look up the character in memory to determine the vectors required to draw it. Then, the processor must activate the vector generation circuitry. The incremental stepping information is fed to the two motor drive circuits to convert the steps into drive signals for the motors. The vector generation/motor drive sequence is repeated for each vector within the character to be drawn.

If the received command is a move or draw, a similar sequence occurs. The processor performs the necessary math operations to determine the ratio of the axes and then feeds that information to the vector generator. If the joystick generates a motion, the processor monitors the axes' movement to update the pen position registers. For moves and draws, the processor determines the acceleration/deceleration rates and the maximum velocity. Information from the vector generator is then fed to the motor pen drive circuits which cause the pen carriage to move across the platen. The processor also examines each vector to determine if it is a move or draw and causes the pen to lift or lower as required. In addition, the processor checks to see if the draw vector end-point is in the defined plotting area. If not, the draw is converted to a move.

In general, all interfunctional block communications are initiated with an interrupt and then are carrried out as a processor read or write transaction.

Interrupt Description

The plotter is an interrupt-driven device. Interrupts, as the term indicates, refer to the process in which the processor is interrupted from its present task so that it may perform a more important task. This means that when a functional block has generated some activity which requires processor handling (such as the end of a vector), it must first interrupt the processor before the processor accomplishes that activity. The processor first completes its present instruction and then services the interrupt. The interrupt is serviced according to a set of priority instructions stored in ROM (the system firmware). This means that if a functional block generates data for another functional block, it must first convert the data into 8-bit data bytes before interrupting the processor. Some typical requests that generate interrupts include receiving a host-character, transmitting a character to the host, and the eight-millisecond timer elapsing.

The plotter uses two levels of interrupts. These are NMI (nonmaskable interrupt) and IRQ (interrupt request). Because NMI is nonmaskable, it is the highest priority interrupt. The Vector Generator uses the NMI interrupt to keep the processor advised of the location of the pen carriage as it is moving across the platen. For further details of this interrupt, see in the Vector Generator description.

The IRQ interrupt is used by all other functional blocks (RS-232 interface, GPIB interface, Miscellaneous Interface, and Option 31, if present) to request service from the processor. In all cases, this interrupt request originates from the functional block's PIA whenever data for the processor has been loaded into that PIA. The PIA requests the interrupt by asserting IRQ-0.

When interrupted, the processor sequentially reads and tests the control registers in each PIA to find the one which initiated the interrupt. The sequence is as follows:

1. Option 31 Step-Rate Timer Interrupt (PIA 6, CB1)
2. Eight Millisecond Timer Interrupt (PIA 4, CB1)
3. Interrupts caused by options (none currently defined)
4. Active Interface (RS-232 or GPIB)(PIA 5 or PIA 2 and 3)

Once the interrupting PIA is identified, the processor refers to ROM for specific instructions for servicing and clearing that interrupt. After servicing the interrupt, the processor resumes the task prior to the interrupt, unless another PIA has initiated an interrupt request (asserted IRQ-0). In this case, the processor repeats the sequential read of each PIA looking for the interrupting one.

Read Cycle Description

The Read transaction begins when the processor addresses the desired device via the BUS ADDRESS lines (BA0-1 to BA15-1), asserts Read (a high state on the BR-1/W-0 line), and asserts VMA-1. Figure 5-2 shows these events taking place around the fifth clock cycle (T5). The device being read (PROM, ROM, or RAM memory or PIA) responds by placing the addressed data on the DATA BUS lines (BD0-BD7). In reading PROM, ROM, or RAM memory, the appropriate memory device is enabled when its address is decoded along with a high BR-1/W-0 signal. The device being read then copies its data onto the DATA BUS lines. When reading PIAs, the address lines are ANDed with VMA-1 to form PIACS2-0. PIACS2-0, along with appropriate BUS ADDRESS lines and the high state on the BR-1/W-0 line, selects the PIA. The selected PIA places its data on the DATA BUS when the system PHASE 2 (ϕ2-1) signal goes high.

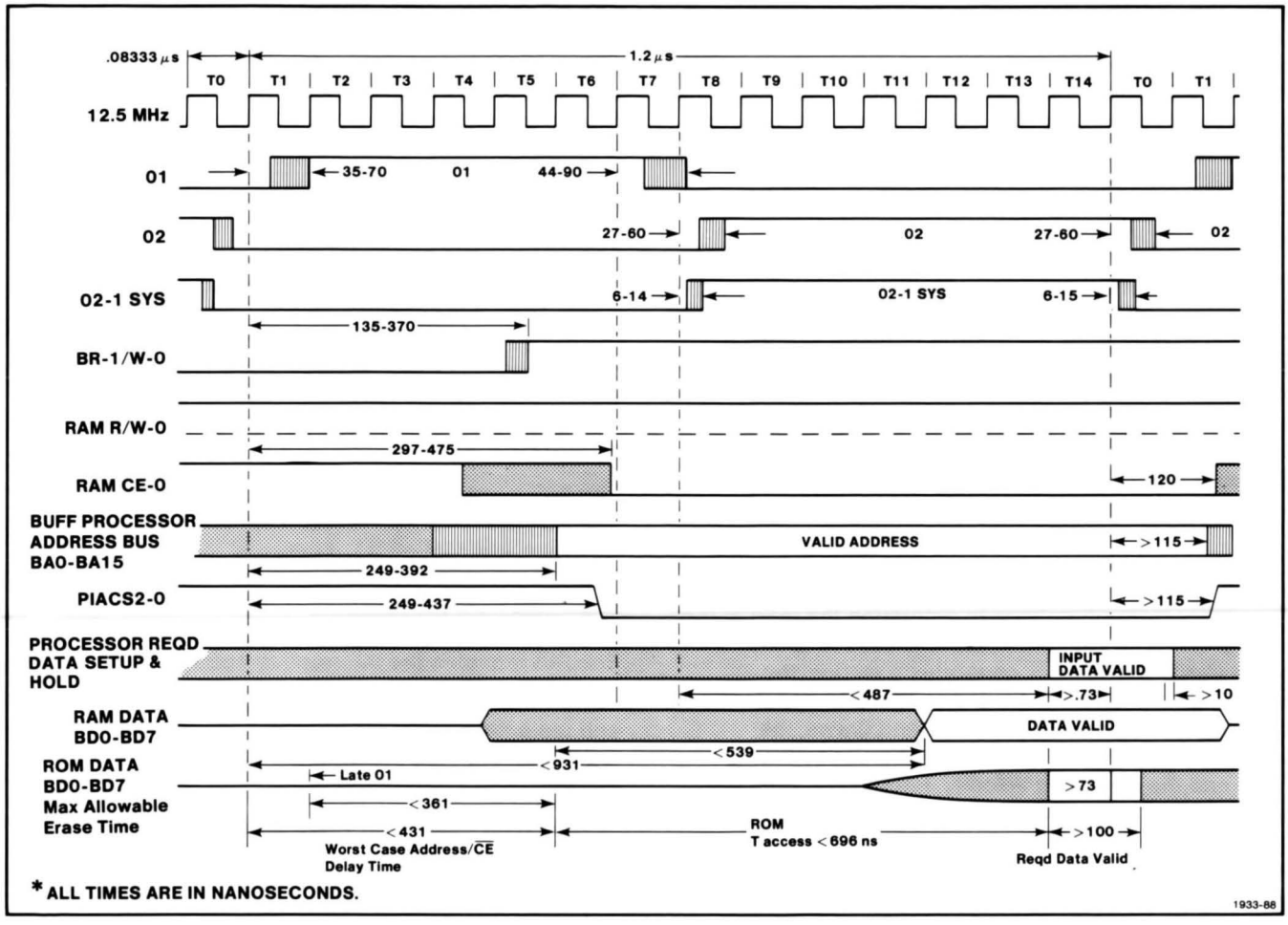


Figure 5-2. Processor Read Transaction Timing.

Write Cycle Description

The Write transaction begins when the processor addresses the desired device via the BUS ADDRESS lines (BA0-1 to BA15-1), asserts Write (a low state on the BR-1/W-0 line), and VMA-1. Figure 5-3 shows these events taking place around the fifth bus clock cycle (T5). Shortly thereafter, the processor asserts data on the DATA BUS (BD0-BD7). This is around the eleventh bus clock cycle (T11). If the device being written to is a RAM, the address will be decoded and the appropriate CE-0 generated to enable the addressed RAM device. Data is stored in the RAM when its R/W signal is driven low by RAM R-1/W-0. In writing to a PIA, the address lines are ANDed with VMA-1 to form PIACS2-0. PIACS2-0, along with appropriate BUS ADDRESS lines and the low state on the BR-1/W-0 (write) line selects the PIA. The selected PIA stores data on the DATA BUS into its internal registers when the system PHASE 2 (ϕ2-1) signal goes high.

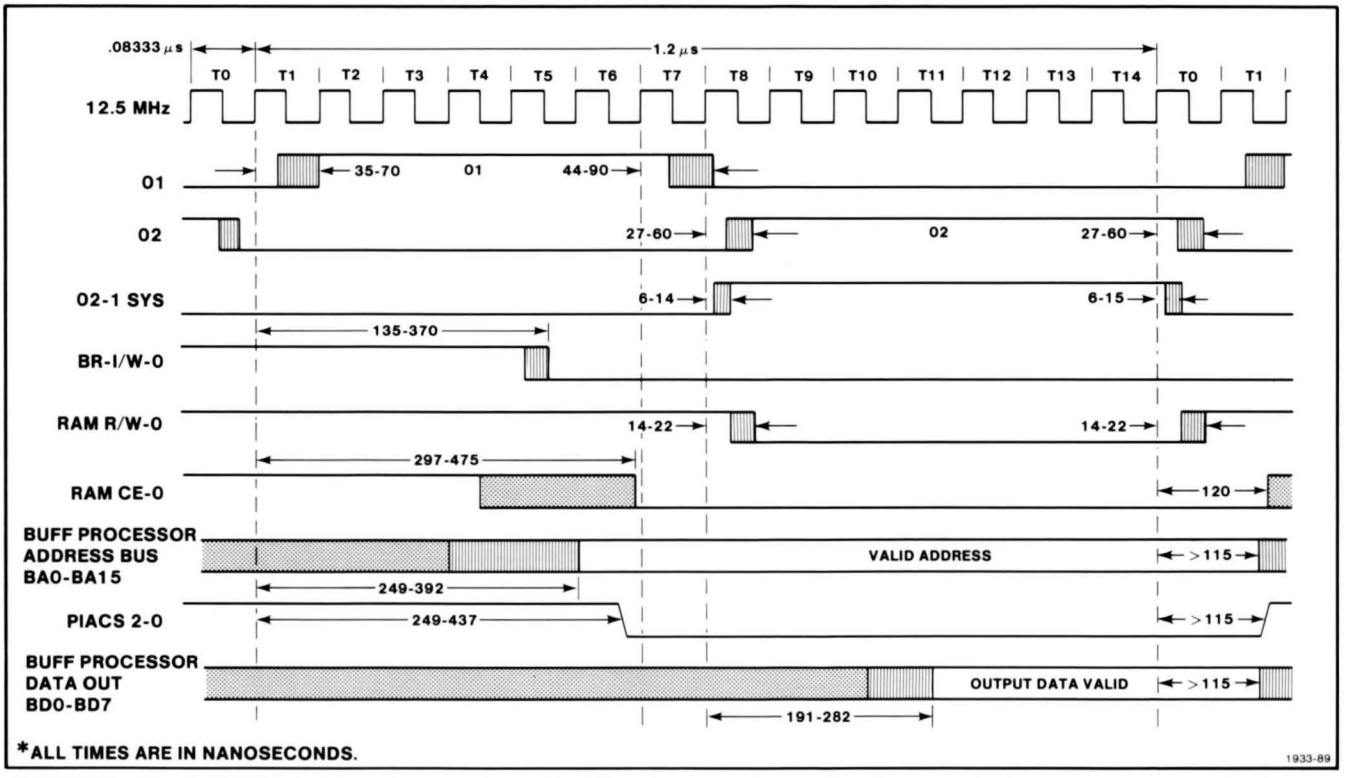


Figure 5-3. Processor Write Transaction Timing.

CIRCUIT DESCRIPTIONS

INTRODUCTION

This section contains detailed descriptions of the plotter's electrical operation. As mentioned earlier, the plotter is composed of the functional blocks shown in Figure 5-1. Each functional block is described in detail. In some cases, a functional block is further broken down with a block diagram showing all of the important electronic components.

The following circuit descriptions are based on the schematics in Section 7. The more complex schematics are further broken down in the same manner as the block diagrams. The circuit blocks are shown on the schematics by a grey tint block around the circuit blocks.

For additional information, refer to the component location photographs (also in the schematics) and the signal descriptions in Appendix A.

PIA (PERIPHERAL INTERFACE ADAPTER)

The PIA is common to all functional blocks that communicate directly with the processor. Therefore, this component is discussed here. Later, while reading descriptions of other functional blocks, you may refer back to this discussion for details concerning the PIA.

The MC6820 PIA provides a universal method of interfacing functional blocks to the 6800 processor. The PIA communicates with the processor over the same eight-bit bidirectional DATA BUS that the system memory and RAM share. The PIA is addressed like any other memory location. The PIA has two separate eight-bit bidirectional peripheral data buses for interfacing with an associated functional block (refer to Figure 5-4). In the schematics, these two buses are shown as PA0 through PA7 and PB0 through PB7. Frequently, the processor uses one peripheral data bus to transmit data to a functional block and the other to receive data from the functional block. Functional blocks which use a PIA for interfacing to the processor are:

- RS-232 Interface
- GPIB Interface
- Vector Generator
- Miscellaneous Interface (front panel, joystick, etc.)
- Option 31 (multiple pens)

Each PIA has two sides, an A side and a B side. Each side has a peripheral data register, a data direction register, and a control register. Each peripheral data register is the interface register between the PIA device and the connecting functional block. These are the two data buses mentioned earlier. The data direction register defines each peripheral data bus line as either an input or output line. The control register controls the operation of the four peripheral control lines CA1, CA2, CB1, and CB2. CA1 and CB1 are peripheral input lines (from the functional blocks) which cause the generation of IRQA-0 or IRQB-0 to the processor. CA2 and CB2 can be programmed to act as either an interrupt input (like CA1 or CB1 above) or the functional block's data control line. Because of the uniqueness of each functional block, these four control lines will be described further with each functional block description.

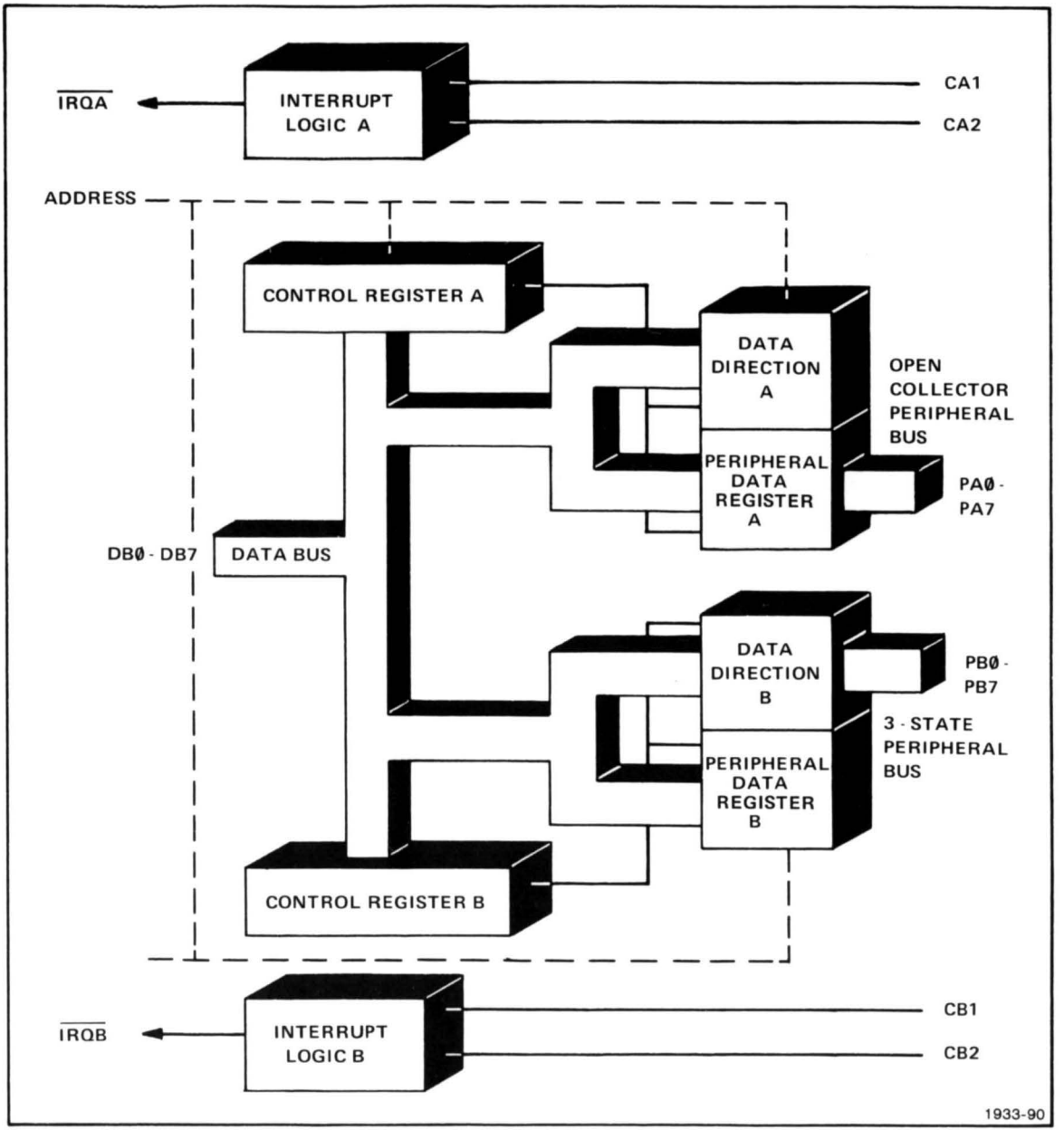


Figure 5-4. Peripheral Interface Adapter (PIA) Block Diagram.

RS-232 INTERFACE

The RS-232 interface, shown in Schematic A1-1, interfaces the plotter to a RS-232 communications system. The RS-232 circuitry is shown divided into the following circuit blocks, which are described in subsequent paragraphs:

- Data Routing
- UART (Universal Asynchronous Receiver/Transmitter) and 6800 Interface
- Time Base

Data Routing

The Data Routing circuit provides routing for the data transmitted to or received from the RS-232 communications system. The RS-232 interface has two ports, one marked MODEM (J103) and one marked TERMINAL (J104). This means that, in a typical configuration like that shown in Figure 5-5, the plotter is in series with the RS-232 communications line between a terminal and the host. This also means that the connector marked MODEM is wired to appear as an active terminal and the connector marked TERMINAL is wired to appear as an active modem. When the plotter is turned off, all RS-232-C lines are looped through the plotter without interruption (see Figure 5-6A). The relay, K706, controls this looping process. Schematic A1-1 shows the relay when the plotter is turned off. Whenever the plotter is turned on, relay K706 is energized and RS-232 data passes through the Data Selector, which is controlled by LINE-1. The plotter receives serially transmitted data over the MODEM RDATA (received data from modem) line and transmits serial data over the TERM TDATA (transmitted data from terminal/plotter) line.

NOTE

T and R always refer to transmitted or received data with respect to a terminal (i.e., TDATA is data transmitted from a terminal to a modem and RDATA is data received by a terminal from a modem).

Two possible modes exist when the RS-232 interface is active. These modes are Line and Local.

Line Mode is selected whenever the LOCAL switch is released or up. The processor reads that switch position and asserts LINE-1. LINE-1 causes the Data Selector to pass MODEM RDATA (serial data from host) to the SI (serial input) of the UART (see Figure 5-6B).

Mute can also be chosen as a variation of Line Mode by setting Switch A (S101) on the back panel. Then, when the processor receives a Plotter On command, MUTEREQ-0 is asserted, causing MUTE-1. MUTE-1 does not permit the terminal to receive MODEM RDATA.

Also in Line Mode, the TERM TDATA is OR'd with the SO line from the UART to the modem (MODEM TDATA). This means that the modem receives data from either the terminal or the plotter.

In Local Mode (when the front panel LOCAL switch is locked down), LINE-1 goes low and causes the Data Selector to cut off the modem and all communications then occur between the terminal and the plotter's UART (see Figure 5-6C).

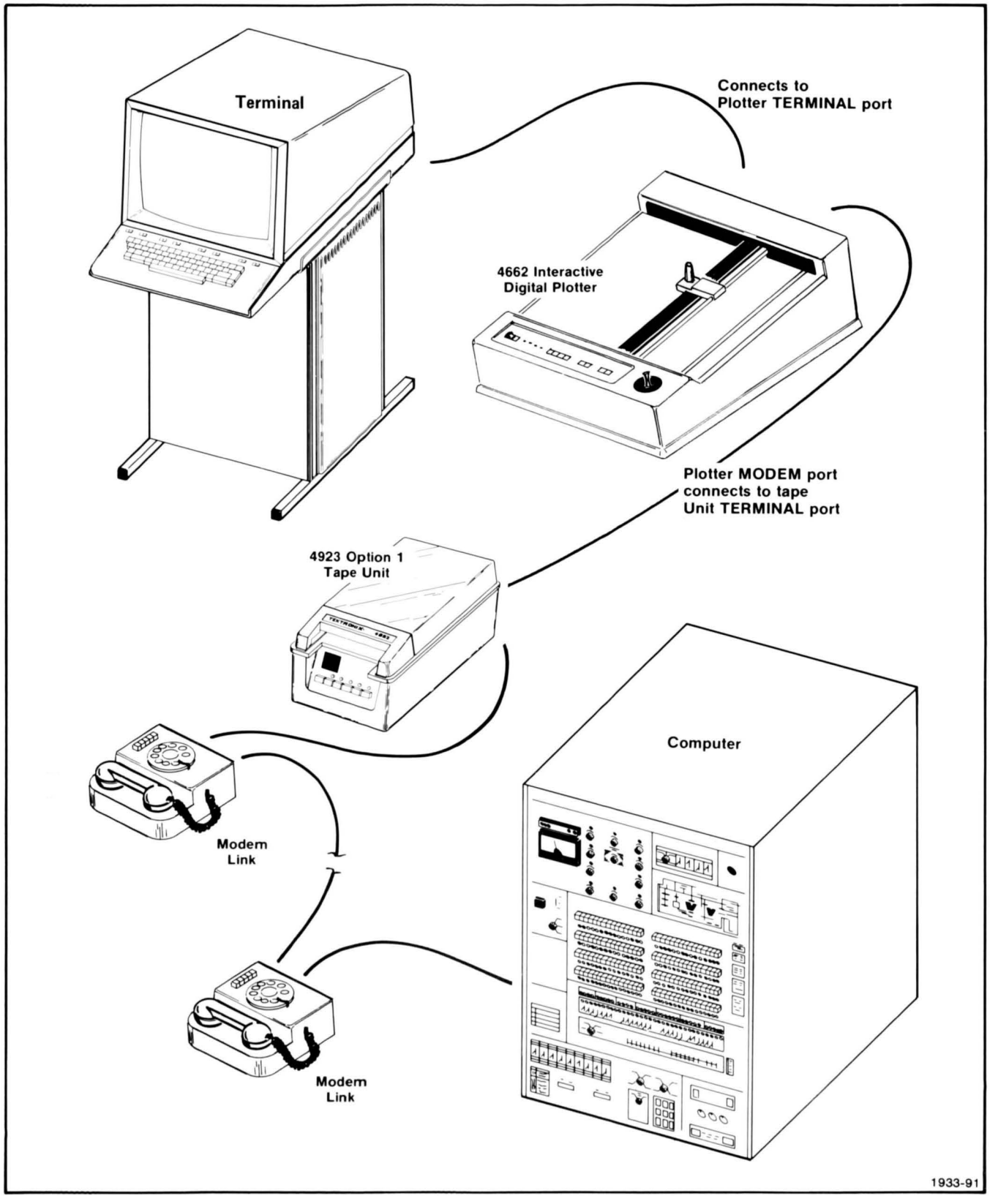


Figure 5-5. Typical RS-232 Connections for Terminal, Plotter, and Modem.

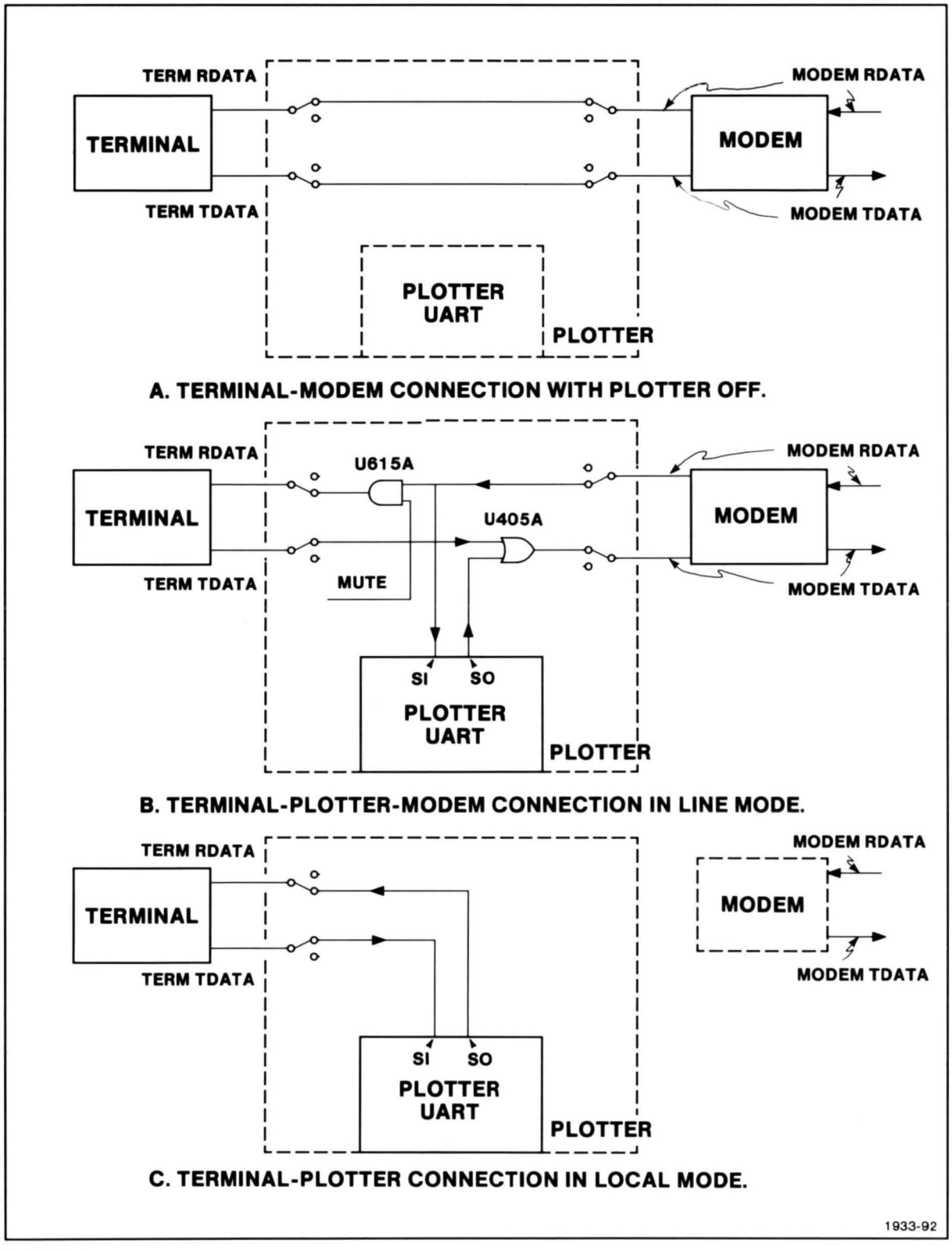


Figure 5-6. Terminal-Plotter-Modem RS-232 Connection.

UART and 6800 Interface

The UART is a Universal Asynchronous Receiver/Transmitter. In this application, the UART acts as a one-byte buffer and a parallel-to-serial converter during data transmission and a serial-to-parallel converter during data reception. Serial data from the modem or terminal (depending upon the LOCAL switch position) is received at the SI (serial input). Received data is converted to parallel in the UART and transferred to the PIA over the PA0-PA6 lines. From the PIA, the processor transfers the data out over the BD0-BD7 lines to another functional block (such as memory).

The processor transfers data to be transmitted through the PIA's PB0-PB7 lines to the UART. It is then converted to a serial format and transmitted through the SO (serial output). Rear panel Switches B and C (S105 and S201) control UART communication parameters. These include parity checking (even or odd parity — EPS, or none — NP) and the number of stop bits (one or two — TSB and NB1).

Whenever a character has been received by the UART, the UART's DAV (receive data available) line signals the PIA to assert IRQ-0 to the processor. This requests the processor to read the received character. Parity errors, framing errors, or overrun conditions will also generate an IRQ-0.

As each character is transmitted from the UART, the UART's TBMT (transmitter buffer empty) line signals the PIA to assert IRQ-0 to the processor. This requests the processor to send another character to the UART for transmission.

Time Base

The Time Base circuit, operating as a programmable frequency divider, provides a clock input to the UART that is 16 times the frequency of the desired RS-232 baud rate. Three switch contacts from rear panel Switch D are programmed inputs to the three Time Base Counters.

The 12.5 MHz Bus Clock frequency is divided by two (into 6.25 MHz) and sent to the three Time Base Counters. Table 5-1 shows the relationship of the RS-232 baud rate, the output frequency of the Time Base, Counters one and three, and the three S205 switch positions.

Table 5-1

TIME BASE COUNTER FREQUENCIES AND BAUD RATES

Switch Position	U635 Pin 2 Time Base	U601 Pin 15 Counter 1	U501 Pin 11 Counter 3	Baud Rate
D-4 = 1	6.25 MHz	397 kHz	1.76 kHz	110
All switches gnd'd	6.25 MHz	397 kHz	2.4 kHz	150
D-1 = 1	6.25 MHz	781 kHz	4.8 kHz	300
D-2 = 1	6.25 MHz	1.563 MHz	9.6 kHz	600
D-1 & D-2 = 1	6.25 MHz	3.125 MHz	19.2 kHz	1200

Figure 5-7 shows a timing diagram of the Time Base-Counter 1 signals.

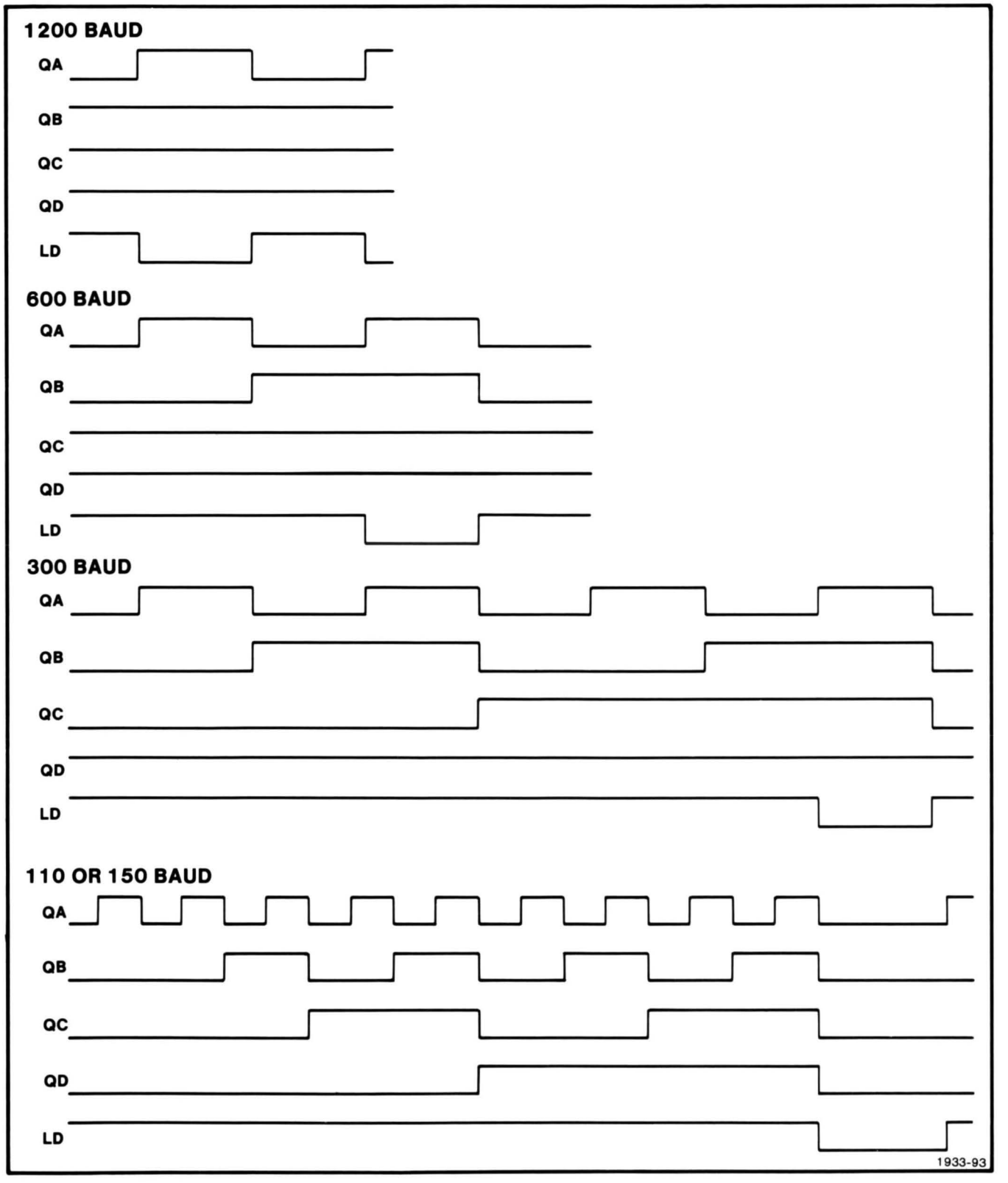


Figure 5-7. Time Base Counter Timing Diagram.

GPIB INTERFACE

General Information

The GPIB is a group of 24 signal lines between the plotter and the GPIB controller. Eight of these lines are grounds and the other 16 are functionally grouped into three buses: Data, Management, and Transfer. These three buses are described in more detail in subsequent paragraphs. Lines are active low and passive high.

Data Bus. The data bus consists of eight bidirectional signal lines (DIO1 through DIO8). Data on these lines represents device addresses (either primary or secondary), control words, or data bytes. One eight-bit byte is transferred over the bus at a time in parallel. DIO1 (data in-out, bit 1) represents the least significant bit in the byte whereas DIO8 represents the most significant bit. Primary or secondary addresses and control words (or universal commands) are distinquished from data bytes by having ATTENTION (ATN — see the Management Bus description) asserted while they are sent.

Management Bus. The Management Bus is a group of five signal lines which are used to control the data transfer over the GPIB Data Bus. Table 5-2 describes the five signal lines.

Table 5-2

MANAGEMENT BUS SIGNAL LINES

Signal	Signal Name	Function
ATN	Attention	When ATN is asserted on the GPIB, the Communications Interface is forced to listen. Only device addresses (primary or secondary) and control messages can be transferred over the GPIB when ATN is active low. After the ATN goes high, only the devices assigned as listeners and talkers can take part in the data transfer.
SRQ	Service Request	Any device on the GPIB can request the attention of the GPIB controller by asserting SRQ active low. The plotter generates an SRQ when an error condition occurs or when the CALL button is pressed.
IFC	Interface Clear	The IFC signal may be sent by the GPIB controller to put all devices on the GPIB into an inactive state. If the plotter is performing a task when the GPIB controller asserts IFC (active low), the interface interrupts that task and goes into an inactive state, awaiting possible commands from the GPIB controller. The IFC message does not clear the input queue but does clear the output queue.
REN	Remote Enable	The REN signal is used by GPIB systems to transfer devices from manual operation to remote control operation. The plotter does not have the capability to respond to REN.
EOI	End or Identity	The EOI signal is used by the Talker to indicate the end of a data transfer sequence. The Talker activates EOI as the last byte of data is transmitted.

Transfer Bus. The Transfer Bus is composed of three signal lines which execute a handshake sequence each time a byte is transferred over the data bus. Table 5-3 lists the Transfer Bus signals.

Table 5-3

TRANSFER BUS SIGNAL LINES

Signal	Signal Name	Function
NRFD	Not Ready For Data	An active low NRFD signal indicates that one or more assigned Listeners are not ready to receive the next byte. When all of the Listeners for a particular data transfer have released NRFD, the NRFD line goes inactive high. This tells the Talker that it may place the next byte on the Data Bus.
DAV	Data Valid	The DAV line is activated by the Talker shortly after placing a valid byte on the Data Bus. An active low DAV signal tells each Listener to capture the data presented on the Data Bus. The Talker is inhibited from activating DAV when NRFD is active low.
NDAC	No Data Accepted	The NDAC signal is held active low by each Listener until it has captured the byte currently presented on the data bus. When all Listeners have captured the byte, NDAC goes inactive high. This notifies the Talker that it may remove the byte from the Data Bus.

Handshake Sequence. Figure 5-8 shows the handshake sequence by which the Transfer Bus regulates the exchange of data bytes over the Data Bus.

If the plotter's GPIB interface is transmitting bytes to the GPIB bus, the initial conditions would have NRFD (not ready for data) as false (inactive) and NDAC (no data accepted) asserted true (active). The processor would then load data into the Transmit/Receive Data PIA. The processor would also write a 01 in hex to the Transfer/Management PIA. This asserts DAV (data valid) to the receiving device on the GPIB bus. The receiving of this data (and DAV) causes the receiving device to change the status of NRFD to true and NDAC to false. The processor reads the false going change of NDAC and changes DAV to false. Later, after the receiving device has processed the data and sees DAV false, it changes the states of NDAC to true and NRFD to false. This indicates that the receiving device can receive more data. Now, the false-going change of NRFD from the receiving device causes an interrupt to the processor. The processor responds by loading more data into the Transmit/Receive Data PIA and writes a 01 in hex to the Transfer/Management PIA. This asserts DAV and repeats the process.

The sequence is reversed when the plotter is receiving bytes from the GPIB bus and transferring them to the processor's data bus. The receiving plotter has NRFD false and NDAC true as initial conditions. The transmitting device starts by loading data on the GPIB bus and asserting DAV. This means that this data is received by the Data Bus Transceiver. The reception of the DAV generates an IRQ-0 to the processor. This IRQ-0 causes the processor to stop and process the incoming GPIB data. At the same time, the processor causes the GPIB interface to assert NRFD-0 back to the transmitting device. This tells the transmitting device that the plotter is not yet ready to receive more data. After the data has been read and processed, the

processor changes NDAC to false. This tells the transmitting device that the data has been accepted and another data byte can be sent. The transmitting device must then change DAV to false, which will interrupt the processor and cause it to change NDAC to true and NRFD to false. This establishes the initial receive condition; the transmitting device can now load more data on the GPIB bus and assert DAV to repeat the process.

The plotter's back panel GPIB connector is shown in Figure 5-9. All devices on the GPIB are connected in parallel and all lines on the GPIB are active low and passive high.

The GPIB Interface, shown in Schematic A1-2, is divided into the following circuit blocks which are subsequently described:

- Transmit Data
- Receive Data
- Data Bus Transceiver
- Control Bus Transceiver
- Handshake Control
- Debounce

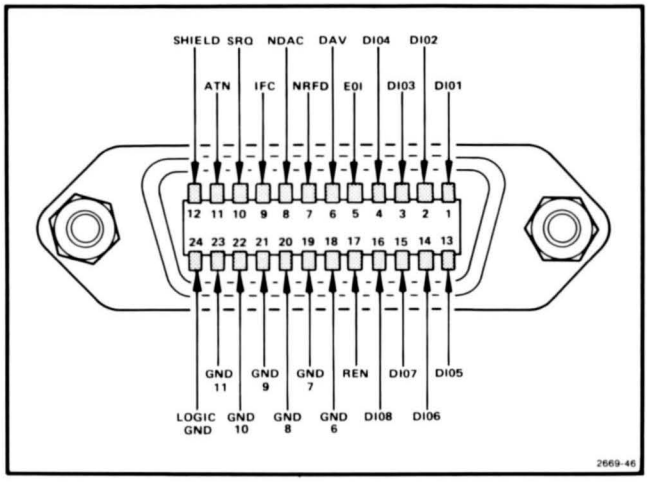


Figure 5-9. GPIB Connector.

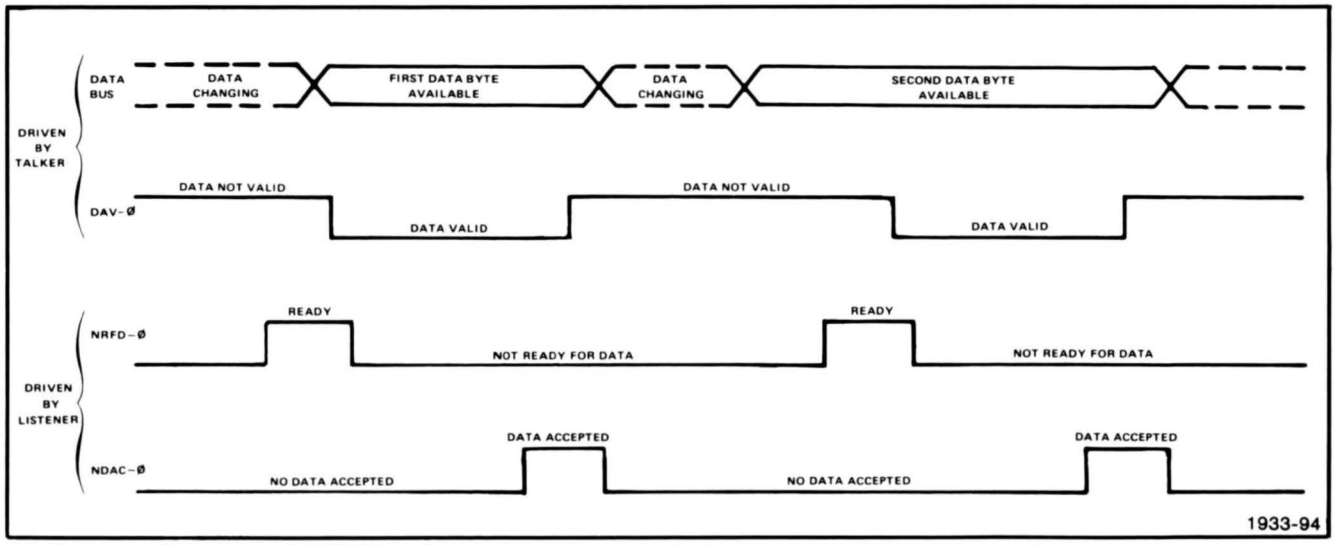


Figure 5-8. GPIB Handshaking Sequence.

Transmit Data

The Transmit Data circuit block consists of the A-side of the Transmit/Receive Data PIA. The processor loads data to be transmitted into Peripheral Data Register A. The BR-1/W-0 (read/write) line would be asserted for write and the Chip Select and Register Select lines asserted. Then, an enable, which is ϕ2-1 SYS, would clock the data (BD0 through BD7) through the Data Bus Transceiver.

Receive Data

The Receive Data circuit block consists of the B-side of the Transmit/Receive Data PIA. Received data is loaded into the Peripheral Data Register B from the Data Bus Transceiver. The accompanying true DAV signal from the transmitting device is received as CB1 and CB2, which causes an IRQ-0 to the processor. The processor, in its interrupt routine, selects the Peripheral Data Register B and asserts read. On the next ϕ2-1 SYS, the incoming GPIB data is transferred to the processor's data bus for processing.

Data Bus Transceiver

The Data Bus Transceiver consists of two quad bus transceivers. One of them, U401, controls GPIB Data Bus lines DIO1 through DIO4, while the other, U305, controls DIO5 through DIO8.

When the plotter is transmitting data, the processor places a low on the transceiver's enable input (E). This causes the transceiver to pass data from the A0-D0 inputs to the A-D outputs.

When the plotter is receiving data, the processor places a high on the transceiver's enable input (E). This causes the transceiver to pass data from the A-D inputs to the A1-D1 outputs.

GPIB ports (A, B, C, D) are active-low to conform with the GPIB standard, while transmit and receive ports (A0, B0, C0, D0, and A1, B1, C1, and D1, respectively) are active high.

The enable input (E) is controlled by bit 2 of the Transfer/Management PIA's Peripheral Data Register A. The processor writes 02 to the Transfer/Management PIA to transmit data on the GPIB Data Bus. This is the same as the plotter acting as a Talker. Otherwise, the transceivers are enabled for receiving data from the GPIB Data Bus.

Control Bus Transceiver

The Control Bus Transceiver consists of two quad bus transceivers. One of them U101, controls GPIB Transfer Bus Line (DAV-0, NRFD-0, and HDAC-0) plus the Management Bus Line, EOI-0. The other quad bus transceiver, U205, controls the remaining Management Bus Lines, REN-0, ICF-0, ATN-0, and SRQ-0.

The processor controls the combination of the enable input (E) and PIA lines (PA0 through PA7, PB5, 6, and 7, and CA2) to form all of the outgoing Transfer and Management Bus Signals (refer to the Handshake Sequence for a description of each signal's role in the data transfer process). Incoming Transfer and Management Bus Signals are input to the CA or CB ports to generate interrupts to the processor.

ATN/DAV Holdoff Circuit

When bit 4 of Switch A is set true (high), the NRFD signal line is asserted true (low) for about 3 ms nominal at the end of every attention sequence (a true to false transition of the ATN signal line). This delays the transmission of the first data character following the attention sequence and allows the plotter to complete the processing after the attention sequence. This is important for some newer GPIB devices that operate with a very short time span between the attention sequence and data, thus not permitting the plotter to complete its processing.

Handshake Control

The Handshake Control circuit block consists of the Transfer/Management PIA and the A- and B-Interrupt Logic Registers of the Transmit/Receive Data PIA. This circuit controls the generation and processing of Transfer Bus and Management Bus signals from the GPIB bus.

Transfer Bus signals are received by the A- and B-Logic registers of the Transmit/Receive Data PIA and, therefore, generate an interrupt to the processor. Each of the Transfer Bus signals also form a specific bit pattern in the Peripheral Data Register A of the Transfer/Management PIA. Then, when the processor is interrupted, it reads this register to determine which Transfer Bus signal caused the interrupt. In response to this interrupt, the processor reads or writes Data Bus data, asserts another Transfer Bus signal, etc. (refer to GPIB Handshaking Sequence earlier).

Only two Management Bus signals can be generated by the plotter. These are EOI-0 and SRQ-0. In addition, SRQ-0 and REN-0 are the only Management Bus signals the plotter will not respond to when receiving them. ATN-0, IFC-0, and EOI-0 all generate interrupts to the processor.

Five lines from switches S201 and S205 (rear panel Switches C and D) are used as inputs to the Transfer/Management PIA. These lines establish the plotter's primary address.

Table 5-4 shows a summary of the Transfer and Management Bus signals.

Table 5-4

HANDSHAKE CONTROL LINES

PIA	PIA Pin Output/Input	Signal
Transmit/ Receive Data PIA	CA1[a] (input)	NRFD
	CA2[a] (input)	NDAC
	CB1, CB2[a] (input)	DAV
Transfer/ Management PIA	PA0 (output)	DAV
	PA1 (output)	Data Bus Enable & NRFD/NDAC Enable
	PA2 (input)	NRFD
	PA3 (input)	NDAC
	PA4 (output)	EOI
	PA5 (output)	NRFD-1/NDAC-0
	PA6 (output)	Transfer Bus Enable
	PA7 (input)	EOI
	IRQA,B (output)	IRQ
	CA2 (output)	Transfer/Management Bus Enable
	PB5 (input)	REN
	PB6 (output)	SRQ
	PB7 (output)	Transfer/Management Bus Enable
	CA1,CB1[a] (input)	ATN
	CB2[a] (input)	IFC

[a]Edge sensitive; all others are level sensitive.

Debounce

The Debounce circuit is a contact bounce eliminator that is used to "clean up" all input Transfer and some Management Bus signals. This circuit minimizes erroneous signals to the processor due to signal line "ringing."

The Contact Bounce Eliminator is both an up and down digital integrator with a four-bit shift register for each of the six input lines. Internally, the logic compares each input with the contents of its shift register. A 208-kHz signal clocks the six Transfer and Management signals through their respective shift registers. When a signal changes states, there is usually some "ringing" following that edge. As this signal is clocked through the shift register, the output is not changed until the levels in all sections of the shift register are the same. This means that both the leading and the trailing edges of each transfer or Management Bus signal are delayed by at least 0.1923 μs (four periods of the 208-kHz clock).

The 208-kHz clock is generated by the Vector Generator's Timing circuit block (described later).

PROCESSOR AND CLOCK

General Information

The processor (shown in Schematic A1-3) controls the transfer of data and commands between the plotter's functional blocks. The plotter can be described as an interrupt-driven device. This means that whenever a functional block receives, generates, or passes a command (or data), the functional block first sends an interrupt to the processor. The processor sequentially polls the PIAs to identify the interrupting block and then accesses instructions from the system firmware stored in ROM. These instructions guide the processor in transferring or modifying the command or data. The functional block(s) receiving the command or data then take the required action.

The processor requires two non-overlapping clock signals (Phase 1 and Phase 2) from the Clock Driver and a RST-0 from the Power Supply. RST-0 causes the processor to begin operation by jumping to the restart instruction address in system firmware.

Crystal-Controlled Oscillator

The Crystal-Controlled Oscillator generates a 12.5-MHz master clock from which all other timing in the plotter is derived. A strap, XCK, allows the plotter to be driven from an external clock during troubleshooting tests.

Clock Generator

The Clock Generator (shown in Schematic A1-3) generates the 12.5-MHz square-wave Bus Clock and the two-phase non-overlapping clock for the processor as well as several other system timing signals (from the 12.5-MHz master clock signal). A drawing of these waveforms is shown in Figure 5-10.

A Shift Register, functioning like a Johnson (or ring) Counter, is clocked on each positive transition of the 12.5-MHz master clock. Its outputs are decoded to produce the various system timing signals.

Initially, at power-up (T0), the condition of the Shift Register is unknown. However, after several clock pulses, the Shift Register's output will enter into the desired count sequence and proper operation will begin.

Assume that the Shift Register is currently at State T0 (Figure 5-10). This means that all of the Q outputs are high and the output of the 8-input NAND gate (A) will be low. This low resets the R-S Flip-Flop so that B is also low. Since A and B are low and become inputs (which are internally "ANDed") to the Shift Register, the next clock shifts a low into QA of the Shift Register. This causes A to go high, but since B is still held low by the R-S Flip-Flop, lows continue to be shifted into the Shift Register until QG goes low. This resets the R-S Flip-Flop, causing B to go high. Now, since A and B are both high, highs start shifting into the Shift Register. With each clock pulse, the outputs of the Shift Register become highs until QH. When QH goes high, A goes low, which returns the Shift Register to its initial condition (T0). The cycle starts over, with 15 clock pulses required for each cycle.

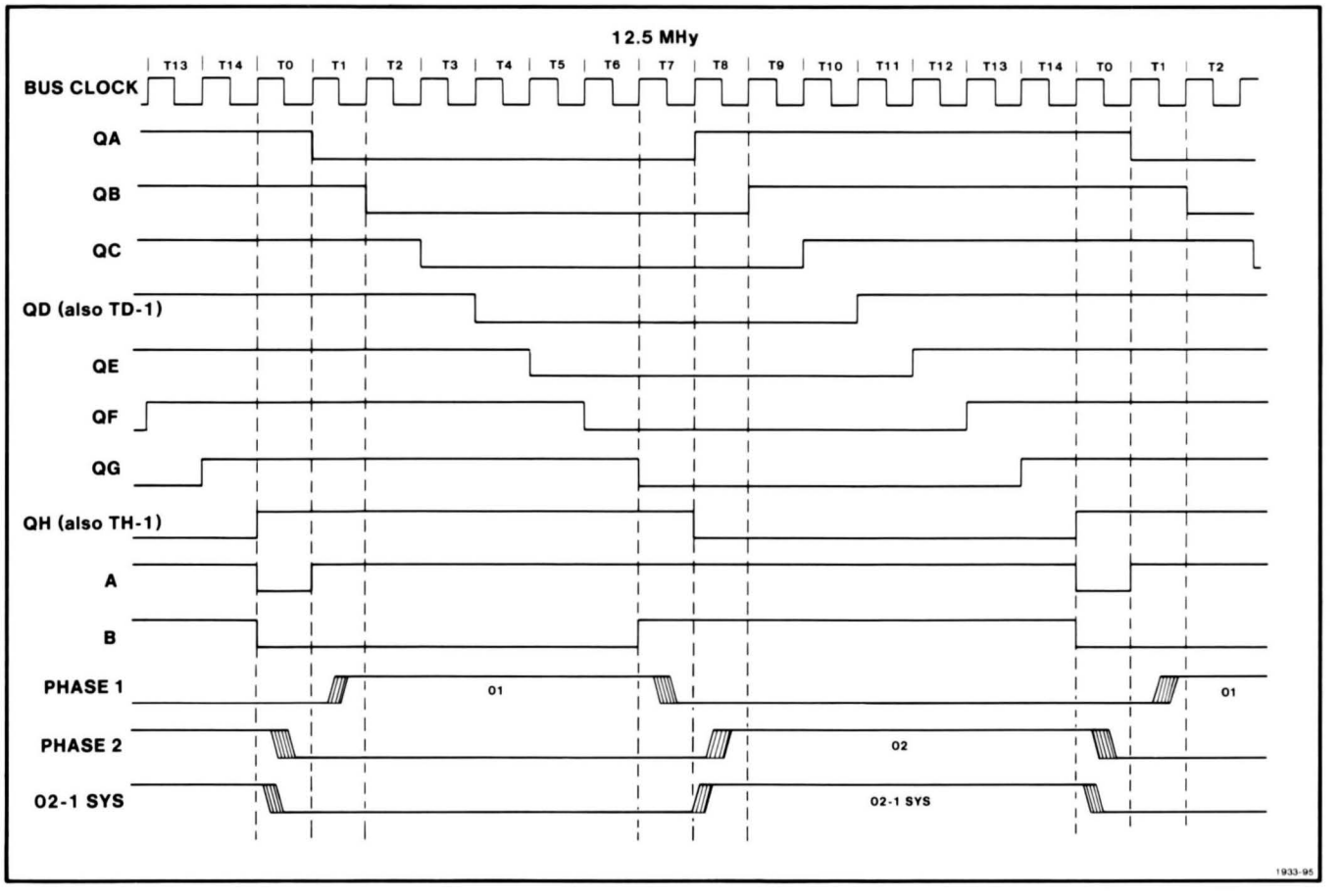


Figure 5-10. Clock Generator Timing Diagram.

QA through QH are used to produce several timing signals used in the plotter. Among them are:

- Processor PHASE ϕ1
- Processor PHASE ϕ2
- PHASE ϕ2-1 SYS
- TD-1
- TH-1

Clock Driver

The Clock Driver buffers the Phase 1 and Phase 2 signals to meet input levels requirements to the processor.

ϕ2-1 SYS provides the synchronization and clocking for all of the Peripheral Interface Adapters as well as a 833-kHz clock for the Vector Generator.

Processor

The 6800 microprocessor (called processor in this manual) controls the transfer of data and commands between the other functional blocks.

The processor's operation is synchronized with two non-overlapping clock signals (Phase 1 and Phase 2) from the Clock Driver (described immediately before).

RST-0 initializes the processor at power-up and causes it to begin operation by jumping to the restart instruction address in the system firmware each time RST-0 goes low.

HALT-0 is used by the System Test Fixture only (in troubleshooting), and stops the processor after the completion of the current instruction. Once stopped, the processor asserts a high on BA-1, thereby tri-stating the Address, Data, and R/W lines. This allows these lines to be driven by external test equipment.

As mentioned earlier, the plotter is described as an interrupt-driven device. This means that whenever a functional block requires service by the processor, the functional block must send an interrupt request to the processor. The processor finishes its current task and then polls each PIA (by reading the control registers in each PIA) sequentially to identify the interrupting block. Once the interrupting block is identified, the processor addresses specific locations in firmware seeking instructions to service that interrupt. Two levels of interrupts are used by the plotter — IRQ and NMI.

IRQ interrupts are generated by the receiving and transmitting of data through the two communications interfaces, the eight-millisecond timer, or the Option 31 motor step rate timer, if Option 31 is installed. The priority level of an IRQ interrupt is less than that for a NMI interrupt.

NMI interrupts are generated by the Vector Generator whenever the pen carriage is moving and are used to keep track of the location of the pen as it is moving across the platen. This interrupt is generated every third motor step unless the axis is within five steps of the end of the vector, in which case, NMI is generated with each step (refer to the Vector Generator description for details). NMI is also generated for each motor step when the joystick is controlling the motors.

VMA is asserted by the processor whenever the processor places a valid address on the address bus. VMA is driven false whenever the processor is performing an internal operation, during which the state of the Address Bus is undefined. This prevents accidental selection of PIAs and registers during these times.

In normal operation, BA is low, indicating that the address and data buses are under processor control. The low BA enables the address buffers and the processor read/write line (BR-1/W-0). BA is driven high whenever the processor is halted. This causes the Address, Data, and R/W lines to be tri-stated so that they can be driven by external test equipment.

BR-1/W-0 is high whenever the processor is reading the contents of a memory or PIA location and is low whenever the processor is writing to a memory or PIA location.

Address Buffer

In order to transfer data to or from a functional block, the processor must first select the block by placing its address on the address lines, A0 through A15 (BA0 through BA15). The most significant bit of the address is A15. This address may identify a specific register in either a PIA, RAM, or ROM. The address bus is buffered with three buffers which are enabled by the normally low state of BA. This allows the addresses to be input to several different functional blocks. These lines are not bidirectional.

Data Buffers

The bidirectional data bus lines, D0 through D7 (or BD0 through BD7), carry bytes of data between the processor and the various functional blocks. The buffering of these lines permits several functional blocks to accept the data bytes. The processor's read/write line (BR-1/W-0) and BBA-1 (buffered bus available) control the direction of these buffers. This permits the passing of data from the processor to the bus for write operations (BR-1/W-0= 0) or from the bus to the processor for read operations (BR-1/W-0= 1). In addition, a third case may occur when the processor is halted (BBA-1= 1), allowing the bus to be driven by external test equipment in troubleshooting.

A pull-up resistor on BD7-1 forces this line to be a 1 during read operations if there is no device present at the address being read. In this manner, the processor can determine if a ROM is installed at any given address.

I/O Control Buffer

The I/O Control Buffer consists of a buffer for the processor's read/write line, BR-1/W-0, which in turn indicates whether data is to be read from, or written into, a memory location or PIA. The BR-1/W-0 line is tri-stated whenever the processor is halted (BBA-1= 1). This allows the BR-1/W-0 line to be driven by an external device during troubleshooting.

MEMORY

The plotter's memory consists of RAM (Random Access Memory), ROM (Read Only Memory), and PROM (Programmable Read Only Memory).

RAM memory is used by the plotter (1) to store incoming commands until the processor can act on them, (2) to store outgoing responses until transmission, and (3) to form a "scratch-pad" for the processor while it is processing data (commands).

ROM memory is the permanent set of instructions used by the processor in carrying out its activities (acting on commands, calculating vectors, etc.).

PROM memory may be used to add optional or additional processor instructions.

Table 5-5 shows the plotter's memory map.

Table 5-5
PLOTTER MEMORY MAP

Address	Description		Early Configuration			Capacity
			Address	Description		
0000	RAM 0	2K	0000[a]	RAM 0		
0400	RAM 1	standard	0100[a]	1		
0800	RAM 2		0200[a]	2		
0C00	RAM 3		0300[a]	3	2K	8K
1000	RAM 4	Option 20	0400[a]	4		
1400	RAM 5		0500[a]	5		
1800	RAM 6		0600[a]	6		
1C00	RAM 7		0700[a]	7		
2000 to 7FFF	Reserved					24K
800C	PIA 1 VECTOR GENERATOR					
8014						
8018	PIA 3 GPIB					
8024						
8028	PIA 4 FRONT PANEL					
8030	PIA 5 RS-232					128 Bytes
8044	PIA 2 GPIB					
8048						
8050	PROMPT LIGHT					
8060	OPTION 31 PIA					
8080 to 87FF	Reserved					1920 Bytes
8800 to 8FFF	Reserved					2K
9000 to 9FFF	Patch PROM					4K
A000	PROM 0					
A400	PROM 1					
A800	PROM 2					
AC00	PROM 3					
B000	PROM 4					8K
B400	PROM 5					
B800	PROM 6					
BC00	PROM 7					
C000	ROM C					
D000	ROM D					16K
E000	ROM E					
F000	ROM F					
			C000[b]	ROM 0 (Not used)		
			C800[b]	ROM 1		
			D000[b]	ROM 2		
			D800[b]	ROM 3		
			E000[b]	ROM 4		16K
			E800[b]	ROM 5		
			F000[b]	ROM 6		
			F800[b]	ROM 7		

[a]Used in Plotter boards with part numbers 670-4102-00 to 670-4102-05.
[b]Used in Plotter board part numbers 670-4102-00 to 670-4102-07 without the System Memory circuit board (670-7176-00).

The plotter has three major memory configurations. These are: (1) 2K RAM plus ROM; (2) 2K (expandable to 8K) RAM plus ROM; and (3) 2K (expandable to 8K) RAM plus ROM that is located on a separate System Memory circuit board.

The following description covers the RAM of all three versions and the ROM (and PROM) of the first two configurations. The ROM circuitry of the separate System Memory circuit board (670-7176-00) is described under System Memory and is shown on Schematic A3-1.

2K RAM Version

RAM. Plotters using a Plotter board with a part number ranging from 670-4102-00 to 670-4102-05 (shown in Schematic A1-4) have 2K bytes of RAM installed (each of the 16 RAM devices stores 256x4 bits). The RAM Decode decodes the bus addresses 0000 to 7FFF.

RAM R/W-0 is an OR of the processor BR-1/W-0 and QH from the Clock Generator (Schematic A1-3). This means that the processor can only write into the RAM during $\phi 2$ time.

ROM. Up to 16K bytes of system firmware can be stored on the Plotter board (670-4102-00 to 670-4102-07). These ROM devices are shown in Schematics A1-4 and A1-4A. Each ROM contains 2Kx8 bits of data (instructions for the processor). Table 5-6 shows a table of the general ROM content.

Table 5-6

PLOTTER ROM MEMORY

ROM	Location	Address	Contents
0	U245	C000-C7FF	Not used
1	U250	C800-CFFF	GPIB
2	U345	D000-D7FF	RS-232
3	U445	D800-DFFF	Alphanumeric Printing
4	U450	E000-E7FF	Math Functions
5	U145	E800-EFFF	Motion Processing, Motor Control
6	U50	F000-F7FF	Power-up, Front Panel, System Command Processing
7	U45	F800-FFFF	Power-up, Front Panel, System Command Processing

ROM ENABLE-1 is normally high but may be pulled low by external devices (such as the System Test Fixture) to disable the ROM memory during troubleshooting.

PROM. Up to 8K bytes of optional or additional firmware can be stored on the Plotter board (670-4102-00 to 670-4102-07) in the form of PROM. These are 1Kx8 bit devices (shown in Schematics A1-4 and A1-4A). The standard plotter does not contain any PROM.

The PROM ADDRESS strap (if set in the "1" position) maps the PROM into the same addresses as ROM. Plotters equipped with Option 31 add PROM 7 to U51, which becomes part of the System ROM. These plotters must have this strap set to the "1" position.

2K (Expandable to 8K) RAM Configuration

This is a 670-4102-07 (or higher) version Plotter board. This memory configuration does not incorporate the System Memory circuit board (670-7176-00).

RAM. Plotters using a Plotter board with a part number of 670-4102-07 (shown in Schematic A1-4A) have 2K bytes of RAM installed (in four 512-byte 2114 devices). In addition, empty sockets exist for the addition of 6K more of RAM storage (Option 20). This means that the RAM Decode decodes addresses 0000 to 07FF for the standard 2K RAM and 0800 to 1FFF for the additional 6K of RAM added as Option 20 (refer back to Table 5-5).

ROM. Refer to the earilier description of ROM under the 2K RAM Configuration.

PROM. Refer to the earlier description of PROM under the 2K RAM Configuration.

2K (Expandable to 8K) RAM Configuration Plus System Memory

This configuration has 2K (expandable to 8K) RAM on the 670-4102-07 Plotter board plus ROM located on the System Memory circuit board (670-7176-00).

RAM. Refer to the description of RAM under the 2K (Expandable to 8K) RAM Configuration.

ROM. When the System Memory circuit board (670-7176-00) was added, the eight ROMs on the Plotter board were combined into four ROMs and moved to the System Memory circuit board. The System Memory circuitry is described later in this section.

PROM. Refer to the earlier description of the PROM under the 2K RAM Configuration.

PIA Select

Whenever the processor addresses a functional block other than the memory (RAM, ROM, etc.), the processor actually addresses the Peripheral Interface Adapter (PIA) of that functional block. Each functional block (except memory) that connects directly to the processor's address and data bus has a PIA (see Figure 5-1). Each time the processor addresses a PIA, the 8000 to 805F address (see Plotter Memory Map, Table 5-5) is AND'd with VMA-1 to form a chip select to each PIA (PIACS2-0). This chip select is common to all PIAs and is one of the three chip selects required by each PIA. The other two chip selects come from the address bus to specify a specific PIA.

VECTOR GENERATOR

General Information

The Vector Generator (shown in Schematics A1-5 and A1-6, and in Figure 5-11) converts the processor's vector calculation data into the correct number of step counts to the X and Y pen drive motors in order to create the desired vector. All vectors contain X and Y components. In any move, draw, or print operation, these two components contribute motor movements relative to that vector. In the Vector Generator, these are referred to as Δ small and Δ large. For example, to draw a nearly vertical line, the Y-axis contributes more to the vector. In this case, the Y-axis has the largest change component and, therefore, the Y-axis is referred to as Δ large.

To draw a vector, the processor calculates the ratio of the desired change in the X-axis and the desired change in the Y-axis and arranges this ratio such that the fraction is always equal to or less than 1.0 (ΔX/ΔY or ΔY/ΔX). This quotient is the axis change quotient and is stored in the Quotient Accumulator.

The processor then loads the three Velocity Storage Registers with velocity constants. Velocity constants are numbers stored in the system firmware that are used by the Vector Generator to determine the step rate of the pen drive motors. Collectively, in system firmware, these numbers form the acceleration and deceleration tables for the motors when starting, maintaining, and ending vectors. Since the pen is accelerating at the start of a vector, increasing velocity constants are used initially.

Each velocity constant is added, in turn, to an accumulator (the Velocity Accumulator). When the third velocity constant has been added to the accumulator, the processor is interrupted (with an NMI interrupt), causing it to load three new velocity constants in the Velocity Storage Registers. (These constants are the same if the pen's speed is constant, or if it is decreasing because the pen is slowing down near the end of a vector.) Again each velocity constant is added to the accumulator until an overflow (carry) occurs from the accumulator. This overflow becomes FAS-1 (fast axis overflow).

Each fast axis overflow represents one-sixteenth of an actual pen drive motor step. The FAS-1 pulses are further processed by the X or Y Secondary Integrator to output one motor step pulse (XSTEP-0 or YSTEP-0) for every 16 Velocity Accumulator overflow pulses (FAS-1). These pulses will drive the pen drive motor whose axis has the largest change component. The Rate Multiplexer determines which axis (X or Y) contains the larger component of the vector (based upon the axis change quotient) and enables the appropriate X or Y Secondary Integrator.

The process for stepping the other motor (the motor controlling the axis with the smaller change component) is slightly different. Each time a FAS-1 pulse occurs from the Fast Axis Overflow to turn the motor whose axis has the largest change, the Axes Change Quotient (loaded by the processor earlier) is added to the Quotient Accumulator. After several additions, the adder asserts an overflow (carry). This overflow results in a step (XSTEP-0 or YSTEP-0, or one-sixteenth of a pen drive motor step) for the small axis (the axis with the smaller vector component). For example, if the Axes Change Quotient equalled 0.25, the Quotient Accumulator would overflow every fourth FAS-1. Therefore, the motor undergoing the largest axis change would turn four times as often as the other motor.

If the pen is accelerating at the start of a vector, each successive velocity constant is larger than the one preceding. This means that fewer additions are required to create the overflow FAS-1 pulse. The result is that the Velocity Accumulator overflows faster and the stepping rate of both motors increases.

When the pen reaches terminal velocity (after about 1.28 inches or 32.5 mm), the processor loads the same velocity constant into the three Velocity Storage Registers. Later, when the pen reaches about 1.28 inches (32.5 mm) from the end of the vector, the processor starts loading gradually decreasing velocity constants, causing the step rate of the motors to decrease and the pen's speed to decrease.

For moves of less than 2.56 inches (65 mm), the process is the same, except that terminal velocity is not attained.

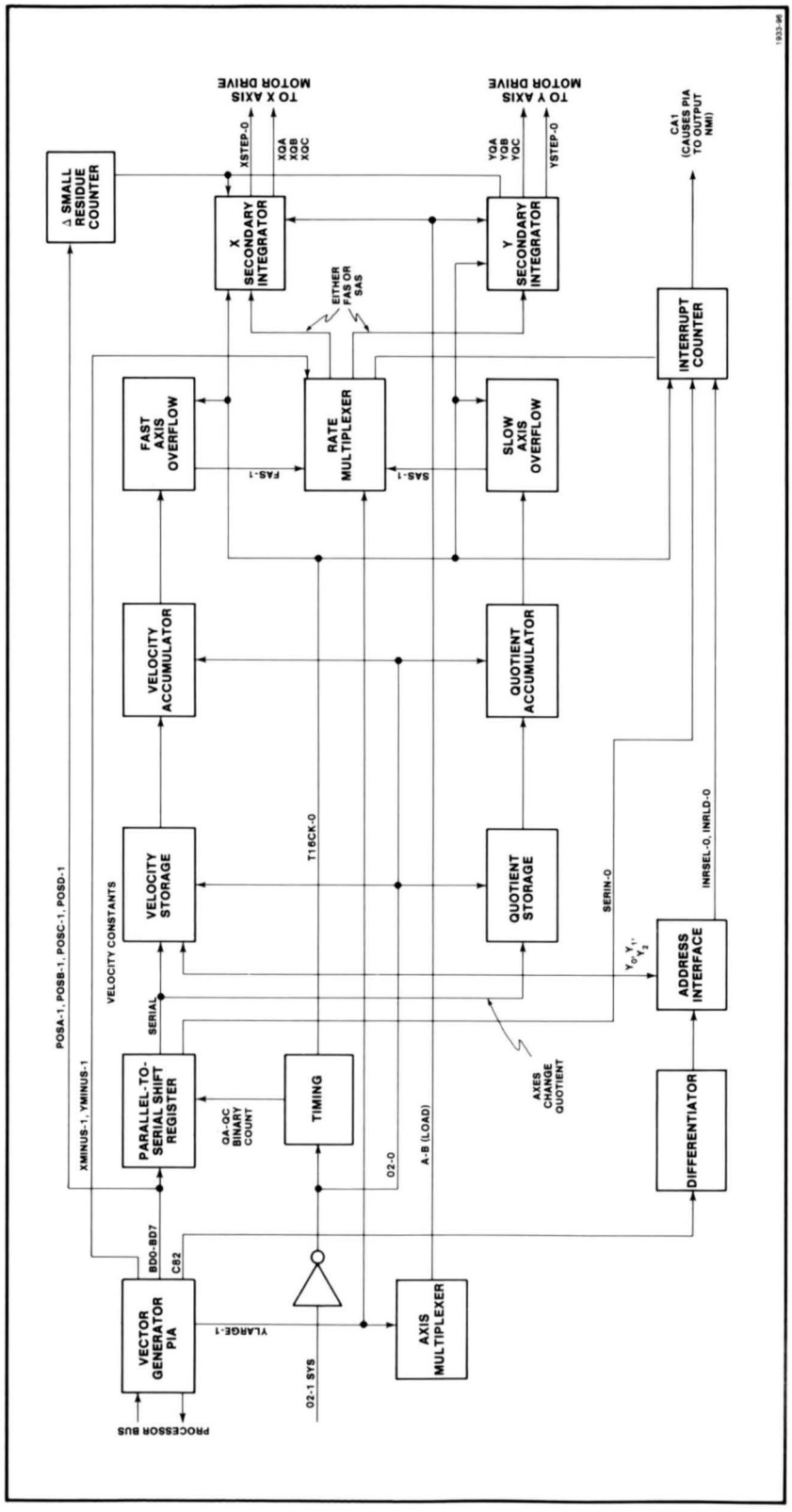


Figure 5-11. Vector Generator Block Diagram.

Timing

The Timing circuitry consists of a four-bit counter that (1) controls the operation of the Parallel-to-Serial Shift Register, (2) synchronizes the shift of the velocity constants through the Velocity Storage Registers and into the Velocity Accumulator, and (3) synchronizes the shift of the 16-bit axes change quotient through the Quotient Storage and Quotient Accumulator.

The four-bit counter is counting ϕ2-1 SYS pulses and outputting a binary count on the QA through QD lines. The binary count is used by the Parallel-to-Serial Shift Register to sequentially address each processor data line (through the PIA). The result is the data is changed to a serial format.

The QB output, which is a 208-kHz signal, is also used to clock all input GPIB Transfer and some Management Bus signals through the GPIB Debounce circuit. This minimizes signal line ringing.

The QD output synchronizes the shift of the velocity constants through the Velocity Storage Registers and into the Velocity Accumulator. QD also shifts the 16-bit-axes-change-quotient through the Quotient Storage and into the Quotient Accumulator.

The carry output from the counter is used to create the T16CK-0 (ϕ2-1 divided by 16), which is used to synchronize the X and Y Secondary Integrators and the X-and Y-Axis Drive circuits.

Parallel-to-Serial

The Parallel-to-Serial circuitry converts the parallel data on the BD0 through BD7 lines into serial data to the Velocity Storage Registers, the Quotient Storage, or the Interrupt Counter.

Input parallel data from the processor (through the PIA) appears at the inputs. Address lines A, B, and C (the binary count from the Timing circuits) select each data line sequentially and output it on Pins 5 and 6. This means that as the Timer counts from zero to seven, Pins 5 and 6 output BD0, BD1, BD2, BD3, BD4, BD5, BD6, and BD7 in a serial sequence.

Velocity Storage

The Velocity Storage circuit consists of three eight-bit shift registers. The processor serially loads these registers with velocity constants stored as acceleration/deceleration tables in ROM. The loading starts in Register 1, and when it is full, the data shifts into Register 2 and then into Register 3. When the pen is accelerating, each successive velocity constant is larger than its preceding one. On the other hand, each succesive velocity constant is smaller if the pen is slowing down near the end of the vector.

In the interest of speed, a fourth velocity constant is stored in the Vector Generator PIA. This constant becomes the first of the next series of three velocity constants that the processor will load into the Velocity Storage after the previous three constants have been processed.

The three velocity constants stored in the Velocity Storage are shifted sequentially into the Velocity Accumulator, starting with Register 3, to determine the stepping rate of the two axes motors. If the velocity constants are large, overflows (FAS-1) will be frequent to the X-and Y-Axis Integrators.

Timing is obtained from both the ϕ2-1 SYS and the Timing circuitry (described earlier).

Velocity Accumulator

The Velocity Accumulator is a digital integrator that provides an output that is sixteen times the actual motor step rate for the axis undergoing the largest change. Each velocity constant from the Velocity Storage is added to the serial Adder until an overflow (carry) occurs. The Velocity Register becomes an accumulator to which each velocity constant is added. Successive additions of velocity constants cause an overflow, which is output from Pin 5 of the Adder. This pulse is latched by the Fast Axis Overflow circuit and is output as a stepping pulse, FAS-1 (fast axis step), to the X and Y Secondary Integrators. These carry pulses occur at a rate that is 16 times the step rate of the motor whose axis is undergoing the largest change.

Fast Axis Overflow

The Fast Axis Overflow circuit synchronizes the carry pulse from the Velocity Accumulator with T16CK-0 (ϕ2-1 SYS divided by 16). The FAS-1 (fast axis step) represents one-sixteenth of a motor step for the axis undergoing the largest change.

Quotient Storage

The Quotient Storage is a 16-bit register that stores the Axes Change Quotient, which is a fraction equal to or less than 1.0, and represents the ratio between the small axis vector component and the large axis vector component ($\Delta X/\Delta Y$ or $\Delta Y/\Delta X$). The reciprocal of this quotient is the motor steps needed by each motor. The dividend (first or top number) of the reciprocal is the number of steps needed by the motor whose axis has the largest change per motor step. The divisor (second or bottom number) is the number of steps needed by the motor whose axis has the smallest change per motor step. For example, if the operating conditions were such that the quotient equalled .25, then the motor in the axis with the largest change will step four times as often as the other motor.

The Axes Change Quotient is calculated by the processor and loaded serially via the Parallel-to-Serial Shift Register.

Quotient Accumulator

The Quotient Accumulator, like the Velocity Accumulator, is a digital integrator. It uses two eight-bit shift registers making one 16-bit storage register, and a serial adder. Each time the Fast Axis Overflow outputs a FAS-1, the Axes Change Quotient stored in the Quotient Storage is added to the Quotient Accumulator value. The Quotient Register becomes the accumulator to which the Axes Change Quotient is added with each FAS-1 pulse. After repeated additions, a carry (or overflow) pulse is asserted from Pin 11 of the Adder. This pulse is latched by the Slow Axis Overflow circuit and is output as a stepping pulse, SAS-1 (slow axis step), to the X and Y Secondary Integrators. These SAS-1 pulses occur only fractionally as often as the FAS-1 pulses. This fraction is the Axes Change Quotient expressed as a percentage.

Slow Axis Overflow

The Slow Axis Overflow circuit synchronizes the carry pulses from the Quotient Accumulator with T16CK-0 (ϕ2-1 SYS divided by 16). The SAS-1 (slow axis step) represents one-sixteenth of a motor step for the axis undergoing the smallest change.

Differentiator

The Differentiator detects the processor's attempt to write using the B side of the PIA over data lines PB0 through PB7. The resulting detection pulse is then synchronized with T16CK-0 (ϕ2-1 SYS divided by 16) to enable the Address Interface to synchronize the loading (writing into) of various registers via the Parallel-to-Serial Shift Register.

Address Interface

The Address Interface is a three-line to eight-line multiplexer that expands the use of the Vector Generator PIA. The processor-controlled state of input lines A, B, and C determine the state of the eight output lines, Y0-Y7. This allows eight discrete signals from the combination of three PIA outputs.

Five of the output lines form a data select for the Velocity Storage Registers and the Quotient Storage Registers.

- Y6 and Y7 (XCLEAR-0 and YCLEAR-0) also clear the Joystick Interface flip-flops (Schematic A1-10) after the processor (1) has checked the Miscellaneous I/F PIA to see which joystick axis moved and (2) updated the pen position registers accordingly.
- INRSEL-0 enables serial data (a one or three) to be loaded into the Interrupt Buffer during ϕ2 time.
- INRLD-0 loads the contents of the Interrupt Buffer (a one or three) into the Interrupt Counter.
- SLOPOS-0

Rate Multiplexer

The Rate Multiplexer determines which Secondary Integrator (X or Y) receives the FAS-1 pulses and which receives the SAS-1 pulses. In addition, the Rate Multiplexer multiplexes (interfaces) the joystick signals to the X and Y Secondary Integrators for joystick-controlled pen moves.

YLARGE-1 is high if the processor has determined that the Y-axis has the largest vector component. The FAS-1 pulses are then passed to the Y Secondary Integrator. The SAS-1 pulses would then be passed to the X Secondary Integrator.

X Secondary Integrator

The X Secondary Integrator consists of an Up/Down Counter that counts the FAS or SAS step pulses and outputs a pulse to the X-Axis Motor Drive after counting every sixteenth step pulse.

If the pen is to move right, XMINUS-1 is low. This loads (when the processor places a momentary low on the load line) all zeros in the counter. Since the DN pin is also low, the counter will start counting up, in binary, each SAS-1 or FAS-1 pulse. The QB through QD output (XQA through XQC) is used to determine the current direction through the Phase A and B Bridge (X-Axis Motor Drive) and motor coil windings.

Every sixteenth FAS-1 or SAS-1 pulse results in an overflow from Pin 12 (M/M or Max/Min) and this pulse is processed by the X-Axis Motor Drive as an actual step in the X-axis motor.

Y Secondary Integrator

The Y Secondary Integrator works identically to the X Secondary Integrator and its outputs go to the Y-Axis Motor Drive.

If the pen is to move toward the front of the plotter, YMINUS is low.

Axis Multiplexer

The Axis Multiplexer works as a data selection switch to cause the Up/Down Counters in the X and Y Secondary Integrators to load either all zeros or ones, enable VELCHG-1, and/or enable the Δ Small Residue Counter.

Δ Small Residue Counter

The Δ Small Residue Counter makes a small correction in the axis with the smallest change at the end of some vectors. Under certain conditions at the end of a vector, the large axis may not move enough to cause the axis with the smallest change to make its last step. The Δ Small Residue Counter is used to make this adjustment. The Δ Small Residue Counter is loaded with the complement of the four least significant bits of the small axis quotient (the value stored in the Quotient Storage). Clocked by T16CK-0, this counter outputs a carry in relation to the quotient. When the P input to the counter is enabled, a small positive axis count is forced at the end of the vector.

The output carry pulse also enables the CA1 (finish vector) flag to the processor (this generates an NMI interrupt).

Interrupt Counter

The Interrupt Counter consists of a serial-to-parallel shift register (Interrupt Buffer) and a counter. The serial-to-parallel component converts a serial format number (the complement of a one or three) from the processor (via SERIN-0) to parallel data to be latched into the counter. The counter then overflows after receiving the number of step counts for which it was programmed. The overflow produces an NMI interrupt to the processor. The programmed number latched into the counter corresponds to the number of velocity constants that the processor has loaded into the Velocity Storage. This is usually three, except at the beginning and end of a vector, when the processor uses only one at a time.

CATSUP-1 causes the Slow Axis Quotient Accumulator to generate extra steps, if necessary, at the end of a vector. This signal is an interrupt input to the processor during joystick manual motion and is used to count steps.

X-AXIS MOTOR DRIVE

General Information

The X-Axis Motor Drive circuitry, shown in Schematic A1-7, converts the Vector Generator's stepping pulses (X or YSTEP-0) into current levels for the X-axis motor windings. Notice from Figure 5-1, that the X-Axis piggybacks to the Vector Generator and not to the processor bus. The X- and Y-Axis Motor Drives receive all of their inputs from the Vector Generator.

XSTEP-0 (FAS-1 or SAS-1 divided by 16) enables the Phase Counter to count either up or down the incoming T16CK-0 pulses. If the pen is to move to the right, XMINUS-1 is low and the Phase Counter will count up. On the other hand, if the pen is to move to the left, XMINUS-1 will be high and the Phase Counter will count down. The Phase Counter's binary weighted output, QA, QB, and QC, along with the XQA, XQB, and XQC from the Vector Generator's X and Y Secondary Integrator Up/Down Counter, causes the output of the Phase B Digital-to-Analog Converter to resemble a 64-step haversine. At the same time, the output of the Phase A Digital-to-Analog Converter will resemble a 64-step havercosine. Figure 5-12 shows a timing diagram of the motor drive circuitry.

The 64-step haversine/havercosine signal is compared to its respective motor winding current. Anytime the voltage level of the haversine/havercosine exceeds the voltage across the motor winding current sensor, the Phase A or B Bridge keeps the motor turned on. When the motor winding current reaches or exceeds the output of the Digital-to-Analog level, the current in the motor winding is turned off. Built-in hysteresis allows the current to drop until the voltage across the motor current sensing resistor becomes less than the voltage level of the haversine/havercosine, at which point the current to the motor winding is switched on again.

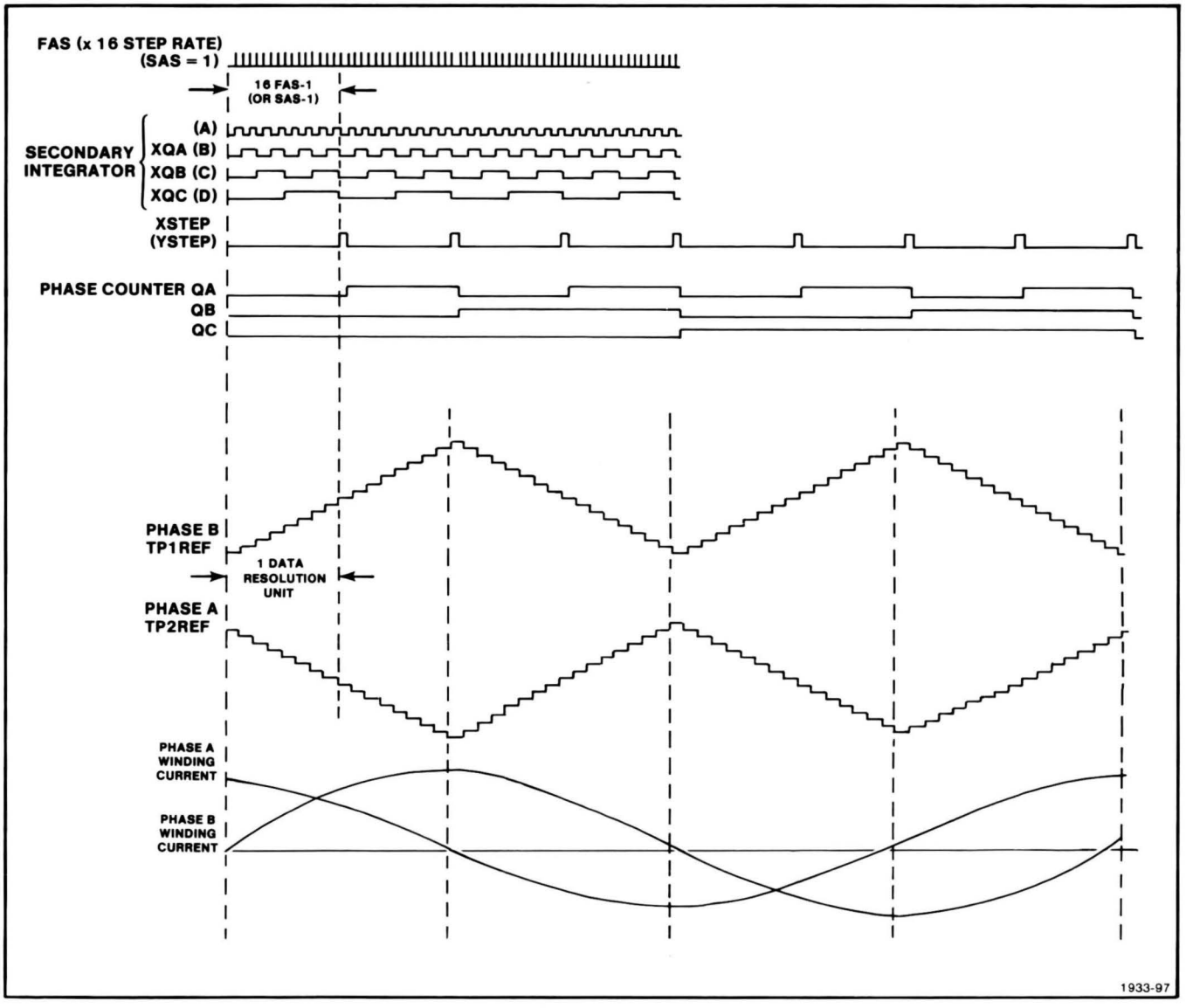


Figure 5-12. Motor Drive Timing Diagram.

The Phase A and B Bridge circuits form separate drives for the two motor windings. These two phases are 90 degrees apart. Motor direction is determined by which phase is leading, which in turn, is determined by the up/down counting of the Phase Counter. Each bridge acts as a double-pole, double-throw switch to alternate the direction of current flow through each motor winding. Figure 5-13 shows a simplified block diagram of the motor drive circuitry.

Each block of the X-Axis Motor Drive (Schematic A1-7) is described in more detail in subsequent paragraphs.

Phase Counter

The Phase Counter counts each XSTEP-0 pulse from the Vector Generator. This counter is synchronized by the T16CK-0 signal (ϕ2-1 SYS divided by 16). The binary count on the output, QA, QB, and QC, is combined with the eight discrete levels of XQA, XQB, and XQC from the Vector Generator X Secondary Integrator to form haversines and havercosines in the Digital-to-Analog Converter. QA forms a one-half step input to the Digital-to-Analog Converter. (The eight levels of XQA, XQB, and XQC together form the other half-step.) QB determines whether the Digital-to-Analog output steps up or down (i.e., whether the haversine/havercosine signal is rising or falling). The combination of QB and QC determine the direction of current flow in the motor coils.

Digital-to-Analog Converter

The Digital-to-Analog Converter consists of five exclusive-OR gates and resistor-diode pairs, which form a voltage-summing network. The output of each exclusive-OR gate is weighted by the size of its resistor. Together, the outputs of all exclusive-OR gates add to produce one analog voltage, as shown in Figure 5-12. Then, the cyclic 64 steps of the Vector Generator produce a haversine signal.

At the same time, QB is inverted to the Phase A Bridge Amplifier and, therefore, produces a havercosine signal that is 90 degrees out of phase from Phase B (see Figure 5-12).

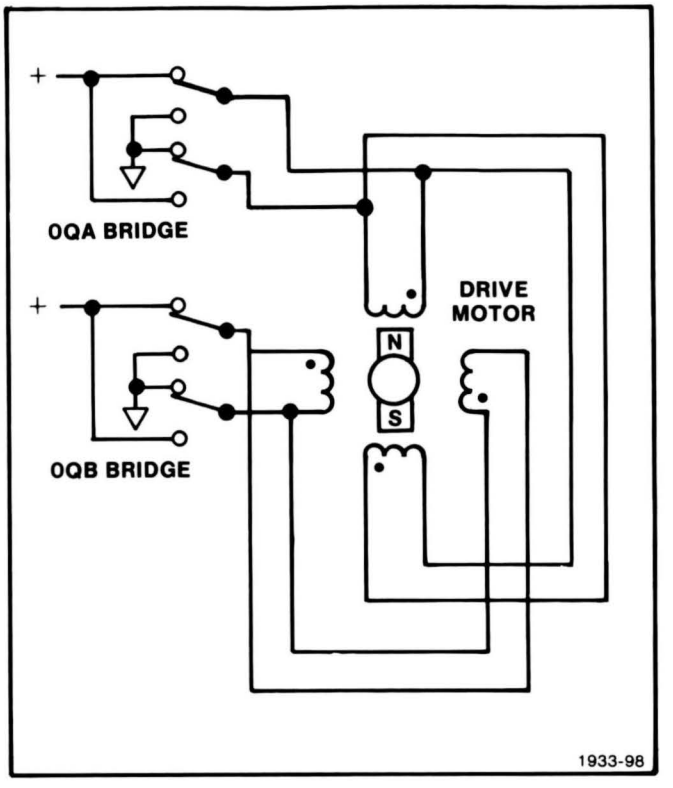


Figure 5-13. Simplified Motor Drive Diagram.

The eight levels of XQA, XQB, and XQC form one-half motor step, to which QA, from the Phase Counter, is added to complete the complete motor step.

XMINUS-1 determines the motor direction. The pen moves right when XMINUS-1 is low and left if XMINUS-1 is high.

Test Points (TP) 1 and 2REF allow the technician to display the haversine/havercosine on an oscilloscope.

Current Regulator

The Current Regulator controls the output current to its associated motor coil. The input haversine/havercosine is compared to the voltage developed across the motor coil current sensing resistor. When the voltage level across the sensing resistor exceeds the input haversine/havercosine level; the comparator goes high and switches off the conducting half of the Phase Bridge Amplifier.

The built-in hysteresis of the motor allows the current to continue, but decrease, until the voltage across the sensing resistor is less than the input haversine/havercosine level; at which point the output of the comparator goes low and the Phase Bridge Amplifier is turned back on.

Phase A and B Bridge Amplifiers

The Phase A and B Bridge Amplifiers produce the motor coil current. Each bridge amplifier drives one of the two windings in a motor and is composed of two identical halves. Only one half can be turned on and be active while the other is turned off and bypassed for alternate haversine/havercosines. Later, when the haversine/havercosine signal switches to the second half of its 360 degree cycle, the two amplifier halves reverse their roles. QB and QC, from the Phase Counter, turn on or off the proper amplifier halves.

The Phase A Bridge Amplifier and the Phase B Bridge Amplifier are identical. In this description, references made to the Phase B Bridge Amplifier can be applied to the corresponding portion of the Phase A Bridge Amplifier. Each bridge amplifier acts as a double-pole, double-throw switch to alternate the direction of current flow through each motor phase winding, as shown in Figure 5-13.

As mentioned earlier, each bridge amplifier is divided into two halves; each half controls the current drive for one of the two polarities. Together, the Phase Counter's QB and QC outputs control which half of the bridge amplifier is turned on. When QB and QC are either both high or low, the left half of the Phase B Bridge Amplifier is turned on. Inverter U475B disables the right half. Therefore, when the left half is enabled, the current path is through Q589 and Q691 to the Phase B winding, and then through Q785 and Q786 to ground. Later, when either QB or QC switches, the right half is enabled (disabling the left half) and the current path is through Q787 and Q793 to the Phase B winding, and then through Q587 and Q588 to ground.

CR871 and CR872 are catch diodes that allow current in the motor coils to recircluate when the motor has shut off because its voltage across the motor current sensing resistor exceeded the level of the input haversine/havercosine.

During power-up, the RST-0 signal prevents the motors from turning while the power supply voltages are being established. After the plotter has powered-up, RST-0 goes high, permitting Q661 to conduct and produce DRIVE ENABLE-1. DRIVE ENABLE-1 sets the proper bias levels for the bridge amplifier halves as well as those for the Y-Axis Motor Drive.

Y-AXIS MOTOR DRIVE

The Y-Axis Motor Drive, shown in Schematic A1-8, functions like the X-Axis Motor Drive just described, except that when YMINUS-1 is low, the pen moves toward the front of the plotter and when YMINUS-1 is high, the pen moves toward the rear of the plotter.

JOYSTICK RATE GENERATOR

General Information

The Joystick Rate Generator interfaces the joystick and the plotter pen carriage. This enables the operator to use the joystick to manually move the pen carriage to any desired location on the platen surface while the plotter is not processing host commands.

The joystick consists of two potentiometers arranged perpendicular to each other with a common control. This control is oriented so that the pen moves in the same direction as the joystick's handle. One potentiometer is used for X-axis pen movements and the other potentiometer is used for Y-axis pen movements. Figure 5-14 shows the relationship of these two potentiometers.

The Joystick Rate Generator is a voltage-controlled oscillator that converts the positive or negative dc voltage from the joystick potentiometer wiperarm into a pulsing signal. This pulsing signal is processed in the Vector Generator in the same manner as the FAS-1 and SAS-1 pulses to drive the two pen drive motors. The frequency of the voltage-controlled oscillator is directly proportional to the input dc voltage level.

The Joystick Rate Generator detects either a positive or negative input voltage level and also sets a Direction Latch. The output of the Direction Latch, in turn, is used by the Vector Generator to direct which way the motors are to step.

The Joystick Rate Generator consists of two identical halves — one for the X-axis and one for the Y-axis. This description will describe the X-axis half, but the Y-axis half functions in the same way.

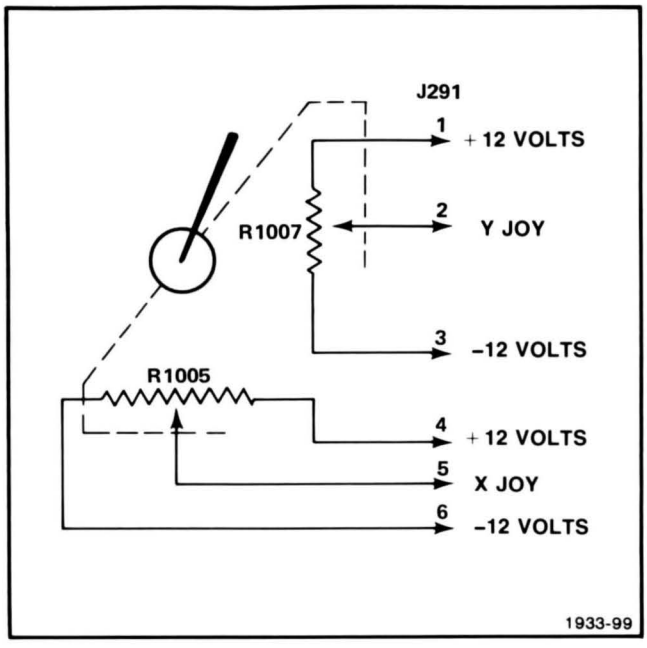


Figure 5-14. Joystick Connection.

+ Level Detect

The + Level Detect examines the output of the joystick potentiometer wiperarm (XJOY or YJOY), looking for a positive voltage. If the joystick is moved so that it causes a positive voltage from its wiperarm, the input capacitor, acting as a sample capacitor, charges up to the XJOY (or YJOY) input voltage. When the input XJOY voltage on the + input of the op-amp rises above the level on the negative input (set by a voltage divider network), the op-amp outputs a positive voltage from Pin 6. This output goes to both the Direction Latch and the Step circuitry (both described later). Later, when the Step circuitry outputs a step (MXRT-1), Q276 (or Q275 in the Y-axis) conducts, causing the Discharge FET to discharge the Input Capacitor. With the Input Capacitor shorted, the input XJOY voltage is reduced to zero and the op-amp's output also ends, causing the end of the MXRT-1 pulse with the next T16CK-0 clock.

The diode on Pin 8 (Compensation) of the op-amp prevents the op-amp's output from going negative when the input XJOY (or YJOY) voltage is negative.

— Level Detect

The — Level Detect works like the + Level Detect except that its minus input is connected to the wiperarm of the joystick. This input looks for a negative XJOY (or YJOY). The sequence of events then is identical to the + Level Detect circuitry.

Direction Latch

The two inputs of the Direction Latch are the outputs of the + Level Detect and — Level Detect circuits. However, only one input is active at a time. If the joystick has been moved to the right, the + Level Detect outputs a positive signal which is clocked (by T16CK-0) through the Direction Latch (a J-K flip-flop) as PLUSXM-1. PLUSXM-1 is used by the Vector Generator to generate signals to the motor that causes it to move the pen to the right. On the other hand, if the joystick had been moved to the left, the — Level Detect outputs a positive signal which is clocked through the Direction Latch as MINXM-1. Opposite to PLUSXM-1, MINXM-1 is used by the Vector Generator to generate signals to the motor that causes it to move the pen to the left.

BUSY-0 is asserted by the processor to disable the Direction Latch and Step circuits while the plotter is drawing a plot under host control or if paper is being loaded.

Step

The Step circuit outputs step pulses (MXRT-1 and MYRT-1) to the Vector Generator at T16CK-0 time when either the + or — Level Detect circuits detect a voltage from the joystick. The Vector Generator treats the MXRT-1 and MYRT-1 pulses in the same manner as FAS-1 and SAS-1 pulses (described in the Vector Generator description). These are processed into motor drive signals. When the MXRT-1 pulse is generated, Q276 is turned on which, in turn, turns on the Discharge FET and discharges the Input Capacitor. This, of course, reduces the input XJOY voltage to zero and causes the op-amp's output to also go to zero. On the next T16CK-0 clock, the MXRT-1 pulse ends — as well as the PLUSXM-1 (or MINXM-1) output, the Step flip-flop is reset, and Q276 and the Discharge FET are turned off to await the next XJOY or YJOY level from the joystick.

MISCELLANEOUS INTERFACE

General Information

The Miscellaneous Interface, shown in Schematic A1-10, provides a communication link between the processor and several small peripheral circuits in the plotter. A PIA (U215) is used to interface some joystick circuitry, the front and rear panel switches, an eight millisecond general purpose timer, and the speaker. Each of these circuits is described in greater detail in subsequent paragraphs.

Joystick Interface

Some of the joystick signals, after being processed by the Vector Generator, are routed through the Miscellaneous Interface (I/F) PIA to the processor. These signals are XSTEP and YSTEP, and XMINUS and YMINUS. The processor uses these signals during manual (joystick-controlled) moves to update the processor's position registers. Whenever the joystick is used and the Vector Generator processes a XSTEP-1 and/or YSTEP-1, an NMI interrupt is sent to the processor. In addition, XSTEP-1 and YSTEP-1 sets the X Step and Y Step Flip-Flops. The Q output of these flip-flops is multiplexed into the PIA to permit the processor to read the PIA (in its interrupt routine) to see which joystick axis was moved and to update the position registers accordingly. This enables the processor to know exactly where the pen is even if the operator uses the joystick to move the pen manually.

The processor clears the X and Y Step Flip-Flops with the XCLEAR and YCLEAR line after reading the PIA.

XMINUS-1 and YMINUS-1 tells the processor which way the joystick has moved the pen so the processor can update the position register in the correct direction.

Switch Interface

The Switch Interface circuit interfaces the front and rear panel switches to the processor through the PIA, U215. Most of the front panel switches connect directly to the PIA, but approximately half of the rear panel switch lines are multiplexed into the PIA with several joystick interface lines and a couple of front panel switch lines. Two multiplexers (data selectors) handle these lines. PB6 and PB7 from the PIA (controlled by the processor) control the multiplexers.

The PIA also interfaces the processor-controlled ERROR LED, as well as two signals to the RS-232 interface (LINE-1 and MUTEREQ-0) and BUSY-0 to both the Vector Generator and the X-Axis Motor Drive.

PROMPT-0 turns on the PROMPT LED when the Prompt Decoder decodes an address of 8052. PROMPT-0 turns off when an address of 8051 is decoded.

The unused TS-1 strap (not labeled on the circuit board, but located between U1 and U5) is a spare line reserved for future expansion through the rear panel REMOTE CALL connector (J101).

CALL-0 from J31 goes to the rear panel REMOTE CALL connector (J101).

Timer

The Timer consists of a 555 oscillator operating at an eight-millisecond rate. The timer outputs a 14-microsecond TTL low pulse every eight milliseconds. This pulse is used by the processor for such functions as RS-232 turn-around delay, pen up/down settling time, and front panel switch scanning and switch debouncing.

The TS-0 strap (labeled + 50 on the circuit board) connects this timing pulse to the PIA and is removed only for troubleshooting purposes.

Speaker Driver

The Speaker Driver consists of a 1-kHz square-wave oscillator, which is enabled by the processor through the PIA's CB2 line. The oscillator's square-wave output drives the plotter speaker through three parallel drivers.

+880 VOLT ELECTROSTATIC PLATEN POWER SUPPLY

The Electrostatic Platen Power Supply, shown in Schematic A1-11, places an electrostatic charge of + 880 Vdc inside the plotter's drawing surface when the LOAD switch is up. The plotter drawing surface (platen) looks electrically like a capacitor. When electrostatically charged, the platen has the ablility to attract and hold paper. With the electrostatic paper hold-down, no mechanical paper holders are necessary.

A blocking oscillator, Q61, is used to generate the electrostatic hold-down voltage. When the LOAD switch is down, the transistor is not forward-biased (the base is grounded), and the transistor shuts off. When the LOAD switch is released (up), Q61 is forward-biased and starts oscillating. The transformer feed-back winding on the base of Q61 maintains oscillations by repeatedly triggering Q61 into conduction. Rectifier and filter circuits are used on the high voltage secondary windings of T61 to produce the + 880 Vdc.

The large series load resistor minimizes the shock hazard should the insulation coating on the platen become damaged. However, if the platen coating is damaged, the platen must be replaced.

FRONT PANEL SWITCHES

The Front Panel Switches circuit board, shown in Schematic A2-1, contains the eight front panel operator switches and three indicator LEDs. The switches are single-pole-double-throw (SPDT) and with the exception of two (LOAD and LOCAL) have spring-returns to the up position. When up, the switches connect + 5 volts to their logic lines and when down, the switches ground their respective logic lines.

The LOWLFT-0 signal line (lower left) is a combination of the SET LL (set lower left) and LOCATE LL (locate lower left) switches. When the processor detects any change in the SET or LOCATE switch positions, it examines the LOWLFT-0 signal to determine whether the SET or LOCATE switch was upper right or lower left. A low on the LOWLFT-0 line means that either the SET LL or LOCATE LL switch is down. On the other hand, LOWLFT-0 stays high if either SET UR or LOCATE UR is pressed. This circuit permits three lines to represent four functions.

When the plotter is first powered up, the pen carriage is moved to the lower right corner until it closes the contacts on two microswitches. One of these microswitches is in the X-axis and when closed on power-up, XLIM-0 is generated which shuts off the X-axis motor and updates the processor's X-axis position register to reflect the pen's maximum X position.

When the pen carriage closes the YLIM switch, YLIM-0 is generated, which shuts off the Y-axis motor and updates the processor's Y position register to reflect the pen's minimum Y position.

With the just described initialization process completed, the processor knows exactly where the pen is so that it can calculate future vector commands from that position.

The front panel POWER LED is powered from the + 5 volt power supply line.

Schematic A1-10 shows the PROMPT and ERROR LEDs also on the front panel. These are described under the Miscellaneous I/F circuit descriptions.

SYSTEM MEMORY

General Information

As mentioned earlier in the description of the plotter's memory, there are three major memory configurations. Briefly, these are: (1) 2K RAM plus ROM; (2) 2K (expandable to 8K) RAM plus ROM; and (3) 2K RAM, expandable to 8K) RAM, plus ROM that is located on a separate System Memory circuit board. Early model plotters that have not been retrofitted with Option 31 (multiple-pen capability) are equipped with one of the first two configurations and those circuit descriptions are located earlier in this section under Memory.

Present plotters and those earlier models that have been retrofitted with Option 31 have the third memory configuration. The ROM circuitry used in this third configuration is described here. Table 5-5 (the plotter's memory map) is located earlier in the Memory description and describes all configurations of the RAM/ROM memory.

When the third memory configuration was introduced, the contents of the eight ROM devices on the Plotter circuit board were combined into four ROM devices and moved to a separate circuit board — the System Memory circuit board shown in Schematic A3-1. The RAM memory was not affected in this configuration and still resides on the Plotter circuit board. The System Memory also contains the processor's interface to the Option 31 circuits on the Pen Turret Drive circuit board (described later). Plotters equipped with Option 31 have an EPROM (PROM 7) added to U51 of the main Plotter circuit board.

The two circuit blocks on the System Memory circuit board are listed below and then described in more detail in subsequent paragraphs:

ROM
Option 31 Interface

ROM

The ROM circuitry consists of the ROM Decoder and the four ROM devices. Table 5-7 shows each ROM's location and briefly describes its contents.

The ROM Decoder decodes the addresses C000 to FFFF and enables each ROM as shown in Table 5-7 (or Table 5-5).

W41, W51, W61, and W71 provide straps to permit the use of either 2732 or 2532 ROMs. Schematic A3-1 shows the jumper (strap) arrangement for either device.

Table 5-7

PLOTTER ROM MEMORY

ROM	Location	Address	Contents
7	U51[a]	BC00	Option 31 command processing
C	U141	C000	Motion control
D	U151	D000	RS-232 driver, pen turret control, front panel, command processing, gin processing
E	U161	E000	GPIB Driver, mathematics package
F	U171	F000	Alpha command processor, system monitor, interrupt dispatcher, power up installation, selftest routines

[a]Main Plotter circuit board (Option 31 only).

Option 31 Interface

The Option 31 (multiple-pen capability) Interface consists of a PIA which interfaces the processor to the Pen Turret Drive circuit board (described later in this section). J190 provides the connection from the System Memory circuit board to the Pen Turret Drive circuit board.

The FONT strap programs the plotter to draw slightly different variations of the character set in fonts 1 through 9. Figure 5-15 shows the existing character sets in fonts 1 through 9 along with the font 0 equivalent. These characters are drawn with the FONT strap in the OLD position. If the FONT strap is in the NEW position, the processor reads the B register in the PIA and modifies the character set in fonts 1 through 9 to that shown in Figure 5-16.

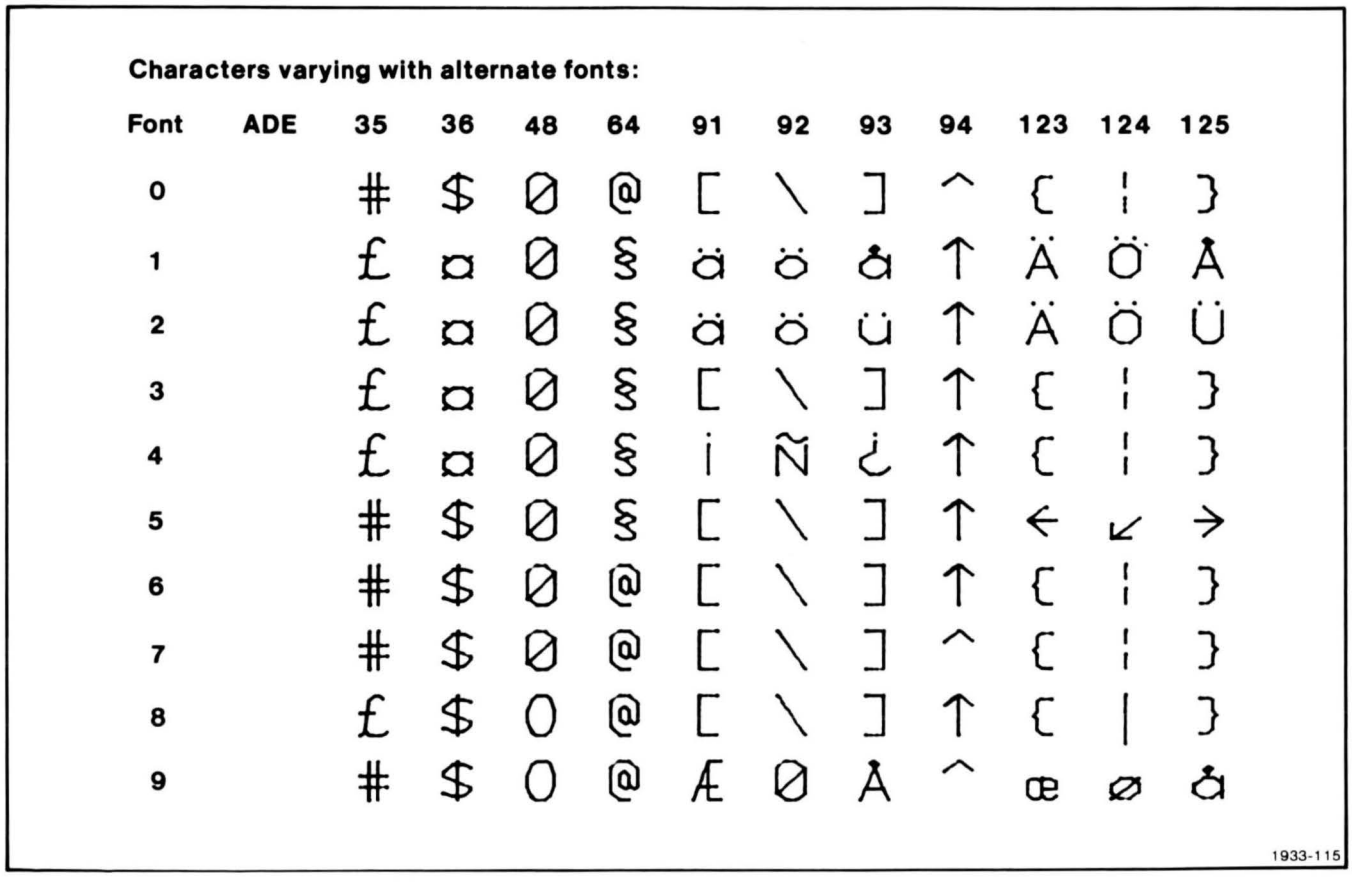


Figure 5-15. Alpha Font Character Variations With FONT Strap in OLD Position.

Of the two eight-bit ports contained in the PIA, the "A" side is used to monitor the sense switches (Pen Presence, Pen Type, and Pens Uncapped) on the Option 31 rotary pen turret and the eight front panel PEN SELECTION switches. The "B" side is used to provide the output signals to drive the rotary pen turret's dc stepping motor.

The addresses at which the PIA ports are accessable are:

PIA Register	Address
Peripheral Register "A"	8060
Control Register "A"	8061
Peripheral Register "B"	8062
Control Register "B"	8063

Characters varying with alternate fonts:

Font	ADE	35	36	48	64	91	92	93	94	123	124	125
0		#	$	0	@	[	\	]	^	{	|	}
1		#	$	0	@	Ä	Ö	Å	^	ä	ö	å
2		£	$	0	@	Ä	Ö	Ü	^	ä	ö	ü
3		£	$	0	@	[	\	]	^	{	|	}
4		#	$	0	@	¡	Ñ	¿	^	{	|	}
5		#	$	0	§	[	\	]	↑	←	↙	→
6		#	$	0	@	[	\	]	↑	{	|	}
7		#	$	0	@	[	\	]	^	{	|	}
8		£	$	0	@	[	\	]	↑	{	|	}
9		#	$	0	@	Æ	0	Å	^	œ	ø	å

1933-120

Figure 5-16. Alpha Font Character Variations With FONT Strap in NEW Position.

POWER SUPPLY

General Information

The 4662 main power supply, shown in Schematic A4-1, uses a switching, or "chopping" method of regulating its output voltage. Figure 5-17 shows a simplified block diagram of the power supply and how it regulates the + 5 volt supply. Once the + 5 volt supply is set, the transformer secondary winding ratios provide the necessary voltages for the other power supply outputs.

The chopper functions as a switch, sending current through one half or the other of an autotransformer (T331), or cutting off the current to that transformer altogether. Pulses from the autotransformer secondary are rectified and filtered by a choke-input smoothing filter. The average dc voltage to the filter depends upon the duration of the pulses from the chopper, and the duration of the chopper's pulses, in turn, depends upon the power supply load. If the load increases (load resistance decreases), the chopper's pulses get longer; if the load gets smaller (load resistance increases), the chopper's pulses get shorter.

The control circuitry controls the chopper based on three inputs: (1) a 50-kHz signal from the oscillator, (2) the + 5 volt supply output, and (3) a + 5 volt reference voltage. With each pulse from the oscillator, the control circuitry turns on one of the two switching transistors in the chopper, causing it to send current through the autotransformer. As long as the chopper's switching transistor is turned on, a dc pulse will be input to the rectifier and smoothing filter, and the filter capacitor charges. This produces an increasing voltage from the + 5 volt supply's output. The control circuitry monitors this increasing voltage and compares it to a + 5 volt reference voltage. When the + 5 volt output voltage exceeds the reference voltage, the control circuitry turns off the chopper. This shuts off the dc pulse at the smoothing filter's input, and the + 5 volt supply's output starts to decay. This decay continues until the next pulse from the oscillator causes the control circuitry to turn the chopper back on. This time, however, the opposite transistor in the chopper conducts and the process repeats. The resulting ac signal from T331 is rectified and filtered as described before.

The 4662's main power supply consists of the following circuit blocks:

- + 28 Volt Supply
- Reference Supply
- Oscillator
- Control Circuitry
- Chopper
- + 5 Volt Supply
- −5 Volt Supply
- + 12 Volt Supply
- −12 Volt Supply

Also located on the Power Supply circuit board are the Reset and Solenoid Driver circuits. Each of these circuits and the power supply circuits listed above are described in detail in the following paragraphs.

+28 Volt Supply

The + 28 Volt Supply consists of the line input circuits and the main isolation-step down transformer. This circuit provides a + 28 volts dc for the motors and is also the power source for the remainder of the power supply's regulated sources.

The line filter is a low-pass filter designed to remove high frequency voltage spikes and transients from the input line.

The plotter can be used with a variety of different input line voltages by using different jumper (strap) combinations on the eight taps of the transformer's primary (T1001). Table 5-8 shows the jumper combination used for different input line voltages.

Table 5-8

TRANSFORMER JUMPERS USED IN LINE VOLTAGE SELECTION

Voltage Range	Jumper Connection
105 V	1-8 and 4-5
116 V	1-2 and 3-4
210 V	5-8
232 V	2-3

The transformer's output is full-wave rectified and filtered with a large capacitor and becomes the + 28 volt power source for the motors and the remainder of the power supply.

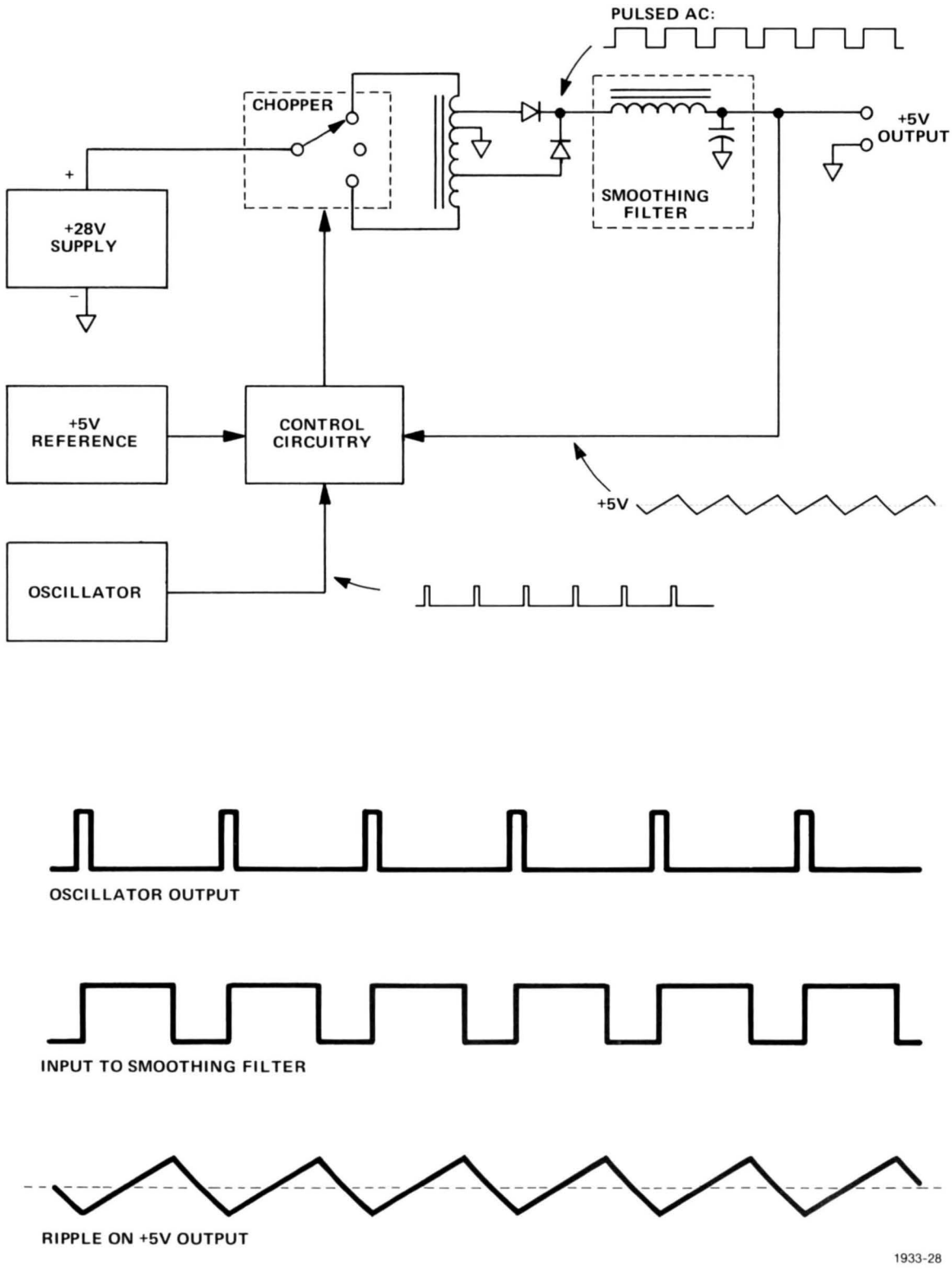


Figure 5-17. Power Supply Simplified Block Diagram and Waveforms.

Reference Supply

The Reference Supply provides a + 14 volt reference standard to which the various regulated power supplies are compared. The + 14 volt reference voltage is obtained from an adjustable series regulator (a 273 and a heat-sinked PNP pass transistor — Q51). In normal operation, R53 is adjusted such that the + 5 volt supply outputs + 5 volts. The + 14 volt reference voltage is measured from the collector of Q51.

Oscillator

A 50-kHz relaxation oscillator provides two waveforms for the Control Circuitry (described later). These waveforms are shown in Figure 5-18. One signal is output from Pin 14 of the comparator, which is wired as a pulse generator. These pulses cause the switching transistors in the Chopper to conduct alternately. These pulses also disable the Error Latch during the duration of the Oscillator pulse to prevent the Error Latch from being prematurely triggered by switching transients on the + 5 Volt Supply's output.

The Oscillator's second waveform is found at the source of Q201. A reduced magnitude version of this signal is superimposed upon a + 5 volt reference voltage in the Control Circuitry (descibed later).

Control

Two comparators, U201A and U201D, monitor the total current drawn from the regulated supplies and the voltage on the + 5 Volt Supply's regulated output. Should either be excessive, the switching transistors are shut down.

In normal operation, each Oscillator pulse clears the Error Latch. With the Error Latch cleared, each Oscillator pulse causes the Switching Transistor Control to turn on one Switching Transistor Driver, Q403 or Q404. The next Oscillator pulse then causes the other Switching Transistor Driver to turn on.

Each Switching Transistor Driver conducts current through one-half or the other of T301's primary. This current turns on one of the two switching transistors in the Chopper by current induced in T301's secondary.

However, if either the total regulated current from the power supply (detected across R236 and U201A) or the voltage from the + 5 Volt Supply (detected by U201D) is excessive, the appropriate comparator will output a low. This low sets the Error Latch to disable the Switching Transistor Drivers. In addition, Q402 is turned on, effectively shorting the T301 primary winding. This helps to speed the switching process in turning off the Chopper's switching transistor, by inducing a short across the secondary windings of T301.

As mentioned earlier in the description of the Control Circuitry, the waveform from the source of Q201 is added to the + 5 volt reference voltage (the + 5 reference is taken from the voltage divider of R101 and R133). This causes the + 5 volt reference voltage at the voltage comparator U201D to rise and fall in step with the Oscillator. The rise and fall of the reference voltage will ultimately cause the + 5 volt output to also rise and fall in step with the Oscillator, as will be described later. this increases power supply stability. If the output ripple frequency should change and get out of step with the oscillator frequency, the voltage comparator (U201D) detects a voltage difference and turns off the switching transistors in the Chopper (through the Error Latch and Switching Transistor Drivers) until the next Oscillator pulse.

Chopper

The switching transistors in the Chopper function as current switches, directing the + 28 Vdc current through one-half of the autotransformer (T331) or the other, first in one direction and then in the other. The switching transistors, which operate alternately from each other, are controlled by the Switching Transistor Control flip-flop described earlier. Various taps on the autotransformer supply power for the four regulated power supplies, described next.

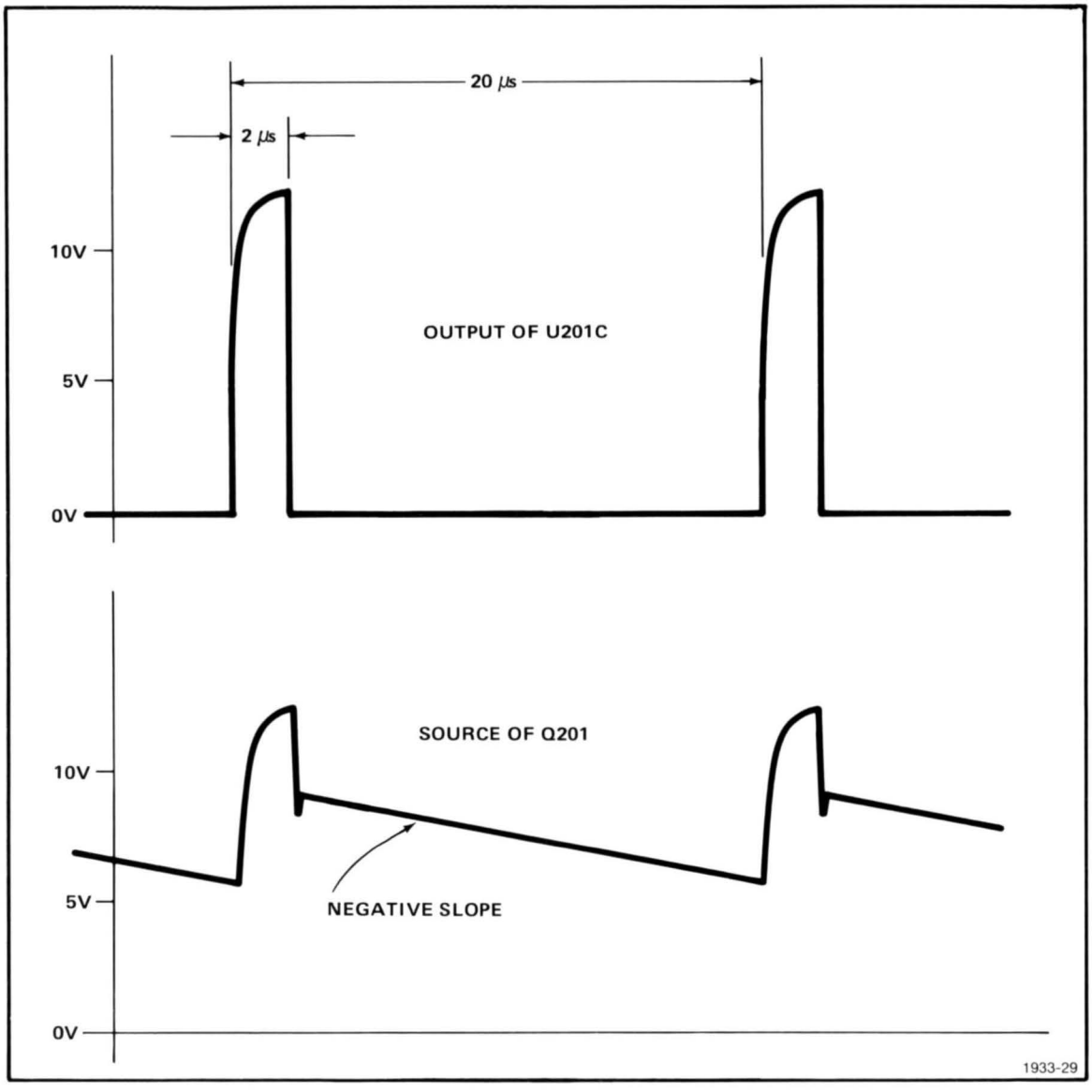


Figure 5-18. Oscillator Waveforms.

+12 Volt and −12 Volt Supplies

The + 12 Volt and −12 Volt Supplies use heat-sinked series-pass transistors controlled by op-amp comparators to regulate their outputs. Both supplies use a common full-wave bridge rectifier and a choke-input filter as shown in Figure 5-19. However, notice that the two chokes (one for the + 12 Volt Supply and one for the −12 Volt Supply) are wound on the same toroidal core: they comprise the two windings of a pulse transformer with a 1:1 turns ratio. This pulse transformer couples error energy from the −12 volt line through the + 12 Volt Supply, where the + 12 Volt Supply's regulation can eliminate it. The effect is that the two output voltages track together, so that the two series-pass transistors share equally the burden of regulating the two supplies.

Pulsating dc at + and −13.5 volts rms is taken from these supplies' rectifier outputs to power the Pen Solenoid Driver (described later).

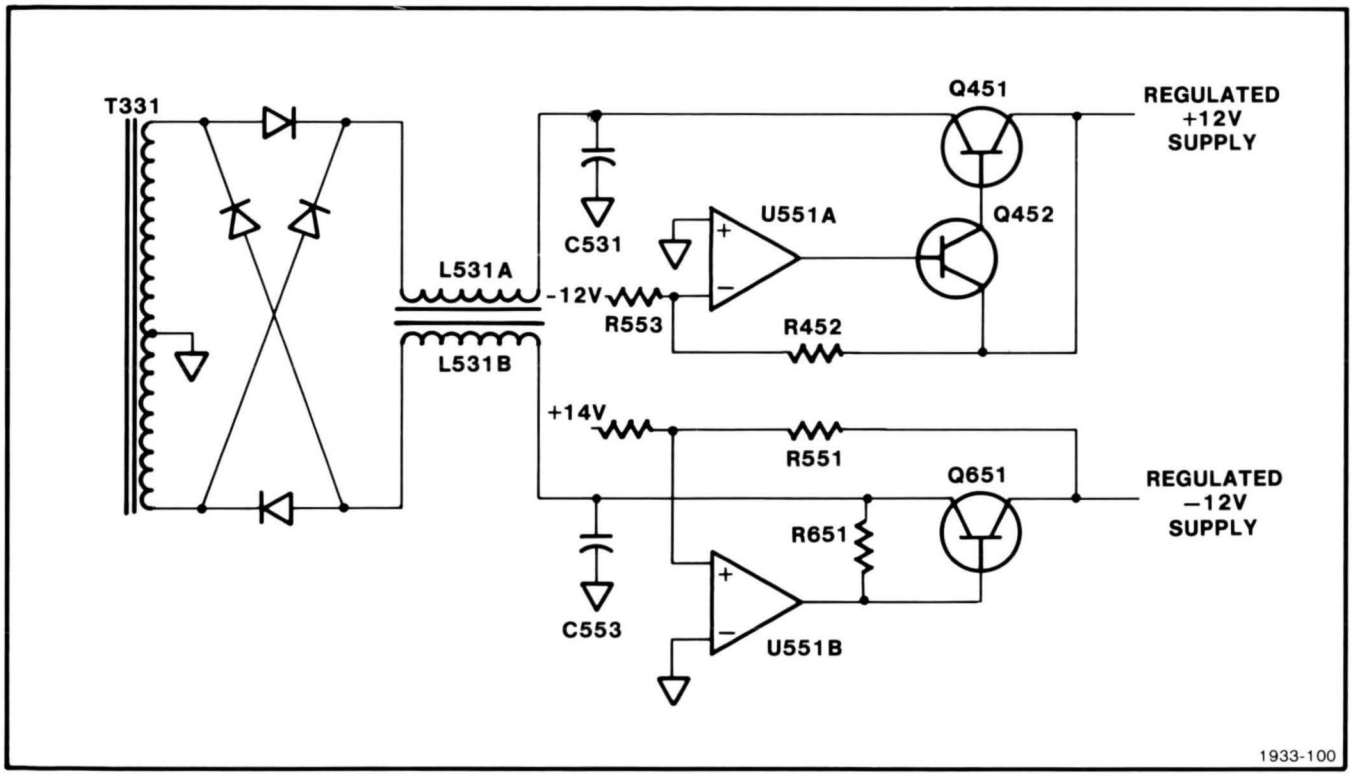


Figure 5-19. +12 Volt and −12 Volt Supply.

+5 Volt Supply

The + 5 Volt Supply consists of a full-wave rectifier followed by a choke-input smoothing filter. A zener diode and an SCR (Silicon Controlled Rectifier) provide "crowbar" protection for the 4662 logic circuitry by shorting this supply to ground in the event of excessive voltage at its output (approximately 6.5 volts).

As described earlier, this supply is regulated by controlling the "on" time of the switching transistors in the Chopper, while a voltage comparator in the Control Circuitry monitors the supply's output, comparing it to a reference voltage (see Figure 5-20).

Each Oscillator pulse turns on the Chopper. After the Oscillator pulse is gone, the + 5 Volt Supply's output rises while the reference voltage falls; when the two voltages become equal, the Control Circuitry detects this and shuts off the Chopper. The + 5 volt output then falls until the next oscillator pulse starts the process over again.

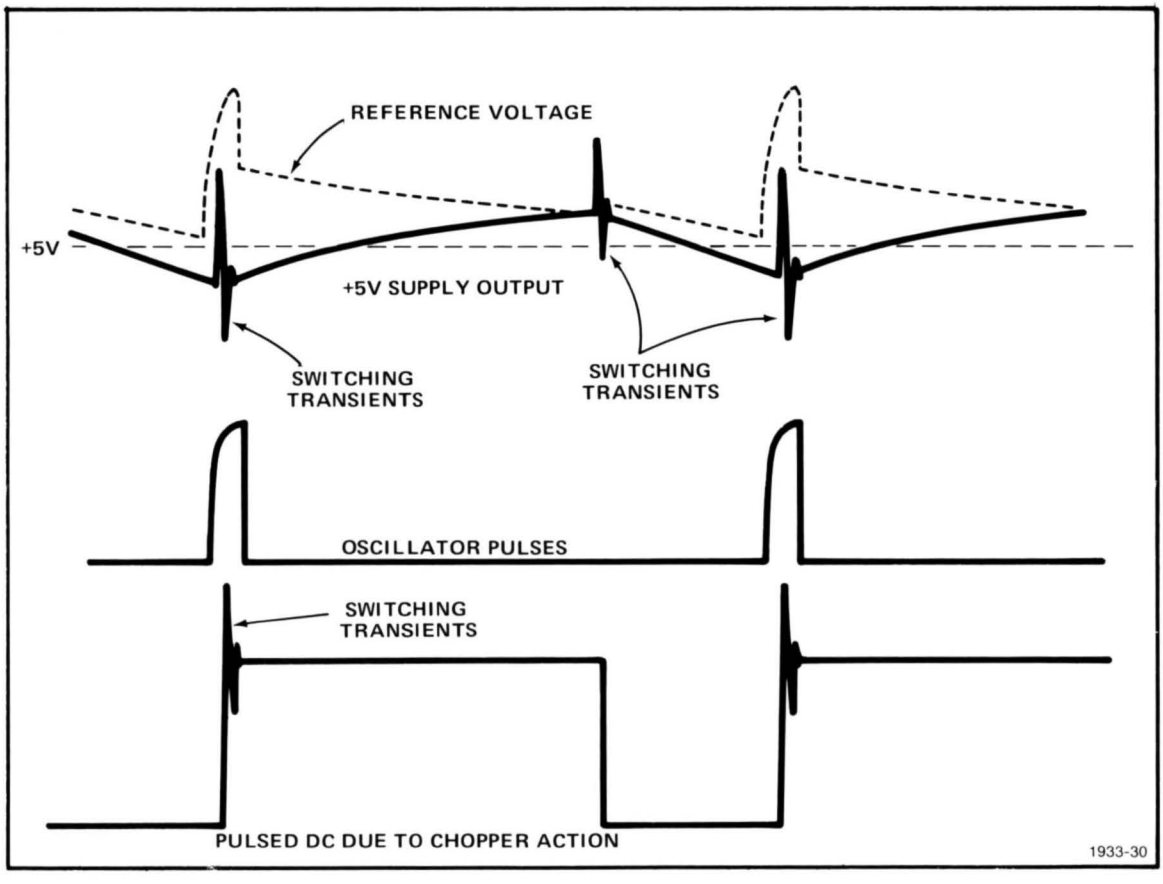


Figure 5-20. +5 Volt Supply Waveforms.

−5 Volt Supply

The −5 Volt Supply uses the same full-wave bridge rectifier as the + 5 Volt Supply. Consequently, the pulsed dc at the −5 Volt Supply has nearly the same amplitude (although opposite polarity) as that at the + 5 Volt Supply's rectifier output.

In a manner similar to the + 12 Volt and −12 Volt Supply (described earlier), the choke filters in the + 5 and −5 Volt Supplies are wound on the same toroidal core (see Figure 5-21). This causes the −5 Volt Supply's output voltage to follow (although with opposite polarity) the + 5 Volt Supply's output.

L252 and C351 filter switching transients.

Reset Circuit

The Reset circuit generates a reset pulse for initializing the processor and PIAs on system power-up or on power failure. On power-up, a + 28 volt voltage divider, consisting of R302 and R332, charge a 0.1 microfarad capacitor (C302) to five volts. A comparator (U201B) compares the voltage on this capacitor to the + 5 volt reference, asserting RST-1 (reset) until the capacitor is sufficiently charged. When RST-1 goes low, the processor assumes that the power supply is working properly and starts the activity of operating the plotter.

If either the + 5 or + 28 voltage should fail, the comparator will output a high on the RST-1 line and the processor will go into the power-down routine.

The Reset circuit may also be remotely triggered by a low on the RRST-0 (remote reset) line. This discharges the capacitor and generates a high on the RST-1 line until the capacitor charges again.

Pen Solenoid Driver

Whenever the processor wishes to draw (or write), it activates the PEN DOWN-0 signal line. The processor may also activate this line in response to the operator pressing the front panel PEN switch.

A low on the PEN DOWN-0 signal line turns on Q601, which in turn, turns on Q501. With Q501 conducting current through the pen solenoid (L1005), the pen is pulled down to the paper.

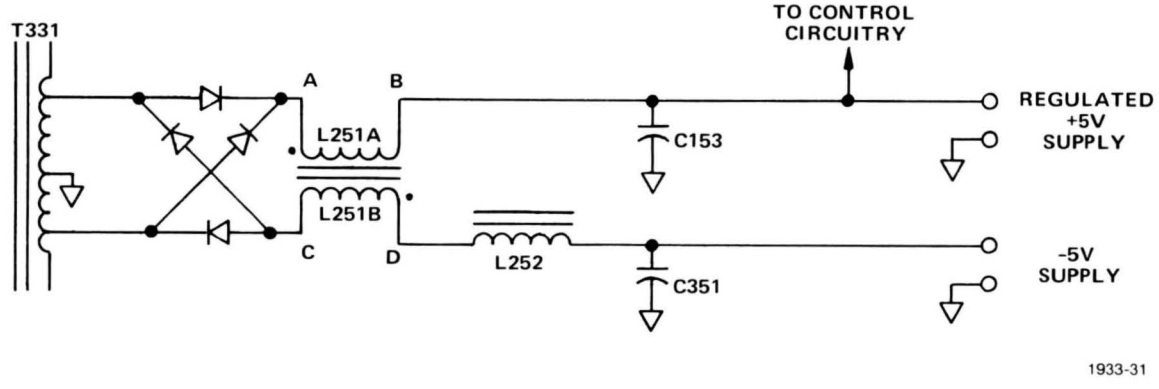


Figure 5-21. −5 Volt Supply.

FIRMWARE PATCH CIRCUIT BOARD

General Information

Some early model plotters used the Firmware Patch circuit board (shown in Schematic A5-1) to permit installing patch (or "fix-it") EPROMs. Later model plotters using the System Memory circuit board do not use this Firmware Patch circuit board. Instead any patch or fix-it EPROMs are installed directly on the System Memory circuit board (described earlier).

These EPROMs permit the addition or minor changes of the system firmware code stored in ROM. These changes can be either byte replacement or code enlargement (addition).

Generally, this patching operates as follows. If the data at a ROM address is to be changed, that address is programmed into the FPLA (field-programmable logic array) and the new data is programmed into the Patch PROMs (EPROMs). Then, when that normal ROM memory location is addressed, the FPLA first recognizes the address and prevents the system ROM from placing the incorrect data on the data bus and then causes the Patch PROMs to instead substitute the corrected data on the data bus. To disable the system ROM memory, the FPLA issues ROM EN-1, which disables the chip selects in the ROM address decoding circuits. Also, ROM EN-1 enables the Address Switching to address the associated code programmed in the Patch PROMs.

If the firmware change can be made within one code block, the FPLA selects and enables (through Address Switching) the Patch PROM, U115, whose outputs 01 through 08 will directly replace the data block from the normal ROM on the main Plotter circuit board.

If the replacement code exceeds the address space of the changed code, code enlargement (addition) is required. The FPLA switches to a look-up table in U115 for a jump to a U115 address that is between 9800 and 9BFF and is accessed directly by the processor. When the processor references an address within the space not normally used in the memory map and assigned to the Firmware Patch circuit board, the Chip Select (U40) turns on the Patch PROM. The Chip Select is a 3-line to 8-line decoder that augments 4662 address decoding to enable the Patch PROMs. A low output from the Chip Select occurs on one of the two output ports (Y6 or Y7), depending on the binary count at the A, B, and C inputs. A low from Y6 enables U115; or, if more than 1K bytes of memory is needed, Y7 will enable U123 for a real address space between 9C00 and 9FFF, allowing 2K bytes of firmware on the Firmware Patch circuit board. After executing the new firmware stored in Patch PROMs, the last instruction is a jump back to the next unmodified address following the new block.

FPLA (Field-Programmable Logic Array)

The FPLA is programmed to respond to any addresses of system firmware code stored in ROM that have been changed or added to. The FPLA disables that ROM from responding by issuing ROM EN-1 and outputs a partial address for the Address Switching circuitry to locate the corresponding replacement code in the Patch PROMs.

Address Switching

U10, U22, and U30A (all controlled by F7 of the FPLA) select and enable the corresponding replacement firmware code programmed in the Patch PROM U115.

Chip Select

As described earlier, the Chip Select selects Patch PROM U115 or the optional U123 for larger blocks of replacement or additional code (code enlargement).

Patch PROMs

Either programmable PROMs 82S2708 or EPROM 2708 allow up to 2K bytes of firmware additionsor changes. These PROMs can be addressed directly by the processor or addressed through the FPLA or Chip Select.

PEN TURRET DRIVE CIRCUIT BOARD (OPTION 31)

General Information

Option 31 adds an eight-pen rotary pen turret to the left of the platen (viewing the front of the plotter) and gives the plotter the capability of plotting with up to eight different colors or pen types. The rotary pen turret is controlled through a belt drive to a dc stepper motor and the plotter's pen carriage is capable of exchanging pens with the rotary pen turret without manual assistance. The selection of pens can be actuated by the host under program control or manually by pressing one of the eight front panel switches (added to the plotter with the addition of Option 31). The eight pens are stored and capped between uses in the rotary pen turret.

The Pen Turret Drive circuit board (shown in Schematics A6-1 and A6-2) connects directly to the Option 31 Interface of the System Memory circuit board (described earlier in this manual). This means that before Option 31 can be added to early model plotters it will be necessary to verify that the System Memory circuit board (670-7176-00, 01, 02, . . .) is installed. If Option 31 is ordered for early model plotters not equipped with the System Memory circuit board, the System Memory circuit board will be a part of the installation package.

The Option 31 Interface on the System Memory circuit board contains the PIA, which interfaces the rotary pen turret drive motor to the plotter's processor (see Figure 5-1). This connection from the System Memory also supplies power to the Pen Turret Drive circuit board.

Option 31 Front Panel Switches

The Option 31 Front Panel Switches circuitry consists of eight front panel switches, a CALIBRATE strap, one rotary pen turret microswitch, an optical sensor, and a data selector. These are shown in Schematic A6-1. The data selection is controlled by the processor to read each switch periodically. The reading rate of these switches is controlled by the system firmware and is therefore not at a cyclic rate. For example, the CALIBRATE strap is read only upon system power-up, while the switches are read during or between certain operations. They are, however, read often enough that the operator can press a switch anytime and the processor will detect it.

The eight front panel switches permit the operator to manually select a pen for subsequent drawing operations (or to load or store pens). The microswitch is located near the rotary pen turret and detects the pen's location. The optical sensor aligns the rotary pen turret to the motor.

The outputs of all of the switches (except the Optical Switch—CAPPED-0), the Option 31 input, and the CALIBRATE strap are multiplexed by the Switch Data Selectors. The Switch Data Selectors are addressed by the processor (under firmware control) using the SELECT 0-1 and SELECT 1-1 signal lines from the PIA. The addressed or selected data then appears on the three sense lines (SENSE A-1, SENSE B-1, and SENSE C-1) and is read by the processor at the PIA. Table 5-9 shows the data selected for each address on the two SELECT lines.

Table 5-9

OPTION 31 SWITCH DATA OUTPUTS

SELECT 1	SELECT 0	SENSE A	SENSE B	SENSE C
0	0	Pen Presence	Not Used	CALIBRATE Strap
0	1	Switch 1	Switch 2	Switch 3
1	0	Switch 4	Switch 5	Switch 6
1	1	Switch 7	Switch 8	Option 31 Input

When each switch is pressed, a TTL low is transferred to the PIA when the Switch Data Selector addresses that switch.

The CALIBRATE strap is used by the technician when mechanically adjusting the microswitches. The processor reads this strap only when powering up, and if the strap is in the CALIBRATE position, the processor reorganizes the motor stepping data to the rotary pen turret drive motor to position the rotary pen turret for properly positioning the three microswitches. In addition, the meaning of the eight PEN SELECT switches is changed to aid in the adjustment of the plotter (see Section 2 and the Straps appendix).

The PEN PRESENCE switch tells the processor whether a pen is actually present in each of the eight positions around the rotary pen turret as the turret is being rotated. Each pen brushes a microswitch. The processor can use this information to remember each pen's location and to prevent a later attempt to store a pen in a position already containing a pen, or the attempt to pick up a non-existent pen.

The CAM SENSE OPTICAL switch detects the location of a cam "blade" on the main turret shaft. By knowing the location of the cam (and therefore knowing the position of the turret), the processor can calculate the number of straps to rotate each pen out for exchanges. When the rotary pen turret is in the "home" or closed position, the pens are capped to prevent their drying out. To cap the pens, a mechanical plate containing pen caps is raised up against the pen tips. When the plate is up and the pens are capped, the cam sense optical switch detects the cam blade which breaks the light beam from the LED and turns off the phototransistor. When the phototransistor turns off, the CAPPED LED is turned on.

When loading, storing, or changing pens, the rotary pen turret stepper motor (or an operator turning the rotary pen turret knob) rotates the turret's shaft approximately 90 degrees (the rotary pen turret does not rotate at this time however). This action lowers the plate containing the pen caps and uncaps the pens. When the plate containing the pen caps reaches the end of its downward travel, the cam blade moves away from the cam sense optical switch. The phototransistor now detects the light from the LED and conducts. This turns off the CAPPED LED, and causes the signal, UNCAPPED-0 to go high. Any further motion by the motor or turning of the rotary pen turret knob, will cause the rotary pen turret and pens to rotate also.

A high on the CAPPED-0 signal line during a manual pen change/load/unload will cause an interrupt to be generated to the processor. The interrupt causes the processor, after reading the CAPPED-0 signal directly at the PIA, to suspend plotting motion. This is because of the possibility that a pen on the rotary pen turret may swing out into the plotting area and collide with the pen carriage.

When the plotter is capping the pens (either manually, with the front panel switches, or under host control), the cam blade breaks the light beam in the cam sense optical switch when the plate contining the pen caps reaches the end of its upward travel. The CAPPED LED turns on and a low is placed on the CAPPED-0 signal line. The change in the CAPPED-0 line's state generates an interrupt to the processor. The processor then reads the low on the CAPPED-0 signal and resumes plotting.

The Option 31 input is wired to ground at the Switch Data Selector, permitting the processor to read this signal upon power-up if Option 31 is installed in the plotter. If Option 31 is not present, the plotter reads this signal as a high and assumes Option 31 is not present.

Motor Coil A Voltage Source

The Motor Coil Voltage Source circuitry connects one of the two leads of its associated motor coil winding to either + 5 volts, + 12 volts, or no connection. This gives five possible combinations: + 5 volts to either motor coil lead, + 12 volts to either coil lead, or no connection. The plotter's processor determines which connection is to be made. When the motor is being stepped, + 12 volts is applied for 13 milliseconds to the coils on each step. Between motor step pulses or while the motor is waiting for further use (such as during a pen exchange operation, loading, unloading, etc.), + 5 volts is applied to the coils. Finally, when the motor is not needed to rotate the rotary pen turret (such as during plotting), no potential is applied to the motor coils.

The key element in the Motor Coil A Voltage Source circuit is the Voltage Supply Switch. There is one for each coil. In this manual, only the A coil is described but the description is the same for the B coil. The Voltage Supply Switch is a two-line to four-line decoder which is enabled by the ENABLE A-0 signal line and controlled by the A and B inputs (13 ms pulses and POLARITY A-1).

When there is no need for the rotary pen turret to be rotated, the processor shuts off the motor entirely. It does this by placing a high on the ENABLE A-0 line, causing the A coil to be removed from any voltage source. If the B coil is likewise disconnected from a voltage source, the motor will be completely shut off. However, if the processor wishes for the motor to be active, it places a low on the ENABLE A-0 line. Then the signals to the A and B inputs to the Voltage Supply Switch determine whether the + 5 or the + 12 volt source is connected to the coil and to which polarity. Table 5-10 shows the four combinations (five counting no connection) for connecting the two motor coil leads to different voltage sources and the necessary signals (ENABLE, PULSE, and POLARITY).

Table 5-10

VOLTAGE SUPPLY SWITCH SELECTIONS

POLARITY A-1	ENABLE A-0	PULSE A-0	Conduction Voltager Supply Transistor
low	low	high	Q160A (+ 5 volts)
high	low	high	Q160D (+ 5 volts)
low	low	low	Q160B (+ 12 volts)
high	low	low	Q160C (+ 12 volts)
don't care	high	either	none

Table 5-10 shows that whenever Q160B or Q160C conducts (when PULSE and ENABLE are active), + 12 volts is applied to motor coil A and the motor steps. The POLARITY line, however, determines which motor coil lead the + 12 volt potential is applied to.

Table 5-10 also shows that whenever Q160A or Q160D conducts (when ENABLE is active and PULSE is inactive), + 5 volts is applied to motor coil A. This is the condition between actual motor steps. Once again the POLARITY line determines which motor coil lead the + 5 volt potential is applied to.

When the processor wants to step the rotary pen turret motor, it places a momentary low on the PULSE A-0 line. This low causes the 13 ms Pulse Generator (a one-shot multivibrator) to output a 13 millisecond TTL high pulse to the A input of the Voltage Supply Switch. If ENABLE A-0 is active, either Q160B or Q160C (depending upon POLARITY A-1) will conduct and place + 12 volts on one lead or the other of coil A and the motor will step.

A summary of the waveforms necessary to step the rotary pen turret drive motor is shown in Figure 5-22.

Half steps are possible with this arrangement by stepping only one motor coil at a time (the other motor coil is left inactive). Half steps are used in positioning the rotary pen turret during some adjustment procedures.

In normal operation, as shown in Figure 5-22, ENABLE A-0 and ENABLE B-0 are momentarily turned off during polarity switches. This prevents switching transients from accidently turning on the wrong voltage source momentarily and shorting the source to ground (bypassing the coil).

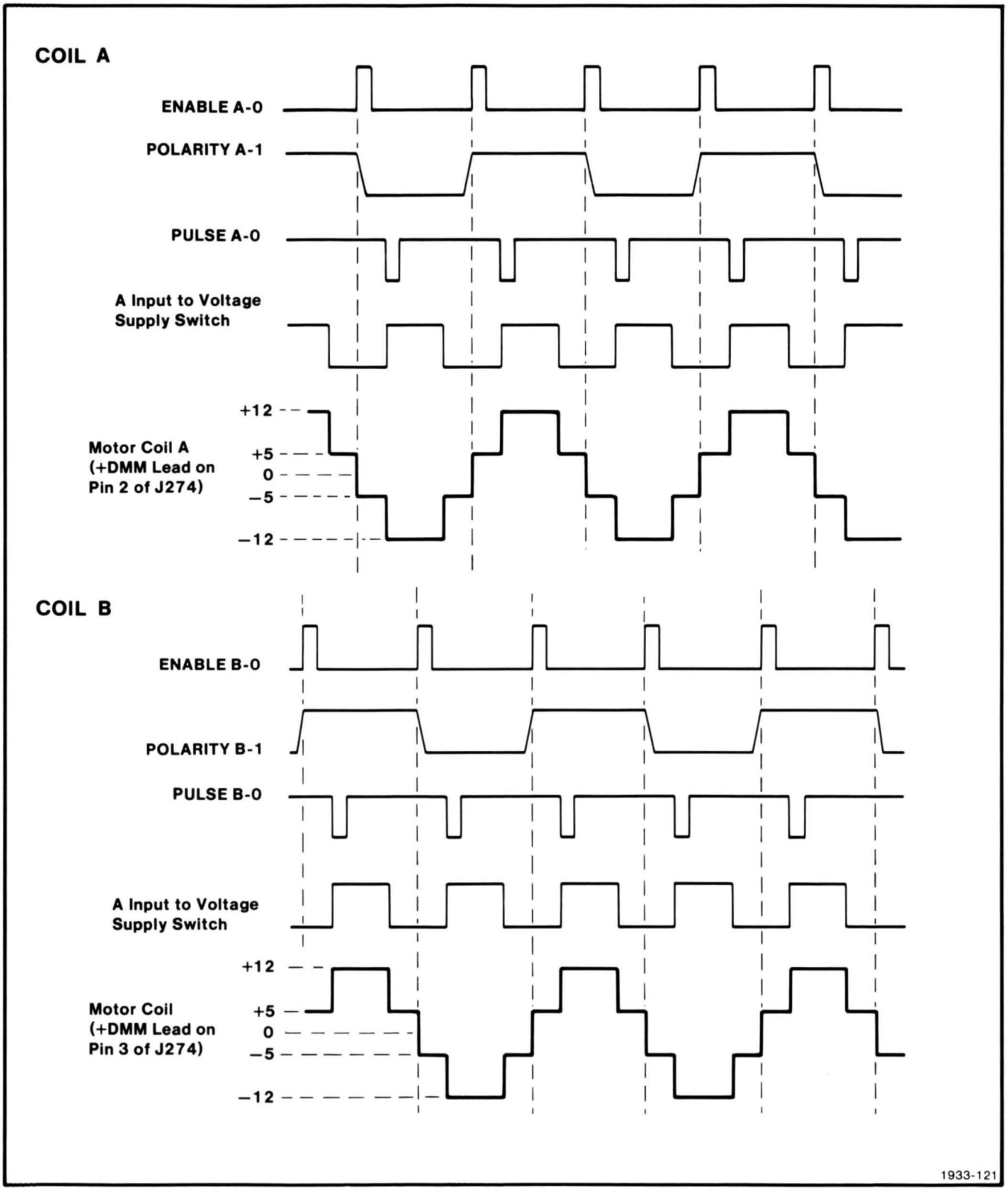


Figure 5-22. Option 31 Rotary Pen Turret Stepper Motor Waveforms.

Motor Coil A Ground Switch

The Motor Coil A Ground Switch determines which lead of the motor coil A is connected to ground.

POLARITY is the key signal that determines which motor coil lead is connected to the voltage source and which is connected to ground. When ENABLE A-0 is present, the two transistors connecting both motor coil leads to ground are enabled, but only the transistor having the high from POLARITY A-1 will conduct (notice the inverter, U130, on the POLARITY A-1 signal line).

Fifteen-volt zener diodes are attached to the motor coil leads and ground to suppress any large voltage spikes generated by the induction of the motor when currents change suddenly.

Motor Coil B Voltage Source

This description is directly analogous to that of the Motor Coil A Voltage Source (described earlier).

Motor Coil B Ground Switch

This description is directly analogous to that of the Motor Coil A Ground Switch (described earlier).

Motor Operation

To step the motor forward and rotate the rotary pen turret out from its home (or stored) position, the processor outputs the POLARITY and PULSE values as shown in Table 5-11 for each step as you move downward through the table. When you reach the bottom of the table, simply start over again at the top and move down. Use the Forward column for the value of the PULSE bits.

To step the motor backward and rotate the rotary pen turret into its home (or stored) position, the processor outputs the POLARITY and PULSE values as shown in Table 5-11 for each step as you move upward through the table. When you reach the top of the table, simply start over again at the bottom and move up. Use the Reverse column for the value of the PULSE bits. At maximum speed, the motor will step at a 125 step/second rate.

Table 5-12 shows the rotational angle of the rotary pen turret for the pen exchange positions, pen presence sense positions, and rotational limits in both degrees and motor steps. All rotations are in relation to the point where the cam blade stops interrupting the light beam in the cam sense optical switch. This is the point where the CAPPED LED goes out. Positive rotations are those in the direction of opening the rotary pen turret from this position and negative rotations occur during the pen capping and uncapping cycle.

Table 5-11

MOTOR DRIVE TABLE

Step	POLARITY-1		Forward Pulse		Reverse Pulse	
	Coil A	Coil B	Coil A	Coil B	Coil A	Coil B
Step 1	0	1	0	1	1	0
Step 2	0	0	1	0	0	1
Step 3	1	0	0	1	1	0
Step 4	1	1	1	0	0	1

Table 5-12

OPTION 31 MOTOR ROTATION AND POSITION POINTS

Degrees	Motor Steps	Description
−90.0	−36	Pen caps fully on
−5.0	−2	Pen cam activates capped switch
00.0	0	Turret to cam detent activates
07.5	3	Pen check arm at pen presence switch
22.5	9	Sense Pen 1 presence
45.0	18	Sense Pen 2 presence
67.5	27	Sense Pen 3 presence
90.0	36	Sense Pen 4 presence
97.5	39	Pen 1 at exchange position
112.5	45	Sense Pen 5 presence
120.0	48	Pen 2 at exchange position
135.0	54	Sense Pen 6 presence
142.5	57	Pen 3 at exchange position
157.5	63	Sense Pen 7 presence
165.0	66	Pen 4 at exchange position
180.0	72	Sense Pen 8 presence
187.5	75	Pen 5 at exchange position
210.0	84	Pen 6 at exchange position
232.5	93	Pen 7 at exchange position
255.0	102	Pen 8 at exchange position

Section 6
REPLACEABLE ELECTRICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

LIST OF ASSEMBLIES

A list of assemblies can be found at the beginning of the Electrical Parts List. The assemblies are listed in numerical order. When the complete component number of a part is known, this list will identify the assembly in which the part is located.

CROSS INDEX-MFR. CODE NUMBER TO MANUFACTURER

The Mfr. Code Number to Manufacturer index for the Electrical Parts List is located immediately after this page. The Cross Index provides codes, names and addresses of manufacturers of components listed in the Electrical Parts List.

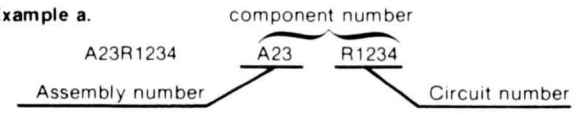
ABBREVIATIONS

Abbreviations conform to American National Standard Y1.1.

COMPONENT NUMBER (column one of the Electrical Parts List)

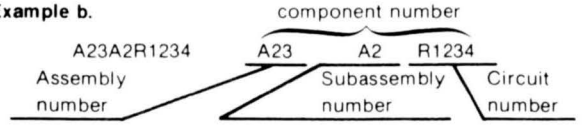
A numbering method has been used to identify assemblies, subassemblies and parts. Examples of this numbering method and typical expansions are illustrated by the following:

Example a.



Read: Resistor 1234 of Assembly 23

Example b.



Read: Resistor 1234 of Subassembly 2 of Assembly 23

Only the circuit number will appear on the diagrams and circuit board illustrations. Each diagram and circuit board illustration is clearly marked with the assembly number. Assembly numbers are also marked on the mechanical exploded views located in the Mechanical Parts List. The component number is obtained by adding the assembly number prefix to the circuit number.

The Electrical Parts List is divided and arranged by assemblies in numerical sequence (e.g., assembly A1 with its subassemblies and parts, precedes assembly A2 with its subassemblies and parts).

Chassis-mounted parts have no assembly number prefix and are located at the end of the Electrical Parts List.

TEKTRONIX PART NO. (column two of the Electrical Parts List)

Indicates part number to be used when ordering replacement part from Tektronix.

SERIAL/MODEL NO. (columns three and four of the Electrical Parts List)

Column three (3) indicates the serial number at which the part was first used. Column four (4) indicates the serial number at which the part was removed. No serial number entered indicates part is good for all serial numbers.

NAME & DESCRIPTION (column five of the Electrical Parts List)

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

MFR. CODE (column six of the Electrical Parts List)

Indicates the code number of the actual manufacturer of the part. (Code to name and address cross reference can be found immediately after this page.)

MFR. PART NUMBER (column seven of the Electrical Parts List)

Indicates actual manufacturers part number.

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
000HX	SAN-O INDUSTRIAL CORP.	170 WILBUR PLACE	BAHEMIA LONG ISLAND, NY 11716
00779	AMP, INC.	P.O. BOX 3608	HARRISBURG, PA 17105
00853	SANGAMO ELECTRIC CO., S. CAROLINA DIV.	P.O. BOX 128	PICKENS, SC 29671
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
01295	TEXAS INSTRUMENTS, INC. SEMICONDUCTOR GROUP	P.O. BOX 5012	DALLAS, TX 75222
01963	CHERRY ELECTRICAL PRODUCTS CORPORATION	3600 SUNSET AVENUE	WAUKEGAN, IL 60085
02777	HOPKINS ENGINEERING COMPANY	12900 FOOTHILL BLVD.	SAN FERNANDO, CA 91342
03508	GENERAL ELECTRIC COMPANY, SEMI-CONDUCTOR PRODUCTS DEPARTMENT	ELECTRONICS PARK	SYRACUSE, NY 13201
04222	AVX CERAMICS, DIVISION OF AVX CORP.	P O BOX 867	MYRTLE BEACH, SC 29577
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
07109	OAKTRON INDUSTRIES, INC.	704 30TH STREET	MONROE, WI 53566
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS STREET	MOUNTAIN VIEW, CA 94042
12954	SIEMENS CORPORATION, COMPONENTS GROUP	8700 E THOMAS RD, P O BOX 1390	SCOTTSDALE, AZ 85252
12969	UNITRODE CORPORATION	580 PLEASANT STREET	WATERTOWN, MA 02172
13409	SENSITRON SEMICONDUCTOR, DIV. OF RSM ELECTRON POWER INC.	221 W. INDUSTRIAL COURT	DEER PARK, NY 11729
14752	ELECTRO CUBE INC.	1710 S. DEL MAR AVE.	SAN GABRIEL, CA 91776
15605	CUTLER-HAMMER, INC.	4201 27TH STREET	MILWAUKEE, WI 53216
17856	SILICONIX, INC.	2201 LAURELWOOD DRIVE	SANTA CLARA, CA 95054
18324	SIGNETICS CORP.	811 E. ARQUES	SUNNYVALE, CA 94086
19396	ILLINOIS TOOL WORKS, INC. PAKTRON DIV.	900 FOLLIN LANE, SE	VIENNA, VA 22180
19701	ELECTRA-MIDLAND CORP., MEPCO ELECTRA INC.	P O BOX 760	MINERAL WELLS, TX 76067
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
24546	CORNING GLASS WORKS, ELECTRONIC COMPONENTS DIVISION	550 HIGH STREET	BRADFORD, PA 16701
26769	NCI INC.	5900 AUSTRALIAN AVENUE	WEST PALM BEACH, FL 33407
27014	NATIONAL SEMICONDUCTOR CORP.	2900 SEMICONDUCTOR DR.	SANTA CLARA, CA 95051
32997	BOURNS, INC., TRIMPOT PRODUCTS DIV.	1200 COLUMBIA AVE.	RIVERSIDE, CA 92507
34649	INTEL CORP.	3065 BOWERS AVE.	SANTA CLARA, CA 95051
50434	HEWLETT-PACKARD COMPANY	640 PAGE MILL ROAD	PALO ALTO, CA 94304
50522	MONSANTO CO., ELECTRONIC SPECIAL PRODUCTS	3400 HILLVIEW AVENUE	PALO ALTO, CA 94304
56289	SPRAGUE ELECTRIC CO.	87 MARSHALL ST.	NORTH ADAMS, MA 01247
56699	MEPCO/ELECTRA INC.	6071 ST. ANDREWS RD.	COLUMBIA, SC 29210
59660	TUSONIX INC.	2155 N FORBES BLVD	TUCSON, AZ 85705
71400	BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.	2536 W. UNIVERSITY ST.	ST. LOUIS, MO 63107
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
76493	BELL INDUSTRIES, INC., MILLER, J. W., DIV.	19070 REYES AVE., P O BOX 5825	COMPTON, CA 90224
77342	AMF INC., POTTER AND BRUMFIELD DIV.	200 RICHLAND CREEK DRIVE	PRINCETON, IN 47670
78277	SIGMA INSTRUMENTS INC.	170 PEARL STREET	SOUTH BRAINTREE, MA 02185
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
83003	VARO, INC.	P O BOX 411, 2203 WALNUT STREET	GARLAND, TX 75040
90201	MALLORY CAPACITOR CO., DIV. OF P. R. MALLORY AND CO., INC.	3029 E. WASHINGTON STREET P. O. BOX 372	INDIANAPOLIS, IN 46206
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				CIRCUIT BOARD ASSEMBLIES		
A1	670-4102-02	B010100	B010119	CKT CARD ASSY:	80009	670-4102-02
A1	670-4102-03	B010120	B029999	CKT CARD ASSY:	80009	670-4102-03
A1	670-4102-04	B030000	B039999	CKT CARD ASSY:	80009	670-4102-04
A1	670-4102-05	B040000	B055624	CKT CARD ASSY:	80009	670-4102-05
A1	670-4102-06	B055625	B055924	CKT BOARD ASSY:PLOTTER	80009	670-4102-06
A1	670-4102-07	B055925	B069999	CKT BOARD ASSY:PLOTTER	80009	670-4102-07
A1	670-4102-08	B070000		CKT BOARD ASSY:PLOTTER	80009	670-4102-08
A2	670-4103-00			CKT BOARD ASSY:FRONT PANEL	80009	670-4103-00
A2	670-4103-01			CKT CARD ASSY:	80009	670-4103-01
A3	672-0541-00	B010100	B069999	CKT BOARD ASSY:POWER SUPPLY	80009	672-0541-00
A3	670-0541-01	B070000	B085103	CKT BOARD ASSY:RECTIFIER	80009	670-0541-01
A3	670-0541-02	B085104		CKT BOARD ASSY:RECTIFIER	80009	670-0541-02
A3A1	670-4099-XX			CKT BOARD ASSY:POWER SUPPLY		
A3A1	----- -----			(NOT AVAILABLE, SEE A3)		
A4	670-5120-00	B030000	B039999	CKT BOARD ASSY:FIRMWARE PATCH	80009	670-5120-00
A5	670-7176-00	B070000	B076308	CKT BOARD ASSY:SYSTEM MEMORY	80009	670-7176-00
A5	670-7176-01	B076309		CKT BOARD ASSY:SYSTEM MEMORY	80009	670-7176-01
A	672-0985-00	B010100	B074799	CKT BOARD ASSY:PEN TURRET DRIVE	80009	672-0985-00
A	672-0985-01	B074800		CKT BOARD ASSY:PEN TURRET DRIVE	80009	672-0985-01
A	----- -----			(OPTION 31 ONLY)		
A6	670-7175-XX			CKT BOARD ASSY:PEN TURRET DRIVE		
A6	----- -----			(NOT REPLACEABLE SEE 672-0985-00)		
A	670-0606-XX			CKT BOARD ASSY:AUTO ERASE	80009	670-0606-XX
A	----- -----			(OPTION 30 ONLY. SEE 4081 FOR BREAK DOWN)		
A	670-5043-01			CKT BOARD ASSY:ELECTROSTATIC HOLD DOWN	80009	670-5043-01
A	----- -----			(NO ELECTRICAL PARTS. SEE FIG. 1-3 RMPL)		
A	672-1030-00			CKT BOARD ASSY:PLOTTER	80009	672-1030-00
A	----- ----			(SEE RMPL FIG. 3 INDEX 32)		
				A1 PLOTTER ASSEMBLY		
A1	670-4102-02	B010100	B010119	CKT CARD ASSY:	80009	670-4102-02
A1	670-4102-03	B010120	B029999	CKT CARD ASSY:	80009	670-4102-03
A1	670-4102-04	B030000	B039999	CKT CARD ASSY:	80009	670-4102-04
A1	670-4102-05	B040000	B055624	CKT CARD ASSY:	80009	670-4102-05
A1	670-4102-06	B055625	B055924	CKT BOARD ASSY:PLOTTER	80009	670-4102-06
A1	670-4102-07	B055925	B069999	CKT BOARD ASSY:PLOTTER	80009	670-4102-07
A1	670-4102-08	B070000		CKT BOARD ASSY:PLOTTER	80009	670-4102-08
A1C1	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C5	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C13	285-0598-00			CAP.,FXD,PLSTC:0.01UF,5%,100V	19396	DU490B103J
A1C15	285-1076-00			CAP.,FXD,PLSTC:0.2UF,5%,100V	14752	230B1B204J
A1C21	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A1C43	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C55	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C61	283-0279-00			CAP.,FXD,CER DI:0.001UF,20%,3000V	59660	878-521-S-Y5S-10
A1C64	283-0279-00			CAP.,FXD,CER DI:0.001UF,20%,3000V	59660	878-521-S-Y5S-10
A1C65	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	56289	273C11
A1C68	281-0546-00			CAP.,FXD,CER DI:330PF,10%,500V	04222	7001-1380
A1C69	290-0524-00			CAP.,FXD,ELCTLT:4.7UF,20%,10V	90201	TDC475M010EL
A1C69	----- -----			(USED ON 670-4102-00 ONLY)		
A1C69	290-0525-00			CAP.,FXD,ELCTLT:4.7UF,20%,50V	56289	196D475X0050KA1

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1C75	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A1C76	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A1C83	290-0117-00			CAP.,FXD,ELCTLT:50UF,+75-10%,50V	56289	30D506G050DD9
A1C115	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C141	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C145	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C154	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C155	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C161	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C176	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C178	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A1C179	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A1C201	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C241	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C243	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C245	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C260	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C261	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C265	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C270	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C277	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C279	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C291	285-1076-00			CAP.,FXD,PLSTC:0.2UF,5%,100V	14752	230B1B204J
A1C291	----- -----			(USED ON 670-4102-00 AND 670-4102-01 ONLY)		
A1C291	285-1075-00			CAP.,FXD,PLSTC:0.1UF,5%,100V	14752	230B1B104J
A1C301	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C315	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C345	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C382	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C392	290-0524-00			CAP.,FXD,ELCTLT:4.7UF,20%,10V	90201	TDC475M010EL
A1C392	----- -----			(USED ON 670-4102-00 ONLY)		
A1C392	290-0525-00			CAP.,FXD,ELCTLT:4.7UF,20%,50V	56289	196D475X0050KA1
A1C394	290-0524-00			CAP.,FXD,ELCTLT:4.7UF,20%,10V	90201	TDC475M010EL
A1C394	----- -----			(USED ON 670-4102-00 ONLY)		
A1C394	290-0525-00			CAP.,FXD,ELCTLT:4.7UF,20%,50V	56289	196D475X0050KA1
A1C405	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C415	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C441	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C452	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C465	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C481	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C542	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C555	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C565	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C574	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C575	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C592	285-1076-00			CAP.,FXD,PLSTC:0.2UF,5%,100V	14752	230B1B204J
A1C592	----- -----			(USED ON 670-4102-00 AND 670-4102-01 ONLY)		
A1C592	285-1075-00			CAP.,FXD,PLSTC:0.1UF,5%,100V	14752	230B1B104J
A1C601	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C641	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C642	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
A1C645	290-0530-00			CAP.,FXD,ELCTLT:68UF,20%,6V	90201	TDC686M006NLF
A1C646	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C655	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1C677	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A1C678	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A1C680	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C741	281-0564-00			CAP.,FXD,CER DI:24PF,5%,500V	59660	301-000C0G0240J
A1C742	281-0508-00			CAP.,FXD,CER DI:12PF,+/-0.6PF,500V	04222	7001-COG-120J
A1C778	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A1C779	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
A1C780	290-0117-00			CAP.,FXD,ELCTLT:50UF,+75-10%,50V	56289	30D506G050DD9
A1C781	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
A1C805	290-0114-00			CAP.,FXD,ELCTLT:47UF,20%,6V	56289	150D476X0006B2
A1C815	290-0114-00			CAP.,FXD,ELCTLT:47UF,20%,6V	56289	150D476X0006B2
A1C841	290-0114-00			CAP.,FXD,ELCTLT:47UF,20%,6V	56289	150D476X0006B2
A1C850	290-0114-00			CAP.,FXD,ELCTLT:47UF,20%,6V	56289	150D476X0006B2
A1C852	290-0114-00			CAP.,FXD,ELCTLT:47UF,20%,6V	56289	150D476X0006B2
A1CR11	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR61	152-0385-00			SEMICOND DEVICE:SILICON,2000V,100MA	83003	VB20-2
A1CR64	152-0385-00			SEMICOND DEVICE:SILICON,2000V,100MA	83003	VB20-2
A1CR65	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR66	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR71	152-0414-00			SEMICOND DEVICE:SILICON,200V,0.75A	12969	UTR308
A1CR72	152-0414-00			SEMICOND DEVICE:SILICON,200V,0.75A	12969	UTR308
A1CR73	152-0414-00			SEMICOND DEVICE:SILICON,200V,0.75A	12969	UTR308
A1CR74	152-0414-00			SEMICOND DEVICE:SILICON,200V,0.75A	12969	UTR308
A1CR82	152-0414-00			SEMICOND DEVICE:SILICON,200V,0.75A	12969	UTR308
A1CR93	152-0414-00			SEMICOND DEVICE:SILICON,200V,0.75A	12969	UTR308
A1CR94	152-0414-00			SEMICOND DEVICE:SILICON,200V,0.75A	12969	UTR308
A1CR171	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR172	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR173	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR174	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR181	152-0414-00			SEMICOND DEVICE:SILICON,200V,0.75A	12969	UTR308
A1CR192	152-0414-00			SEMICOND DEVICE:SILICON,200V,0.75A	12969	UTR308
A1CR193	152-0414-00			SEMICOND DEVICE:SILICON,200V,0.75A	12969	UTR308
A1CR271	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR272	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR273	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR274	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR281	152-0414-00			SEMICOND DEVICE:SILICON,200V,0.75A	12969	UTR308
A1CR285	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR291	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR292	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR293	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR371	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR372	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR373	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR374	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR381	152-0414-00			SEMICOND DEVICE:SILICON,200V,0.75A	12969	UTR308
A1CR398	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR492	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR571	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR572	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR575	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR585	152-0414-00			SEMICOND DEVICE:SILICON,200V,0.75A	12969	UTR308
A1CR588	152-0414-00			SEMICOND DEVICE:SILICON,200V,0.75A	12969	UTR308

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A1CR591	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR593	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR595	152-0414-00			SEMICOND DEVICE:SILICON,200V,0.75A	12969	UTR308
A1CR596	152-0414-00			SEMICOND DEVICE:SILICON,200V,0.75A	12969	UTR308
A1CR641	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR645	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR671	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR672	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR673	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR674	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR771	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR772	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR773	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR774	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR775	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A1CR785	152-0414-00			SEMICOND DEVICE:SILICON,200V,0.75A	12969	UTR308
A1CR786	152-0414-00			SEMICOND DEVICE:SILICON,200V,0.75A	12969	UTR308
A1CR791	152-0414-00			SEMICOND DEVICE:SILICON,200V,0.75A	12969	UTR308
A1CR792	152-0414-00			SEMICOND DEVICE:SILICON,200V,0.75A	12969	UTR308
A1CR871	152-0414-00			SEMICOND DEVICE:SILICON,200V,0.75A	12969	UTR308
A1CR872	152-0414-00			SEMICOND DEVICE:SILICON,200V,0.75A	12969	UTR308
A1CR873	152-0414-00			SEMICOND DEVICE:SILICON,200V,0.75A	12969	UTR308
A1CR874	152-0414-00			SEMICOND DEVICE:SILICON,200V,0.75A	12969	UTR308
A1J21	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
A1J21	----- -----			(QUANTITY OF 2)		
A1J31	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
A1J31	----- -----			(QUANTITY OF 4)		
A1J35	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
A1J35	----- -----			(QUANTITY OF 20)		
A1J41	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
A1J41	----- -----			(QUANTITY OF 34)		
A1J51	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
A1J51	----- -----			(QUANTITY OF 34)		
A1J61	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
A1J61	----- -----			(QUANTITY OF 2)		
A1J71	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
A1J71	----- -----			(QUANTITY OF 4)		
A1J105	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
A1J105	----- -----			(QUANTITY OF 8)		
A1J291	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
A1J291	----- -----			(QUANTITY OF 6)		
A1J765	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
A1J765	----- -----			(QUANTITY OF 20)		
A1J871	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
A1J871	----- -----			(QUANTITY OF 4)		
A1K706	148-0082-00			RELAY,ARMATURE:4PDT,12VDC,28VDC,250VDC	77342	R10-E2435-1
A1L741	108-0054-00			COIL,RF:6.4UH	80009	108-0054-00
A1Q61	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A1Q81	151-0466-00			TRANSISTOR:SILICON,NPN	04713	SJE327
A1Q82	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A1Q83	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A1Q91	151-0465-00			TRANSISTOR:SILICON,PNP	80009	151-0465-00
A1Q94	151-0465-00			TRANSISTOR:SILICON,PNP	80009	151-0465-00
A1Q181	151-0466-00			TRANSISTOR:SILICON,NPN	04713	SJE327

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A1Q182	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A1Q183	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A1Q191	151-0465-00			TRANSISTOR:SILICON,PNP	80009	151-0465-00
A1Q193	151-0465-00			TRANSISTOR:SILICON,PNP	80009	151-0465-00
A1Q275	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A1Q276	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A1Q281	151-0466-00			TRANSISTOR:SILICON,NPN	04713	SJE327
A1Q282	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A1Q283	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A1Q285	151-1021-00			TRANSISTOR:SILICON,JFE	17856	FN815
A1Q481	151-0466-00			TRANSISTOR:SILICON,NPN	04713	SJE327
A1Q482	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A1Q483	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A1Q581	151-0466-00			TRANSISTOR:SILICON,NPN	04713	SJE327
A1Q582	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A1Q583	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A1Q584	151-0466-00			TRANSISTOR:SILICON,NPN	04713	SJE327
A1Q585	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A1Q586	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A1Q587	151-0466-00			TRANSISTOR:SILICON,NPN	04713	SJE327
A1Q588	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A1Q589	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A1Q591	151-1021-00			TRANSISTOR:SILICON,JFE	17856	FN815
A1Q593	151-0465-00			TRANSISTOR:SILICON,PNP	80009	151-0465-00
A1Q596	151-0465-00			TRANSISTOR:SILICON,PNP	80009	151-0465-00
A1Q661	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
A1Q691	151-0465-00			TRANSISTOR:SILICON,PNP	80009	151-0465-00
A1Q785	151-0466-00			TRANSISTOR:SILICON,NPN	04713	SJE327
A1Q786	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A1Q787	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A1Q793	151-0465-00			TRANSISTOR:SILICON,PNP	80009	151-0465-00
A1R11	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A1R14	321-0372-00			RES.,FXD,FILM:73.2K OHM,1%,0.125W	91637	MFF1816G73201F
A1R15	321-0362-00			RES.,FXD,FILM:57.6K OHM,1%,0.125W	91637	MFF1816G57601F
A1R16	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
A1R21	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
A1R22	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
A1R61	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A1R62	301-0226-00			RES.,FXD,CMPSN:22M OHM,5%,0.50W	01121	EB2265
A1R63	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A1R64	301-0226-00			RES.,FXD,CMPSN:22M OHM,5%,0.50W	01121	EB2265
A1R65	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
A1R66	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
A1R67	307-0105-00			RES.,FXD,CMPSN:3.9 OHM,5%,0.25W	01121	CB39G5
A1R75	308-0779-00			RES.,FXD,WW:2 OHM,1%,3W	91637	NS2B-2R000F-T/R
A1R76	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
A1R77	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
A1R78	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A1R79	321-0147-00			RES.,FXD,FILM:332 OHM,1%,0.125W	91637	MFF1816G332R0F
A1R80	321-0143-00			RES.,FXD,FILM:301 OHM,1%,0.125W	91637	MFF1816G301R0F
A1R81	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
A1R82	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
A1R83	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
A1R84	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215

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A1R91	308-0252-00			RES.,FXD,WW:390 OHM,5%,3W	91637	CW2B-B390R0J
A1R92	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
A1R94	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
A1R95	308-0252-00			RES.,FXD,WW:390 OHM,5%,3W	91637	CW2B-B390R0J
A1R105	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A1R113	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
A1R114	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
A1R115	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A1R116	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A1R117	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
A1R171	321-0238-00			RES.,FXD,FILM:2.94K OHM,1%,0.125W	91637	MFF1816G29400F
A1R172	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
A1R173	321-0209-00			RES.,FXD,FILM:1.47K OHM,1%,0.125W	91637	MFF1816G14700F
A1R174	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
A1R175	321-0180-00			RES.,FXD,FILM:732 OHM,1%,0.125W	91637	MFF1816G732R0F
A1R176	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
A1R177	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
A1R178	308-0779-00			RES.,FXD,WW:2 OHM,1%,3W	91637	NS2B-2R000F-T/R
A1R179	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
A1R180	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
A1R181	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
A1R182	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
A1R183	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
A1R184	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
A1R191	308-0252-00			RES.,FXD,WW:390 OHM,5%,3W	91637	CW2B-B390R0J
A1R192	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
A1R193	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
A1R195	308-0252-00			RES.,FXD,WW:390 OHM,5%,3W	91637	CW2B-B390R0J
A1R260	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A1R272	321-0178-00			RES.,FXD,FILM:698 OHM,1%,0.125W	91637	MFF1816G698R0F
A1R273	321-0178-00			RES.,FXD,FILM:698 OHM,1%,0.125W	91637	MFF1816G698R0F
A1R274	321-0238-00			RES.,FXD,FILM:2.94K OHM,1%,0.125W	91637	MFF1816G29400F
A1R275	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A1R276	321-0147-00			RES.,FXD,FILM:332 OHM,1%,0.125W	91637	MFF1816G332R0F
A1R277	321-0143-00			RES.,FXD,FILM:301 OHM,1%,0.125W	91637	MFF1816G301R0F
A1R278	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
A1R279	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
A1R282	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
A1R283	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
A1R284	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
A1R292	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
A1R293	315-0433-00			RES.,FXD,CMPSN:43K OHM,5%,0.25W	01121	CB4335
A1R360	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A1R371	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
A1R372	321-0209-00			RES.,FXD,FILM:1.47K OHM,1%,0.125W	91637	MFF1816G14700F
A1R373	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
A1R374	321-0180-00			RES.,FXD,FILM:732 OHM,1%,0.125W	91637	MFF1816G732R0F
A1R375	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A1R380	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
A1R381	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
A1R382	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
A1R383	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
A1R384	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
A1R391	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1R392	315-0363-00			RES.,FXD,CMPSN:36K OHM,5%,0.25W	01121	CB3635
A1R392	----- -----			(USED ON 670-4102-00 AND 670-4102-01 ONLY)		
A1R392	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
A1R393	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
A1R394	307-0105-00			RES.,FXD,CMPSN:3.9 OHM,5%,0.25W	01121	CB39G5
A1R395	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
A1R396	315-0363-00			RES.,FXD,CMPSN:36K OHM,5%,0.25W	01121	CB3635
A1R396	----- -----			(USED ON 670-4102-00 AND 670-4102-01 ONLY)		
A1R396	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
A1R397	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
A1R398	307-0105-00			RES.,FXD,CMPSN:3.9 OHM,5%,0.25W	01121	CB39G5
A1R415	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
A1R450	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
A1R451	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
A1R476	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A1R481	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A1R482	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
A1R483	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
A1R484	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A1R491	311-1222-00			RES.,VAR,NONWIR:100 OHM,20%,0.50W	32997	3386F-T04-101
A1R492	311-1222-00			RES.,VAR,NONWIR:100 OHM,20%,0.50W	32997	3386F-T04-101
A1R493	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
A1R494	315-0433-00			RES.,FXD,CMPSN:43K OHM,5%,0.25W	01121	CB4335
A1R495	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
A1R496	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
A1R497	315-0363-00			RES.,FXD,CMPSN:36K OHM,5%,0.25W	01121	CB3635
A1R497	----- -----			(USED ON 670-4102-00 AND 670-4102-01 ONLY)		
A1R497	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
A1R498	315-0363-00			RES.,FXD,CMPSN:36K OHM,5%,0.25W	01121	CB3635
A1R498	----- -----			(USED ON 670-4102-00 AND 670-4102-01 ONLY)		
A1R498	315-0183-00			RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
A1R499	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
A1R501	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A1R505	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A1R515	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A1R571	321-0209-00			RES.,FXD,FILM:1.47K OHM,1%,0.125W	91637	MFF1816G14700F
A1R572	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
A1R573	321-0180-00			RES.,FXD,FILM:732 OHM,1%,0.125W	91637	MFF1816G732R0F
A1R574	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
A1R575	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
A1R576	321-0143-00			RES.,FXD,FILM:301 OHM,1%,0.125W	91637	MFF1816G301R0F
A1R580	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
A1R581	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
A1R582	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
A1R583	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
A1R584	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
A1R585	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
A1R586	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
A1R587	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
A1R588	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
A1R591	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
A1R593	308-0252-00			RES.,FXD,WW:390 OHM,5%,3W	91637	CW2B-B390R0J
A1R594	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
A1R596	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1R598	308-0252-00			RES.,FXD,WW:390 OHM,5%,3W	91637	CW2B-B390R0J
A1R599	308-0252-00			RES.,FXD,WW:390 OHM,5%,3W	91637	CW2B-B390R0J
A1R601	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
A1R602	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
A1R603	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
A1R604	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
A1R605	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
A1R641	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A1R642	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
A1R645	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
A1R660	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
A1R661	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
A1R662	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A1R671	321-0238-00			RES.,FXD,FILM:2.94K OHM,1%,0.125W	91637	MFF1816G29400F
A1R673	321-0178-00			RES.,FXD,FILM:698 OHM,1%,0.125W	91637	MFF1816G698R0F
A1R674	321-0178-00			RES.,FXD,FILM:698 OHM,1%,0.125W	91637	MFF1816G698R0F
A1R675	321-0147-00			RES.,FXD,FILM:332 OHM,1%,0.125W	91637	MFF1816G332R0F
A1R676	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A1R677	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
A1R678	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
A1R679	308-0779-00			RES.,FXD,WW:2 OHM,1%,3W	91637	NS2B-2R000F-T/R
A1R680	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
A1R681	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
A1R685	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
A1R686	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
A1R687	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
A1R688	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
A1R691	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
A1R710	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
A1R711	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
A1R712	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A1R760	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A1R761	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A1R771	321-0180-00			RES.,FXD,FILM:732 OHM,1%,0.125W	91637	MFF1816G732R0F
A1R772	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
A1R773	321-0209-00			RES.,FXD,FILM:1.47K OHM,1%,0.125W	91637	MFF1816G14700F
A1R774	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
A1R775	321-0143-00			RES.,FXD,FILM:301 OHM,1%,0.125W	91637	MFF1816G301R0F
A1R776	321-0147-00			RES.,FXD,FILM:332 OHM,1%,0.125W	91637	MFF1816G332R0F
A1R777	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A1R778	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
A1R779	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
A1R780	308-0779-00			RES.,FXD,WW:2 OHM,1%,3W	91637	NS2B-2R000F-T/R
A1R785	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
A1R786	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
A1R787	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
A1R788	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
A1R793	315-0750-00			RES.,FXD,CMPSN:75 OHM,5%,0.25W	01121	CB7505
A1R794	308-0252-00			RES.,FXD,WW:390 OHM,5%,3W	91637	CW2B-B390R0J
A1R871	321-0238-00			RES.,FXD,FILM:2.94K OHM,1%,0.125W	91637	MFF1816G29400F
A1S101	260-1777-00			SWITCH,ROTARY:16 POSN,28VDC,100MA	00779	53137-1
A1S105	260-1777-00			SWITCH,ROTARY:16 POSN,28VDC,100MA	00779	53137-1
A1S201	260-1777-00			SWITCH,ROTARY:16 POSN,28VDC,100MA	00779	53137-1
A1S205	260-1777-00			SWITCH,ROTARY:16 POSN,28VDC,100MA	00779	53137-1

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1T61	120-0929-00			XFMR,PWR,STU:POT CORE	80009	120-0929-00
A1TP501	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
A1TP641	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
A1U1	156-0471-02			MICROCIRCUIT,DI:DUAL 4/1 LINE DATA SEL	01295	SN74LS253NP3
A1U5	156-0471-02			MICROCIRCUIT,DI:DUAL 4/1 LINE DATA SEL	01295	SN74LS253NP3
A1U11	156-0402-02			MICROCIRCUIT,LI:TIMER,CHK	27014	LM555CN/A+
A1U15	156-0402-02			MICROCIRCUIT,LI:TIMER,CHK	27014	LM555CN/A+
A1U41	156-0695-00	B010100	B055624	MICROCIRCUIT,DI:ROM,256 X 4 STATIC	18324	2606-1B
A1U41	156-1461-00	B058310		MICROCIRCUIT,DI:1024 X 4 SRAM	34649	D2114AL-4/S7127
A1U41	----- -----			(OPTION 20 ONLY)		
A1U42	156-0695-00	B010100	B055624	MICROCIRCUIT,DI:ROM,256 X 4 STATIC	18324	2606-1B
A1U42	156-1461-00	B058310		MICROCIRCUIT,DI:1024 X 4 SRAM	34649	D2114AL-4/S7127
A1U42	----- -----			(OPTION 20 ONLY)		
A1U45	156-0675-00	B010100	B029999	MICROCIRCUIT,DI:	80009	156-0675-00
A1U45	156-0675-01	B030000	B069999	MICROCIRCUIT,DI:2048 X 8 ROM,CUSTOM MASK	80009	156-0675-01
A1U50	156-0676-00	B010100	B029999	MICROCIRCUIT,DI:	80009	156-0676-00
A1U50	156-0676-01	B030000	B039999	MICROCIRCUIT,DI:2048 X 8 ROM,CUSTOM MASK	80009	156-0676-01
A1U50	156-0676-02	B040000	B069999	MICROCIRCUIT,DI:2048 X 8 ROM,CUSTOM MASK	80009	156-0676-02
A1U51	160-1527-00			MICROCIRCUIT,DI:1024 X 8 EPROM,PRGM	80009	160-1527-00
A1U51	----- -----			(OPTION 31 ONLY)		
A1U55	156-0385-02			MICROCIRCUIT,DI:HEX INVERTER	01295	SN74LS04
A1U55	156-0387-02			MICROCIRCUIT,DI:DUAL J-K FF,BURN IN	01295	SN74LS73
A1U75	156-0013-00			MICROCIRCUIT,DI:DIFF COMPARATOR	07263	SL21770
A1U101	156-0600-00			MICROCIRCUIT,DI:QUAD BUS XCVR	80009	156-0600-00
A1U105	156-0479-02			MICROCIRCUIT,DI:QUAD 2-INP OR GATE	01295	SN74LS32NP3
A1U111	156-0385-02			MICROCIRCUIT,DI:HEX INVERTER	01295	SN74LS04
A1U115	156-0480-02			MICROCIRCUIT,DI:QUAD 2 INP & GATE	01295	SN74LS08NP3
A1U141	156-0695-00	B010100	B055624	MICROCIRCUIT,DI:ROM,256 X 4 STATIC	18324	2606-1B
A1U141	156-1461-00	B058310		MICROCIRCUIT,DI:1024 X 4 SRAM	34649	D2114AL-4/S7127
A1U141	----- -----			(OPTION 20 ONLY)		
A1U142	156-0695-00	B010100	B055624	MICROCIRCUIT,DI:ROM,256 X 4 STATIC	18324	2606-1B
A1U142	156-1461-00	B058310		MICROCIRCUIT,DI:1024 X 4 SRAM	34649	D2114AL-4/S7127
A1U142	----- -----			(OPTION 20 ONLY)		
A1U145	156-0677-00	B010100	B039999	MICROCIRCUIT,DI:	80009	156-0677-00
A1U145	156-0677-01	B040000	B069999	MICROCIRCUIT,DI:2048 X 8 ROM,CUSTOM MASK	80009	156-0677-01
A1U154	156-0452-02			MICROCIRCUIT,DI:4-WIDE,2-INP AOI,SCREENED	07263	74LS54
A1U155	156-0452-02			MICROCIRCUIT,DI:4-WIDE,2-INP AOI,SCREENED	07263	74LS54
A1U161	156-0422-02			MICROCIRCUIT,DI:UP/DOWN SYN BINARY CNTR	01295	SN74LS191
A1U201	156-0383-02			MICROCIRCUIT,DI:QUAD 2-INP NOR GATE	01295	SN74LS02
A1U205	156-0600-00			MICROCIRCUIT,DI:QUAD BUS XCVR	80009	156-0600-00
A1U211	156-0140-02			MICROCIRCUIT,DI:HEX BUFFERS W/OC HV OUT	01295	SN7417 (NP3)
A1U215	156-0427-00			MICROCIRCUIT,DI:PERIPHERAL INTERFACE ADPTR	04713	MC6820(L OR P)
A1U241	156-0695-00	B010100	B055624	MICROCIRCUIT,DI:ROM,256 X 4 STATIC	18324	2606-1B
A1U241	156-1461-00	B058310		MICROCIRCUIT,DI:1024 X 4 SRAM	34649	D2114AL-4/S7127
A1U241	----- -----			(OPTION 20 ONLY)		
A1U242	156-0695-00	B010100	B055624	MICROCIRCUIT,DI:ROM,256 X 4 STATIC	18324	2606-1B
A1U242	156-1461-00	B058310		MICROCIRCUIT,DI:1024 X 4 SRAM	34649	D2114AL-4/S7127
A1U242	----- -----			(OPTION 20 ONLY)		
A1U243	156-0695-00	B010100	B055624	MICROCIRCUIT,DI:ROM,256 X 4 STATIC	18324	2606-1B
A1U243	156-1127-02	B055625	B055924	MICROCIRCUIT,DI:1024 X 4 STATIC MEMORY,SEL	80009	156-1127-02
A1U243	156-1127-01	B055925		MICROCIRCUIT,DI:1024 X 4 STATIC RAM	80009	156-1127-01
A1U244	156-0695-00	B010100	B055624	MICROCIRCUIT,DI:ROM,256 X 4 STATIC	18324	2606-1B
A1U244	156-1127-02	B055625	B055924	MICROCIRCUIT,DI:1024 X 4 STATIC MEMORY,SEL	80009	156-1127-02
A1U244	156-1127-01	B055925		MICROCIRCUIT,DI:1024 X 4 STATIC RAM	80009	156-1127-01

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1U250	156-0794-00	B010100	B029999	MICROCIRCUIT,DI:ROM,CUSTOM MASK	80009	156-0794-00
A1U250	156-0794-01	B030000	B039999	MICROCIRCUIT,DI:2048 X 8 ROM,CUSTOM MASK	80009	156-0794-01
A1U250	156-0794-02	B040000	B069999	MICROCIRCUIT,DI:2048 X 8 ROM,CUSTOM MASK	80009	156-0794-02
A1U255	156-0382-02			MICROCIRCUIT,DI:QUAD 2-INP NAND GATE	01295	SN74LS00
A1U260	156-0030-03			MICROCIRCUIT,DI:QUAD 2-INP NAND GATE,SCRN	01295	SN7400(NP3 OR JP
A1U261	156-0480-02			MICROCIRCUIT,DI:QUAD 2 INP & GATE	01295	SN74LS08NP3
A1U265	156-0530-02	B010100	B010117	MICROCIRCUIT,DI:QUAD 2-INP MUX,SCRN	01295	SN74LS157P3
A1U265	156-0125-02	B010118		MICROCIRCUIT,DI:QUAD 2-INP MUX,SCRN	01295	SN74157(NP3 OR J
A1U270	156-0652-02			MICROCIRCUIT,DI:QUAD 2-INPUT EXCL NOR GATE	01295	SN74LS266
A1U275	156-0652-02			MICROCIRCUIT,DI:QUAD 2-INPUT EXCL NOR GATE	01295	SN74LS266
A1U277	156-0013-00			MICROCIRCUIT,DI:DIFF COMPARATOR	07263	SL21770
A1U281	156-0424-02			MICROCIRCUIT,DI:QUAD 2 INP NOR BFR,SCRN	18324	N7433(NB OR FB)
A1U285	156-0105-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	27014	LM301AN
A1U291	156-0105-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	27014	LM301AN
A1U301	156-0763-02			MICROCIRCUIT,DI:HEX CONT BOUNCE ELIMINATOR	04713	MC14490BCLD
A1U302	307-0365-00			RES.,FXD,FILM:1K OHM,2%,15 RES NETWORK	91637	LDP1602102GS7
A1U305	156-0600-00			MICROCIRCUIT,DI:QUAD BUS XCVR	80009	156-0600-00
A1U315	156-0427-00			MICROCIRCUIT,DI:PERIPHERAL INTERFACE ADPTR	04713	MC6820(L OR P)
A1U341	156-0695-00	B010100	B055624	MICROCIRCUIT,DI:ROM,256 X 4 STATIC	18324	2606-1B
A1U341	156-1127-02	B055625	B055924	MICROCIRCUIT,DI:1024 X 4 STATIC MEMORY,SEL	80009	156-1127-02
A1U341	156-1127-01	B055925		MICROCIRCUIT,DI:1024 X 4 STATIC RAM	80009	156-1127-01
A1U342	156-0695-00	B010100	B055624	MICROCIRCUIT,DI:ROM,256 X 4 STATIC	18324	2606-1B
A1U342	156-1127-02	B055625	B055924	MICROCIRCUIT,DI:1024 X 4 STATIC MEMORY,SEL	80009	156-1127-02
A1U342	156-1127-01	B055925		MICROCIRCUIT,DI:1024 X 4 STATIC RAM	80009	156-1127-01
A1U345	156-0792-00	B010100	B029999	MICROCIRCUIT,DI:ROM,CUSTOM MASK	80009	156-0792-00
A1U345	156-0792-01	B030000	B069999	MICROCIRCUIT,DI:2048 X 8 ROM,CUSTOM MASK	80009	156-0792-01
A1U355	156-0479-02			MICROCIRCUIT,DI:QUAD 2-INP OR GATE	01295	SN74LS32NP3
A1U360	156-0248-02			MICROCIRCUIT,DI:SYN 4 BIT BINARY COUNTER	01295	SN74163
A1U361	156-0480-02			MICROCIRCUIT,DI:QUAD 2 INP & GATE	01295	SN74LS08NP3
A1U365	156-0383-02			MICROCIRCUIT,DI:QUAD 2-INP NOR GATE	01295	SN74LS02
A1U371	156-0652-02			MICROCIRCUIT,DI:QUAD 2-INPUT EXCL NOR GATE	01295	SN74LS266
A1U372	156-0422-02			MICROCIRCUIT,DI:UP/DOWN SYN BINARY CNTR	01295	SN74LS191
A1U375	156-0422-02			MICROCIRCUIT,DI:UP/DOWN SYN BINARY CNTR	01295	SN74LS191
A1U376	156-0388-03			MICROCIRCUIT,DI:DUAL D FLIP-FLOP	07263	74LS74A
A1U381	156-0186-02			MICROCIRCUIT,DI:QUAD 2-INP NAND GATE,SCRN	01295	SN7403(NP3 OR JP
A1U382	156-0387-02			MICROCIRCUIT,DI:DUAL J-K FF,BURN IN	01295	SN74LS73
A1U401	156-0600-00			MICROCIRCUIT,DI:QUAD BUS XCVR	80009	156-0600-00
A1U405	156-0480-02			MICROCIRCUIT,DI:QUAD 2 INP & GATE	01295	SN74LS08NP3
A1U411	156-0427-00			MICROCIRCUIT,DI:PERIPHERAL INTERFACE ADPTR	04713	MC6820(L OR P)
A1U415	156-0385-02			MICROCIRCUIT,DI:HEX INVERTER	01295	SN74LS04
A1U441	156-0695-00	B010100	B055624	MICROCIRCUIT,DI:ROM,256 X 4 STATIC	18324	2606-1B
A1U441	156-1461-00	B058310		MICROCIRCUIT,DI:1024 X 4 SRAM	34649	D2114AL-4/S7127
A1U441	----- -----			(OPTION 20 ONLY)		
A1U442	156-0695-00	B010100	B055624	MICROCIRCUIT,DI:ROM,256 X 4 STATIC	18324	2606-1B
A1U442	156-1461-00	B058310		MICROCIRCUIT,DI:1024 X 4 SRAM	34649	D2114AL-4/S7127
A1U442	----- -----			(OPTION 20 ONLY)		
A1U443	156-0695-00	B010100	B055624	MICROCIRCUIT,DI:ROM,256 X 4 STATIC	18324	2606-1B
A1U443	156-1461-00	B058310		MICROCIRCUIT,DI:1024 X 4 SRAM	34649	D2114AL-4/S7127
A1U443	----- -----			(OPTION 20 ONLY)		
A1U445	156-0791-00	B010100	B069999	MICROCIRCUIT,DI:ROM,CUSTOM MASK	80009	156-0791-00
A1U450	156-0678-00	B010100	B069999	MICROCIRCUIT,DI:	80009	156-0678-00
A1U455	156-0248-02			MICROCIRCUIT,DI:SYN 4 BIT BINARY COUNTER	01295	SN74163
A1U460	156-0470-02			MICROCIRCUIT,DI:8 INP DATA SEL W/3 STATE	01295	SN74LS251
A1U461	156-0391-02			MICROCIRCUIT,DI:HEX LATCH W/CLEAR	01295	SN74LS174

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1U465	156-0310-02			MICROCIRCUIT,DI:DUAL 8 BIT SHIFT REGISTER,S	07263	93L28 (PCQR OR D
A1U471	156-0383-02			MICROCIRCUIT,DI:QUAD 2-INP NOR GATE	01295	SN74LS02
A1U472	156-0381-02			MICROCIRCUIT,DI:QUAD 2-INP EXCL OR GATE	01295	SN74LS86
A1U475	156-0385-02			MICROCIRCUIT,DI:HEX INVERTER	01295	SN74LS04
A1U476	156-0422-02			MICROCIRCUIT,DI:UP/DOWN SYN BINARY CNTR	01295	SN74LS191
A1U481	156-0092-00			MICROCIRCUIT,DI:HEX INV W/OPEN COLLECTOR	80009	156-0092-00
A1U501	156-0248-02			MICROCIRCUIT,DI:SYN 4 BIT BINARY COUNTER	01295	SN74163
A1U505	156-0248-02			MICROCIRCUIT,DI:SYN 4 BIT BINARY COUNTER	01295	SN74163
A1U515	156-0427-00			MICROCIRCUIT,DI:PERIPHERAL INTERFACE ADPTR	04713	MC6820(L OR P)
A1U541	156-0695-00	B010100	B055624	MICROCIRCUIT,DI:ROM,256 X 4 STATIC	18324	2606-1B
A1U541	156-1461-00	B058310		MICROCIRCUIT,DI:1024 X 4 SRAM	34649	D2114AL-4/S7127
A1U541	----- -----			(OPTION 20 ONLY)		
A1U542	156-0695-00	B010100	B055624	MICROCIRCUIT,DI:ROM,256 X 4 STATIC	18324	2606-1B
A1U542	156-1461-00	B058310		MICROCIRCUIT,DI:1024 X 4 SRAM	34649	D2114AL-4/S7127
A1U542	----- -----			(OPTION 20 ONLY)		
A1U543	156-0695-00	B010100	B055624	MICROCIRCUIT,DI:ROM,256 X 4 STATIC	18324	2606-1B
A1U543	156-1461-00	B058310		MICROCIRCUIT,DI:1024 X 4 SRAM	34649	D2114AL-4/S7127
A1U543	----- -----			(OPTION 20 ONLY)		
A1U545	156-0469-02			MICROCIRCUIT,DI:3/8 LINE DCDR	01295	SN74LS138NP3
A1U550	156-0535-02			MICROCIRCUIT,DI:3-STATE HEX BUFFER,SCRN	27014	DM8097NA+
A1U551	156-0469-02			MICROCIRCUIT,DI:3/8 LINE DCDR	01295	SN74LS138NP3
A1U552	156-0535-02			MICROCIRCUIT,DI:3-STATE HEX BUFFER,SCRN	27014	DM8097NA+
A1U555	156-0479-02			MICROCIRCUIT,DI:QUAD 2-INP OR GATE	01295	SN74LS32NP3
A1U560	156-0469-02			MICROCIRCUIT,DI:3/8 LINE DCDR	01295	SN74LS138NP3
A1U561	156-0310-02			MICROCIRCUIT,DI:DUAL 8 BIT SHIFT REGISTER,S	07263	93L28 (PCQR OR D
A1U565	156-0148-00			MICROCIRCUIT,DI:DUAL FULL ADDER	07263	U6B930459X
A1U571	156-0652-02			MICROCIRCUIT,DI:QUAD 2-INPUT EXCL NOR GATE	01295	SN74LS266
A1U574	156-0652-02			MICROCIRCUIT,DI:QUAD 2-INPUT EXCL NOR GATE	01295	SN74LS266
A1U575	156-0013-00			MICROCIRCUIT,DI:DIFF COMPARATOR	07263	SL21770
A1U581	156-0424-02			MICROCIRCUIT,DI:QUAD 2 INP NOR BFR,SCRN	18324	N7433(NB OR FB)
A1U585	156-0105-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	27014	LM301AN
A1U593	156-0105-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	27014	LM301AN
A1U601	156-0248-02			MICROCIRCUIT,DI:SYN 4 BIT BINARY COUNTER	01295	SN74163
A1U604	156-0139-02			MICROCIRCUIT,DI:DUAL LINE DRIVER,SCREENED	01295	SN75150(PP3 OR J
A1U605	156-0530-02			MICROCIRCUIT,DI:QUAD 2-INP MUX,SCRN	01295	SN74LS157P3
A1U611	156-0361-00			MICROCIRCUIT,DI:UNIV A SYN RCVR XMTR	80009	156-0361-00
A1U615	156-0479-02			MICROCIRCUIT,DI:QUAD 2-INP OR GATE	01295	SN74LS32NP3
A1U635	156-0387-02			MICROCIRCUIT,DI:DUAL J-K FF,BURN IN	01295	SN74LS73
A1U642	156-0206-02			MICROCIRCUIT,DI:CORE DRIVER,SCREENED	01295	SN75325(NP3 OR J
A1U645	156-0535-02			MICROCIRCUIT,DI:3-STATE HEX BUFFER,SCRN	27014	DM8097NA+
A1U650	156-0426-00			MICROCIRCUIT,DI:MICROPROCESSOR	04713	MC6800S
A1U651	156-0531-02			MICROCIRCUIT,DI:QUAD UNIFIED BUS XCVR,SCRN	80009	156-0531-02
A1U652	156-0427-00			MICROCIRCUIT,DI:PERIPHERAL INTERFACE ADPTR	04713	MC6820(L OR P)
A1U653	156-0535-02			MICROCIRCUIT,DI:3-STATE HEX BUFFER,SCRN	27014	DM8097NA+
A1U655	156-0480-02			MICROCIRCUIT,DI:QUAD 2 INP & GATE	01295	SN74LS08NP3
A1U660	156-0385-02			MICROCIRCUIT,DI:HEX INVERTER	01295	SN74LS04
A1U661	156-0310-02			MICROCIRCUIT,DI:DUAL 8 BIT SHIFT REGISTER,S	07263	93L28 (PCQR OR D
A1U665	156-0310-02			MICROCIRCUIT,DI:DUAL 8 BIT SHIFT REGISTER,S	07263	93L28 (PCQR OR D
A1U680	156-0013-00			MICROCIRCUIT,DI:DIFF COMPARATOR	07263	SL21770
A1U701	156-0138-02			MICROCIRCUIT,DI:CORE LINE RECEIVER,SCREENED	01295	SN75154(NP3 OR J
A1U715	156-0382-02			MICROCIRCUIT,DI:QUAD 2-INP NAND GATE	01295	SN74LS00
A1U721	156-0383-02			MICROCIRCUIT,DI:QUAD 2-INP NOR GATE	01295	SN74LS02
A1U725	156-0465-02			MICROCIRCUIT,DI:8 INP NAND GATE	01295	SN74LS30NP3
A1U731	156-0469-02			MICROCIRCUIT,DI:3/8 LINE DCDR	01295	SN74LS138NP3

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1U735	156-0131-02			MICROCIRCUIT,DI:8-BIT PRL-OUT SER SHFT RGTR	01295	SN74164(NP3 OR J
A1U741	156-0323-02			MICROCIRCUIT,DI:HEX INVERTER,BURN-IN	01295	SN74S04
A1U755	156-0383-02			MICROCIRCUIT,DI:QUAD 2-INP NOR GATE	01295	SN74LS02
A1U759	156-0531-02			MICROCIRCUIT,DI:QUAD UNIFIED BUS XCVR,SCRN	80009	156-0531-02
A1U760	156-0248-02			MICROCIRCUIT,DI:SYN 4 BIT BINARY COUNTER	01295	SN74163
A1U761	156-0388-03			MICROCIRCUIT,DI:DUAL D FLIP-FLOP	07263	74LS74A
A1U765	156-0651-02			MICROCIRCUIT,DI:8 BIT PRL-OUT SER SHF RGTR	01295	SN74LS164(NP3 OR
A1Y741	158-0103-00			XTAL UNIT,QTZ:12.5MHZ,0.01% SERIES RESN	80009	158-0103-00

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				A2 FRONT PANEL ASSEMBLY		
A2	670-4103-00			CKT BOARD ASSY:FRONT PANEL	80009	670-4103-00
A2	670-4103-01			CKT CARD ASSY:	80009	670-4103-01
FXXX	159-0141-00	B010100	B057249	FUSE,WIRE LEAD:1.5A,125V,0.1 SEC	71400	GLX1-1/2
FXXX	159-0153-00	B057250		FUSE,WIRE LEAD:1.5A,125V,FAST BLOW	71400	GFA 1-1/2
FXXX	----- -----			(3 EA FOR STORAGE ONLY,SEE A3 REPL)		
FXXX	159-0090-00			FUSE,CARTRIDGE:0.25A,125V,FAST-BLOW	71400	GFA 1/4
FXXX	----- -----			(1 EA FOR STORAGE ONLY,SEE A3 REPL)		
A2R8	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
A2R18	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
A2S20 A2S25 A2S30 A2S35 A2S50	260-1816-00			SWITCH,PUSH:DPDT,1A,28VAC 4 BUTTON		
A2S55 A2S75	260-1817-00			SWITCH,PUSH:DPDT,1A,28VAC 2 BUTTON		
A2S80	260-1817-00			SWITCH,PUSH:DPDT,1A,28VAC 2 BUTTON		
A2U65	156-0480-02			MICROCIRCUIT,DI:QUAD 2 INP & GATE	01295	SN74LS08NP3

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				A3 POWER SUPPLY ASSEMBLY		
A3	672-0541-00	B010100	B069999	CKT BOARD ASSY:POWER SUPPLY	80009	672-0541-00
A3	670-0541-01	B070000	B085103	CKT BOARD ASSY:RECTIFIER	80009	670-0541-01
A3	670-0541-02	B085104		CKT BOARD ASSY:RECTIFIER	80009	670-0541-02
A3C1	290-0655-00			CAP.,FXD,ELCTLT:8,800UF,+75-10%,40V	56289	36D7708
A3C52	281-0523-00			CAP.,FXD,CER DI:100PF,+/-20PF,500V	72982	301-000U2M0101M
A3C133	283-0644-00			CAP.,FXD,MICA D:150PF,1%,500V	00853	D155F151F0
A3C151	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145651 104Z
A3C152	290-0145-00			CAP.,FXD,ELCTLT:10UF,+75-10%,50V	56289	30D106G050CB9
A3C153	290-0299-00			CAP.,FXD,ELCTLT:	26769	XNS337D010M1
A3C201	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145651 104Z
A3C207	283-0115-00			CAP.,FXD,CER DI:47PF,5%,200V	59660	805-519-C0G0470J
A3C235	290-0522-00			CAP.,FXD,ELCTLT:1UF,20%,50V	56289	196D105X0050HA1
A3C302	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145651 104Z
A3C303	283-0203-00			CAP.,FXD,CER DI:0.47UF,20%,50V	72982	8131M058Z5U0474M
A3C304	283-0087-00			CAP.,FXD,CER DI:300PF,10%,1000V	59660	0838020X5F00301K
A3C351	290-0297-00			CAP.,FXD,ELCTLT:39UF,10%,10V	56289	150D396X9010B2
A3C394	283-0028-00	B010100	B031399	CAP.,FXD,CER DI:0.0022UF,20%,50V	59660	0805585Y5SO222M
A3C394	283-0119-00	B031400		CAP.,FXD,CER DI:2200PF,5%,200V	59660	855-536Y5E0222J
A3C395	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145651 104Z
A3C400	290-0135-00			CAP.,FXD,ELCTLT:15UF,20%,20V	56289	150D156X0020B2
A3C401	283-0203-00			CAP.,FXD,CER DI:0.47UF,20%,50V	72982	8131M058Z5U0474M
A3C451	290-0135-00			CAP.,FXD,ELCTLT:15UF,20%,20V	56289	150D156X0020B2
A3C531	290-0162-00			CAP.,FXD,ELCTLT:22UF,20%,35V	12954	D22C35M1
A3C551	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145651 104Z
A3C552	290-0135-00			CAP.,FXD,ELCTLT:15UF,20%,20V	56289	150D156X0020B2
A3C553	290-0162-00			CAP.,FXD,ELCTLT:22UF,20%,35V	12954	D22C35M1
A3C601	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145651 104Z
A3CR51	152-0406-00			SEMICOND DEVICE:SILICON,200V,3A	80009	152-0406-00
A3CR131	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A3CR201	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A3CR351	152-0581-00	B010100	B069999	SEMICOND DEVICE:SILICON,20V,1A	04713	1N5817
A3CR351	152-0655-01	B070000	B085103	SEMICOND DEVICE:RECT,SI,100V,3A,FAST RCVRY	13409	SRSFR310
A3CR351	152-0655-00	B085104		SEMICOND DEVICE:SILICON,100V,3A	03508	A115AX39
A3CR352	152-0502-00	B010100	B069999	SEMICOND DEVICE:SILICON,20V,5A	04713	1N5823
A3CR352	152-0754-00	B070000		SEMICOND DEVICE:RECT,SI,SCHOTTKY,40V,8A	80009	152-0754-00
A3CR401	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A3CR402	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A3CR431	152-0655-00			SEMICOND DEVICE:SILICON,100V,3A	03508	A115AX39
A3CR432	152-0655-00			SEMICOND DEVICE:SILICON,100V,3A	03508	A115AX39
A3CR433	152-0400-00			SEMICOND DEVICE:SILICON,400V,1A	80009	152-0400-00
A3CR434	152-0400-00			SEMICOND DEVICE:SILICON,400V,1A	80009	152-0400-00
A3CR451	152-0502-00	B010100	B069999	SEMICOND DEVICE:SILICON,20V,5A	04713	1N5823
A3CR451	152-0754-00	B070000		SEMICOND DEVICE:RECT,SI,SCHOTTKY,40V,8A	80009	152-0754-00
A3CR452	152-0581-00	B010100	B069999	SEMICOND DEVICE:SILICON,20V,1A	04713	1N5817
A3CR452	152-0655-01	B070000	B085104	SEMICOND DEVICE:RECT,SI,100V,3A,FAST RCVRY	13409	SRSFR310
A3CR452	152-0655-00	B085104		SEMICOND DEVICE:SILICON,100V,3A	03508	A115AX39
A3CR501	152-0400-00			SEMICOND DEVICE:SILICON,400V,1A	80009	152-0400-00
A3CR502	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A3CR503	152-0400-00			SEMICOND DEVICE:SILICON,400V,1A	80009	152-0400-00
A3F343	159-0059-00	B070000		FUSE,WIRE LEAD:5A,FAST-BLOW	000HX	SPI-5A
A3F351	159-0141-00	B010100	B057249	FUSE,WIRE LEAD:1.5A,125V,0.1 SEC	71400	GLX 1 1/2
A3F351	159-0153-00	B057250		FUSE,WIRE LEAD:1.5A,125V,FAST BLOW	71400	GFA 1-1/2

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A3F352	159-0141-00	B010100	B057249	FUSE,WIRE LEAD:1.5A,125V,0.1 SEC	71400	GLX 1 1/2
A3F352	159-0153-00	B057250		FUSE,WIRE LEAD:1.5A,125V,FAST BLOW	71400	GFA 1-1/2
A3F431	159-0141-00	B010100	B057249	FUSE,WIRE LEAD:1.5A,125V,0.1 SEC	71400	GLX 1 1/2
A3F431	159-0153-00	B057250		FUSE,WIRE LEAD:1.5A,125V,FAST BLOW	71400	GFA 1-1/2
A3F551	159-0090-00			FUSE,CARTRIDGE:0.25A,125V,FAST-BLOW	71400	GFA 1/4
A3L131	108-0240-00			COIL,RF:FIXED,820UH	76493	B5147
A3L251	108-0841-00			COIL ASSY,RF:FXD,2 70MH TOROIDAL INDCTR	80009	108-0841-00
A3L252	108-0842-00			COIL,RF:FIXED,121UH,PDT CORE	80009	108-0842-00
A3L531	108-0840-00			COIL ASSY,RF:FXD,2 500UH INDCTR,POT CORE	80009	108-0840-00
A3Q51	151-0335-00			TRANSISTOR:SILICON,PNP	04713	SJE917
A3Q151	151-0521-00			SCR:SI,MU-27	03508	C122B
A3Q201	151-1025-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	01295	SFB8129
A3Q301	151-0426-00	B010100	B042844	TRANSISTOR:SILICON,NPN	03508	X44H242
A3Q301	151-0426-02	B042845	B069999	TRANSISTOR:SILICON,NPN,SEL FROM 044H24	80009	151-0426-02
A3Q301	151-0426-01	B070000		TRANSISTOR:SILICON,NPN,SEL FROM D44H11	03508	X44H298
A3Q401	151-0426-00	B010100	B042844	TRANSISTOR:SILICON,NPN	03508	X44H242
A3Q401	151-0426-02	B042845	B069999	TRANSISTOR:SILICON,NPN,SEL FROM 044H24	80009	151-0426-02
A3Q401	151-0426-01	B070000		TRANSISTOR:SILICON,NPN,SEL FROM D44H11	03508	X44H298
A3Q402	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
A3Q403	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A3Q404	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A3Q451	151-0335-00			TRANSISTOR:SILICON,PNP	04713	SJE917
A3Q452	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A3Q501	151-0465-00			TRANSISTOR:SILICON,PNP	80009	151-0465-00
A3Q601	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
A3Q651	151-0334-00			TRANSISTOR:SILICON,NPN	04713	SJE914
A3R51	321-0240-00			RES.,FXD,FILM:3.09K OHM,1%,0.125W	91637	MFF1816G30900F
A3R52	321-0242-00			RES.,FXD,FILM:3.24K OHM,1%,0.125W	91637	MFF1816G32400F
A3R53	311-1224-00			RES.,VAR,NONWIR:500 OHM,20%,0.50W	32997	3386F-T04-501
A3R101	321-0266-00			RES.,FXD,FILM:5.76K OHM,1%,0.125W	91637	MFF1816G57600F
A3R102	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
A3R132	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
A3R133	321-0242-00			RES.,FXD,FILM:3.24K OHM,1%,0.125W	91637	MFF1816G32400F
A3R151	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
A3R152	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
A3R201	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
A3R202	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
A3R203	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
A3R204	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
A3R205	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
A3R207	315-0914-00			RES.,FXD,CMPSN:910K OHM,5%,0.25W	01121	CB9145
A3R231	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
A3R232	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
A3R233	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
A3R234	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
A3R235	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
A3R236	176-0252-01			RESISTANCE WIRE:0.0625 X 0.004,CUT 12.0 L	80009	176-0252-01
A3R300	321-0268-00			RES.,FXD,FILM:6.04K OHM,1%,0.125W	91637	MFF1816G60400F
A3R301	321-0369-00			RES.,FXD,FILM:68.1K OHM,1%,0.125W	91637	MFF1816G68101F
A3R302	321-0242-00			RES.,FXD,FILM:3.24K OHM,1%,0.125W	91637	MFF1816G32400F
A3R303	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
A3R304	307-0108-00	B010100	B031924	RES.,FXD,CMPSN:6.8 OHM,5%,0.25W	01121	CB68G5
A3R304	307-0589-00	B031925		RES.,FXD,CMPSN:6.8 OHM,5%,0.25W	19701	145P6R8T
A3R331	321-0110-00			RES.,FXD,FILM:137 OHM,1%,0.125W	91637	MFF1816G137R0F

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A3R332	321-0297-00			RES.,FXD,FILM:12.1K OHM,1%,0.125W	91637	MFF1816G12101F
A3R400	301-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.50W	01121	EB4705
A3R401	307-0108-00	B010100	B031924	RES.,FXD,CMPSN:6.8 OHM,5%,0.25W	01121	CB68G5
A3R401	307-0589-00	B031925		RES.,FXD,CMPSN:6.8 OHM,5%,0.25W	19701	145P6R8T
A3R402	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
A3R403	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
A3R404	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
A3R405	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
A3R406	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
A3R407	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
A3R408	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
A3R409	315-0150-00	B031925		RES.,FXD,CMPSN:15 OHM,5%,0.25W	01121	CB1505
A3R452	321-0297-00			RES.,FXD,FILM:12.1K OHM,1%,0.125W	91637	MFF1816G12101F
A3R453	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
A3R502	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
A3R503	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
A3R551	321-0297-00			RES.,FXD,FILM:12.1K OHM,1%,0.125W	91637	MFF1816G12101F
A3R552	321-0303-00			RES.,FXD,FILM:14K OHM,1%,0.125W	91637	MFF1816G14001F
A3R553	321-0297-00			RES.,FXD,FILM:12.1K OHM,1%,0.125W	91637	MFF1816G12101F
A3R651	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
A3T301	120-1040-00			TRANSFORMER,RF:BASE DRIVE,POT CORE	80009	120-1040-00
A3T331	120-1041-00			XFMR,PWR,FXD AU:STPDN,POT CORE	80009	120-1041-00
A3U151	156-0053-00			MICROCIRCUIT,LI:VOLTAGE REGULATOR	07263	SL21721
A3U201	156-0411-00			MICROCIRCUIT,LI:QUAD-COMP,SGL SUPPLY	27014	LM339N
A3U501	156-0349-00			MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE	27014	CD4001CJ
A3U551	156-0158-00			MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458N
A3U601	156-0366-02			MICROCIRCUIT,DI:DUAL D FLIP-FLOP,CHK	80009	156-0366-02
A3VR151	152-0175-00			SEMICOND DEVICE:ZENER,0.4W,5.6V,5%	04713	SZG35008
A3VR453	152-0175-00			SEMICOND DEVICE:ZENER,0.4W,5.6V,5%	04713	SZG35008
A3VR551	152-0175-00			SEMICOND DEVICE:ZENER,0.4W,5.6V,5%	04713	SZG35008

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				A4 FIRMWARE PATCH ASSEMBLY		
A4	670-5120-00	B030000	B039999	CKT BOARD ASSY:FIRMWARE PATCH	80009	670-5120-00
A4C52	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	56289	273C11
A4C124	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	56289	273C11
A4J41	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
A4J41	----- -----			(QUANTITY OF 34)		
A4J51	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
A4J51	----- -----			(QUANTITY OF 34)		
A4J105	131-0589-00			TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
A4J105	----- -----			(QUANTITY OF 4)		
A4U10	156-0530-02			MICROCIRCUIT,DI:QUAD 2-INP MUX,SCRN	01295	SN74LS157P3
A4U22	156-0530-02			MICROCIRCUIT,DI:QUAD 2-INP MUX,SCRN	01295	SN74LS157P3
A4U30	156-0381-02			MICROCIRCUIT,DI:QUAD 2-INP EXCL OR GATE	01295	SN74LS86
A4U40	156-0469-02			MICROCIRCUIT,DI:3/8 LINE DCDR	01295	SN74LS138NP3
A4U115	156-0973-01			MICROCIRCUIT,DI:1024 X 8 PROM	80009	156-0973-01
A4U133	156-0940-01			MICROCIRCUIT,DI:FPLA,PROGRAMMED	80009	156-0940-01

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				A5 SYSTEM MEMORY ASSEMBLY		
A5	670-7176-00	B070000	B076308	CKT BOARD ASSY:SYSTEM MEMORY	80009	670-7176-00
A5	670-7176-01	B076309		CKT BOARD ASSY:SYSTEM MEMORY	80009	670-7176-01
A5C161	283-0421-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	04222	DG015E104Z
A5C341	283-0421-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	04222	DG015E104Z
A5C361	283-0421-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	04222	DG015E104Z
A5C371	283-0421-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	04222	DG015E104Z
A5C419	283-0421-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	04222	DG015E104Z
A5C462	285-1189-00			CAP.,FXD,MTLZD:0.1UF,5%,100V	56699	719A1CA104PJ101S
A5C463	283-0421-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	04222	DG015E104Z
A5C464	290-0770-00			CAP.,FXD,ELCTLT:100UF,+50-10%,25V	56289	502D230
A5J41	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
A5J41	----- -----			(QUANTITY OF 34)		
A5J51	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
A5J51	----- -----			(QUANTITY OF 34)		
A5J105	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
A5J105	----- -----			(QUANTITY OF 8)		
A5J106	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
A5J106	----- -----			(QUANTITY OF 4)		
A5J190	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
A5J190	----- -----			(QUANTITY OF 20)		
A5J241	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
A5J241	----- -----			(QUANTITY OF 3)		
A5J242	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
A5J242	----- -----			(QUANTITY OF 3)		
A5J244	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
A5J244	----- -----			(QUANTITY OF 3)		
A5J391	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
A5J391	----- -----			(QUANTITY OF 3)		
A5R341	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
A5R461	321-0371-00			RES.,FXD,FILM:71.5K OHM,1%,0.125W	91637	MFF1816G71501F
A5U141	160-1349-00	B010100	B076308	MICROCIRCUIT,DI:4096 X 8 EPROM,PRGM	80009	160-1349-00
A5U141	160-1349-01	B076309		MICROCIRCUIT,DI:4096 X 8 EPROM,PRGM	80009	160-1349-01
A5U151	160-1347-00	B010100	B076308	MICROCIRCUIT,DI:4096 X 8 EPROM,PRGM	80009	160-1349-00
A5U151	160-1347-01	B076309		MICROCIRCUIT,DI:4096 X 8 EPROM,PRGM	80009	160-1347-01
A5U161	160-1348-00			MICROCIRCUIT,DI:4096 X 8 EPROM,PRGM	80009	160-1348-00
A5U171	160-1350-00	B010100	B076308	MICROCIRCUIT,DI:4096 X 8 EPROM,PRGM	80009	160-1350-00
A5U171	160-1350-01	B076309		MICROCIRCUIT,DI:4096 X 8 EPROM,PRGM	80009	160-1350-01
A5U341	156-0469-02			MICROCIRCUIT,DI:3/8 LINE DCDR	01295	SN74LS138NP3
A5U345	156-0480-02			MICROCIRCUIT,DI:QUAD 2 INP & GATE	01295	SN74LS08NP3
A5U371	156-0427-04			MICROCIRCUIT,DI:PERIPHERAL INTERFACE ADPTR	80009	156-0427-04
A5U461	156-0402-02			MICROCIRCUIT,LI:TIMER,CHK	27014	LM555CN/A+

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				A6 PEN TURRET DRIVE ASSEMBLY		
A6	672-0985-00	B010100	B074799	CKT BOARD ASSY:PEN TURRET DRIVE	80009	672-0985-00
A6	672-0985-01	B074800		CKT BOARD ASSY:PEN TURRET DRIVE	80009	672-0985-01
A6	----- -----			(OPTION 31 ONLY)		
A6	670-7175-XX			CKT BOARD ASSY:PEN TURRET DRIVE		
A6	----- -----			(NOT REPLACEABLE SEE 672-0985-00)		
A6C5	290-0830-00	B010100	B074799	CAP.,FXD,ELCTLT:10 UF,5%,20V	56289	150D106X5020B2
A6C5	290-0983-00	B074800		CAP.,FXD,ELCTLT:4.7UF,5%,10VDC	56289	150D475X5010A2
A6C10	283-0421-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	04222	DG015E104Z
A6C25	290-0830-00	B010100	B074799	CAP.,FXD,ELCTLT:10 UF,5%,20V	56289	150D106X5020B2
A6C25	290-0983-00	B074800		CAP.,FXD,ELCTLT:4.7UF,5%,10VDC	56289	150D475X5010A2
A6C40	283-0421-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	04222	DG015E104Z
A6C130	283-0421-00			CAP.,FXD,CER DI:0.1UF,+80-20%,50V	04222	DG015E104Z
A6C140	290-0770-00			CAP.,FXD,ELCTLT:100UF,+50-10%,25V	56289	502D230
A6C145	290-0770-00			CAP.,FXD,ELCTLT:100UF,+50-10%,25V	56289	502D230
A6C188	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	56289	2C20Z5U105Z025B
A6C270	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	56289	2C20Z5U105Z025B
A6C287	283-0005-00			CAP.,FXD,CER DI:0.01UF,+100-0%,250V	72982	8131N300Z5U0103P
A6C292	290-0770-00			CAP.,FXD,ELCTLT:100UF,+50-10%,25V	56289	502D230
A6CR252	152-0414-00			SEMICOND DEVICE:SILICON,200V,0.75A	12969	UTR308
A6CR260	152-0414-00			SEMICOND DEVICE:SILICON,200V,0.75A	12969	UTR308
A6CR280	152-0414-00			SEMICOND DEVICE:SILICON,200V,0.75A	12969	UTR308
A6CR281	152-0414-00			SEMICOND DEVICE:SILICON,200V,0.75A	12969	UTR308
A6DS101	150-1033-00			LT EMITTING DIO:YELLOW,585NM,40MA MAX	50434	HLMP 1401
A6DS108	150-1061-00			LT EMITTING DIO:RED,660NM,50MA MAX	50434	HLMP-1301
A6J95	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
A6J95	----- -----			(QUANTITY OF 3)		
A6J190	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
A6J190	----- -----			(QUANTITY OF 20)		
A6J231	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
A6J231	----- -----			(QUANTITY OF 2)		
A6J242	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
A6J242	----- -----			(QUANTITY OF 2)		
A6J253	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
A6J253	----- -----			(QUANTITY OF 2)		
A6J274	131-0608-00			TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
A6J274	----- -----			(QUANTITY OF 4)		
A6Q88	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
A6Q160	156-1569-00			MICROCIRCUIT,DI:QUAD TRANSISTOR ARRAY	04713	MPQ3467
A6Q180	156-1569-00			MICROCIRCUIT,DI:QUAD TRANSISTOR ARRAY	04713	MPQ3467
A6R3	321-0242-00	B010100	B074799	RES.,FXD,FILM:3.24K OHM,1%,0.125W	91637	MFF1816G32400F
A6R3	321-0638-00	B074800		RES.,FXD,FILM:7.96K OHM,1%,0.125W	24546	NA55D7961F
A6R4	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A6R20	321-0242-00	B010100	B074799	RES.,FXD,FILM:3.24K OHM,1%,0.125W	91637	MFF1816G32400F
A6R20	321-0638-00	B074800		RES.,FXD,FILM:7.96K OHM,1%,0.125W	24546	NA55D7961F
A6R53	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A6R54	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A6R61	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A6R62	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A6R63	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
A6R64	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
A6R74	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A6R75	315-0181-00			RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
A6R77	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A6R78	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A6R85	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A6R86	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A6R87	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
A6R88	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
A6R89	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A6R90	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
A6R91	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
A6R102	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
A6R104	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
A6R106	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
A6R108	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
A6R110	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
A6R156	301-0361-00			RES.,FXD,CMPSN:360 OHM,5%,0.50W	01121	EB3615
A6R162	301-0361-00			RES.,FXD,CMPSN:360 OHM,5%,0.50W	01121	EB3615
A6R178	301-0361-00			RES.,FXD,CMPSN:360 OHM,5%,0.50W	01121	EB3615
A6R183	301-0361-00			RES.,FXD,CMPSN:360 OHM,5%,0.50W	01121	EB3615
A6R187	308-0793-00			RES.,FXD,WW:0.51 OHM,5%,0.50W	75042	BW20 .51 OHM 5%
A6R189	308-0685-00			RES.,FXD,WW:1.5 OHM,5%,1W	75042	BW20-1R500J
A6SW15	260-2077-00			SWITCH,PUSH:8 BUTTON,2 POLE,PLOTTER	80009	260-2077-00
A6SW25	260-2077-00			SWITCH,PUSH:8 BUTTON,2 POLE,PLOTTER	80009	260-2077-00
A6SW35	260-2077-00			SWITCH,PUSH:8 BUTTON,2 POLE,PLOTTER	80009	260-2077-00
A6SW45	260-2077-00			SWITCH,PUSH:8 BUTTON,2 POLE,PLOTTER	80009	260-2077-00
A6SW55	260-2077-00			SWITCH,PUSH:8 BUTTON,2 POLE,PLOTTER	80009	260-2077-00
A6SW65	260-2077-00			SWITCH,PUSH:8 BUTTON,2 POLE,PLOTTER	80009	260-2077-00
A6SW75	260-2077-00			SWITCH,PUSH:8 BUTTON,2 POLE,PLOTTER	80009	260-2077-00
A6SW85	260-2077-00			SWITCH,PUSH:8 BUTTON,2 POLE,PLOTTER	80009	260-2077-00
A6U10	156-0405-03			MICROCIRCUIT,DI:DUAL RETRIG MONOSTABLE MV	07263	9602
A6U30	156-0798-02			MICROCIRCUIT,DI:DUAL 14 TO 1 LINE SEL/MUX	01295	SN74LS153
A6U40	156-0798-02			MICROCIRCUIT,DI:DUAL 14 TO 1 LINE SEL/MUX	01295	SN74LS153
A6U50	156-0541-02			MICROCIRCUIT,DI:DUAL 2 TO 4 LINE DCDR	01295	SN74LS139NP3
A6U60	156-1080-01			MICROCIRCUIT,DI:HEX BUFFERS U/OC HV	27014	DM7407
A6U80	156-1080-01			MICROCIRCUIT,DI:HEX BUFFERS U/OC HV	27014	DM7407
A6U130	156-0645-02			MICROCIRCUIT,DI:HEX INV ST NAND GATES,SCRN	01295	SN74LS14
A6U150	156-1587-00			MICROCIRCUIT,DI:TTL,DUAL PERIPHERAL NAND DR	01295	SN75402
A6U170	156-1587-00			MICROCIRCUIT,DI:TTL,DUAL PERIPHERAL NAND DR	01295	SN75402
A6VR95	156-1631-00			MICROCIRCUIT,LI:ADJ SHUNT REGULATOR	01295	TL431C-LP
A6VR253	152-0405-00			SEMICOND DEVICE:ZENER,1W,15V,5%	80009	152-0405-00
A6VR261	152-0405-00			SEMICOND DEVICE:ZENER,1W,15V,5%	80009	152-0405-00
A6VR282	152-0405-00			SEMICOND DEVICE:ZENER,1W,15V,5%	80009	152-0405-00
A6VR283	152-0405-00			SEMICOND DEVICE:ZENER,1W,15V,5%	80009	152-0405-00

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				CHASSIS PARTS		
B1003	147-0040-02			MOTOR,DC:1.8 DEG STEP ANGLE,200 STEP	78277	20-2223D-24173
B1005	147-0040-02			MOTOR,DC:1.8 DEG STEP ANGLE,200 STEP	78277	20-2223D-24173
CR1	150-1001-00			LT EMITTING DIO:RED,660NM,100MA MAX	50522	MV5024
CR10	150-1001-00			LT EMITTING DIO:RED,660NM,100MA MAX	50522	MV5024
CR15	150-1001-00			LT EMITTING DIO:RED,660NM,100MA MAX	50522	MV5024
F1001	159-0019-00			FUSE,CARTRIDGE:3AG,1A,250V,SLOW BLOW	71400	MDL1
F1001	159-0032-00			FUSE,CARTRIDGE:3AG,0.5A,250V,SLOW-BLOW	71400	MDL 1/2
F1001	----- -----			(OPTION A1,A2,A3,A4)		
FL1001	119-0389-00	B010100	B074589	FILTER,RAD INTE:115/230V,3A	02777	F11935-3
FL1001	119-1306-00	B074590		FILTER,RFI:6A,250V,50-400HZ	56289	6JX5431A
LS1001	119-0305-00			LOUDSPEAKER,PM:PERMANENT MAGNET,45 OHM,2W	07109	35A45C
L1005	119-0881-01			SOLENOID,ELEC:W/PINS & HOUSING	80009	119-0881-01
R1005						
R1007	119-0748-00			JOYSTICK:2 AXIS GIMBLE	80009	119-0748-00
S1001	260-1179-00			SWITCH,ROCKER:DPST,10A,250W,W/POSTS	15605	8931K162
S1001	----- -----			(S1001, OPTION 48 ONLY)		
S1003	260-1683-00			SWITCH,PUSH:SPDT,O.1A,125 VAC	01963	E63-10A
S1005	260-1309-00			SWITCH,SENS:SPDT,5A,250AC	01963	E63-10H
T1001	120-1039-00	B010100	B051614	XFMR,PWR,STPDN:	80009	120-1039-00
T1001	120-1039-01	B051615		XFMR,PWR,STPDN:	80009	120-1039-01

Section 7
SCHEMATICS

Symbols and Reference Designators

Electrical components shown on the diagrams are in the following units unless noted otherwise:

Capacitors = Values one or greater are in picofarads (pF).
Values less than one are in microfarads (μF).

Resistors = Ohms (Ω).

Graphic symbols and class designation letters are based on ANSI Standard Y32.2-1975.

Logic symbology is based on ANSI Y32.14-1973 in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

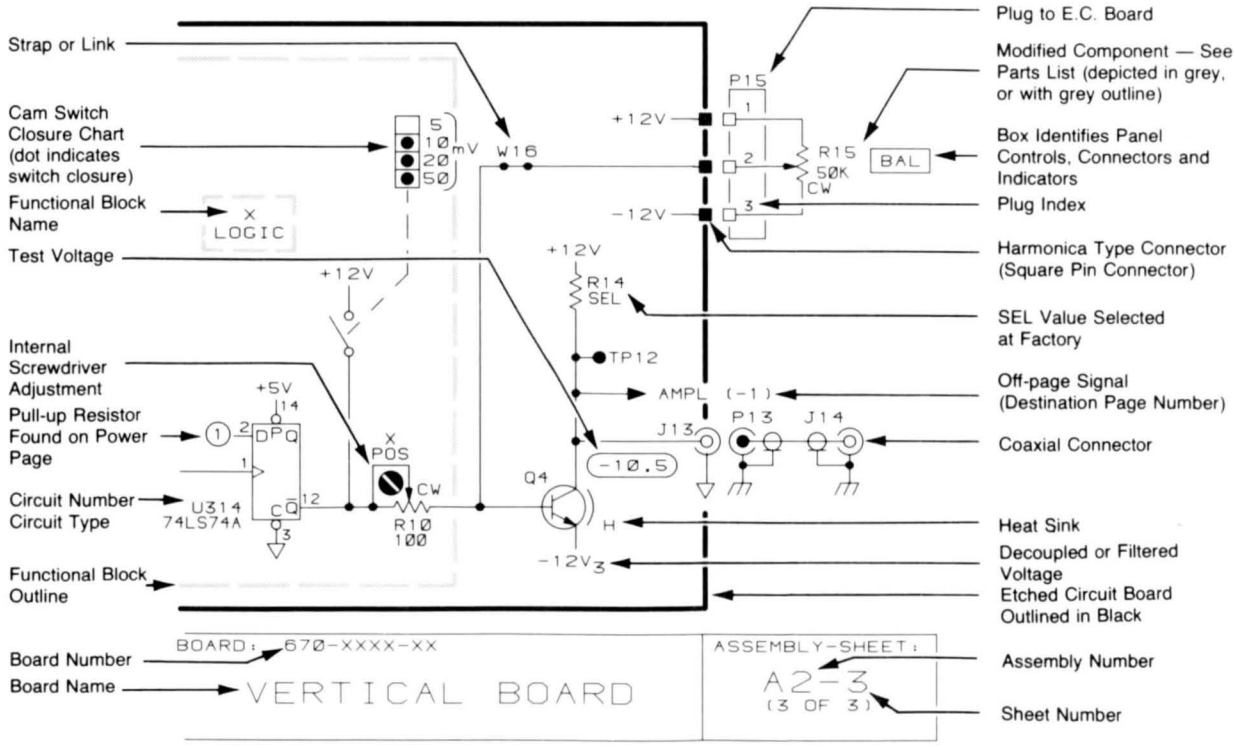
Abbreviations are based on ANSI Y1.1-1972. Other ANSI standards that are used in the preparation of diagrams by Tektronix, Inc., are:

Y14.15, 1966	Drafting Practices.
Y14.2, 1973	Line Conventions and Lettering.
Y10.5, 1968	Letter Symbols for Quantities Used in Electrical Science and Electrical Engineering.

The following prefix letters are used as reference designators to identify components or assemblies on the diagrams.

A	Assembly, separable or repairable (circuit board, etc.)	H	Heat dissipating device (heat sink, heat radiator, etc.)	S	Switch or contactor
AT	Attenuator, fixed or variable	HR	Heater	T	Transformer
B	Motor	HY	Hybrid circuit	TC	Thermocouple
BT	Battery	J	Connector, stationary portion	TP	Test point
C	Capacitor, fixed or variable	K	Relay	U	Assembly, inseparable or non-repairable (integrated circuit, etc.)
CB	Circuit breaker	L	Inductor, fixed or variable	V	Electron tube
CR	Diode, signal or rectifier	M	Meter	VR	Voltage regulator (zener diode, etc.)
DL	Delay line	P	Connector, movable portion	W	Wirestrap or cable
DS	Indicating device (lamp)	Q	Transistor or silicon-controlled rectifier	Y	Crystal
E	Spark Gap, Ferrite bead	R	Resistor, fixed or variable	Z	Phase shifter
F	Fuse	RT	Thermistor		
FL	Filter				

The following special symbols may appear on the diagrams:



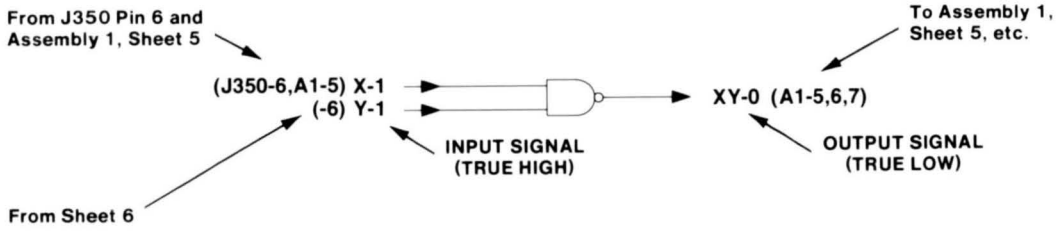
1. True High and True Low Signals

Signal names on the schematics are followed by -1 or a -0. A TRUE HIGH signal is indicated by -1, and a TRUE LOW signal is indicated by -0.

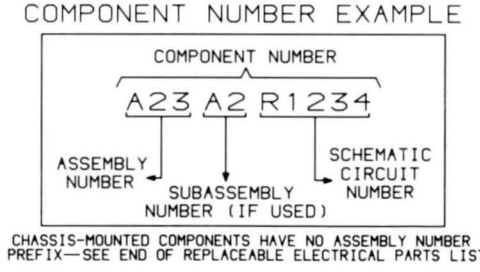
SIGNAL -1 = TRUE HIGH
SIGNAL -0 = TRUE LOW

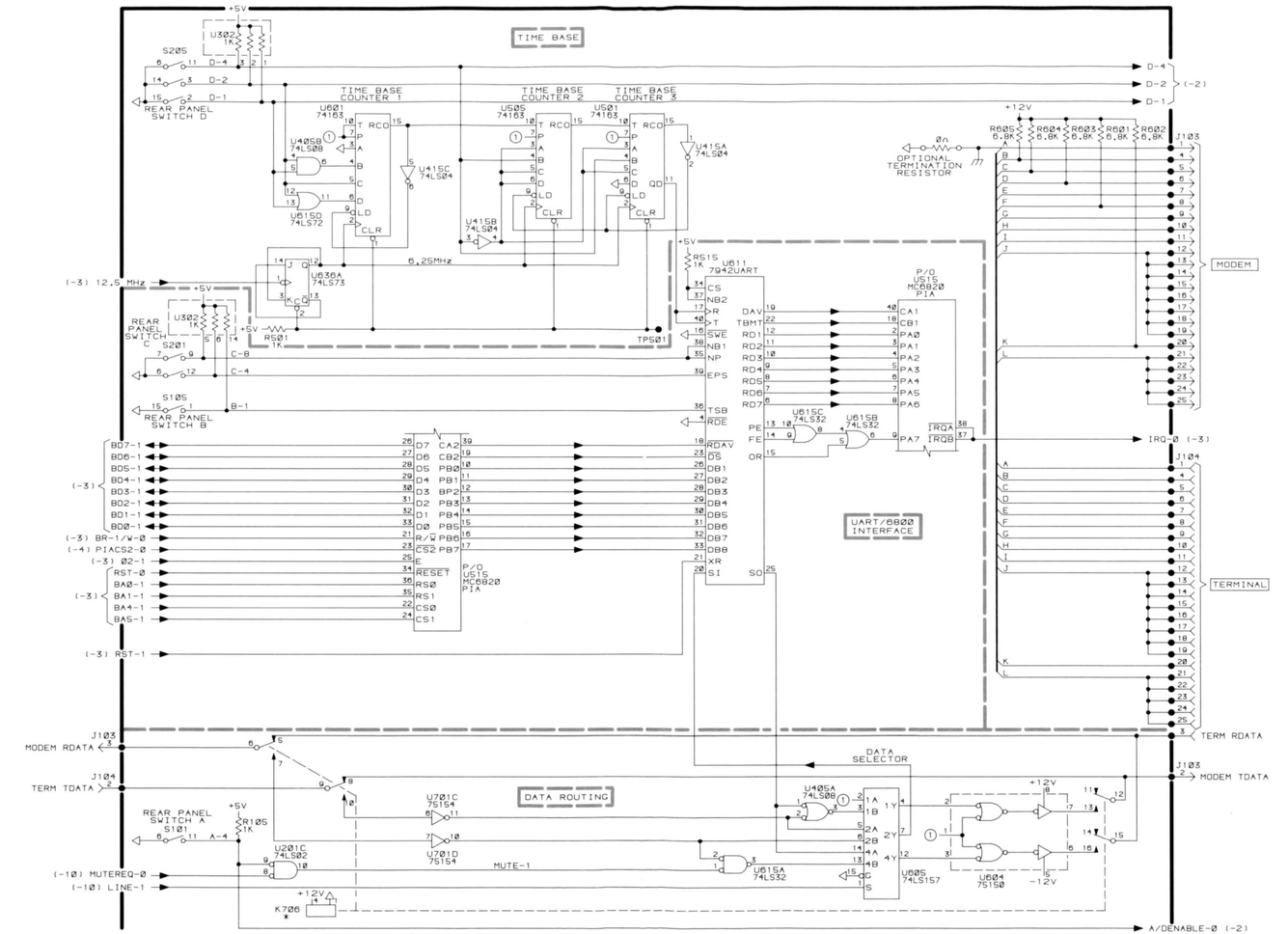
2. Cross-References

Schematic cross-references (from/to information) are included on the schematics. The "from" reference only indicates the signal "source," and the "to" reference lists all loads where the signal is used. All from/to information will be enclosed in parentheses.

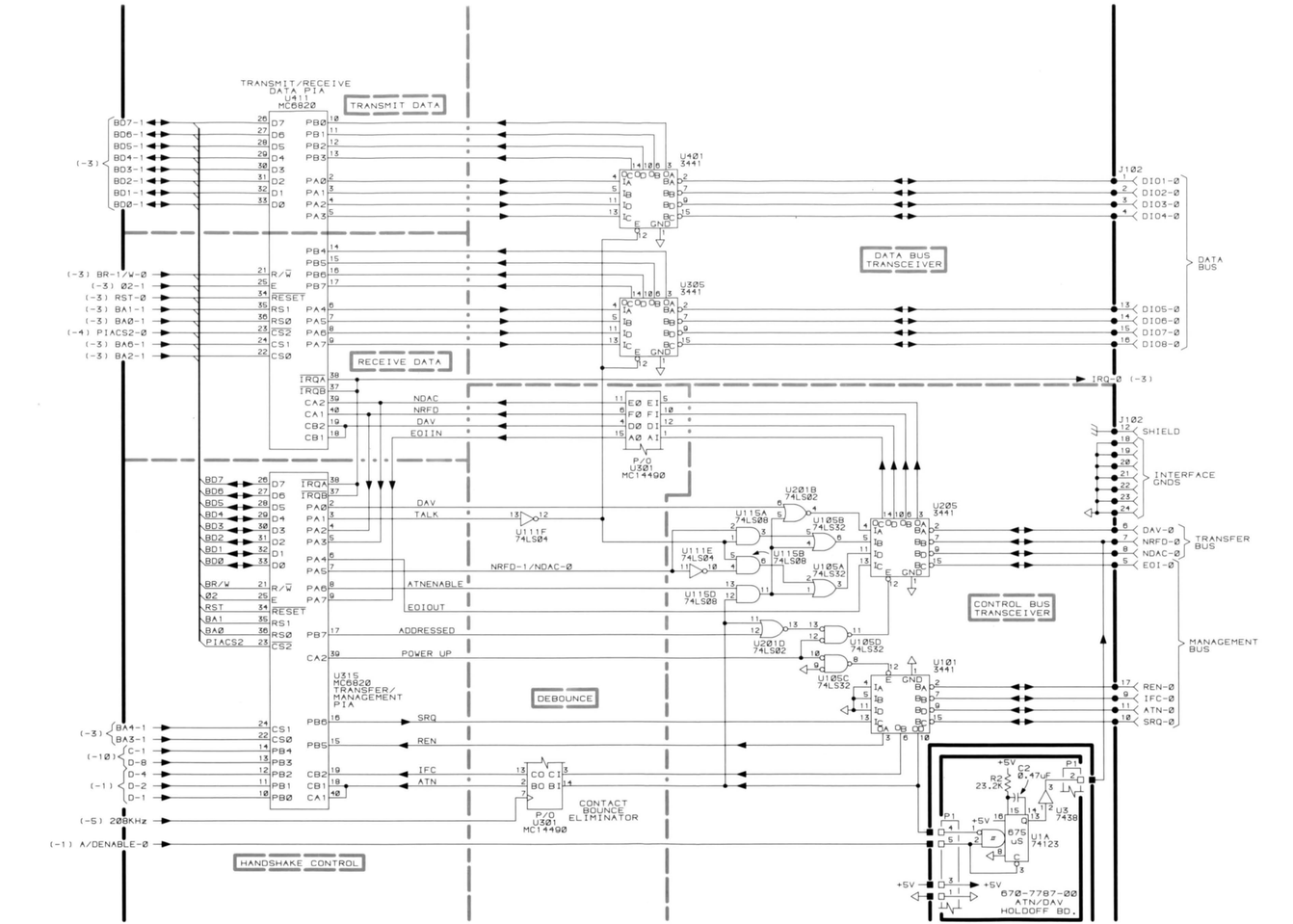


3. Component Number Example

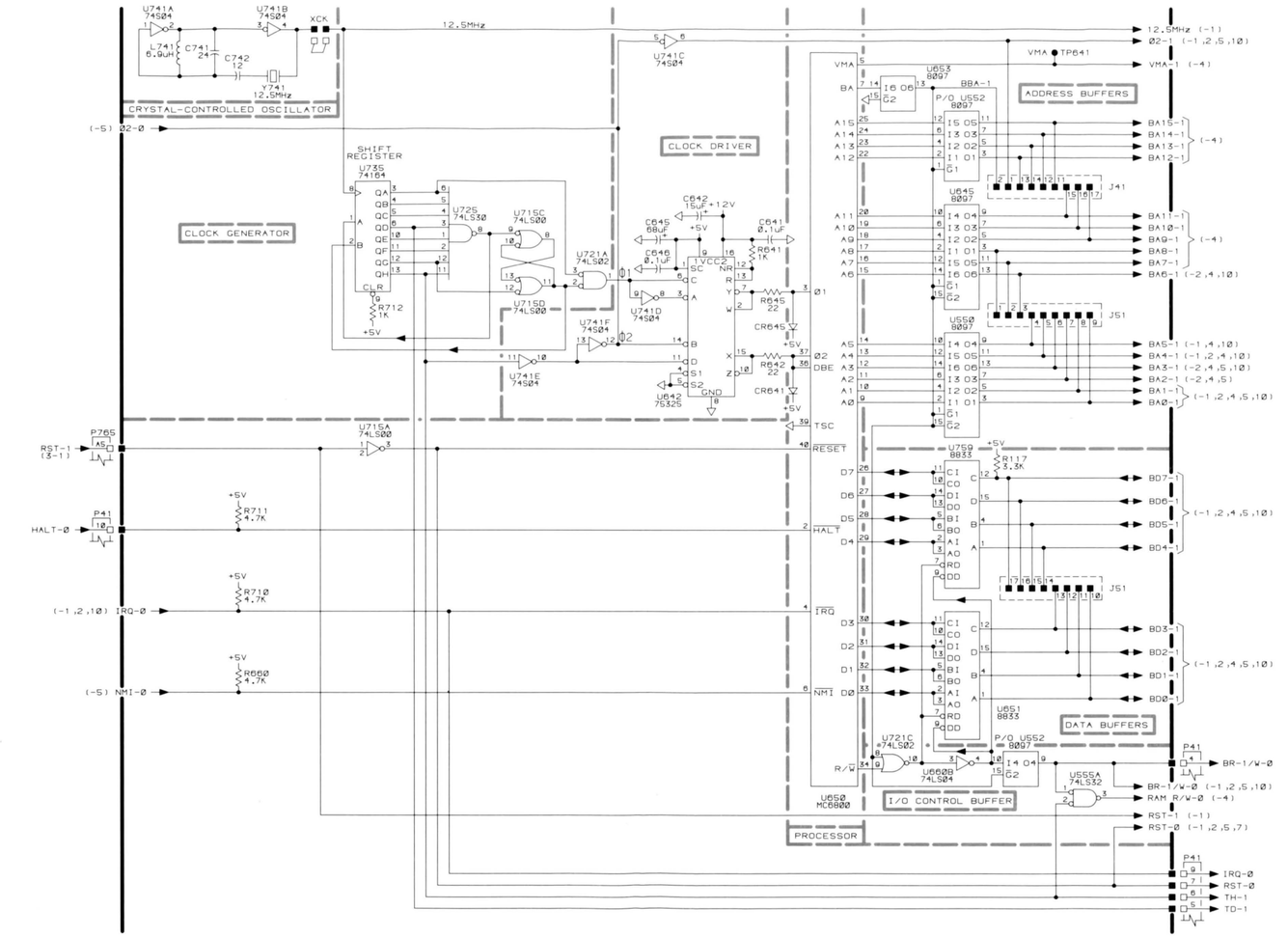




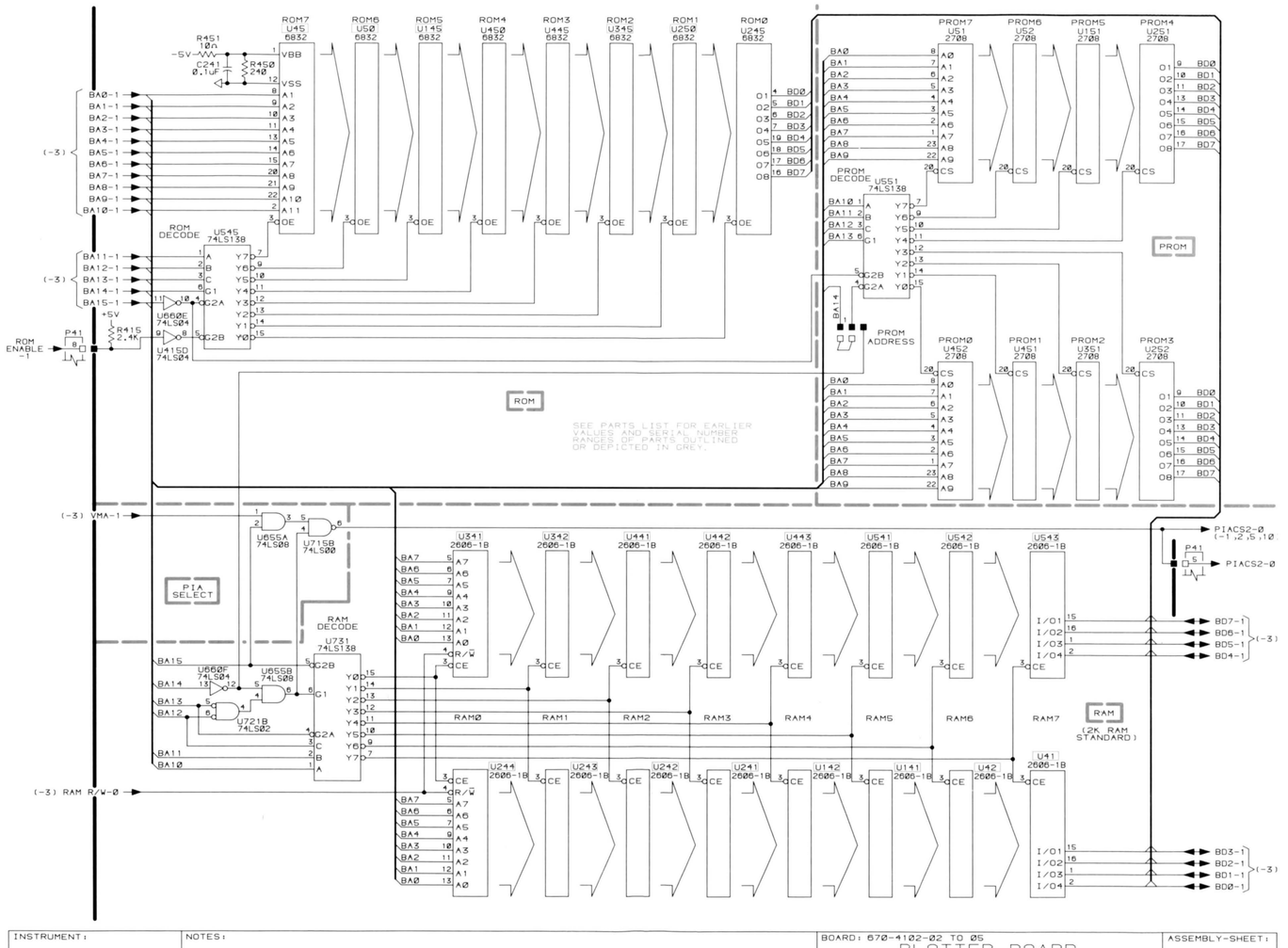
INSTRUMENT:	NOTES: * RELAY K706 SHOWN DE-ENERGIZED.	BOARD: 670-4102-02 & UP	ASSEMBLY-SHEET:
4662	REV. SEP 1982 1933-S1	PLOTTER BOARD RS-232-C INTERFACE	A1-1 (1 OF 12)



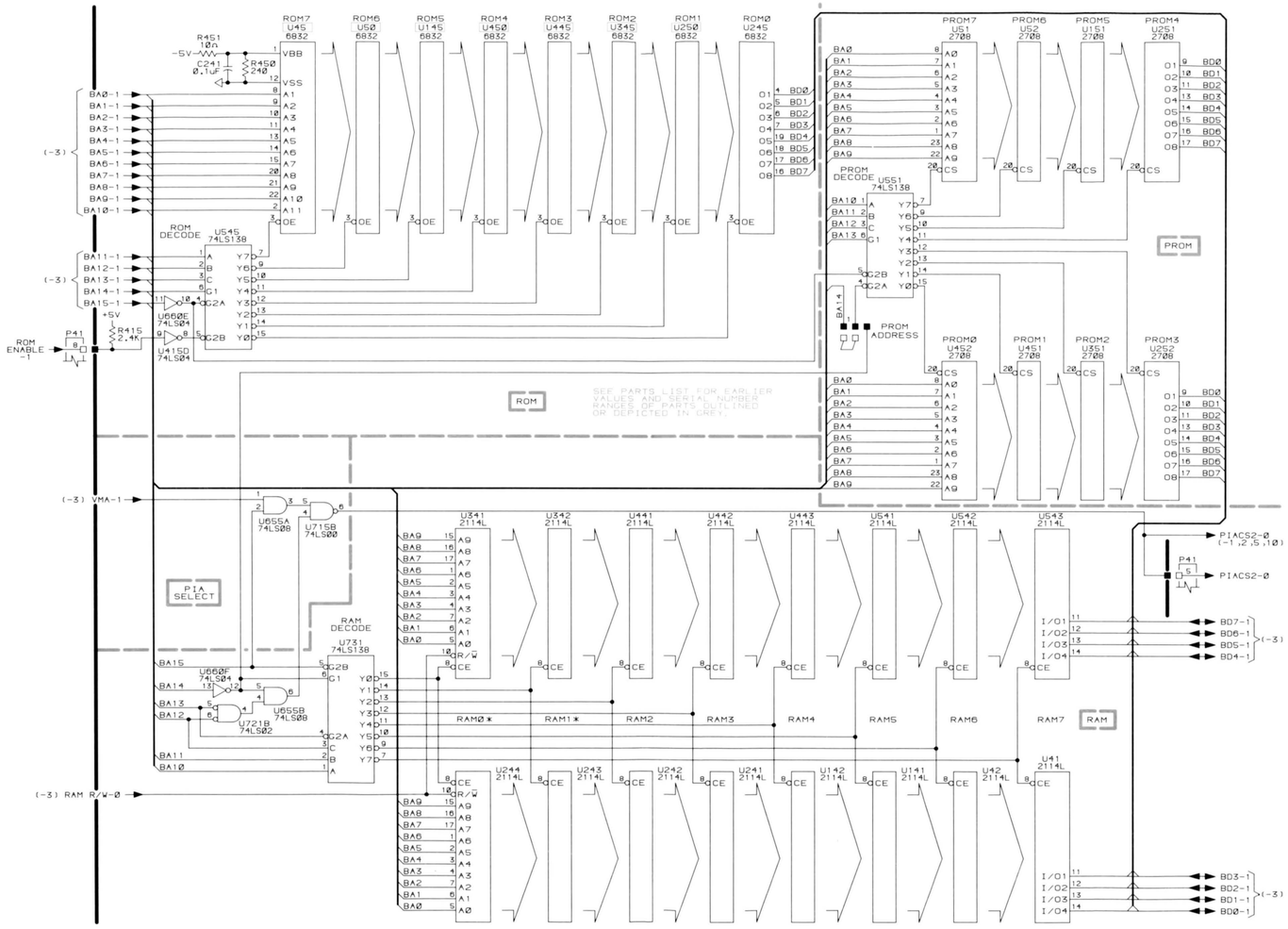
INSTRUMENT:	NOTES:	BOARD: 670-4102-02 & UP	ASSEMBLY-SHEET:
4662	REV, SEP 1982 1933-S2	PLOTTER BOARD GPIB INTERFACE	A1-2 (2 OF 12)



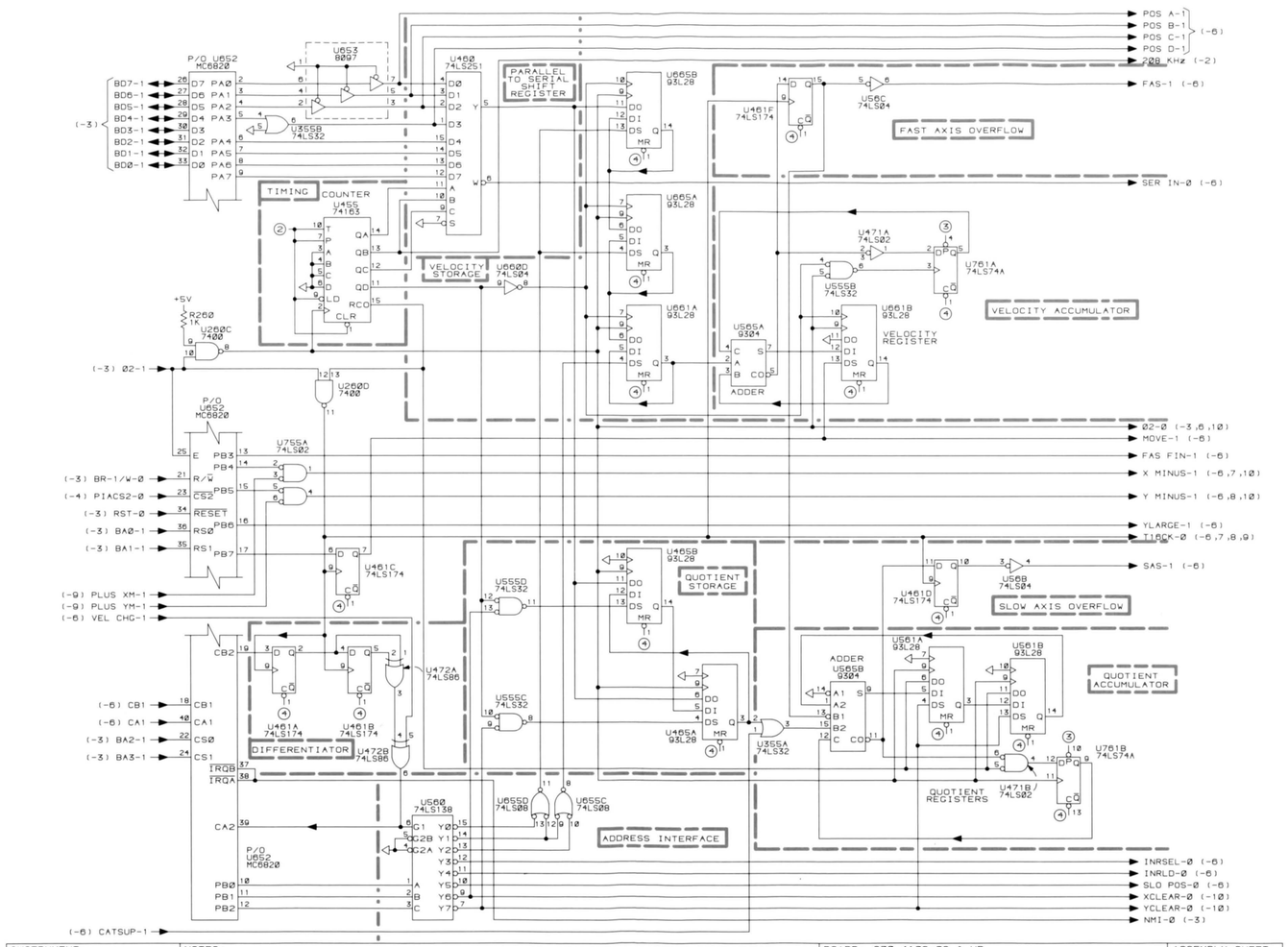
INSTRUMENT:	NOTES:	BOARD: 670-4102-00 & UP	ASSEMBLY-SHEET:
4662	REV, SEP 1982 1933-S3	PLOTTER BOARD PROCESSOR & CLOCK	A1-3 (3 OF 12)



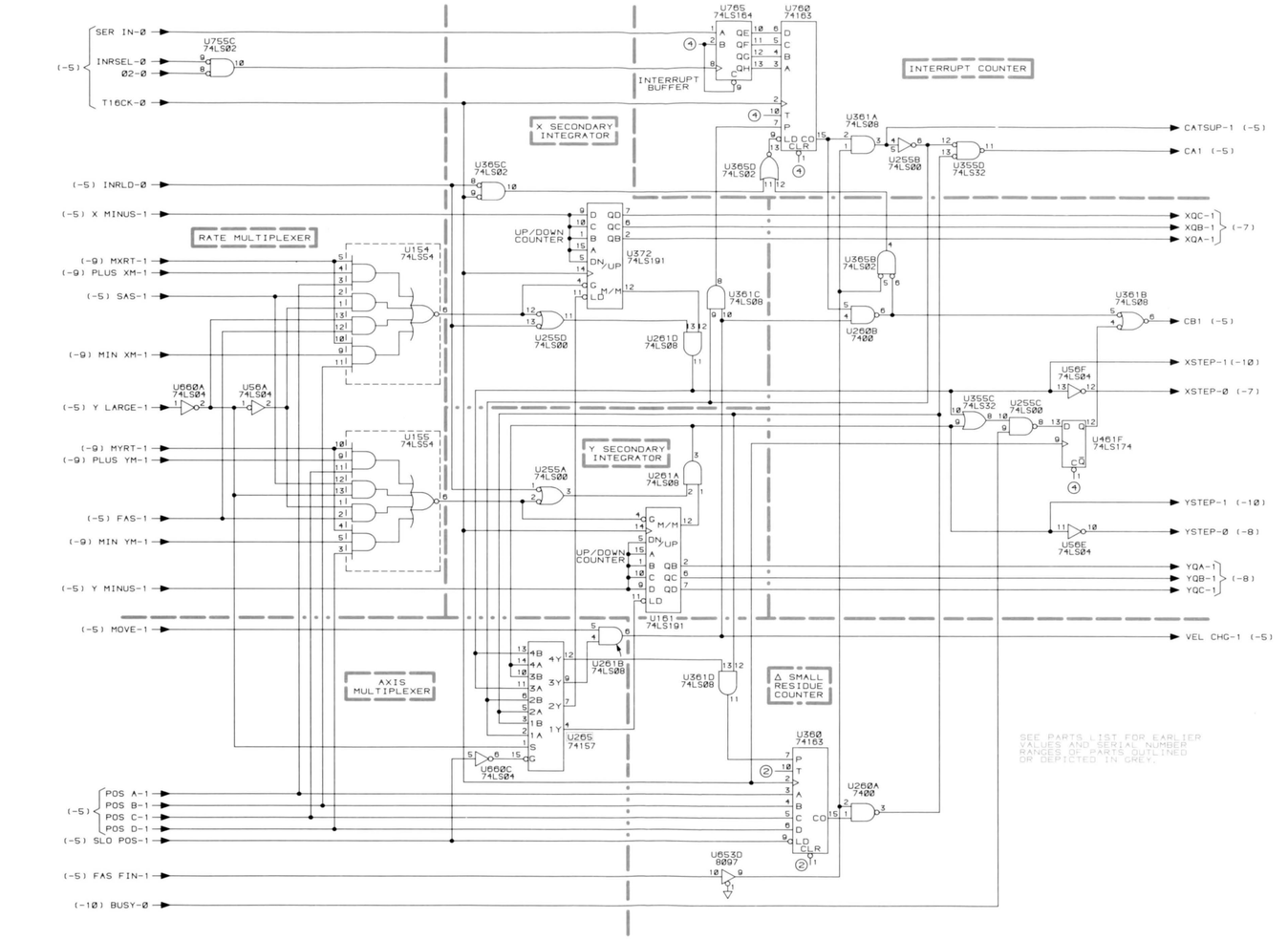
INSTRUMENT:	NOTES:	BOARD: 670-4102-02 TO Ø5	ASSEMBLY-SHEET:
4662	1933-S4	PLOTTER BOARD MEMORY	A1-4 (4 OF 12)



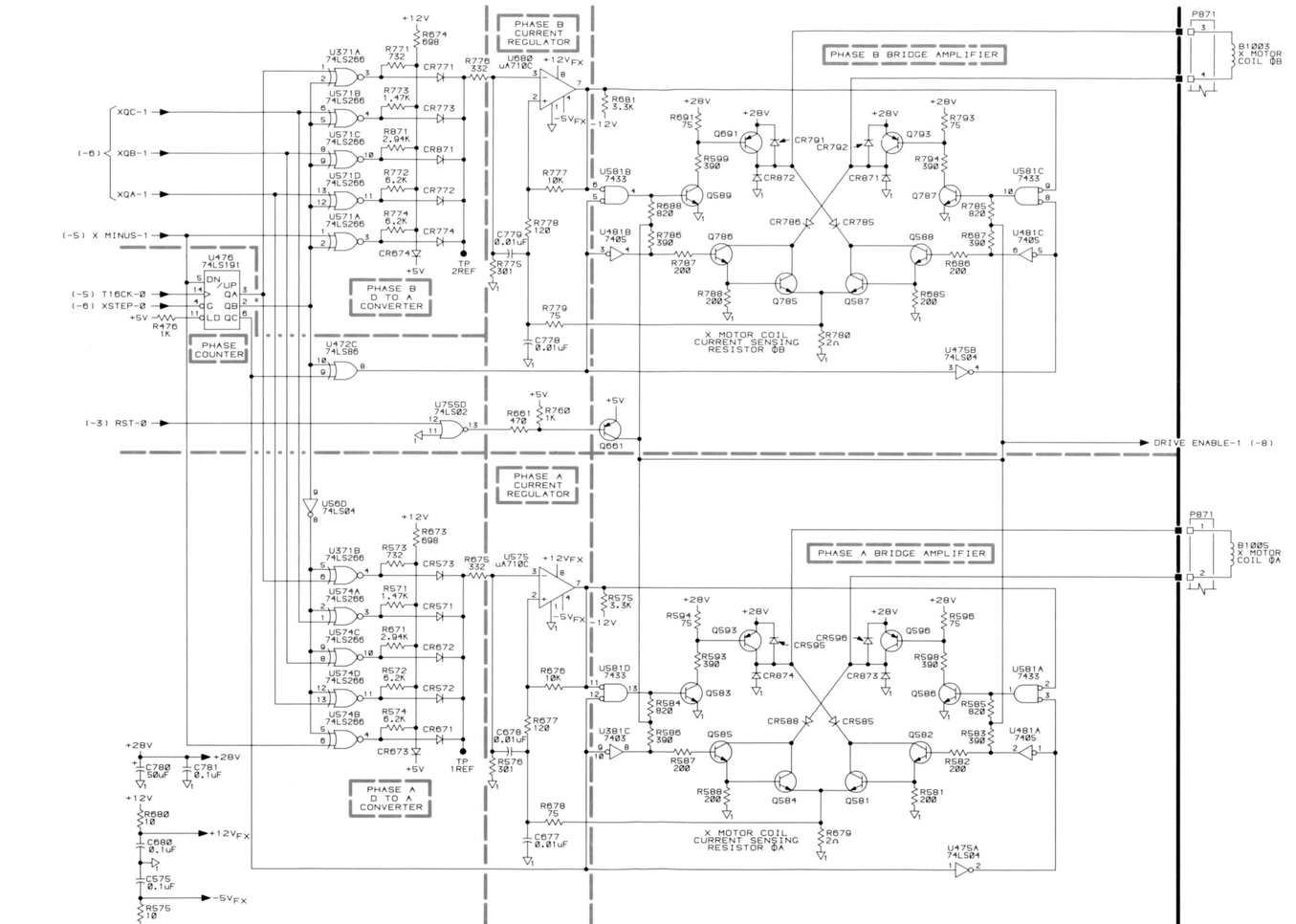
INSTRUMENT:	NOTES:	BOARD: 670-4102-06,07,08	ASSEMBLY-SHEET:
4662	*RAM0 & RAM1 ARE STANDARD 2K RAM INSTALLED RAM2 THRU RAM7 CONSTITUTE THE OPTIONAL 6K OF RAM AVAILABLE (OPTION 20) 1933-55	PLOTTER BOARD MEMORY	A1-4A (5 OF 12)



INSTRUMENT:	NOTES:	BOARD: 870-4102-02 & UP	ASSEMBLY-SHEET:
4662	REV, SEP 1982 1933-56	PLOTTER BOARD VECTOR GENERATOR 1	A1-5 (6 OF 12)

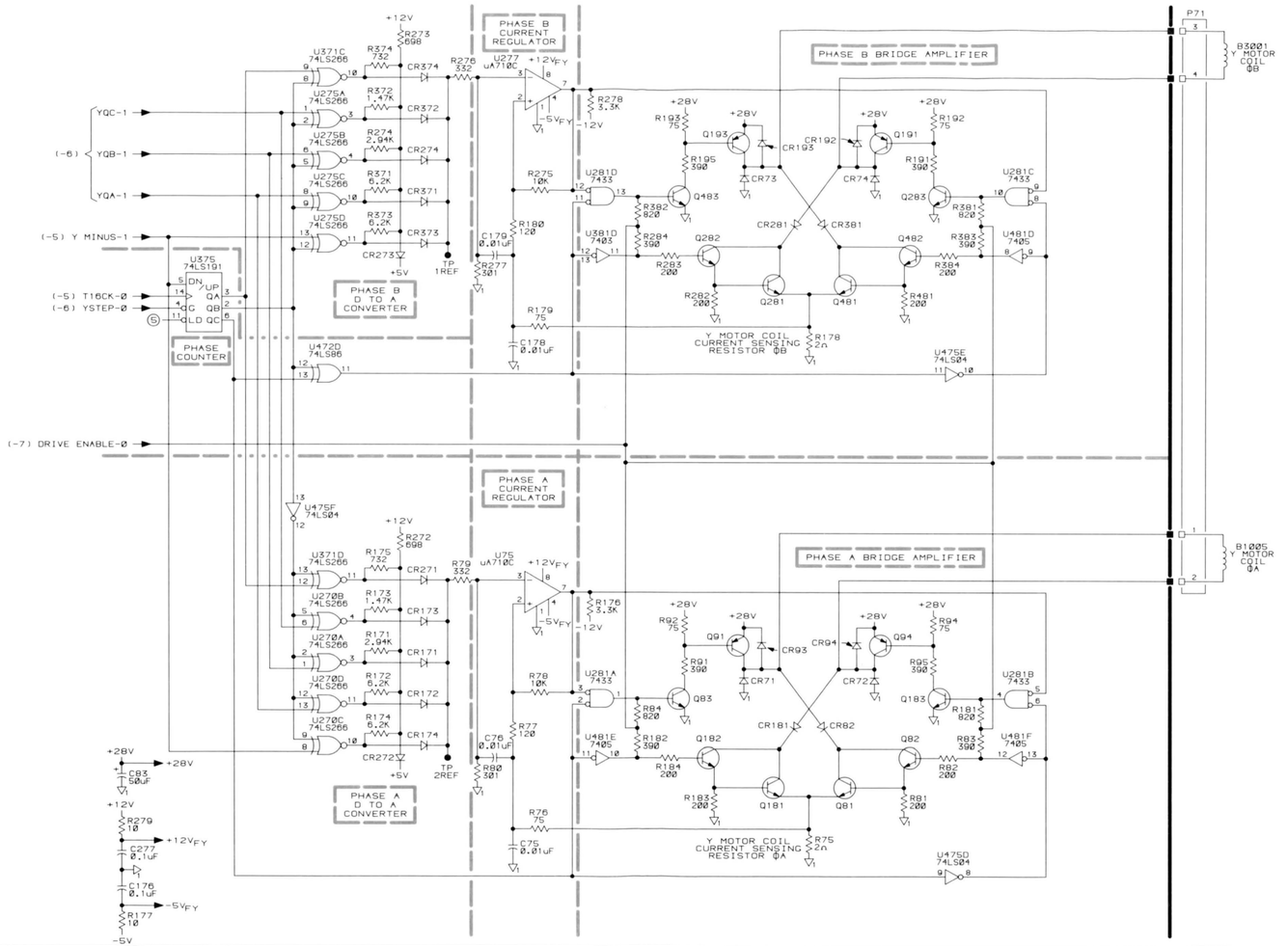


INSTRUMENT:	NOTES:	BOARD: 670-4102-02 & UP	ASSEMBLY-SHEET:
4662	1933-S7	PLOTTER BOARD VECTOR GENERATOR 2	A1-6 (7 OF 12)

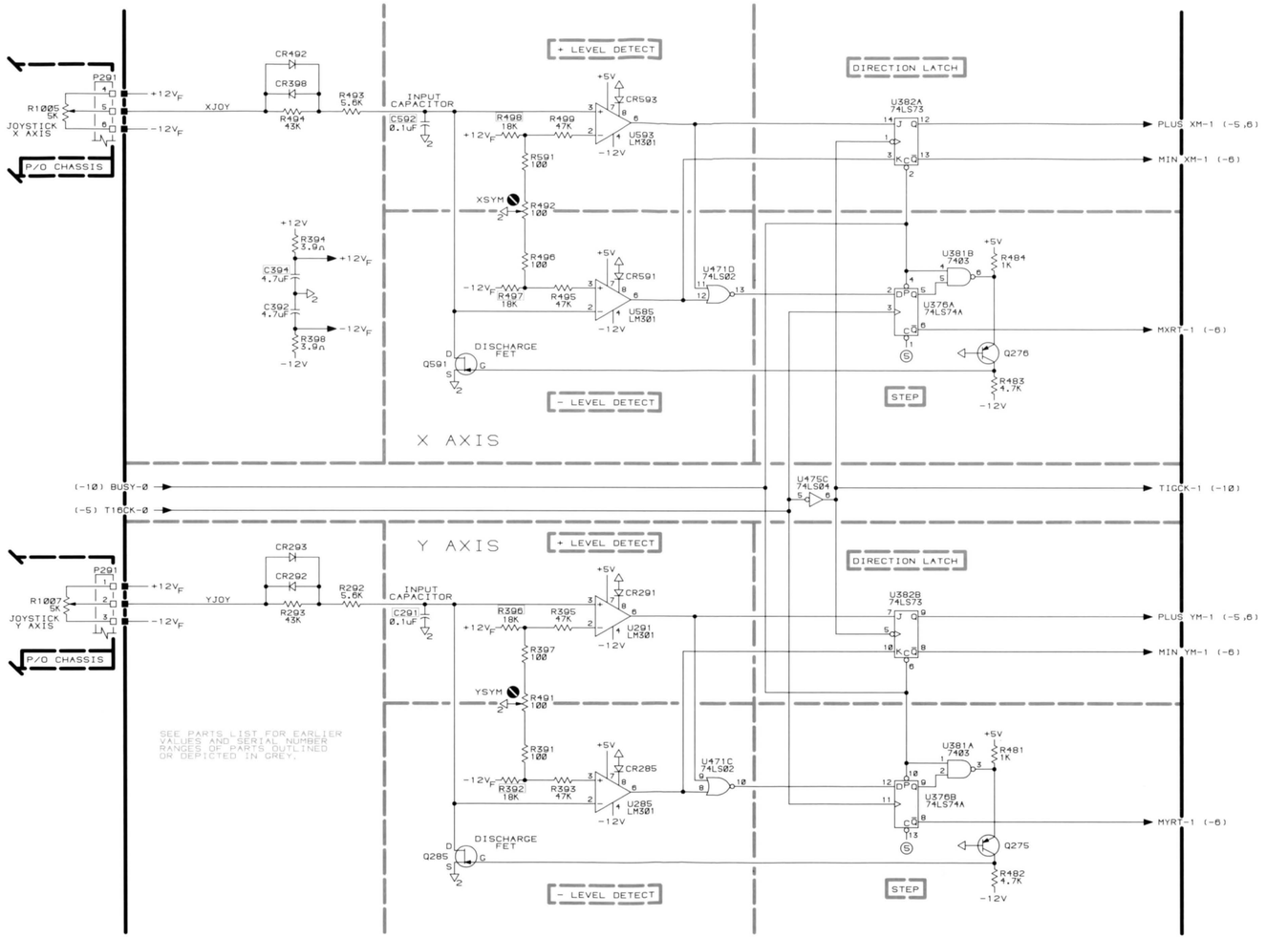


INSTRUMENT:	NOTES:	BOARD: 670-4102-02 & UP	ASSEMBLY-SHEET:
4662	1933-S8	PLOTTER BOARD X AXIS MOTOR DRIVE	A1-7 (8 OF 12)

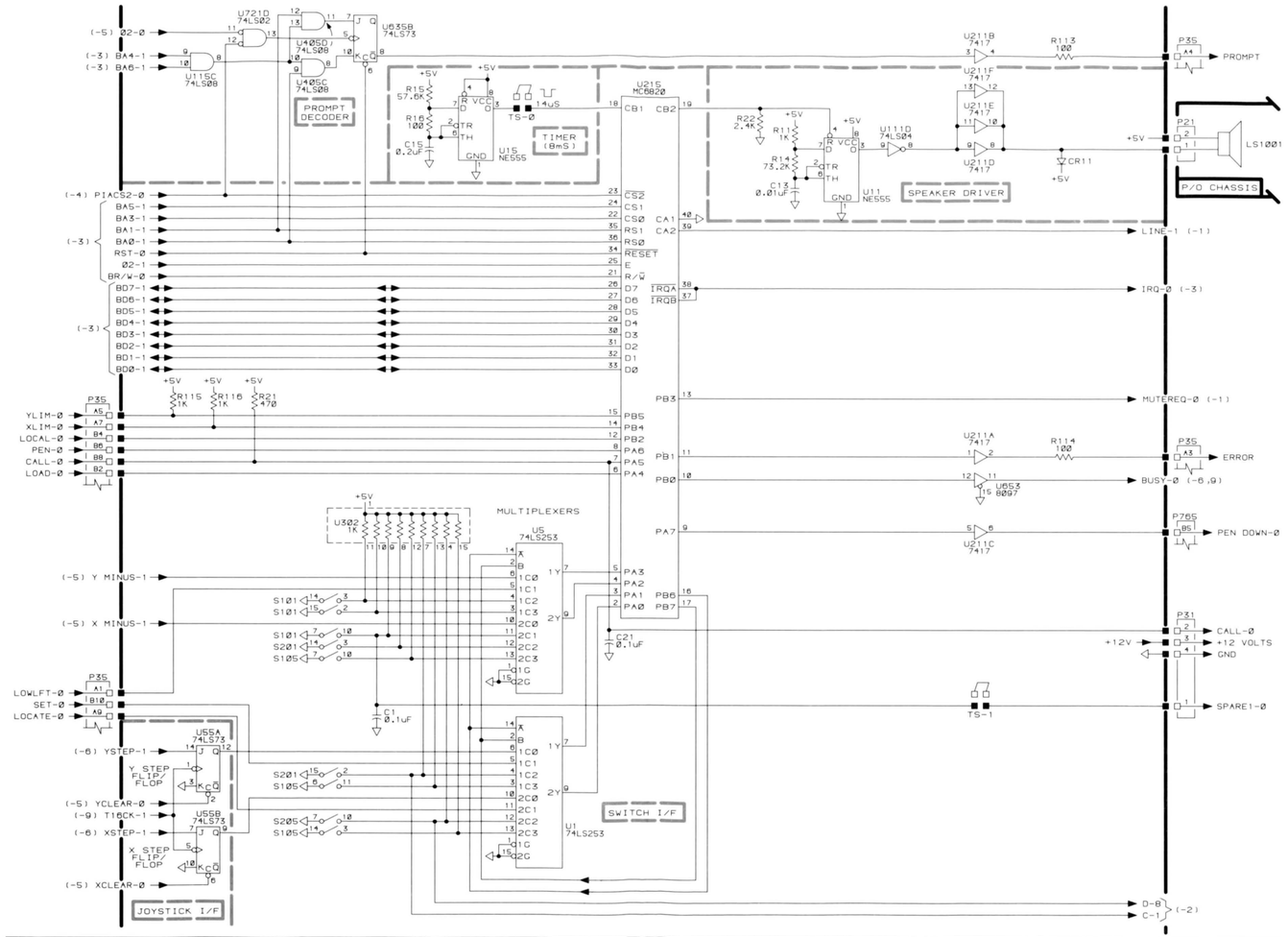
PLOTTER X AXIS MOTOR DRIVE
670-4102-02
A1-7



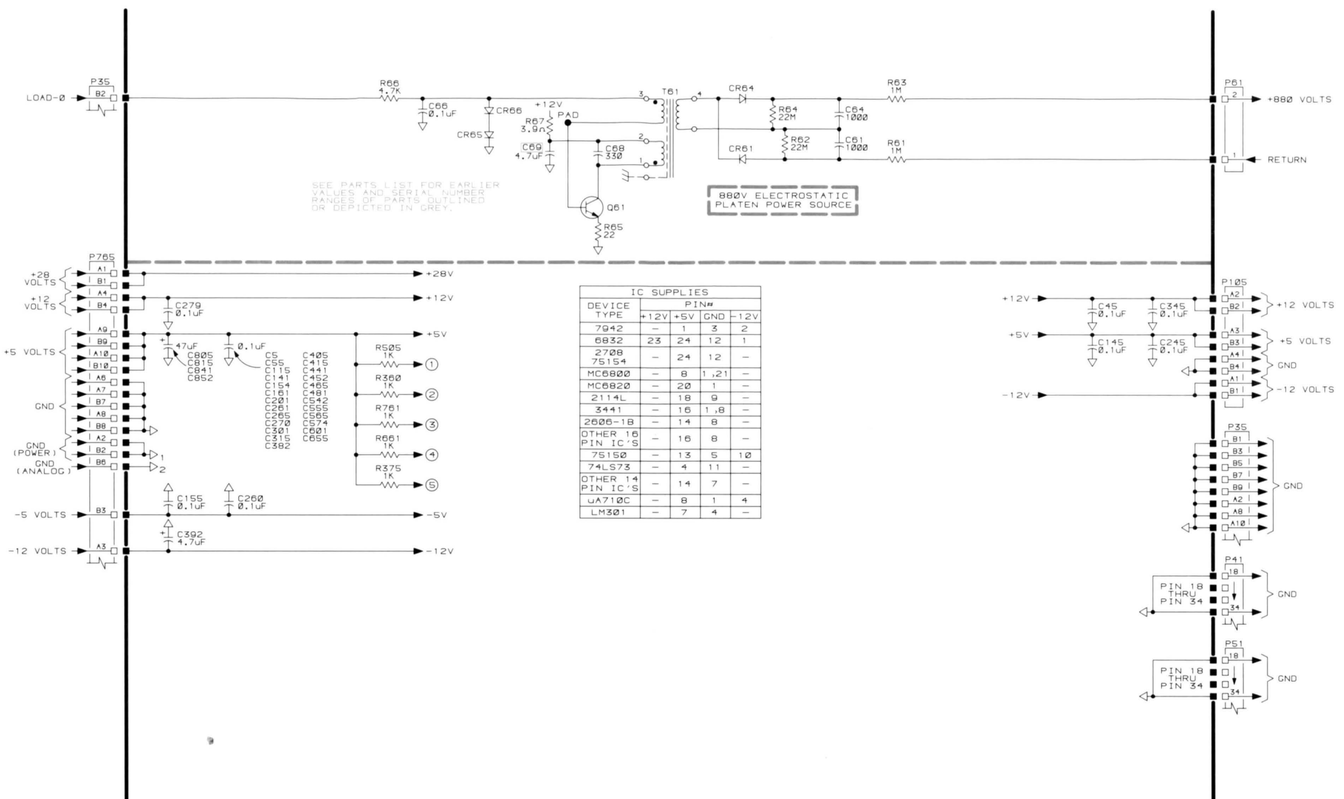
INSTRUMENT:	NOTES:	BOARD: 670-4102-02 & UP	ASSEMBLY-SHEET:
4662	1933-59	PLOTTER BOARD Y AXIS MOTOR DRIVE	A1-8 (9 OF 12)



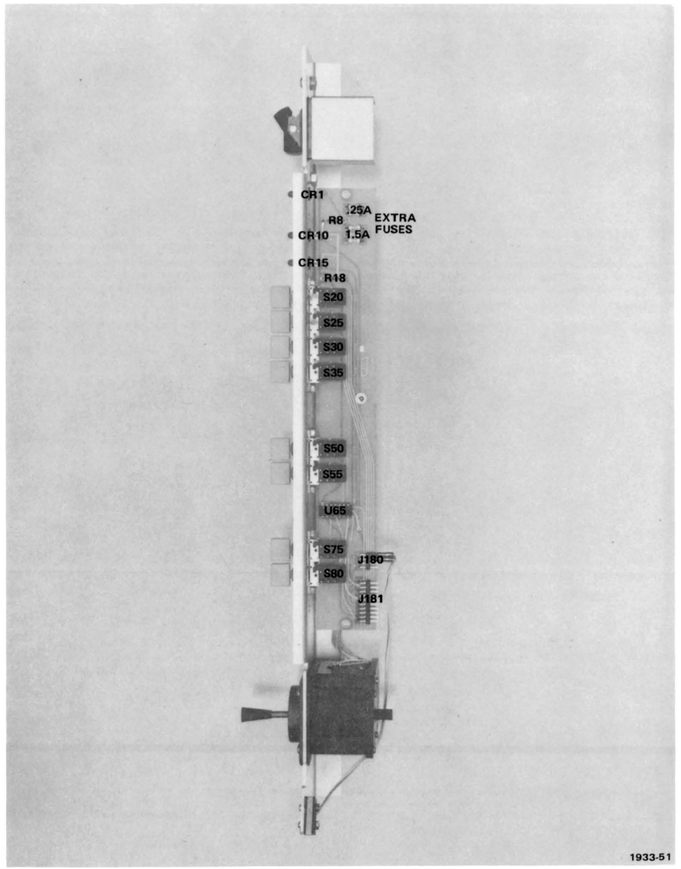
INSTRUMENT:	NOTES:	BOARD: 670-4102-02 & UP	ASSEMBLY-SHEET:
4662	1933-S10	PLOTTER BOARD JOYSTICK RATE GENERATOR	A1-9 (10 OF 12)



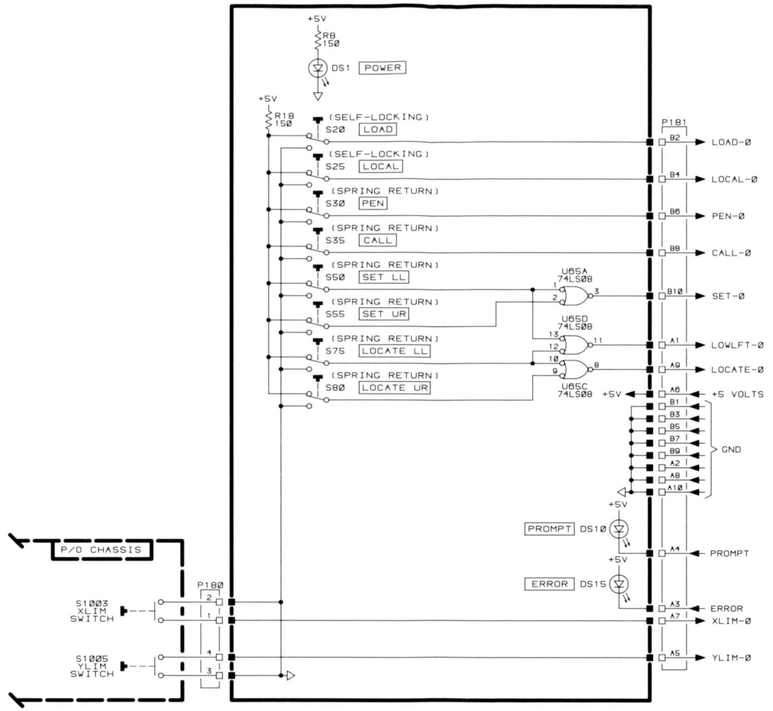
INSTRUMENT:	NOTES:	BOARD: 670-4102-02 & UP	ASSEMBLY-SHEET:
4662	REV, SEP 1982 1933-S11	PLOTTER BOARD MISCELLANEOUS I/F	A1-10 (11 OF 12)



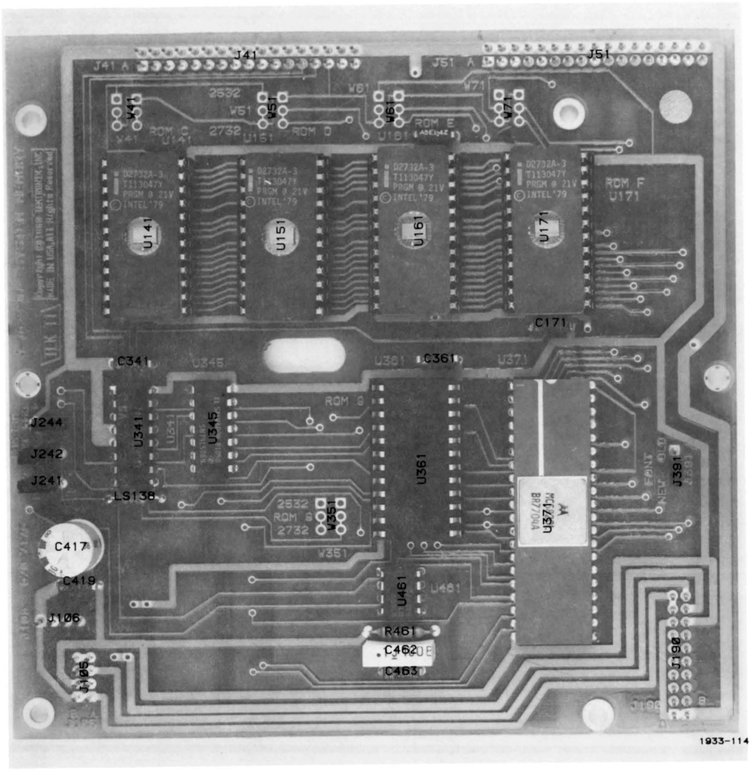
INSTRUMENT:	NOTES:	BOARD: 670-4102-02 & UP	ASSEMBLY-SHEET:
4662	1933-S12	PLOTTER BOARD PLATEN POWER SUPPLY	A1-11 (12 OF 12)



Front Panel Board (670-4103-00,01) Component Locations.

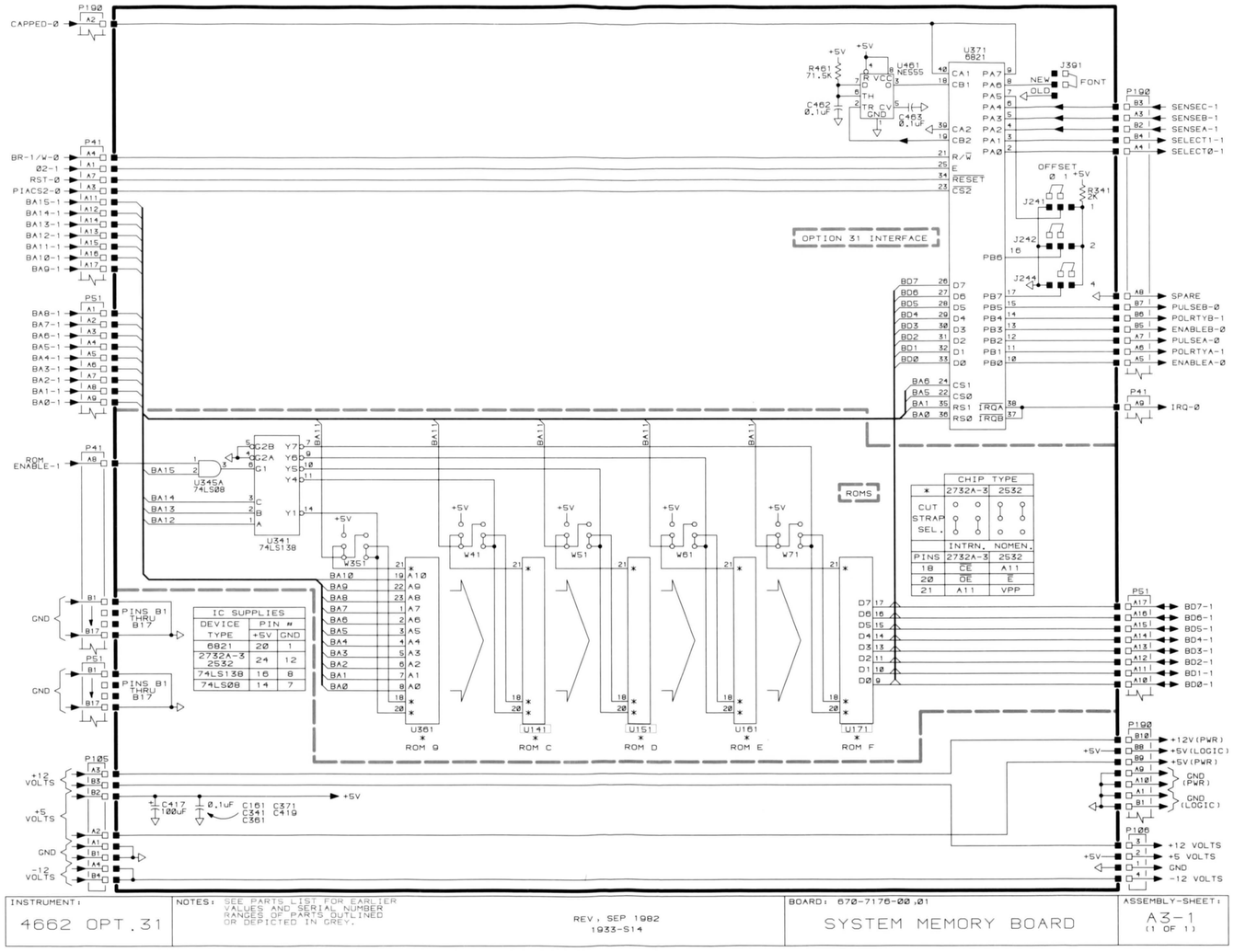


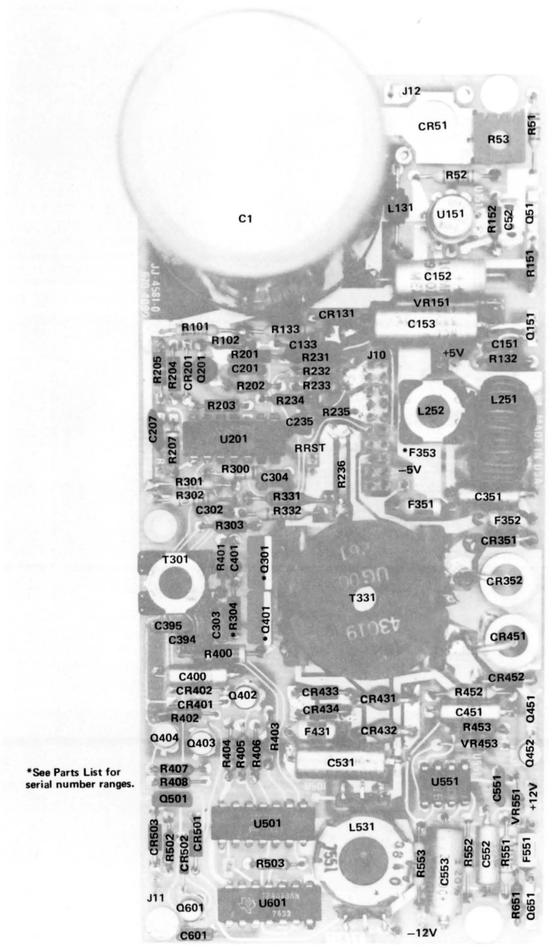
INSTRUMENT:	NOTES:	BOARD: 670-4103-00,01	ASSEMBLY-SHEET:
4662	1933-S13	FRONT PANEL BOARD	A2-1 (1 OF 1)



System Memory Component Locations (670-7176-00,01).

REV, SEP 1982

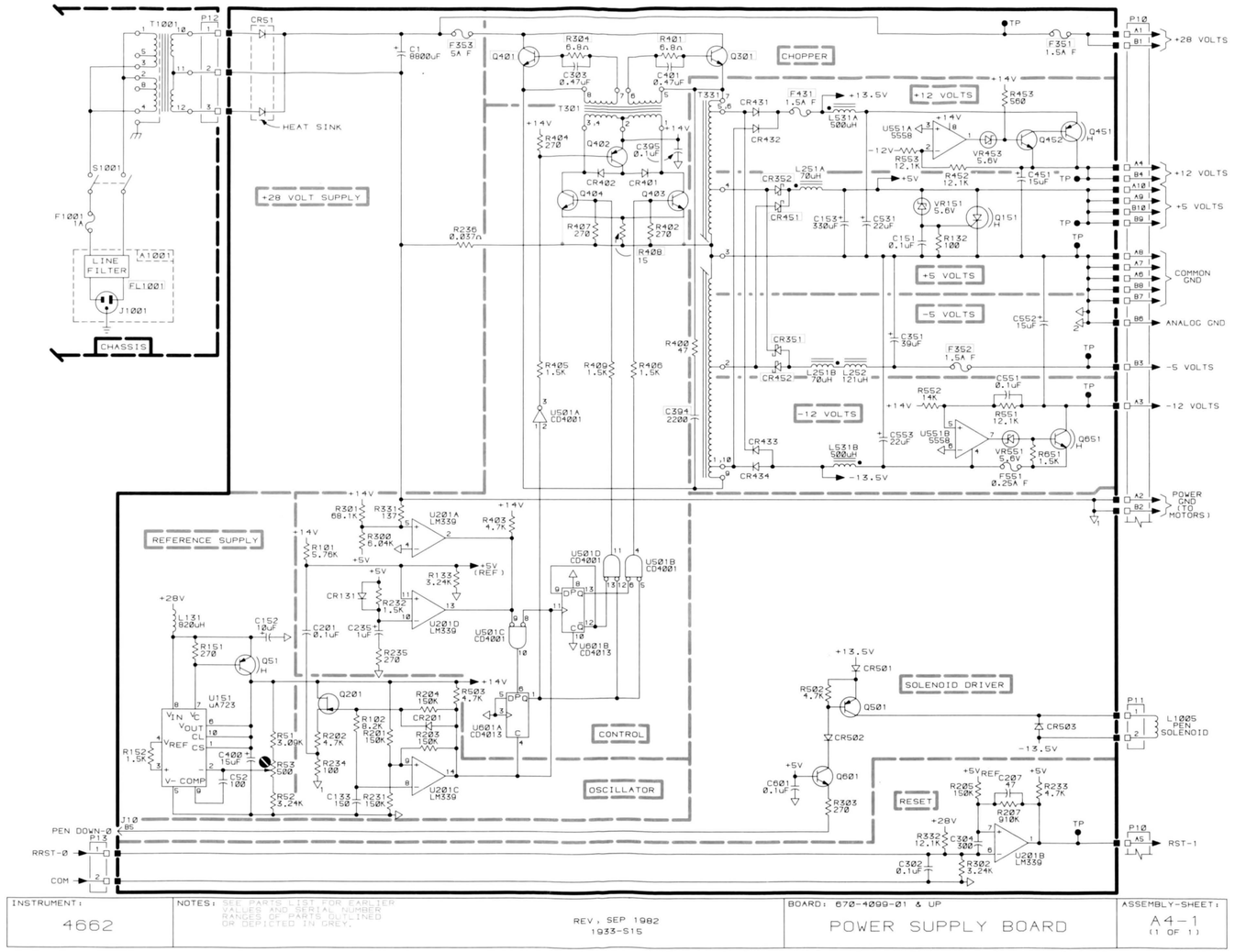


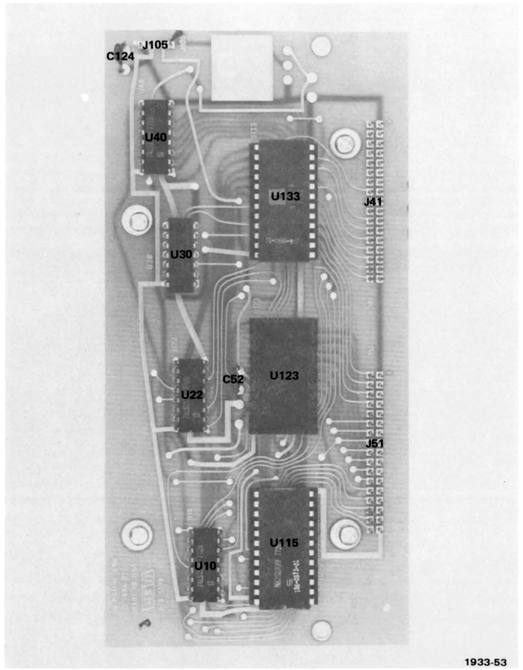


*See Parts List for serial number ranges.

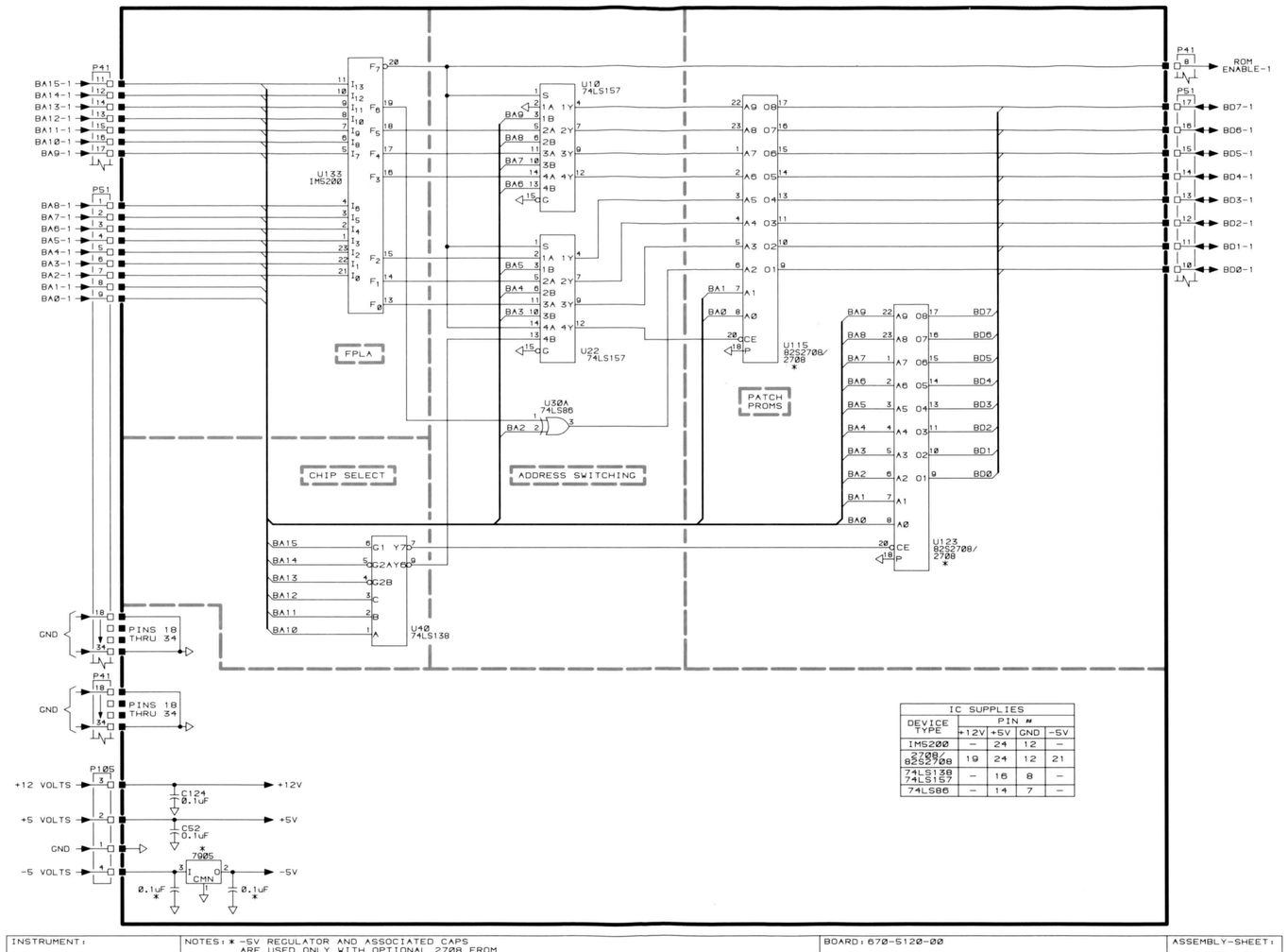
1933-35B

Power Supply Board (670-4099-00,01) Component Locations.



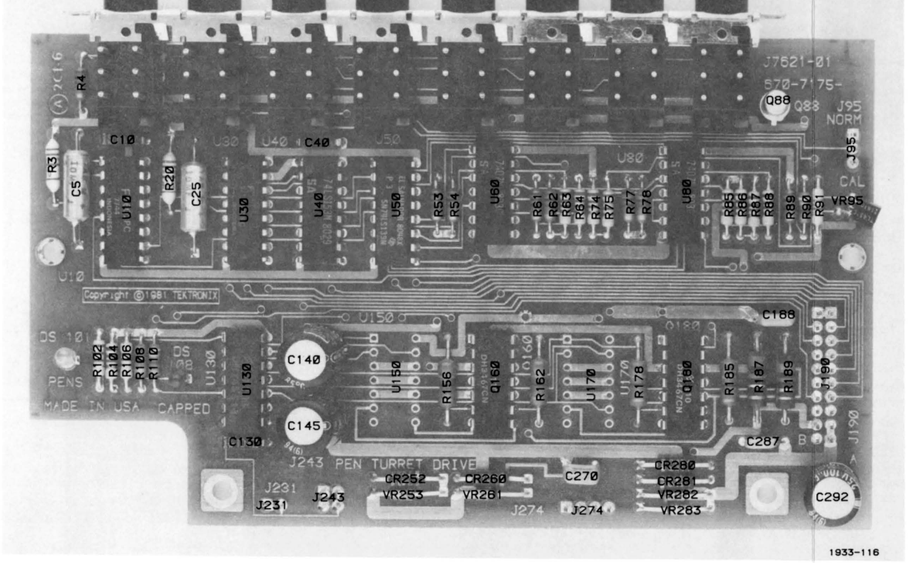


Firmware Patch Board (670-5120-00) Component Locations.

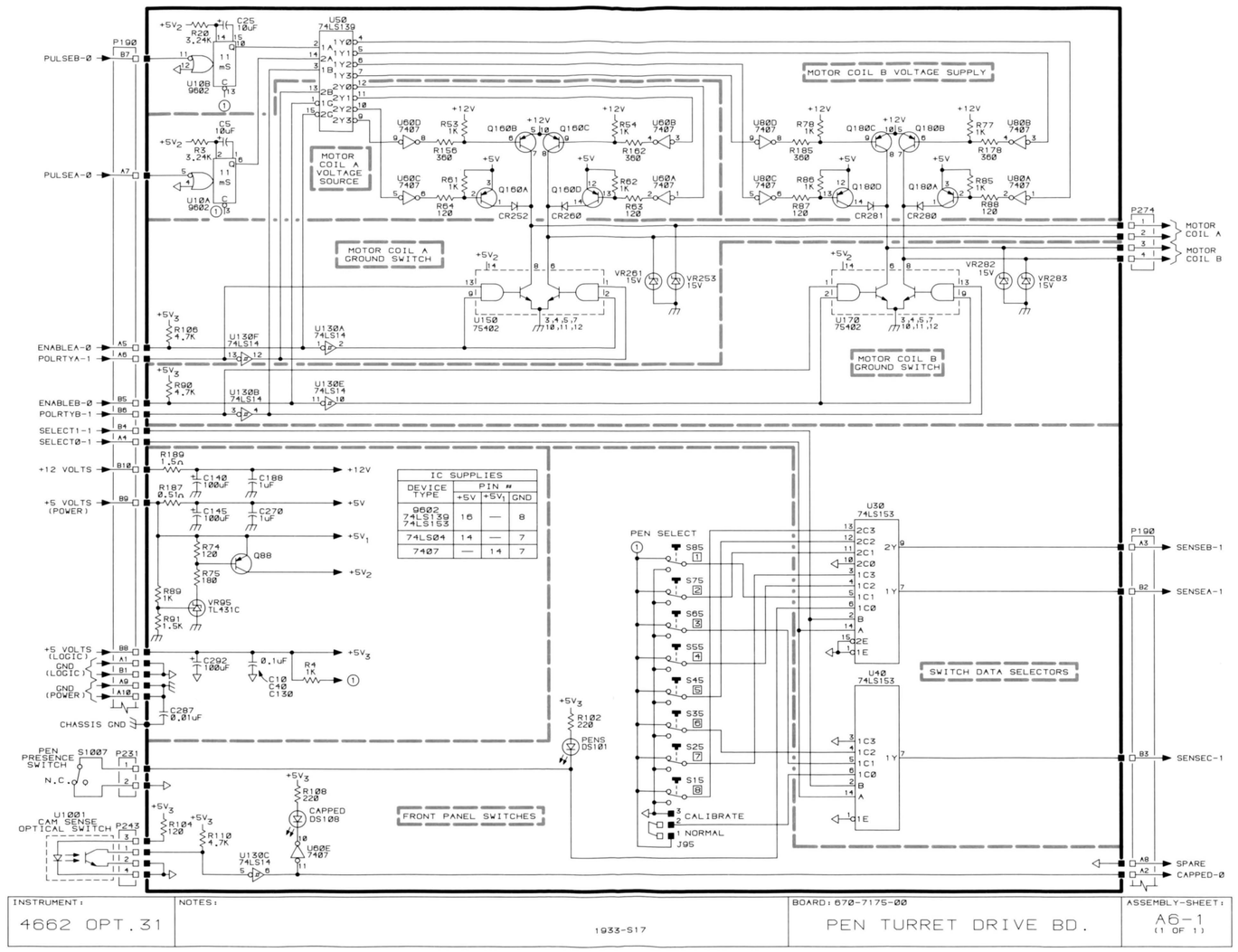


IC SUPPLIES				
DEVICE TYPE	PIN #			
	+12V	+5V	GND	-5V
IM5200	–	24	12	–
2708 82S2708	19	24	12	21
74LS138 74LS157	–	16	8	–
74LS86	–	14	7	–

INSTRUMENT:	NOTES: * -5V REGULATOR AND ASSOCIATED CAPS ARE USED ONLY WITH OPTIONAL 2708 EROM	BOARD: 670-5120-00	ASSEMBLY-SHEET:
4662	1933-S16	FIRMWARE PATCH BOARD	A5-1 (1 OF 1)



Pen Turret Drive Board (670-7175-00) Component Locations.



Section 8
REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations.

INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example of the indentation system used in the description column.

```
1 2 3 4 5                    Name & Description
Assembly and/or Component
Attaching parts for Assembly and/or Component
- - - * - - -
   Detail Part of Assembly and/or Component
   Attaching parts for Detail Part
   - - - * - - -
      Parts of Detail Part
      Attaching parts for Parts of Detail Part
      - - - * - - -
```

Attaching Parts always appear in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation. The separation symbol - - - * - - - indicates the end of attaching parts.

Attaching parts must be purchased separately, unless otherwise specified.

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

ABBREVIATIONS

"	INCH
#	NUMBER SIZE
ACTR	ACTUATOR
ADPTR	ADAPTER
ALIGN	ALIGNMENT
AL	ALUMINUM
ASSEM	ASSEMBLED
ASSY	ASSEMBLY
ATTEN	ATTENUATOR
AWG	AMERICAN WIRE GAGE
BD	BOARD
BRKT	BRACKET
BRS	BRASS
BRZ	BRONZE
BSHG	BUSHING
CAB	CABINET
CAP	CAPACITOR
CER	CERAMIC
CHAS	CHASSIS
CKT	CIRCUIT
COMP	COMPOSITION
CONN	CONNECTOR
COV	COVER
CPLG	COUPLING
CRT	CATHODE RAY TUBE
DEG	DEGREE
DWR	DRAWER
ELCTRN	ELECTRON
ELEC	ELECTRICAL
ELCTLT	ELECTROLYTIC
ELEM	ELEMENT
EPL	ELECTRICAL PARTS LIST
EQPT	EQUIPMENT
EXT	EXTERNAL
FIL	FILLISTER HEAD
FLEX	FLEXIBLE
FLH	FLAT HEAD
FLTR	FILTER
FR	FRAME or FRONT
FSTNR	FASTENER
FT	FOOT
FXD	FIXED
GSKT	GASKET
HDL	HANDLE
HEX	HEXAGON
HEX HD	HEXAGONAL HEAD
HEX SOC	HEXAGONAL SOCKET
HLCPS	HELICAL COMPRESSION
HLEXT	HELICAL EXTENSION
HV	HIGH VOLTAGE
IC	INTEGRATED CIRCUIT
ID	INSIDE DIAMETER
IDENT	IDENTIFICATION
IMPLR	IMPELLER
IN	INCH
INCAND	INCANDESCENT
INSUL	INSULATOR
INTL	INTERNAL
LPHLDR	LAMPHOLDER
MACH	MACHINE
MECH	MECHANICAL
MTG	MOUNTING
NIP	NIPPLE
NON WIRE	NOT WIRE WOUND
OBD	ORDER BY DESCRIPTION
OD	OUTSIDE DIAMETER
OVH	OVAL HEAD
PH BRZ	PHOSPHOR BRONZE
PL	PLAIN or PLATE
PLSTC	PLASTIC
PN	PART NUMBER
PNH	PAN HEAD
PWR	POWER
RCPT	RECEPTACLE
RES	RESISTOR
RGD	RIGID
RLF	RELIEF
RTNR	RETAINER
SCH	SOCKET HEAD
SCOPE	OSCILLOSCOPE
SCR	SCREW
SE	SINGLE END
SECT	SECTION
SEMICOND	SEMICONDUCTOR
SHLD	SHIELD
SHLDR	SHOULDERED
SKT	SOCKET
SL	SLIDE
SLFLKG	SELF-LOCKING
SLVG	SLEEVING
SPR	SPRING
SQ	SQUARE
SST	STAINLESS STEEL
STL	STEEL
SW	SWITCH
T	TUBE
TERM	TERMINAL
THD	THREAD
THK	THICK
TNSN	TENSION
TPG	TAPPING
TRH	TRUSS HEAD
V	VOLTAGE
VAR	VARIABLE
W/	WITH
WSHR	WASHER
XFMR	TRANSFORMER
XSTR	TRANSISTOR

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

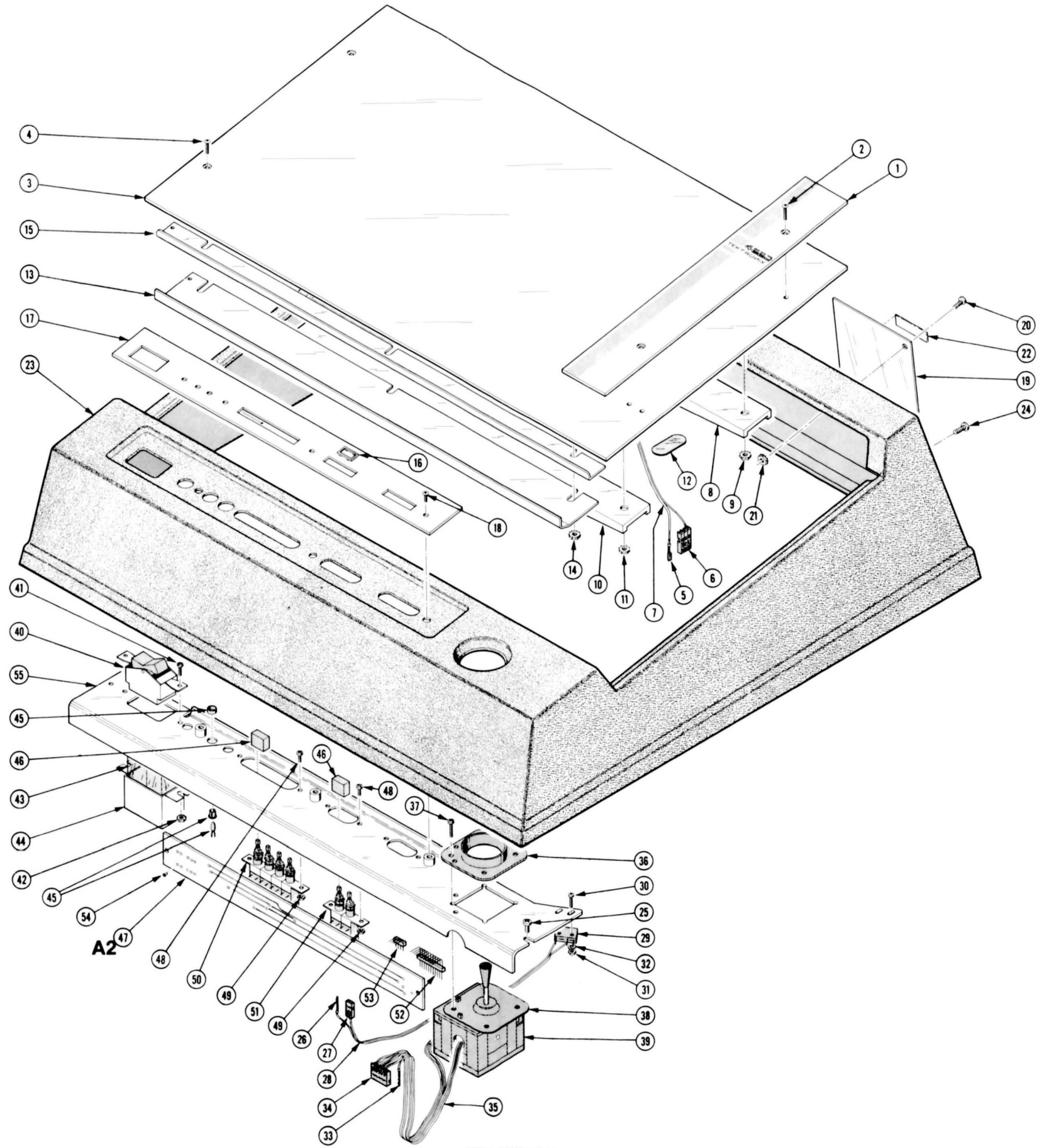
Mfr. Code	Manufacturer	Address	City, State, Zip
000AH	STANDARD PRESSED STEEL CO., UNBRAKO DIV.	8535 DICE ROAD	SANTA FE SPRINGS, CA 90670
000BK	STAUFFER SUPPLY	105 SE TAYLOR	PORTLAND, OR 97214
000BV	SAVA INDUSTRIES	PO BOX 150	POMPTON LAKES, NJ 07442
000EL	PORTLAND SCREW CO.	6520 N. BASIN AVE.	PORTLAND, OR 97217
000EO	ZEPHER ELECTRONIC SALES CORP.	647 INDUSTRY DRIVE	SEATTLE, WA 98188
000EZ	PACIFIC BELTING INDUSTRIES	2557 YATES AVE.	LOS ANGELES, CA 90040
000HA	BAHRS DIE & STAMPING CO., INC.	4375 ROSS PLAIN RD.	CINCINNATI, OH 45236
000HH	SHANNON & CO.	605 SW 10TH	PORTLAND, OR 97205
00779	AMP, INC.	P.O. BOX 3608	HARRISBURG, PA 17105
01295	TEXAS INSTRUMENTS, INC. SEMICONDUCTOR GROUP	P.O. BOX 5012	DALLAS, TX 75222
01963	CHERRY ELECTRICAL PRODUCTS CORPORATION	3600 SUNSET AVENUE	WAUKEGAN, IL 60085
03614	BUSSMAN MFG., DIV. OF MCGRAW EDISON CO.	502 EARTH CITY PLAZA	EARTH CITY, MO 63045
07111	PNEUMO DYNAMICS CORPORATION	4800 PRUDENTIAL TOWER	BOSTON, MA 02199
08261	SPECTRA-STRIP CORP.	7100 LAMPSON AVE.	GARDEN GROVE, CA 92642
09922	BURNDY CORPORATION	RICHARDS AVENUE	NORWALK, CT 06852
12327	FREEWAY CORPORATION	9301 ALLEN DRIVE	CLEVELAND, OH 44125
12360	ALBANY PRODUCTS CO., DIV. OF PNEUMO DYNAMICS CORPORATION	145 WOODWARD AVENUE	SOUTH NORWALK, CT 06586
17405	GRAPHIC CONTROLS CORP. RECORDING CHART DIV.	189 VAN RENSSELAER ST	BUFFALO, NY 14240
18488	CONNOR SPRING AND MFG. CO., DIVISION OF SLOSS AND BRITTAIN	831 MONTEREY PASS RD.	MONTEREY PARK, CA 91754
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
24931	SPECIALITY CONNECTOR CO., INC.	2620 ENDRESS PLACE	GREENWOOD, IN 46142
32674	GRAPHIC CONTROLS CORPORATION, TECHNICAL PRODUCTS AND INSTRUMENTS DIVISION	2 SPRINGDALE ROAD	CHERRY HILL, NJ 08003
52152	MINNESOTA MINING AND MFG CO.	INDUSTRIAL SPECIALTIES DIV. 3M CENTER	ST. PAUL, MN 55144
52905	SIMPLEX MFG. COMPANY	5224 NE 42ND AVENUE	PORTLAND, OREGON 97218
55175	SAVA INDUSTRIES INC.	P.O. BOX 150	POMPTON LAKES, NJ 07442
56878	STANDARD PRESSED STEEL COMPANY	BENSON EAST	JENKINTOWN, PA 19046
57668	R-OHM CORP.	16931 MILLIKEN AVE.	IRVINE, CA 92713
70276	ALLEN MFG. CO.	P. O. DRAWER 570	HARTFORD, CT 06101
70485	ATLANTIC INDIA RUBBER WORKS, INC.	571 W. POLK ST.	CHICAGO, IL 60607
70958	BERGEN WIRE ROPE CO.	1234 GREGG ST.	LODI, NJ 07644
71041	BOSTON GEAR, DIV. ROCKWELL INTL.	14 HAYWARD STREET	QUINCY, MA 02171
71400	BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.	2536 W. UNIVERSITY ST.	ST. LOUIS, MO 63107
71468	ITT CANNON ELECTRIC	666 E. DYER RD.	SANTA ANA, CA 92702
71590	CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC.	P O BOX 858	FORT DODGE, IA 50501
71785	TRW, CINCH CONNECTORS	1501 MORSE AVENUE	ELK GROVE VILLAGE, IL 60007
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
73803	TEXAS INSTRUMENTS, INC., METALLURGICAL MATERIALS DIV.	34 FOREST STREET	ATTLEBORO, MA 02703
74445	HOLO-KROME CO.	31 BROOK ST. WEST	HARTFORD, CT 06110
74868	BUNKER-RAMO CORP., THE AMPHENOL RF DIV.	33 E. FRANKLIN ST.	DANBURY, CT 06810
76381	MINNESOTA MINING AND MFG. CO.	3M CENTER	ST. PAUL, MN 55101
76854	OAK INDUSTRIES, INC., SWITCH DIV.	S. MAIN ST.	CRYSTAL LAKE, IL 60014
77250	PHEOLL MANUFACTURING CO., DIVISION OF ALLIED PRODUCTS CORP.	5700 W. ROOSEVELT RD.	CHICAGO, IL 60650
77342	AMF INC., POTTER AND BRUMFIELD DIV.	200 RICHLAND CREEK DRIVE	PRINCETON, IN 47670
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
78277	SIGMA INSTRUMENTS INC.	170 PEARL STREET	SOUTH BRAINTREE, MA 02185
79136	WALDES, KOHINOOR, INC.	47-16 AUSTEL PLACE	LONG ISLAND CITY, NY 11101
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
83259	PARKER SEAL CO-O-SEAL, DIVISION OF PARKER-HANNIFIN CORP.	10567 JEFFERSON BLVD.	CULVER CITY, CA 90231
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
86928	SEASTROM MFG. COMPANY, INC.	701 SONORA AVENUE	GLENDALE, CA 91201
87506	STAEDTLER, J.S. INC.	PO BOX 68, BOONTON AVENUE	MONTVILLE, NJ 07045
89663	REESE, J. RAMSEY, INC.	71 MURRAY STREET	NEW YORK, NY 10007
91741	NASHUA CORPORATION, GUBELMEN CHARTS DIV.	100 E KINNEY STREET	NEWARK, NJ 07105
91836	KINGS ELECTRONICS CO., INC.	40 MARBLEDALE ROAD	TUCKAHOE, NY 10707
93907	TEXTRON INC. CAMCAR DIV	600 18TH AVE	ROCKFORD, IL 61101
95987	WECKESSER CO., INC.	4444 WEST IRVING PARK RD.	CHICAGO, IL 60641

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
96881	THOMSON INDUSTRIES, INC.	1029 PLANDOME ROAD	MANHASSET, NY 11030
S3109	C/O PANEL COMPONENTS CORP.	P.O. BOX 6626	SANTA ROSA, CA 95406
S3629	PANEL COMPONENTS CORP.	2015 SECOND ST.	BERKELEY, CA 94170
T0433	PORTLAND SCREW CO	6520 N BASIN	PORTLAND, OREG 97217
T1105	J PHILLIP INDUSTRIES INC	5713 NORTHWEST HIGHWAY	CHICAGO, IL 60646
T1372	ELECTRI-CORD MFG CO INC	312 E. MAIN ST.	WESTFIELD, PA 16950

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-1	386-3393-00			1		PLATE,TRIM:	80009	386-3393-00
						••••••••••••••(ATTACHING PARTS)••••••••••		
-2	211-0098-00			2		SCREW,CAP:4-40 X 0.375,BTN HD,STL		
						••••••••••••(END ATTACHING PARTS)•••••••••		
-3	670-5043-01			1		CKT BOARD ASSY:ELECTROSTATIC HOLD DOWN	80009	670-5043-01
						••••••••••••••(ATTACHING PARTS)••••••••••		
-4	211-0227-00			2		SCREW,MACHINE:4-40 X 0.25" SOC BUT HD	74445	ORD BY DESCR
						••••••••••••(END ATTACHING PARTS)•••••••••		
	----- -----			-		CKT BOARD ASSY INCLUDES:		
	175-1967-00			1		.CA ASSY,SP ELEC:2,26 AWG,9.0 L	80009	175-1967-00
-5	131-0621-00			2		..CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOL	22526	46231
-6	352-0199-01			1		..HLDR,TERM CONN:3 WIRE BROWN	80009	352-0199-01
	----- -----			-		..(A1P61)		
-7	175-0734-00			AR		..WIRE,ELECTRICAL:2 WIRE RIBBON,1.500 FT L	80009	175-0734-00
-8	386-3115-00			1		.SUPPORT,PLATEN:	80009	386-3115-00
						.••••••••••••(ATTACHING PARTS)••••••••••		
-9	210-0458-00			7		.NUT,PL,ASSEM WA:8-32 X 0.344 INCH,STL	83385	ORD BY DESCR
						.••••••••••(END ATTACHING PARTS)•••••••••••		
-10	386-3411-00			1		.SUPPORT,PLATEN:13.646 L,CHANNEL	80009	386-3411-00
						.••••••••••••(ATTACHING PARTS)••••••••••		
-11	210-0458-00			6		.NUT,PL,ASSEM WA:8-32 X 0.344 INCH,STL	83385	ORD BY DESCR
						.••••••••••(END ATTACHING PARTS)•••••••••••		
-12	342-0245-00			1		.INSUL,HV LEADS:1.230 INCH L,PLASTIC	80009	342-0245-00
-13	124-0325-00			1		.STRIP,TRIM:FRONT	80009	124-0325-00
						.••••••••••••(ATTACHING PARTS)••••••••••		
-14	210-0458-00			3		.NUT,PL,ASSEM WA:8-32 X 0.344 INCH,STL	83385	ORD BY DESCR
						.••••••••••(END ATTACHING PARTS)•••••••••••		
-15	351-0478-00			1		.GUIDE,PAPER:PLATEN	80009	351-0478-00
-16	426-0568-00			8		FR,PUSHBUTTON:PANEL MOUNT	80009	426-0568-00
-17	333-2077-00			1		PANEL,FRONT:	80009	333-2077-00
						••••••••••••••(ATTACHING PARTS)••••••••••		
-18	211-0626-00			3		SCREW,CAP:6-32 X 0.312,BTN HD,STL	56878	ORD BY DESCR
						••••••••••••(END ATTACHING PARTS)•••••••••		
-19	334-2628-00	B010100	B010346	1		PLATE,IDENT:MARKED CAUTION VOLTAGE INFO	80009	334-2628-00
	334-2628-01	B010347	B059614	1		PLATE,IDENT:MARKED CAUTION VOLTAGE	80009	334-2628-01
	334-2628-02	B059615		1		PLATE,IDENT:MARKED CAUTION VOLTAGE INFO	80009	334-2628-02
	334-2628-03	B059895		1		PLATE,IDENT:MARKED CAUTION VOLTAGE INFO	80009	334-2628-03
	----- -----			-		(OPTION A1,A2,A3,A4)		
						••••••••••••••(ATTACHING PARTS)••••••••••		
-20	211-0626-00	B010347		2		SCREW,CAP:6-32 X 0.312,BTN HD,STL	56878	ORD BY DESCR
-21	210-0457-00	B010347		2		NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	ORD BY DESCR
						••••••••••••(END ATTACHING PARTS)•••••••••		
-22	334-2192-01	B045065	B059614	1		MARKER,IDENT:MKD INT SET FOR 110V	80009	334-2192-01
	334-2193-01	B045065	B059614	1		MARKER,IDENT:MKD INT SET FOR 120V	80009	334-2193-01
	334-2194-01	B045065	B059614	1		MARKER,IDENT:MKD INT SET FOR 200V	80009	334-2194-01
-23	380-0465-01			1		HOUSING,PLOTTER:	80009	380-0465-01
						••••••••••••••(ATTACHING PARTS)••••••••••		
-24	211-0626-00			3		SCREW,CAP:6-32 X 0.312,BTN HD,STL	56878	ORD BY DESCR
						••••••••••••(END ATTACHING PARTS)•••••••••		
	614-0124-00			1		SUBPANEL ASSY:	80009	614-0124-00
						••••••••••••••(ATTACHING PARTS)••••••••••		
-25	211-0504-00			2		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	ORD BY DESCR
						••••••••••••(END ATTACHING PARTS)•••••••••		
	----- -----			-		SUBPANEL ASSEMBLY INCLUDES:		
-26	131-0707-00			2		.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	47439
-27	352-0169-00			1		.HLDR,TERM CONN:2 WIRE BLACK	80009	352-0169-00
-28	175-0825-00			AR		.WIRE,ELECTRICAL:2 WIRE RIBBON	80009	175-0825-00
-29	----- -----			1		.SWITCH,SENS:(SEE S1005 REPL))		
						.••••••••••••(ATTACHING PARTS)••••••••••		
-30	211-0185-00			2		.SCREW,MACHINE:2-56 X 0.438",PNH,STL	07111	ORD BY DESCR
-31	210-0405-00			2		.NUT,PLAIN,HEX.:2-56 X 0.188 INCH,BRS	73743	12157-50
-32	210-0002-00			2		.WASHER,LOCK:EXTERNAL #2	78189	1102-01
						.••••••••••(END ATTACHING PARTS)•••••••••••		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-33	131-0707-00			6		.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	47439
-34	352-0164-01			1		.CONN BODY,PL,EL:6 WIRE BROWN	80009	352-0164-01
-35	175-0829-00			AR		.WIRE,ELECTRICAL:6 WIRE RIBBON	08261	SS-0626-710610C
-36	386-3454-00			1		.PLATE,RETAINING:JOYSTICK	80009	386-3454-00
						.**********(ATTACHING PARTS)**********		
-37	213-0264-00			4		.SCREW,TPG,TC:4-24 X 0.625,TYPE BT,PNH		
						.**********(END ATTACHING PARTS)**********		
-38	348-0474-00			1		.BOOT,DUMR SEAL:JOY STICK	80009	348-0474-00
-39	----- -----			1		.JOYSTICK:(SEE R1005,R1007 REPL)		
-40	----- -----			1		.SWITCH,ROCKER:(SEE S1001 REPL)		
						.**********(ATTACHING PARTS)**********		
-41	211-0507-00			2		.SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	ORD BY DESCR
-42	210-0457-00			2		.NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	ORD BY DESCR
						.**********(END ATTACHING PARTS)**********		
-43	342-0320-00			1		.INSULATOR,FILM:POWER SWITCH	80009	342-0320-00
-44	200-1916-00			1		.COVER,SWITCH:	80009	200-1916-00
-45	----- -----			3		.LAMP,LED:(SEE CR1,10,15 REPL)		
-46	366-1161-00			8		.PUSH BUTTON:SIL GRAY,0.523 X 0.253 X 0.	80009	366-1161-00
-47	----- -----			1		.CKT BOARD ASSY:FRONT PANEL(SEE A2 REPL)		
						.**********(ATTACHING PARTS)**********		
-48	211-0008-00			6		.SCREW,MACHINE:4-40 X 0.250,PNH,STL,POZ	83385	ORD BY DESCR
-49	210-0586-00			6		.NUT,PL,ASSEM WA:4-40 X 0.25,STL	83385	ORD BY DESCR
						.**********(END ATTACHING PARTS)**********		
	----- -----			-		.CKT BOARD ASSEMBLY INCLUDES		
-50	----- -----			1		..SWITCH,PUSH:(SEE S20,25,30,35 REPL)		
-51	----- -----			2		..SWITCH,PUSH:(SEE S50,55,75,80 REPL)		
-52	131-1425-00			1		..TERM SET,PIN:(36) 0.025 SQ RTANG,0.15L	22526	65521-136
-53	131-1426-00			1		..TERM SET,PIN:(36) 0.025 SQ RTANG,0.25L	22526	65524-136
-54	136-0352-00			10		..CONTACT,ELEC:FOR 0.02 INCH DIAMETER PIN	00779	50462-7
-55	386-3398-00			1		.SUBPANEL,FRONT:	80009	386-3398-00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REV, OCT 1981

FIG 2 PEN & ACTUATOR ASSEMBLIES

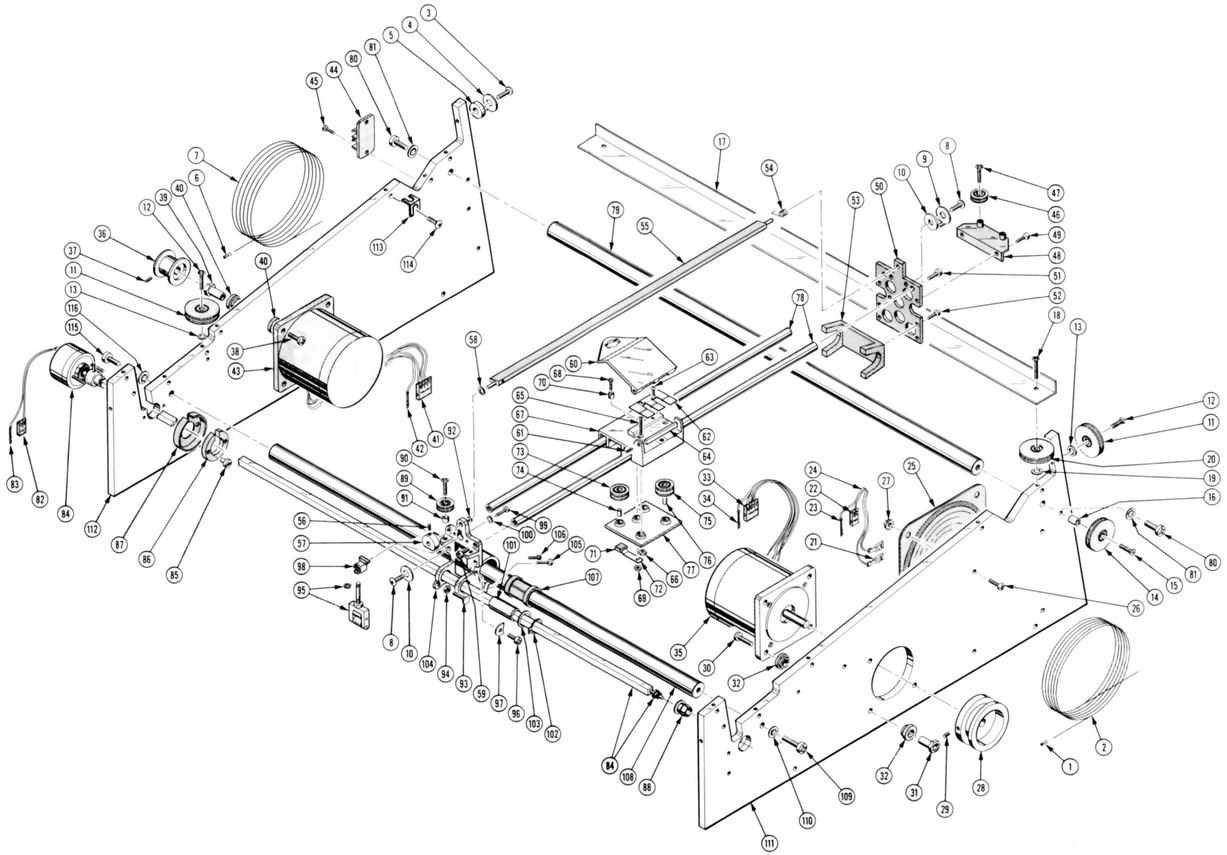


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-1	214-2359-00			1	SLEEVE,CRP LOOP:0.015 - 0.022 DIA CA,0.25	000BV	SAVA-702
-2	214-2001-00			AR	WIRE CORD:0.018 OD,11 FT L,PLSTC COVR	70958	26.1
					••••••••••••••(ATTACHING PARTS)••••••••••		
-3	211-0626-00			2	SCREW,CAP:6-32 X 0.312,BTN HD,STL	56878	ORD BY DESCR
-4	210-1263-00			2	WASHER,KEY:0.156 ID X 0.375 OD,STL	80009	210-1263-00
-5	210-1262-00			2	WASHER,FLAT:0.141 ID X 0.125 THK,AL	80009	210-1262-00
					••••••••••••(END ATTACHING PARTS)•••••••••		
-6	214-2360-00			1	SLEEVE,CRP LOOP:0.027-0.038 OD X 0.28,CU P	55175	SAVA-702
-7	214-2002-00			AR	WIRE CORD:0.034 OD,11 FT L,PLSTC COVR	70958	90.1
					••••••••••••••(ATTACHING PARTS)••••••••••		
-8	211-0626-00			3	SCREW,CAP:6-32 X 0.312,BTN HD,STL	56878	ORD BY DESCR
-9	210-1263-00			2	WASHER,KEY:0.156 ID X 0.375 OD,STL	80009	210-1263-00
-10	210-0803-00			3	WASHER,FLAT:0.15 ID X 0.032 THK,STL CD	12327	ORD BY DESCR
					••••••••••••(END ATTACHING PARTS)•••••••••		
-11	401-0274-03			6	PULLEY,GROOVED:PLASTIC,1.0 DIA X 0.368 DIA	80009	401-0274-03
					••••••••••••••(ATTACHING PARTS)••••••••••		
-12	211-0025-00			6	SCREW,MACHINE:4-40 X 0.375 100 DEG,FLH ST	83385	ORD BY DESCR
-13	210-0994-00			6	WASHER,FLAT:0.125 ID X 0.25" OD,STL	86928	5702-201-20
					••••••••••••(END ATTACHING PARTS)•••••••••		
-14	401-0274-03			3	PULLEY,GROOVED:PLASTIC,1.0 DIA X 0.368 DIA	80009	401-0274-03
					••••••••••••••(ATTACHING PARTS)••••••••••		
-15	211-0106-00			3	SCREW,MACHINE:4-40 X 0.625"100 DEG,FLH,ST	83385	ORD BY DESCR
-16	361-0668-00			3	SPACER,SLEEVE:	80009	361-0668-00
					••••••••••••(END ATTACHING PARTS)•••••••••		
-17	124-0304-00			1	STRIP,TRIM:	80009	124-0304-00
					••••••••••••••(ATTACHING PARTS)••••••••••		
-18	211-0025-00			2	SCREW,MACHINE:4-40 X 0.375 100 DEG,FLH ST	83385	ORD BY DESCR
-19	210-0994-00			4	WASHER,FLAT:0.125 ID X 0.25" OD,STL	86928	5702-201-20
					••••••••••••(END ATTACHING PARTS)•••••••••		
-20	401-0274-03			2	PULLEY,GROOVED:PLASTIC,1.0 DIA X 0.368 DIA	80009	401-0274-03
-21	131-0861-00			2	TERM,QIK DISC:16-20 AWG,0.22 W X 0.02 THK	00779	42617-2
-22	352-0169-01			1	HLDR TERM CONN:2 WIRE,BROWN	80009	352-0169-01
-23	131-0707-00			2	CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	47439
-24	175-0863-00			AR	WIRE,ELECTRICAL:2 WIRE RIBBON	08261	SS-0222-7(1061)
-25	----- -----			1	LOUDSPEAKER,PM:(SEE LS1001 REPL)		
					••••••••••••••(ATTACHING PARTS)••••••••••		
-26	211-0511-00			4	SCREW,MACHINE:6-32 X 0.500,PNH,STL,CD PL	83385	ORD BY DESCR
-27	210-0457-00			4	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	ORD BY DESCR
					••••••••••••(END ATTACHING PARTS)•••••••••		
-28	401-0275-00			1	PULLEY,FLAT:Y-AXIS	80009	401-0275-00
					••••••••••••••(ATTACHING PARTS)••••••••••		
-29	213-0022-00			2	SETSCREW:4-40 X 0.188 INCH,HEX SOC S	74445	ORD BY DESCR
					••••••••••••(END ATTACHING PARTS)•••••••••		
	147-0040-02			1	MOTOR,DC:1.8 DEG STEP ANGLE,200 STEP	78277	20-2223D-24173
					••••••••••••••(ATTACHING PARTS)••••••••••		
-30	212-0509-00			4	SCREW,MACHINE:10-32 X 0.625 INCH,PNH STL	83385	ORD BY DESCR
-31	220-0759-00			4	NUT,SLEEVE:10-32 X 0.375 HEX,0.58 L	80009	220-0759-00
-32	348-0459-00			8	MOUNT RESILIENT:MOTOR,0.25 ID X 0.5 OD	80009	348-0459-00
					••••••••••••(END ATTACHING PARTS)•••••••••		
	----- -----			-	MOTOR INCLUDES:		
-33	352-0162-01			1	.CONN BODY,PL,EL:4 WIRE BROWN	80009	352-0162-01
-34	131-0707-00			4	.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	47439
-35	----- -----			1	.MOTOR,DC:(SEE B1003 REPL),Y-AXIS		
-36	401-0278-00			1	PULLEY,FLAT:X-AXIS	80009	401-0278-00
					••••••••••••••(ATTACHING PARTS)••••••••••		
-37	213-0048-00			2	SETSCREW:4-40 X 0.125 INCH,HEX SOC S	74445	ORD BY DESCR
					••••••••••••(END ATTACHING PARTS)•••••••••		
	147-0040-02			1	MOTOR,DC:1.8 DEG STEP ANGLE,200 STEP	78277	20-2223D-24173
					••••••••••••••(ATTACHING PARTS)••••••••••		
-38	212-0509-00			4	SCREW,MACHINE:10-32 X 0.625 INCH,PNH STL	83385	ORD BY DESCR
-39	220-0759-00			4	NUT,SLEEVE:10-32 X 0.375 HEX,0.58 L	80009	220-0759-00
-40	348-0459-00			8	MOUNT RESILIENT:MOTOR,0.25 ID X 0.5 OD	80009	348-0459-00
					••••••••••••(END ATTACHING PARTS)•••••••••		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-	----- -----			-		MOTOR INCLUDES:		
-41	352-0162-01			1		.CONN BODY,PL,EL:4 WIRE BROWN	80009	352-0162-01
-42	131-0707-00			4		.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	47439
-43	----- -----			1		.MOTOR,DC:(SEE B1005 REPL)X-AXIS		
-44	352-0136-00	B010100	B020422	1		FUSEHOLDER:TEFLON ••••••••••••••(ATTACHING PARTS)••••••••••	80009	352-0136-00
-45	211-0097-00	B010100	B020422	2		SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL ••••••••••••(END ATTACHING PARTS)•••••••••	83385	ORD BY DESCR
-46	401-0279-03			2		PULLEY,GROOVED:PLASTIC,1.0 DIA ••••••••••••••(ATTACHING PARTS)••••••••••	80009	401-0279-03
-47	211-0025-00			2		SCREW,MACHINE:4-40 X 0.375 100 DEG,FLH ST ••••••••••••(END ATTACHING PARTS)•••••••••	83385	ORD BY DESCR
-48	407-1456-00			1		BRACKET,ANGLE:CARRIAGE END ••••••••••••••(ATTACHING PARTS)••••••••••	80009	407-1456-00
-49	211-0008-00			2		SCREW,MACHINE:4-40 X 0.250,PNH,STL,POZ ••••••••••••(END ATTACHING PARTS)•••••••••	83385	ORD BY DESCR
-50	386-3585-00			1		PLATE,MOUNTING:END CARRIAGE ••••••••••••••(ATTACHING PARTS)••••••••••	80009	386-3585-00
-51	211-0504-00			2		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	ORD BY DESCR
-52	213-0113-00			4		SCR,TPG,THD FOR:2-32 X 0.312 INCH,PNH STL ••••••••••••(END ATTACHING PARTS)•••••••••	93907	ORD BY DESCR
-53	401-0245-00			1		BEARING,SLEEVE:X-AXIS	80009	401-0245-00
-54	214-2456-00			1		SPR,HL CL,TRSN:0.125 ID X 0.11 L,0.018 DIA	18488	ORD BY DESCR
-55	381-0353-00			1		BAR,PEN ACTG:ALUMINUM ••••••••••••••(ATTACHING PARTS)••••••••••	80009	381-0353-00
-56	213-0048-00			2		SETSCREW:4-40 X 0.125 INCH,HEX SOC S	74445	ORD BY DESCR
-57	401-0300-00			1		CAM,PEN BAR:	80009	401-0300-00
-58	210-0801-00			1		WASHER,FLAT:0.14 ID X 0.025 THK,BRS NI ••••••••••••(END ATTACHING PARTS)•••••••••	12327	ORD BY DESCR
	352-0430-01			1		HOLDER ASSY,PEN: ••••••••••••••(ATTACHING PARTS)••••••••••	80009	352-0430-01
-59	211-0504-00			2		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL ••••••••••••(END ATTACHING PARTS)•••••••••	83385	ORD BY DESCR
	----- -----			-		PEN ASSEMBLY INCLUDES:		
-60	352-0430-02			1		.HOLDER,PEN:4662 .••••••••••••(ATTACHING PARTS)••••••••••••	80009	352-0430-02
-61	213-0022-01			2		.SETSCREW:4-40 X 0.188 HEX SOC STL .••••••••••(END ATTACHING PARTS)•••••••••••	74445	ORD BY DESCR
-62	214-2332-00			1		.SPRING,PEN ACTR:CU BE .••••••••••••(ATTACHING PARTS)••••••••••••	80009	214-2332-00
-63	211-0069-00			2		.SCREW,MACHINE:2-56 X 0.125 INCH,PNH STL .••••••••••(END ATTACHING PARTS)•••••••••••	77250	ORD BY DESC
-64	361-0754-00			1		.SPACER,SPRING:PEN ACTUATOR,ALUMINUM .••••••••••••(ATTACHING PARTS)••••••••••••	80009	361-0754-00
-65	211-0245-00			2		.SCREW,MACHINE:2-56 X 0.562 FLH,100 DEG,ST	83385	ORD BY DESCR
-66	210-0405-00			2		.NUT,PLAIN,HEX.:2-56 X 0.188 INCH,BRS .••••••••••(END ATTACHING PARTS)•••••••••••	73743	12157-50
-67	351-0406-00			1		.SLIDE HALF,PEN: .••••••••••••(ATTACHING PARTS)••••••••••••	80009	351-0406-00
-68	211-0081-01			1		.SCREW,MACHINE:2-56 X 0.562 INCH,PNH,STL	80009	211-0081-01
-69	210-0405-00			1		.NUT,PLAIN,HEX.:2-56 X 0.188 INCH,BRS	73743	12157-50
-70	361-0680-00			1		.BUSHING,ECC: .••••••••••(END ATTACHING PARTS)•••••••••••	80009	361-0680-00
-71	348-0408-00			1		.PAD,PRESSURE:X-AXIS SLIDE	80009	348-0408-00
-72	214-2179-00			1		.SPRING,FLAT:PRESSURE PAD	80009	214-2179-00
-73	401-0279-03			2		.PULLEY,GROOVED:PLASTIC,1.0 DIA	80009	401-0279-03
-74	384-0951-00			2		.SHAFT,CAM SW:	80009	384-0951-00
-75	401-0306-02			3		.PULLEY,GROOVED:PLASTIC,0.524 DIA	80009	401-0306-02
-76	384-1272-00			2		.SHAFT,PULLEY:Y-AXIS	80009	384-1272-00
-77	386-3104-00			1		.PLATE,SL BODY:Y-AXIS	80009	386-3104-00
-78	384-1443-00			2		.SHAFT,SLIDE:12.375 L X 0.249 OD	80009	384-1443-00
-79	384-1262-00			1		SHAFT,CARRIAGE: ••••••••••••••(ATTACHING PARTS)••••••••••	80009	384-1262-00
-80	212-0557-00			2		SCREW,MACHINE:10-32 X 0.50 INCH,RDH SST	83385	ORD BY DESCR
-81	210-0010-00			2		WASHER,LOCK:#10 INTL,0.02 THK,STL ••••••••••••(END ATTACHING PARTS)•••••••••	78189	1210-00-00-0541C

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-82	352-0169-00			1		HLDR,TERM CONN:2 WIRE BLACK	80009	352-0169-00
-83	131-0707-00			2		CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	47439
-84	644-0096-01			1		SOLENOID ASSY:	80009	644-0096-01
						**********(ATTACHING PARTS)**********		
-85	220-0725-00			2		NUT,PLAIN,ROUND:0.250 X 0.250,3-48 THD	80009	220-0725-00
-86	348-0412-00			1		PAD,CUSHIONING:SHOCK MT	80009	348-0412-00
-87	380-0424-00			1		HSG,CUSHION PAD:NYLON	80009	380-0424-00
						**********(END ATTACHING PARTS)**********		
-88	358-0216-00			1		BUSHING,PLASTIC:0.257 ID X 0.412 INCH OD	80009	358-0216-00
-89	401-0279-01			2		PULLEY,GROOVED:WITH BEARING	80009	401-0279-01
						**********(ATTACHING PARTS)**********		
-90	211-0102-00			2		SCREW,MACHINE:4-40 X 0.500",FLH,STL	83385	ORD BY DESCR
-91	166-0024-00			2		SPACER,SLEEVE:0.133 ID X 0.125 INCH L,BRS	76854	3-5116-314
						**********(END ATTACHING PARTS)**********		
	105-0598-03			1		ACTR,PEN HLDR:	80009	105-0598-03
-92	401-0305-00			1		.BEARING,SLV:0.125 ID X 0.250 OD X 0.125	71041	B24-1
-93	105-0723-00			1		.STOP,ACTUATOR:MICRO SWITCH	80009	105-0723-00
						.**********(ATTACHING PARTS)**********		
-94	210-0407-00			1		.NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
						.**********(END ATTACHING PARTS)**********		
-95	644-0097-00			1		.ACTR LINK ASSY:	80009	644-0097-00
						.**********(ATTACHING PARTS)**********		
-96	211-0504-00			2		.SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	ORD BY DESCR
-97	343-0493-00			2		.RETAINER,SHAFT:	80009	343-0493-00
						.**********(END ATTACHING PARTS)**********		
-98	105-0598-01			1		.ACTR,PEN BAR:	80009	105-0598-01
						.**********(ATTACHING PARTS)**********		
-99	211-0008-00			1		.SCREW,MACHINE:4-40 X 0.250,PNH,STL,POZ	83385	ORD BY DESCR
-100	210-0994-00			1		.WASHER,FLAT:0.125 ID X 0.25" OD,STL	86928	5702-201-20
						.**********(END ATTACHING PARTS)**********		
-101	401-0301-00			1		.CAM,PEN ACTR:	80009	401-0301-00
						.**********(ATTACHING PARTS)**********		
-102	354-0390-00			2		.RING,RETAINING:0.338 ID X 0.025" THK,STL	79136	5100-37MD
-103	210-0840-00			2		.WASHER,FLAT:0.39 ID X 0.562 INCH OD,STL	89663	644R
						.**********(END ATTACHING PARTS)**********		
-104	351-0425-01			1		.SLIDE,CARRIAGE:	80009	351-0425-01
						.**********(ATTACHING PARTS)**********		
-105	211-0225-00			2		.SCR,CAP,SOC HD:4-40 X 0.312 INCH,STL	000AH	ORD BY DESCR
-106	213-0218-00			1		.SETSCREW:6-32 X 0.25 INCH,HEX SOC ST	74445	ORD BY DESCR
						.**********(END ATTACHING PARTS)**********		
-107	401-0298-00			1		.BRG,BALL,LIN MO:0.51 ID X 0.875 OD X 1.25	96881	ORD BY DESCR
-108	384-0953-00			1		SHAFT,CARRIAGE:	80009	384-0953-00
						**********(ATTACHING PARTS)**********		
-109	212-0557-00			2		SCREW,MACHINE:10-32 X 0.50 INCH,RDH SST	83385	ORD BY DESCR
-110	210-0010-00			2		WASHER,LOCK:#10 INTL,0.02 THK,STL	78189	1210-00-00-0541C
						**********(END ATTACHING PARTS)**********		
-111	426-1265-00			1		FRAME SECT,CAB.:RIGHT	80009	426-1265-00
						**********(ATTACHING PARTS)**********		
	212-0023-00			3		SCREW,MACHINE:8-32 X 0.375,PNH,STL CD PL	83385	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
-112	426-1266-00			1		FRAME SECT,CAB.:LEFT	80009	426-1266-00
						**********(ATTACHING PARTS)**********		
	212-0023-00			3		SCREW,MACHINE:8-32 X 0.375,PNH,STL CD PL	83385	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		
-113	361-0855-00			AR		SHIM:0.005 THK COPPER BERYLLIUM	80009	361-0855-00
	361-0857-00			AR		SHIM:0.010 THK COPPER BERYLLIUM	80009	361-0857-00
	361-0856-00			AR		SHIM:0.020 THK COPPER BERYLLIUM	80009	361-0856-00
	----- -----			-		(PLATTEN STRAIGHTNESS AND PEN HEIGHT SPEC)		
						**********(ATTACHING PARTS)**********		
-114	212-0518-00			AR		SCREW,MACHINE:10-32 X 0.312,PNH,STL,CD PL	83385	ORD BY DESCR
						**********(END ATTACHING PARTS)**********		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
3-1	348-0150-00			1		GROMMET,PLASTIC:U SHAPED	80009	348-0150-00
-2	343-0400-00			1		CLAMP,CABLE:1.250 INCH LONG,PLASTIC	80009	343-0400-00
						••••••••••••••(ATTACHING PARTS)••••••••••		
-3	210-0586-00			2		NUT,PL,ASSEM WA:4-40 X 0.25,STL	83385	ORD BY DESCR
						••••••••••••(END ATTACHING PARTS)•••••••••		
-4	352-0169-02			1		CONN BODY,PL,EL:2 WIRE RED	80009	352-0169-00
-5	131-0707-00			2		CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	47439
-6	175-0825-00			AR		WIRE,ELECTRICAL:2 WIRE RIBBON	80009	175-0825-00
-7	----- -----			1		SWITCH,PUSH:(SEE S1003 REPL)		
						••••••••••••••(ATTACHING PARTS)••••••••••		
-8	211-0034-00			2		SCREW,MACHINE:2-56 X 0.50 INCH,PNH	83385	ORD BY DESCR
-9	210-0405-00			4		NUT,PLAIN,HEX.:2-56 X 0.188 INCH,BRS	73743	12157-50
-10	210-0001-00			4		WASHER,LOCK:INTL,0.092 ID X 0.18"OD,ST	78189	1202-00-00-0541C
						••••••••••••(END ATTACHING PARTS)•••••••••		
-11	348-0055-00			1		GROMMET,PLASTIC:0.25 INCH DIA	80009	348-0055-00
-12	200-1867-00			1		COVER,CKT BOARD:PROTECTIVE	80009	200-1867-00
						••••••••••••••(ATTACHING PARTS)••••••••••		
-13	211-0511-00			4		SCREW,MACHINE:6-32 X 0.500,PNH,STL,CD PL	83385	ORD BY DESCR
						••••••••••••(END ATTACHING PARTS)•••••••••		
-14	352-0162-01			1		CONN BODY,PL,EL:4 WIRE BROWN	80009	352-0162-01
-15	131-0707-00			4		CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	47439
-16	175-0827-00			AR		CABLE,SP,ELEC:4,26 AWG,STRD,PVC JKT,RBN	08261	SS04267(1061)0C
-17	131-0771-00			1		CONN,RCPT,ELEC:4 CONT,QUICK DISCONNECT	91836	1904-2M58
						••••••••••••••(ATTACHING PARTS)••••••••••		
	220-0551-00			1		NUT,PLAIN,HEX.:9 MM X 0.437 INCH	73743	ORD BY DESCR
						••••••••••••(END ATTACHING PARTS)•••••••••		
	175-1936-00			1		CA ASSY,SP ELEC:20,26 AWG,13.0 LONG	80009	175-1936-00
-18	352-0453-00			2		.HLDR,TERM CONN:20 WIRES,DBL ROW,BLACK	22526	65043-075
-19	131-0707-00			40		.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	47439
-20	175-0833-00			AR		.WIRE,ELECTRICAL:10 WIRE RIBBON	08261	SS-1026-7
-21	----- -----	B030000	B039999	1		CKT BOARD ASSY:FIRMWARE PATCH(SEE A4 REPL)		
						••••••••••••••(ATTACHING PARTS)••••••••••		
-22	129-0456-00	B030000	B039999	2		SPACER,POST:0.75 L,W/4-40 STUD,TAP,BRAS	80009	129-0456-00
						••••••••••••(END ATTACHING PARTS)•••••••••		
	----- -----			-		CKT BOARD ASSY INCLUDES:		
-23	136-0578-00			3		.SKT,PL-IN ELEK:MICROCKT,24 PIN,LOW PROFIL	73803	C S9002-24
-24	385-0107-00			2		.SPACER,POST:0.75 L W/4-40 THD THRU,NYL	80009	385-0107-00
						.••••••••••••(ATTACHING PARTS)••••••••••••		
-25	211-0207-00	B010100	B057459	2		.SCR,ASSEM WSHR:4-40 X 0.312 DOUBLE SEMS	83385	ORD BY DESCR
	211-0244-00	B057460		2		.SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL	78189	ORD BY DESCR
						.••••••••••(END ATTACHING PARTS)•••••••••••		
-26	175-2062-00	B030000	B039999	1		CA ASSY,SP,ELEC:4,26 AWG,10.0 L	80009	175-2062-00
-27	131-0707-00			8		.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	47439
-28	175-0827-00			AR		.CABLE,SP,ELEC:4,26 AWG,STRD,PVC JKT,RBN	08261	SS04267(1061)0C
-29	352-0162-00			2		.HLDR,TERM CONN:4 WIRE BLACK	80009	352-0162-00
-30	175-2063-00			2		CA ASSY,SP,ELEC:34,28 AWG,10.0L	80009	175-2063-00
	----- -----			-		.EACH CABLE ASSY INCLUDES:		
-31	131-0833-00			4		.CONNECTOR,PLUG,:34 CONTACTS	77342	86987-1
	672-1030-XX			1		CKT BOARD ASSY:PLOTTER		
-32	----- -----			1		.CKT BOARD ASSY:PLOTTER(SEE A1 REPL)		
						••••••••••••••(ATTACHING PARTS)••••••••••		
-33	211-0626-00			4		SCREW,CAP:6-32 X 0.312,BTN HD,STL	56878	ORD BY DESCR
-34	211-0207-00	B010100	B057459	12		SCR,ASSEM WSHR:4-40 X 0.312 DOUBLE SEMS	83385	ORD BY DESCR
	211-0244-00	B057460		12		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL	78189	ORD BY DESCR
						••••••••••••(END ATTACHING PARTS)•••••••••		
	----- -----			-		.CKT BOARD ASSY INCLUDES:		
-35	124-0321-00			1		..TERMINAL STRIP:CIRCUIT BOARD,6 TAB	80009	124-0321-00
-36	124-0318-00			3		..TERMINAL STRIP:CIRCUIT BOARD,14 TAB	80009	124-0318-00
-37	124-0322-00			2		..TERMINAL STRIP:CIRCUIT BOARD,16 TAB	80009	124-0322-00
-38	124-0316-00			9		..TERMINAL STRIP:CIRCUIT BOARD,17 TAB	80009	124-0316-00
-39	131-0566-00			1		..BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	57668	JWW-0200E0
-40	131-0608-00			17		..TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
3-41	131-0813-00			1	..CONN,RCPT,ELEC:CKT BD,25 CONT,FEM	80009	131-0813-00
					..**********(ATTACHING PARTS)**********		
-42	131-0890-00			2	..LOCK,CONNECTOR:4-40 X 0.312 L	71468	D 20418-2
-43	210-0994-00	B010100	B010206	2	..WASHER,FLAT:0.125 ID X 0.25" OD,STL	86928	5702-201-20
					..********(END ATTACHING PARTS)**********		
-44	131-0971-00			1	..CONN,RCPT,ELEC:CKT BD MT,25 CONT,FEMALE	71468	DB25-SH
					..**********(ATTACHING PARTS)**********		
-45	131-0890-00			2	..LOCK,CONNECTOR:4-40 X 0.312 L	71468	D 20418-2
-46	210-0994-00	B010100	B010206	2	..WASHER,FLAT:0.125 ID X 0.25" OD,STL	86928	5702-201-20
					..********(END ATTACHING PARTS)**********		
-47	386-3397-00			1	..PLATE,CONN MTG:	80009	386-3397-00
-48	386-3370-01			1	..PLATE,CONN MTG:REAR,W/HARDWARE	80009	386-3370-01
-49	136-0260-02	B010100	B055624	20	..SKT,PL-IN ELEK:MICROCIRCUIT,16 DIP,LOW C	71785	133-51-92-008
-50	----- -----			1	..RELAY,ARMATURE:(SEE K706 REPL)		
-51	136-0393-00			1	..SOCKET,PLUG-IN:16 PIN	77342	27E710 W/20C250
-52	214-3047-00	B058160		1	..RTNR,ELEC RELAY:STAINLESS STEEL	77342	20C250
-53	136-0578-00	B010100	B055624	16	..SKT,PL-IN ELEK:MICROCKT,24 PIN,LOW PROFI	73803	C S9002-24
	136-0578-00	B055625	B072418	12	..SKT,PL-IN ELEK:MICROCKT,24 PIN,LOW PROFI	73803	C S9002-24
	136-0751-00	B072419		4	..SKT,PL-IN ELEK:MICROCKT,24 PIN	09922	DILB24P108
-54	136-0623-00	B010100	B072418	1	..SOCKET,PLUG-IN:40 DIP,LOW PROFILE	73803	CS9002-40
	136-0756-00	B055625		16	..SKT,PL-IN ELEK:MICROCIRCUIT,18 DIP	09922	DILB18P-108
-55	----- -----			16	..TRANSISTOR:(SEE Q81,Q91,Q94,Q181,Q191,		
	----- -----			-	..Q193,Q291,Q481,Q581,Q584,Q587,Q593,Q596,		
	----- -----			-	..Q691,Q785,Q793 REPL)		
					..**********(ATTACHING PARTS)**********		
-56	211-0097-00			16	..SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	ORD BY DESCR
-57	210-0406-00			16	..NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	12161-50
-58	210-1122-00			16	..WASHER,LOCK:0.12 ID,DISHED,0.025 THK	86928	ORD BY DESCR
					..********(END ATTACHING PARTS)**********		
-59	131-0993-00			1	..BUS,CONDUCTOR:2 WIRE BLACK	00779	850100-01
-60	----- -----			1	.CKT BOARD ASSY:SYSTEM MEMORY(SEE A5 REPL)		
-61	131-0993-00			4	..BUS,CONDUCTOR:2 WIRE BLACK	00779	850100-01
-62	136-0743-00			5	..SKT,PL-IN ELEK:MICROCKT,24 PIN,LOW PROFI	00779	640361-1
-63	129-0888-00			1	.SPACER,POST:1.0 L W/4-40 THD ONE END	80009	129-0888-00
-64	211-0244-00			1	.SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL	78189	ORD BY DESCR
-65	175-2236-00			2	.CA ASSY,SP,ELEC:34,28 AWG,7.0 L	22526	80504-001
-66	198-4504-00			1	.WIRE SET,ELEC:	80009	198-4504-00
-67	175-0861-00			AR	..WIRE,ELECTRICAL:4 WIRE RIBBON	08261	SS-0422-7(1061)
-68	131-0707-00			8	..CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOL	22526	47439
-69	352-0501-00			2	..HLDR,TERM CONN:8 WIRE,DBL ROW,BLACK		
-70	129-0583-00			3	SPACER,POST:0.59 L,W/4-40 THD,PLSTC	80009	129-0583-00
-71	129-0763-00			3	SPACER,POST:1.196 L,4-40 INT,EXT THD	80009	129-0763-00
-72	210-0004-00			3	WASHER,LOCK:#4 INTL,0.015 THK,STL CD PL	000BK	ORD BY DESCR
-73	200-0582-00	B010100	B045144	1	CAP,ELECTRICAL:FUSE HOLDER	71400	9435 1/2
	200-2264-00	B045145		1	CAP.,FUSEHOLDER:3AG FUSES	S3629	FEK 031 1666
-74	200-0237-03	B010100	B056819	1	COVER,FUSE HLDR:	80009	200-0237-03
	200-0237-04	B056820		1	COVER,FUSE HLDR:PLASTIC,SAFETY CONTROLLED	80009	200-0237-04
-75	352-0010-00	B010100	B045144	1	FUSEHOLDER:WITH HARDWARE	03614	HKP-L
	204-0832-00	B045145		1	BODY,FUSEHOLDER:3AG,5 X 20MM FUSES	S3629	031.1673(MDLFEU)
-76	210-0873-00			1	WASHER,NONMETAL:0.5 ID X 0.688 INCH OD,NPR	70485	ORD BY DESCR
-77	210-1039-00	B045145		1	WASHER,LOCK:INT,0.521 ID X 0.625 INCH O	24931	ORD BY DESCR
-78	334-3379-02	B045145		1	MARKER,IDENT:MARKED GROUND SYMBOL	80009	334-3379-02
-79	----- -----			1	FILTER,RFI:(SEE FL1001 REPL)		
					**********(ATTACHING PARTS)**********		
-80	211-0198-00			2	SCREW,MACHINE:4-40 X 0.438 PNH,STL,POZ	77250	ORD BY DESCR
-81	210-0586-00			2	NUT,PL,ASSEM WA:4-40 X 0.25,STL	83385	ORD BY DESCR
					**********(END ATTACHING PARTS)*********		
-82	334-2332-00			1	MARKER,IDENT:DANGER-VOLTAGE IN THIS AREA	80009	334-2332-00
-83	334-2558-00	B010100	B045064	1	MARKER,IDENT:MARKED 115V	80009	334-2558-00
	334-2558-01	B045065	B059614	1	MARKER,IDENT:MARKED 104V,50HZ	80009	334-2558-01
	334-2560-00	B010100	B045064	1	MARKER,IDENT:MARKED 230V	80009	334-2560-00
	334-2560-01	B045065	B059614	1	MARKER,IDENT:MARKED 110V,50HZ	80009	334-2560-01
-84	131-1864-00			2	LINK,TERM.CONNE:2.22 AWG,3.75	80009	131-1864-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
3-85	352-0199-02			1		CONN BODY,PL,EL:3 WIRE RED	80009	352-0199-02
-86	131-0621-00			3		CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	46231
-87	131-1041-00			4		CONTACT,ELEC:QUICK DISCONNECT	00779	61060-2
-88	----- -----			1		XFMR,PWR,STPDN:(SEE T1001 REPL)		
						••••••••••••••(ATTACHING PARTS)••••••••••••		
-89	212-0023-00			4		SCREW,MACHINE:8-32 X 0.375,PNH,STL CD PL	83385	ORD BY DESCR
-90	212-0509-00			2		SCREW,MACHINE:10-32 X 0.625 INCH,PNH STL	83385	ORD BY DESCR
-91	210-1024-00	B010100	B042869	2		WASHER,LOCK:INT,0.20 ID X0.376" OD,STL	78189	1210-00-00-0541C
	210-1008-00	B042870		2		WASHER,FLAT:0.09 ID X 0.188" OD,BRS	12360	ORD BY DESCR
-92	129-0606-00	B010100	B051614	2		SPACER,POST:0.9 L,W/10-32 THRU THD,AL	80009	129-0606-00
	384-0632-00	B051615		2		POST,ELEC-MECH:0.375 X 1.109" LONG,10-32	80009	384-0632-00
						••••••••••••(END ATTACHING PARTS)•••••••••		
-93	210-0202-00			2		TERMINAL,LUG:0.146 ID,LOCKING,BRZ TINNED	78189	2104-06-00-2520N
						••••••••••••••(ATTACHING PARTS)••••••••••		
-94	211-0504-00			1		SCREW,MACHINE:6-32 X 0.25 INCH,PNH STL	83385	ORD BY DESCR
						••••••••••••(END ATTACHING PARTS)•••••••••		
-95	343-0401-01			2		RETAINER,CLIP:W/ADHESIVE BACK,GRAY	80009	343-0401-01
-96	175-1937-00			1		CA ASSY,SP ELEC:20,26 AWG,4.0 LONG	80009	175-1937-00
-97	352-0330-02			2		.HLDR,TERM. CONN:DBL ROW,10 FEMALE PINS	80009	352-0330-02
-98	131-0707-00			40		.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	47439
-99	175-0833-00			FT		.WIRE,ELECTRICAL:10 WIRE RIBBON	08261	SS-1026-7
-100	----- -----			1		CKT BOARD ASSY:POWER SUPPLY(SEE A3 REPL)		
						••••••••••••••(ATTACHING PARTS)••••••••••		
-101	211-0510-00			4		SCREW,MACHINE:6-32 X 0.375,PNH,STL,CD PL	83385	ORD BY DESCR
						••••••••••••(END ATTACHING PARTS)•••••••••		
	----- -----			-		CKT BOARD ASSY INCLUDES:		
-102	----- -----			3		.TRANSISTORS:(SEE Q51,Q451,Q651 REPL)		
						.••••••••••••(ATTACHING PARTS)••••••••••		
-103	211-0025-00			1		.SCREW,MACHINE:4-40 X 0.375 100 DEG,FLH ST	83385	ORD BY DESCR
-104	210-0406-00			1		.NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	12161-50
-105	210-1122-00			1		.WASHER,LOCK:0.12 ID,DISHED,0.025 THK	86928	ORD BY DESCR
						.••••••••••(END ATTACHING PARTS)•••••••••		
-106	----- -----			1		.TRANSISTOR:(SEE Q151 REPL)		
						.••••••••••••(ATTACHING PARTS)••••••••••		
-107	211-0025-00			1		.SCREW,MACHINE:4-40 X 0.375 100 DEG,FLH ST	83385	ORD BY DESCR
-108	210-0406-00			1		.NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	12161-50
-109	210-1171-00			1		.WSHR,SHOULDERED:0.116 ID X 0.138 INCH OD	52905	A7148516P2
						.••••••••••(END ATTACHING PARTS)•••••••••		
-110	342-0202-00			4		.INSULATOR,PLATE:TRANSISTOR	01295	10-21-023-106
-111	----- -----			1		.SEMICOND DEVICE:(SEE CR51 REPL)		
						.••••••••••••(ATTACHING PARTS)••••••••••		
-112	211-0114-00			1		.SCREW,MACHINE:4-40 X 0.438 INCH,FLH STL	83385	ORD BY DESCR
-113	210-0406-00			1		.NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	12161-50
-114	210-1122-00			1		.WASHER,LOCK:0.12 ID,DISHED,0.025 THK	86928	ORD BY DESCR
						.••••••••••(END ATTACHING PARTS)•••••••••		
-115	----- -----			1		.CKT BOARD ASSY:POWER SUPPLY(SEE A3 REPL)		
						.••••••••••••(ATTACHING PARTS)••••••••••••		
-116	211-0207-00	B010100	B057459	4		.SCR,ASSEM WSHR:4-40 X 0.312 DOUBLE SEMS	83385	ORD BY DESCR
	211-0244-00	B057460		4		.SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL	78189	ORD BY DESCR
						.••••••••••(END ATTACHING PARTS)•••••••••		
	----- -----			-		.CKT BOARD ASSEMBLY INCLUDES		
-117	131-0589-00			35		..TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
-118	136-0252-00			6		..SOCKET,PIN TERM:0.145 INCH LONG	00779	2-330808-7
	136-0352-00	B010100	B085103	8		..CONTACT,ELEC:FOR 0.02 INCH DIAMETER PIN	00779	50462-7
	136-0352-00	B085104		10		..CONTACT,ELEC:FOR 0.02 INCH DIAMETER PIN	00779	50462-7
-119	----- -----			1		..CAP.,FXD,ELCTLT:(SEE C1 REPL)		
						..••••••••••(ATTACHING PARTS)••••••••••••		
-120	212-0535-00			2		..SCREW,MACHINE:10-32 X 0.312 INCH,TRH ST	83385	ORD BY DESCR
-121	129-0574-00			2		..SPACER,POST:0.625 L,W/10-32 THD ONE END	80009	129-0574-00
						..••••••••(END ATTACHING PARTS)••••••••••		
	----- -----			-		..CAPACITOR INCLUDES:		
-122	210-0206-00			2		...TERMINAL,LUG:SE #10	86928	A373-147-1
-123	212-0040-00			2		...SCREW,MACHINE:8-32 X 0.375 100 DEG,FLH	83385	ORD BY DESCR
-124	407-1722-00	B010100	B043694	1		.BRKT,POWER SPLY:ALUMINUM	80009	407-1722-00
	407-1722-01	B043695		1		.BRKT,POWER SPLY:ALUMINUM	80009	407-1722-01

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
3-125	348-0178-00			4		BUMPER,PLASTIC:2.0 W X 0.40 INCH H	80009	348-0178-00
						••••••••••••••(ATTACHING PARTS)••••••••••••		
-126	213-0054-00			2		SCR,TPG,THD FOR:6-32 X 0.312 INCH,PNH STL	93907	ORD BY DESCR
-127	210-0803-00			2		WASHER,FLAT:0.15 ID X 0.032 THK,STL CD	12327	ORD BY DESCR
						••••••••••••(END ATTACHING PARTS)•••••••••		
-128	348-0177-00			4		PAD,CABINET FT:1.25 W X 0.50 INCH H	80009	348-0177-00
-129	432-0106-01			1		BASE,PLOTTER:	80009	432-0106-01
-130	012-0714-00			1		CABLE,INTCON:240.0 L	80009	012-0714-00
						(4662 OPT 30,ALSO SEE 4081)		
						••••••••••••••(ATTACHING PARTS)••••••••••••		
-131	210-0457-00			1		NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	ORD BY DESCR
-132	210-0863-00			1		WSHR,LOOP CLAMP:0.187 ID U/W 0.5 W CLP,STL	95987	C191
-133	343-0662-00			1		CLAMP,LOOP:0.187 DIA,STEEL CAD PLATE	80009	343-0662-00

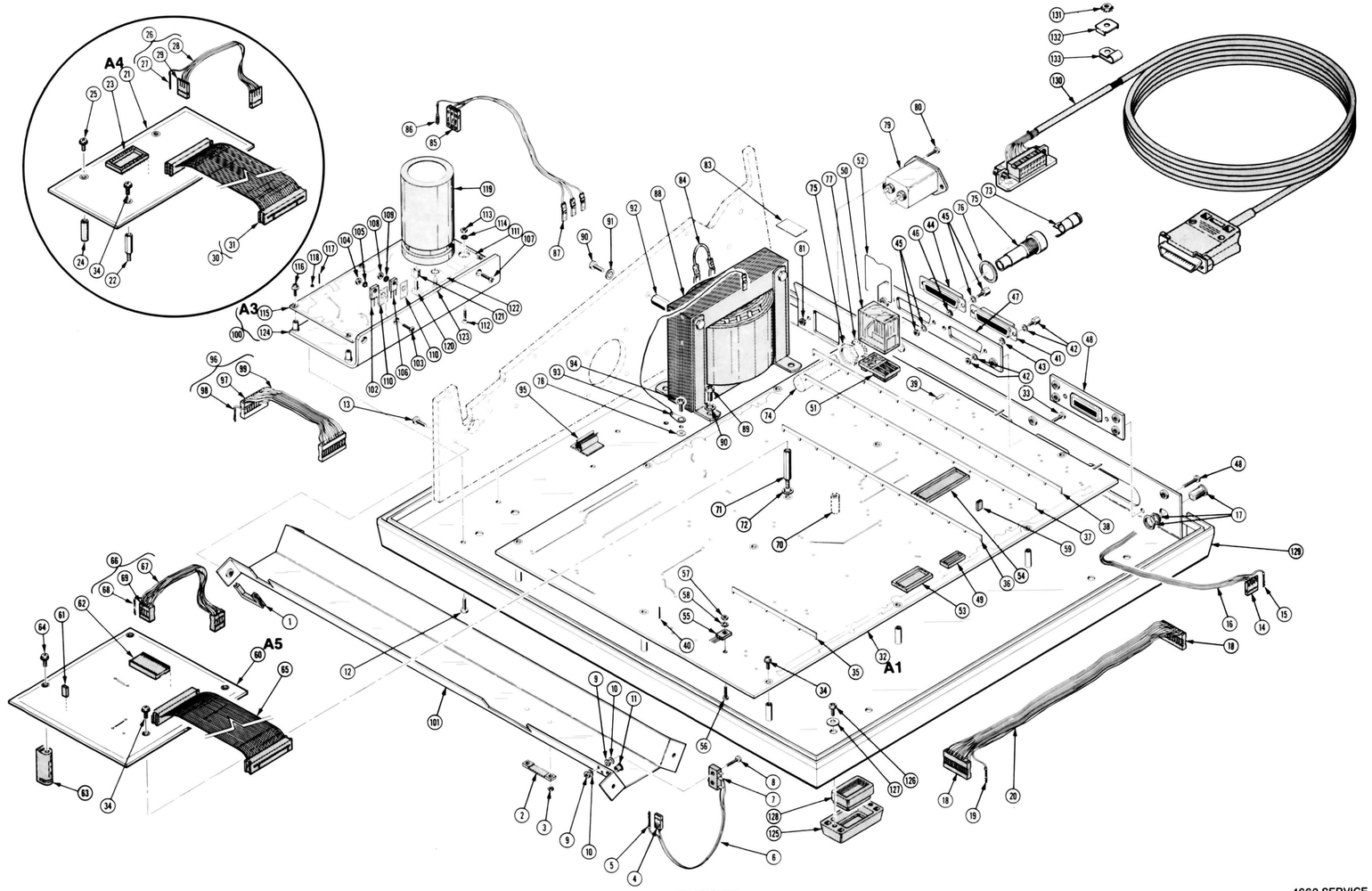


FIG 3 CIRCUIT BOARDS & CHASSIS

FIG 4 OPTION 31

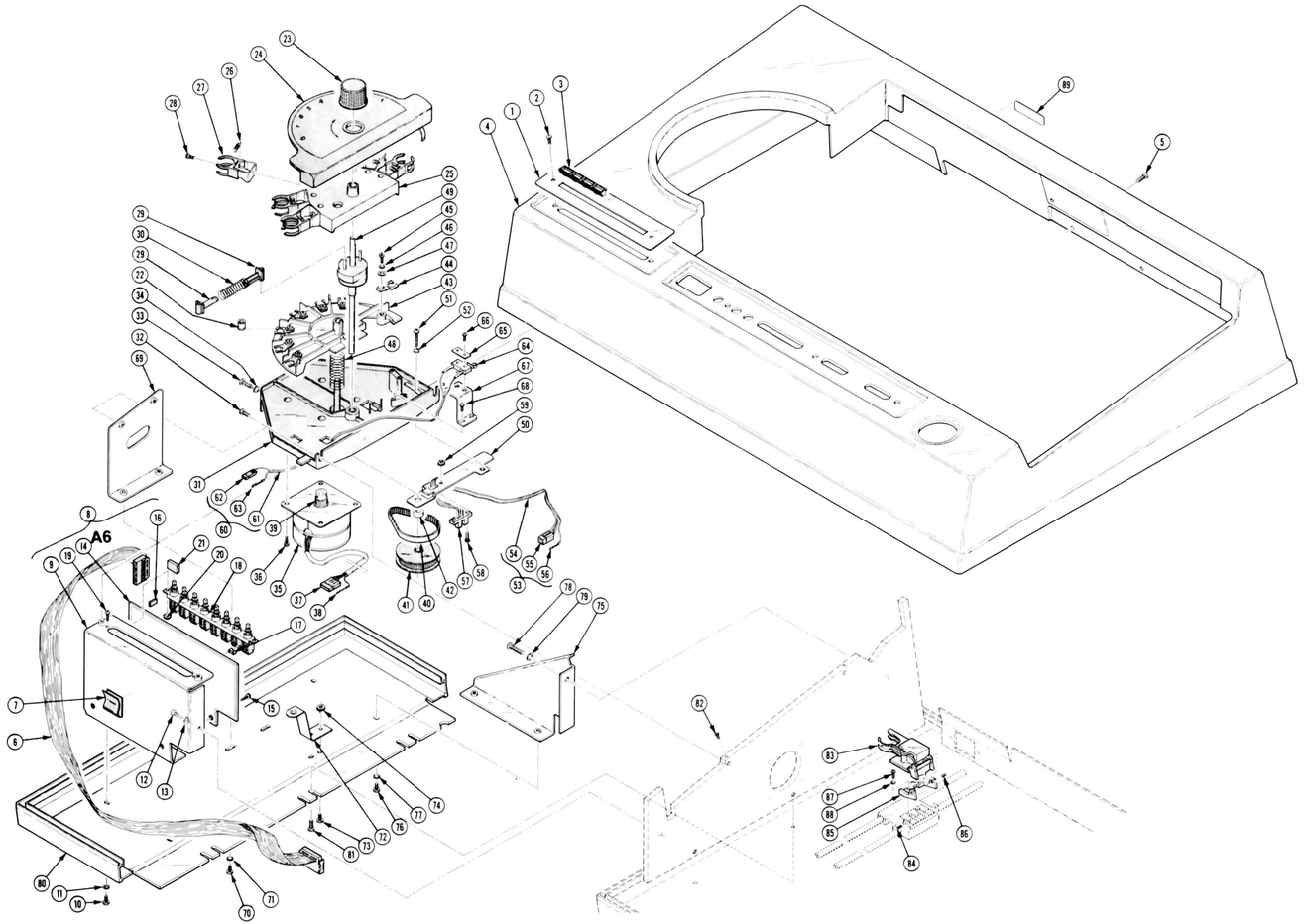


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
4-1	333-2772-00			1		PANEL,PEN SEL:	80009	333-2772-00
						••••••••••••(ATTACHING PARTS)••••••••••		
-2	211-0626-00			2		SCREW,CAP:6-32 X 0.312,BTN HD,STL	56878	ORD BY DESCR
						••••••••••••(END ATTACHING PARTS)•••••••••		
-3	426-1628-00			2		FRAME,PB:PLASTIC,SILVER GRAY	80009	426-1628-00
-4	380-0663-00			1		HOUSING,PLOTTER:	80009	380-0663-00
						••••••••••••(ATTACHING PARTS)••••••••••		
-5	211-0626-00			3		SCREW,CAP:6-32 X 0.312,BTN HD,STL	56878	ORD BY DESCR
						••••••••••••(END ATTACHING PARTS)•••••••••		
-6	175-4162-00			1		CA ASSY,SP,ELEC:20,28 AWG,23.0 L,RIBBON	000EO	ORD BY DESCR
-7	343-0775-00			3		CLIP,SPR TNSN:	52152	3484-1000
-8	----- -----			1		CKT BOARD ASSY:PEN TURRET DRIVE(SEE A6 REP		
-9	407-2697-00			1		.BRACKET,SWITCH:ALUMINUM	80009	407-2697-00
						.••••••••••••(ATTACHING PARTS)••••••••••		
-10	211-0510-00			2		SCREW,MACHINE:6-32 X 0.375,PNH,STL,CD PL	83385	ORD BY DESCR
-11	210-0006-00			2		WASHER,LOCK:#6 INTL,0.018 THK,STL CD PL	78189	1206-00-00-0541C
-12	212-0509-00			1		SCREW,MACHINE:10-32 X 0.625 INCH,PNH STL	83385	ORD BY DESCR
-13	210-0010-00			1		WASHER,LOCK:#10 INTL,0.02 THK,STL	78189	1210-00-00-0541C
						••••••••••••(END ATTACHING PARTS)•••••••••		
	----- -----			-		CKT BOARD ASSY INCLUDES:		
-14	----- -----			1		.CKT BOARD ASSY:(SEE A6 REPL)		
						.••••••••••••(ATTACHING PARTS)••••••••••		
-15	211-0244-00			2		.SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL	78189	ORD BY DESCR
						.••••••••••(END ATTACHING PARTS)•••••••••••		
	----- -----			-		CKT BOARD ASSY INCLUDES:		
-16	131-0993-00			1		..BUS,CONDUCTOR:2 WIRE BLACK	00779	850100-01
-17	361-0411-00			6		..SPACER,PUSH SW:0.13 W X 0.375 INCH L,PLS	71590	J64285-00
-18	----- -----			1		..SWITCH ASSY:(SEE A6 REPL)		
						..••••••••••(ATTACHING PARTS)••••••••••••		
-19	211-0097-00			2		.SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	ORD BY DESCR
-20	210-0586-00			2		.NUT,PL,ASSEM WA:4-40 X 0.25,STL	83385	ORD BY DESCR
						.••••••••••(END ATTACHING PARTS)•••••••••••		
-21	366-1161-00			8		PUSH BUTTON:SIL GRAY,0.523 X 0.253 X 0.	80009	366-1161-00
-22	200-2630-00			8		CAP,PEN:		
-23	366-2019-00			1		KNOB:SILVER GRAY,VERT,0.252 ID X 1.17 OD	80009	366-2019-00
-24	200-2659-01			1		COVER,PEN HLDR:PLASTIC		
-25	214-3218-00			1		HUB,PEN HOLDER:		
-26	214-3314-00			8		SPRING,HLEXT:0.14 OD X 0.25L,XLOOP,STL		
-27	352-0640-00			8		KEEPER,PEN:		
						••••••••••••(ATTACHING PARTS)••••••••••		
-28	211-0595-00			8		SCR,CAP,SOC HD:	70276	ORD BY DESCR
						••••••••••••(END ATTACHING PARTS)•••••••••		
-29	351-0690-00			1		GUIDE,SPRING:PLASTIC		
-30	214-3332-00			1		SPRING,HLCPS:0.41 OD X 1.75 L		
-31	407-2743-00			1		BRACKET,CMPNT:PEN STABLE,AL		
						••••••••••••(ATTACHING PARTS)••••••••••		
-32	212-0023-00			2		SCREW,MACHINE:8-32 X 0.375,PNH,STL CD PL	83385	ORD BY DESCR
-33	211-0510-00			2		SCREW,MACHINE:6-32 X 0.375,PNH,STL,CD PL	83385	ORD BY DESCR
-34	210-0803-00			2		WASHER,FLAT:0.15 ID X 0.032 THK,STL CD	12327	ORD BY DESCR
						••••••••••••(END ATTACHING PARTS)•••••••••		
-35	147-0056-01			1		MOTOR,DC:7.5 DEG STEP ANGLE,48 STEPS	80009	147-0056-01
						••••••••••••(ATTACHING PARTS)••••••••••		
-36	211-0595-00			4		SCR,CAP,SOC HD:	70276	ORD BY DESCR
						••••••••••••(END ATTACHING PARTS)•••••••••		
	----- -----			-		MOTOR INCLUDES:		
-37	352-0162-04			1		.CONN BODY,PL,EL:4 WIRE YELLOW	80009	352-0162-04
-38	131-0707-00			4		.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	47439
-39	401-0186-03			1		SPROCKET WHEEL:W/BUSHING	80009	401-0186-03
-40	214-1865-00			1		BELT,POS DRIVE:81 TOOTH,6.61 L X 0.25 W	000EZ	ORD BY DESCR
-41	401-0403-01			1		SPROCKET WHEEL:W/FLANGE	80009	401-0403-01
-42	358-0670-00			1		BUSHING,SHAFT:0.253 ID X 0.302 THK,BRASS	80009	358-0670-00
-43	386-4690-00			1		PL,PEN CAPPING:		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
4-44	352-0656-00			8		HOLDER,PEN CAP:ALUMINUM	80009	352-0656-00
						••••••••••••••(ATTACHING PARTS)••••••••••		
-45	211-0595-00			8		SCR,CAP,SOC HD:	70276	ORD BY DESCR
-46	210-0006-00			8		WASHER,LOCK:#6 INTL,0.018 THK,STL CD PL	78189	1206-00-00-0541C
-47	210-0803-00			8		WASHER,FLAT:0.15 ID X 0.032 THK,STL CD	12327	ORD BY DESCR
						••••••••••••(END ATTACHING PARTS)•••••••••		
-48	214-3271-00			1		SPRING,HLCPS:0.5 OD X 2.75 L,CLOSED ENDS		
-49	384-1622-00			1		SFT,PEN STABLE:W/CAM,ZYTEL BLACK		
-50	407-2724-00			1		BRKT,OPT INTERR:STEEL	80009	407-2724-00
						••••••••••••••(ATTACHING PARTS)••••••••••		
-51	211-0513-00			1		SCREW,MACHINE:6-32 X 0.625 INCH,PNH STL	83385	ORD BY DESCR
-52	210-0803-00			1		WASHER,FLAT:0.15 ID X 0.032 THK,STL CD	12327	ORD BY DESCR
						••••••••••••(END ATTACHING PARTS)•••••••••		
-53	175-4756-00			1		CA ASSY,SP,ELEC:2,26 AWG,13.0 L,RIBBON	80009	175-4756-00
-54	175-0827-00			AR		.CABLE,SP,ELEC:4,26 AWG,STRD,PVC JKT,RBN	08261	SS04267(1061)0C
-55	352-0176-00			1		.CONN BODY,PL,EL:4 WIRE,DBL ROW BLACK	80009	352-0176-00
-56	131-0707-00			8		.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	47439
-57	156-1237-01			1		.MICROCIRCUIT,LI:OPTICAL INTERRUPTER,AIR G		
						.••••••••••••(ATTACHING PARTS)••••••••••		
-58	211-0012-00			2		SCREW,MACHINE:4-40 X 0.375,PNH STL CD PL	83385	ORD BY DESCR
-59	210-0586-00			2		NUT,PL,ASSEM WA:4-40 X 0.25,STL	83385	ORD BY DESCR
						••••••••••••(END ATTACHING PARTS)•••••••••		
-60	198-4501-00			1		WIRE SET,ELEC:	80009	198-4501-00
-61	175-0825-00			AR		.WIRE,ELECTRICAL:2 WIRE RIBBON	80009	175-0825-00
-62	352-0169-02			1		.CONN BODY,PL,EL:2 WIRE RED	80009	352-0169-00
	----- -----			-		.(A6P231)		
-63	131-0707-00			2		.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	47439
-64	260-1748-00			1		.SWITCH,PUSH:SPDT,0.1A,125VAC,LVR ACTR	01963	E63-02HB
-65	407-2814-00			1		BRACKET,SWITCH:ALUMINUM	80009	407-2814-00
						••••••••••••••(ATTACHING PARTS)••••••••••		
-66	211-0185-00			2		SCREW,MACHINE:2-56 X 0.438",PNH,STL	07111	ORD BY DESCR
						••••••••••••(END ATTACHING PARTS)•••••••••		
-67	407-2785-00			1		BRACKET,SWITCH:STEEL	80009	407-2785-00
						••••••••••••••(ATTACHING PARTS)••••••••••		
-68	211-0717-00			2		SCREW,MACHINE:6-32 X 0.312,PNH,SST,SLOT	T0433	ORD BY DESCR
						••••••••••••(END ATTACHING PARTS)•••••••••		
-69	407-2733-00			1		BRACKET,SUPPORT:CENTER,EXTENSION,ALUMINUM	80009	407-2733-00
						••••••••••••••(ATTACHING PARTS)••••••••••		
-70	211-0510-00			2		SCREW,MACHINE:6-32 X 0.375,PNH,STL,CD PL	83385	ORD BY DESCR
-71	210-0006-00			2		WASHER,LOCK:#6 INTL,0.018 THK,STL CD PL	78189	1206-00-00-0541C
						••••••••••••(END ATTACHING PARTS)•••••••••		
-72	344-0341-01			1		CLIP,GROUNDING:SST		
						••••••••••••••(ATTACHING PARTS)••••••••••		
-73	211-0507-00			2		SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	ORD BY DESCR
-74	210-0457-00			2		NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	ORD BY DESCR
						••••••••••••(END ATTACHING PARTS)•••••••••		
-75	407-2699-00			1		BRACKET,SUPPORT:REAR,ALUMINUM	80009	407-2699-00
						••••••••••••••(ATTACHING PARTS)••••••••••		
-76	211-0510-00			2		SCREW,MACHINE:6-32 X 0.375,PNH,STL,CD PL	83385	ORD BY DESCR
-77	210-0006-00			2		WASHER,LOCK:#6 INTL,0.018 THK,STL CD PL	78189	1206-00-00-0541C
-78	212-0509-00			1		SCREW,MACHINE:10-32 X 0.625 INCH,PNH STL	83385	ORD BY DESCR
-79	210-0010-00			1		WASHER,LOCK:#10 INTL,0.02 THK,STL	78189	1210-00-00-0541C
-80	432-0139-00			1		EXT,PLOTTER BAS:ALUMINUM	80009	432-0139-00
						••••••••••••••(ATTACHING PARTS)••••••••••		
-81	212-0008-00			3		SCREW,MACHINE:8-32 X 0.500 INCH,PNH STL	83385	ORD BY DESCR
						••••••••••••(END ATTACHING PARTS)•••••••••		
-82	211-0310-00			2		SCREW,MACHINE:4-40 X 0.156,BTN HD,STEEL	000EL	ORD BY DESCR
-83	352-0635-01			1		HOLDER,PEN ASSY:W/RETAINER	80009	352-0635-01
						••••••••••••••(ATTACHING PARTS)••••••••••		
-84	213-0022-01			2		SETSCREW:4-40 X 0.188 HEX SOC STL	74445	ORD BY DESCR
						••••••••••••(END ATTACHING PARTS)•••••••••		
-85	103-0239-00			1		ADAPTER,PIVOT:PEN HOLDER,PLASTIC	80009	103-0239-00
						••••••••••••••(ATTACHING PARTS)••••••••••		
-86	213-0048-00			2		SETSCREW:4-40 X 0.125 INCH,HEX SOC S	74445	ORD BY DESCR
-87	211-0118-00			2		SCREW,MACHINE:2-56 X 0.250 INCH,PNH STL	83385	ORD BY DESCR
-88	210-0053-00			2		WASHER,LOCK:INTL,0.092 ID X 0.175"OD,S	83385	ORD BY DESCR
						••••••••••••(END ATTACHING PARTS)•••••••••		
-89	334-1377-04			1		MARKER,IDENT:MARKED IDENTIFICATION NO.	80009	334-1377-04

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
						STANDARD ACCESSORIES		
5-1	161-0066-00			1		CABLE ASSY,PWR,:3,18 AWG,115V,98.0 L	T1372	ORD BY DESCR
-2	161-0066-09	B059895		1		CABLE ASSY,PWR:3,0.75MM SQ,220V,96.0 L	S3109	ORD BY DESCR
	----- -----			-		(OPTION A1 EUROPEAN)		
-3	161-0066-10	B059895		1		CABLE ASSY,PWR:3,0.75MM SQ,240V,96.0 L	S3109	ORD BY DESCR
	----- -----			-		(OPTION A2 UNITED KINGDOM)		
-4	161-0066-11	B059895		1		CABLE ASSY,PWR:3,0.75MM,240V,96.0L	S3109	1600
	----- -----			-		(OPTION A3 AUSTRALIAN)		
-5	334-3995-00	B059895		1		MARKER,IDENT:MARKED CAUTION	80009	334-3995-00
	----- -----			-		(OPTION A3 ONLY)		
-6	161-0066-12	B059895		1		CABLE ASSY,PWR:3,18 AWG,240V,96.0 L	T1105	ORD BY DESCR
	----- -----			-		(OPTION A4 NORTH AMERICAN)		
-7	012-0690-00	B010100	B045874	1		CABLE,INTCON:180.0 L	80009	012-0690-00
	012-0690-01	B045875	B072588	1		CABLE,INTCON:180.0 L	80009	012-0690-01
	012-0829-00	B072589		1		CABLE,INTCON:180.0 L	80009	012-0829-00
-8	016-0589-00			1		PEN,RECORDER:RED,DISPOSABLE 3/PACKAGE	32674	82-17-0012-03
	016-0589-01			1		PEN,RECORDER:GREEN,DISPOSABLE 3/PACKAGE	32674	82-17-0014-03
	016-0589-02			1		PEN,RECORDER:BLACK,DISPOSABLE 3/PACKAGE	32674	82-17-0011-03
	016-0589-03			1		PEN,RECORDER:BLUE,DISPOSABLE 3/PACKAGE	32674	82-17-0013-03
-9	214-2409-01	B010100	B056899	1		SIGHT,DIGITIZER:PEN,W/O RING	80009	214-2409-01
	214-2409-02	B056900		1		SIGHT,DIGITIZER:THREADED	80009	214-2409-02
-10	214-2409-00			1		.SIGHT,DIGITIZIN:PEN	80009	214-2409-00
-11	354-0537-00			1		.PACKING,PREFMD:0.25 ID X 0.062 DIA XSECT	83259	2-010-C557
	070-4165-00			1		MANUAL,TECH:OPERATORS	80009	070-4165-00
	070-4164-00			1		MANUAL,TECH:PROGRAMMER REFERENCE	80009	070-4164-00
	070-2556-00	B045555		1		CARD INFO:OPERATORS	80009	070-2556-00
	006-1698-00			1		CHART,RCDC INST:11 X 16.5",10 X 10 TO 1" S	91741	GCHT-13 OBD
						STANDARD ACCESSORIES FOR OPT 31 ONLY		
	016-0687-00			2		PEN SET,RCDR:9 ASRT COLORS,FIBER TIP	17405	581-17
-12	119-1432-01			1		DIGITIZER:	80009	119-1432-01
-13	103-0229-00			8		ADAPTER,PEN:NYLON		
	006-2410-00			1		PPR,CHART RCDG:11.0 X 16.0,4662,BOX OF 100	91741	ORD BY DESCR

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
						OPTIONAL ACCESSORIES STANDARD 4662		
	016-0428-00			1		INK,WRITING:BLACK,USE ON PAPER	000HA	3074F1
	016-0427-00			1		INK,WRITING:BLACK,USE ON MYLAR	000HH	3000F BLACK
	016-0423-00			1		INK,WRITING:BROWN,USE ON MYLAR	000HH	3000F BROWN
	016-0426-00			1		INK,WRITING:RED,USE ON MYLAR	000HH	3000F RED
	016-0424-00			1		INK,WRITING:GREEN,USE ON MYLAR	000HH	3000F GREEN
	016-0425-00			1		INK,WRITING:BLUE,USE ON MYLAR	000HH	3000F BLUE
	016-0445-00			1		PEN,POINT:63TB-0		
	016-0446-00			1		PEN,POINT:63TB-1		
	016-0447-00			1		PEN,POINT:63TB-2		
	016-0448-00			1		PEN,POINT:7002TB-0		
	016-0449-00			1		PEN,POINT:7002TB-1		
	016-0450-00			1		PEN,POINT:7002TB-2		
	016-0648-00			1		PEN,RECORDER:BLACK,PKG OF 3	32674	35490-000
	016-0648-01			1		PEN,RECORDER:BROWN,PKG OF 3	32674	35490-000
	016-0648-02			1		PEN,RECORDER:RED,PKG OF 3	32674	35490-000
	016-0648-03			1		PEN,RECORDER:ORANGE,PKG OF 3	32674	35490-000
	016-0648-04			1		PEN,RECORDER:YELLOW,PKG OF 3	32674	35490-000
	016-0648-05			1		PEN,RECORDER:GREEN,PKG OF 3	32674	35490-000
	016-0648-06			1		PEN,RECORDER:BLUE,PKG OF 3	32674	35490-000
	016-0648-07			1		PEN,RECORDER:PURPLE,PKG OF 3	32674	35490-000
	016-0648-08			1		PEN,RECORDER:MAGENTA,PKG OF 3	32674	35490-000
	006-1699-00			1		CHART,RCDG INST:11 X 16.5",10 X 10 TO 1CM,	91741	GCHT-13 OBD
	----- -----			-		.TH LINES ACCENTED,10 LINES HEAVY		
	006-1700-00			1		CHART,RCDG INST:SEMI-LOG,10 INCH X 3 CYCLE		
	006-1701-00			1		CHART,RCDG INST:11 X 16.5",2 CYCLES X 15"	91741	GCHT-13 OBD
	----- -----			-		TO TO 1",5TH LINES ACCENTED,10TH LINES HEA		
	006-1702-00			1		CHART,RCDG INST:11 X 16.5",2 CYCLES X 3 CY	91741	GCHT-13 OBD
	006-2410-00			1		PPR,CHART RCDG:11.0 X 16.0,4662,BOX OF 100	91741	ORD BY DESCR
	----- -----			-		BINDER HOLES		
	016-0345-00			1		COVER,PROT:	80009	016-0345-00
	012-0630-03			1		CABLE,INTCON:2 METERS L	74868	AC30147-102
	070-1933-01			1		MANUAL,TECH:SERVICE	80009	070-1933-01
	161-0099-00			1		CABLE ASSY,PWR:96.0"L,250V W/MALE CONN	80009	161-0099-00
	260-1872-01			1		SWITCH,FOOT:W/CABLE & CONNECTOR	80009	260-1872-01

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
						OPTIONAL ACESSORIES FOR OPTION 31 ONLY		
	016-0462-00			1		COVER,PROT:		
	016-0414-00			1		PEN,RECORDER:BLACK,PKG OF 3	32674	581-16
	016-0415-00			1		PEN,RECORDER:RED,PKG OF 3	32674	581-17
	016-0416-00			1		PEN,RECORDER:BLUE,PKG OF 3	32674	581-15
	016-0417-00			1		PEN,RECORDER:GREEN,PKG OF 3	32674	581-18
	016-0682-00			1		PEN,RECORDER:BROWN,FIBER TIP,PKG OF 3		
	016-0683-00			1		PEN,RECORDER:ORANGE,FIBER TIP,PKG OF 3		
	016-0684-00			1		PEN,RECORDER:YELLOW,FIBER TIP,PKG OF 3		
	016-0685-00			1		PEN,RECORDER:PURPLE,FIBER TIP,PKG OF 3		
	016-0686-00			1		PEN,RECORDER:MAGENTA,FIBER TIP,PKG OF 3		
	016-0418-00			1		PEN,RECORDER:BLACK,FIBER TIP,PKG OF 3	80009	016-0418-00
	016-0418-01			1		PEN,RECORDER:BROWN,FIBER TIP,PKG OF 3	80009	016-0418-01
	016-0418-02			1		PEN,RECORDER:RED,FIBER TIP,PKG OF 3	80009	016-0418-02
	016-0418-03			1		PEN,RECORDER:ORANGE,FIBER TIP,PKG OF 3	80009	016-0418-03
	016-0418-04			1		PEN,RECORDER:YELLOW,FIBER TIP,PKG OF 3	80009	016-0418-04
	016-0418-05			1		PEN,RECORDER:GREEN,FIBER TIP,PKG OF 3	80009	016-0418-05
	016-0418-06			1		PEN,RECORDER:BLUE,FIBER TIP,PKG OF 3	80009	016-0418-06
	016-0418-07			1		PEN,RECORDER:MAGENTA,FIBER TIP,PKG OF 3	80009	016-0418-07
	016-0418-08			1		PEN,RECORDER:PURPLE,FIBER TIP,PKG OF 3	80009	016-0418-08
	016-0668-00			1		PEN RECORDER:BLACK,PLASTIC TIP,PKG OF 3	80009	016-0668-00
	016-0668-01			1		PEN RECORDER:RED,PLASTIC TIP,PKG OF 3	80009	016-0668-01
	016-0668-02			1		PEN RECORDER:GREEN,PLASTIC TIP,PKG OF 3	80009	016-0668-02
	016-0668-03			1		PEN RECORDER:BLUE,PLASTIC TIP,PKG OF 3	80009	016-0668-03
	016-0688-00			1		PEN SET,RCDR:9 ASRT COLORS,FIBER TIP	80009	016-0688-00
	016-0689-00			1		PEN SET,RCDR:PKG OF 9,ASSORTED COLORS	80009	016-0689-00
	016-0690-00			1		PEN,RECORDER:BLACK,WATER SOLUBLE	80009	016-0690-00
	016-0690-01			1		PEN,RECORDER:BROWN,WATER SOLUBLE	80009	016-0690-01
	016-0690-02			1		PEN,RECORDER:RED,WATER SOLUBLE	80009	016-0690-02
	016-0690-03			1		PEN,RECORDER:ORANGE,WATER SOLUBLE	80009	016-0690-03
	016-0690-04			1		PEN,RECORDER:YELLOW,WATER SOLUBLE	80009	016-0690-04
	016-0690-05			1		PEN,RECORDER:GREEN,WATER SOLUBLE	80009	016-0690-05
	016-0690-06			1		PEN,RECORDER:BLUE,WATER SOLUBLE	80009	016-0690-06
	016-0690-07			1		PEN,RECORDER:PURPLE,WATER SOLUBLE	80009	016-0690-07
	016-0690-08			1		PEN,RECORDER:MAGENTA,WATER SOLUBLE	80009	016-0690-08
	016-0444-01			1		PEN ASSEMBLY:	80009	016-0444-01
	016-0442-01			1		PEN ASSEMBLY:	80009	016-0442-01
	016-0443-01			1		PEN ASSEMBLY:	80009	016-0443-01
	214-2706-00			1		POINT,PEN:TUNGSTEN CARBIDE	87506	757PL3 C3
	214-2706-01			1		PEN POINT:PL5,TUNGSTEN CARBIDE	87506	757-PL5-C3
	214-2706-02			1		PEN POINT:PL8,TUNGSTEN CARBIDE	87506	757-PL8-C3
	006-2968-01			1		BAG,PAPER:#4 HEAVY,4.75 X 9.5		
	016-0649-00			1		CARTRIDGE,INK:EMPTY	80009	016-0649-00
	020-0888-00			1		ACCESSORY PKG:		
	006-5939-00			1		FILM,PLOTTER:8.5 X 11.0 X 0.005 THK	76381	T-115
	016-0470-00			1		PEN,RECORDER:MULTI-COLORED SET	17405	ORD BY DESCR
	016-0469-00			1		PEN,RECORDER:BLACK,PKG OF 3	17405	ORD BY DESCR
	016-0469-01			1		PEN,RECORDER:BROWN,PKG OF 3	17405	ORD BY DESCR
	016-0469-02			1		PEN,RECORDER:RED,PKG OF 3	17405	ORD BY DESCR
	016-0469-03			1		PEN,RECORDER:ORANGE,PKG OF 3	17405	ORD BY DESCR
	016-0469-04			1		PEN,RECORDER:YELLOW,PKG OF 3	17405	ORD BY DESCR
	016-0469-05			1		PEN,RECORDER:GREEN,PKG OF 3	17405	ORD BY DESCR
	016-0469-06			1		PEN,RECORDER:BLUE,PKG OF 3	17405	ORD BY DESCR
	016-0469-07			1		PEN,RECORDER:PURPLE,PKG OF 3	17405	ORD BY DESCR
	016-0469-08			1		PEN,RECORDER:MEGENTA,PKG OF 3	17405	ORD BY DESCR

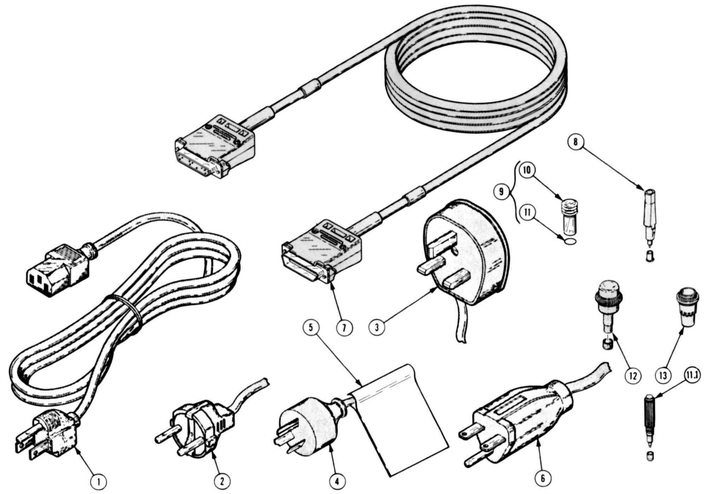


FIG. 5 STANDARD & OPTIONAL ACCESSORIES

OPTION	ORDER PN	DESCRIPTION
1	----- ----- ----- -----	GPIB:4051 COMPATIBLE (NOT FIELD INSTALLABLE)
4	----- ----- ----- -----	GPIB ONLY (NOT FIELD INSTALLABLE)
20	020-0618-00	8K BYTE BFR MEM:RS232 CABLE
30	021-0203-00	4081 COMPATIBLE
31	021-0339-00	INTERFACE:8 PEN TURRET
A1	----- -----	220V EUROPEAN
A2	----- -----	240V UNITED KINGDOM
A3	----- -----	240V AUSTRALIAN
A4	----- -----	240V NORTH AMERICAN

Appendix A

SIGNAL DESCRIPTIONS

Table A-1 lists all of the significant signals in the plotter. These signals are described in the Circuit Descriptions (Section 5) and are shown in the Schematics (Section 7). The numbers in parenthesis refer to the schematic on which the signal can be found.

Table A-1

SIGNAL DESCRIPTIONS

Signal	Name	Source	Destination	Description
A	-----	Clock Generator (1-3)	Clock Generator (1-3)	This signal is the output from an eight-input NAND gate monitoring the timing of the Shift Register. A becomes one of the level inputs for the Shift Register and is an input for the Phase 1 generator flip-flop. Refer to description of Clock Generator for more details.
ATN	Attention	GPIB Controller (1-2)	Control Bus Transceiver (1-2), PIA (U315)(1-2)	Asserted by a GPIB Controller. Only device addresses (primary and secondary) and control messages may be transmitted over the Data Bus when ATN is asserted. After ATN goes high, only the devices assigned as listeners or talkers can take part in the data transfer.
B	-----	Clock Generator (1-3)	Clock Generator (1-3)	This signal is the output from the Phase 1 flip-flop and becomes one of the level inputs for the Shift Register. It is also one of the enables for the generation of Phase 1. Refer to the description of Clock Generator for more detail.
BA-1	Bus Available	Processor (1-3)	Address Buffer (1-3), and I/O Control Buffer (1-3)	Normally BA is low when the processor controls the data and address bus. However, the processor asserts BA-1 when it has received a halt from the System Test Fixture (used in troubleshooting). The low on the BA line enables the address buffers and the processor BR-1/W-0 line.
BA0-BA15	Address Bus	Processor (1-3)	Memory and PIAs	Buffered address lines that the processor uses to address specific components or circuits.
BD0-BD7	Data Bus	Processor, Memory, PIAs	Processor, Memory, PIAs	Bidirectional buffered data lines between the processor, memory, and PIAs.
BR-1/W-0	Read/Write	Processor (1-3)	PIA Read/Write (1-1, 1-2, 1-5, 1-10, and 3-1)	Indicates whether data is to be read from, or written into, a memory location or PIA.
BUSY-0	Busy	PIA U215 (1-10)	Direction Latch (1-9), Step (1-9), Vector Generator (1-6)	This signal is asserted when the plotter is processing and plotting host-generated commands. This signal also disables the joystick.

Table A-1 (cont)

SIGNAL DESCRIPTIONS

Signal	Name	Source	Destination	Description
CALL-0	Call	Front Panel (2-1)	Switch Interface (1-10)	Asserted when the front panel CALL switch is pressed (or a signal from the rear panel REMOTE CALL connector J101) to cause the processor to initiate a GIN (graphic input) activity.
CA1	-----	Interrupt Counter (1-6)	Vector Generator PIA (1-5)	Generated each time either 1 or 3 velocity constants have been added to the Velocity Accumulator. This signal generates an NMI Interrupt to the processor, causing it to load either 1 or 3 more velocity constants.
CAPPED-0	-----	Option 31 Front Panel Switches (6-1)	Option 31 Interface (3-1)	This signal is the inverse of PENS UNCAPPED-0 and indicates that the plate containing pen caps has moved up against the stored pens and capped them.
CATSUP-1	-----	Interrupt Counter (1-6)	Quotient Accumulator (1-5)	This signal causes the Slow Axis Quotient Accumulator to generate extra steps, if necessary, at the end of a vector. This signal is an interrupt input to the processor during joystick manual motion and is used to count steps.
CB1	Interrupt Input	Axis Multiplexer (1-6)	Vector Generator PIA (1-5)	CB1 causes an Interrupt for each MANUAL MOVE step taken or every third step during a vector generation.
DAV	Receive Data Available	UART (1-1)	PIA (U515)(1-1)	Indicates that the UART has received a character and causes the PIA to assert IRQ-0 to the processor. The interrupt causes the processor to read the received character from the host.
DAV	Data Valid	GPIB Talker (1-2), PIA (U315)(1-2)	PIA (U411)(1-2) GPIB Listener (1-2)	Asserted by the GPIB Talker shortly after placing a valid byte on the data bus. An active low tells each listener to read the data bus. The talker is inhibited from activating DAV when NRFD is low.
DIO1-DIO8	GPIB Data Bus	GPIB Controller (1-1) Transmit Data (1-2)	Receive Data (1-2), GPIB Listener (1-2)	Eight bidirectional lines used to transfer device addresses, control words, or data bytes between GPIB devices. Lines are active low. DIO1 (data in-out) is the least significant bit.
ENABLE A-0 (ENABLE B-0)	-----	Option 31 Interface (3-1)	Motor Coil A Voltage Source (6-2)	The processor sends this signal when it wants the rotary pen turret stepper motor to become active. Either + 5 or + 12 volts can be connected to one coil lead or the other (depends upon POLARITY).
EOI	End or Identify	GPIB Talker (1-2), PIA (U315)(1-2)	PIA (U315)(1-2) GPIB Listener (1-2)	Asserted by the GPIB Talker to indicate the end of a data transfer sequence. Activated as the last byte of data is transmitted.
ERROR-0	Error	PIA U215 (1-10)	ERROR LED (1-10)	Turns on the Error LED when the processor detects an error (communications, checksum, etc.).

Table A-1 (cont)

SIGNAL DESCRIPTIONS

Signal	Name	Source	Destination	Description
FAS-1	Fast Axis Step	Fast Axis Overflow (1-5)	X or Y Secondary Integrator (1-6)	This signal results from an overflow in the Velocity Accumulator (after repeated additions of velocity constants) and is output as a stepping pulse to the X or Y Secondary Integrator (whichever has the largest vector component). These pulses occur at 16 times the actual step rate of the motor whose axis is undergoing the largest change.
FAS FIN-1	Fast Finish	Vector Generator PIA (1-5)	Δ Small Residue Counter (1-6), Interrupt Counter (1-6)	An enable signal for the Slow Axis Quotient Accumulator when extra steps are necessary at the end of a vector.
HALT-0	Halt	System Test Fixture (1-3)	Processor (1-3)	This signal stops the processor at the end of a current task (cycle).
IFC	Interface Clear	GPIB Controller (1-2)	PIA (U315)(1-2)	Asserted by a GPIB Controller to put the plotter in a quiescent state. Clears the output queue, but does not clear the input buffer.
INRLD-0	Interrupt Load	Address Interface (1-5)	Interrupt Counter (1-6)	An enable that loads the contents of the Interrupt Buffer into the Interrupt Counter.
INRSEL-0	Interrupt Data Select	Address Interface (1-5)	Interrupt Counter (1-6)	An enable that permits serial data to be loaded into the Interrupt Buffer.
IRQ	Interrupt Request	Each PIA (1-1, 1-2, 1-10, 3-1)	Processor (1-3)	Generated by a PIA receiving or transmitting data to or from a functional block. This signal is a request for processor assistance.
LINE-1	Line	PIA (1-10)	Data Routing (1-1)	Asserted by processor when LOCAL switch is released (LOCAL-0 goes high). This signal causes the UART to receive serial data from host (MODEM RDATA).
LOAD-0	Load	Front Panel (2-1)	880 V Electrostatic Power Supply (1-11), Switch Interface (1-10)	Asserted when the front panel LOAD switch is pressed. This signal causes the processor to stop processing host-generated move and draw commands and disables the 880 V Electrostatic Power Supply.
LOCAL-0	Local	Front Panel (2-1)	Switch Interface (1-10)	Asserted when the front panel LOCAL switch is pressed and causes the processor to assert LINE, which in turn, causes the RS-232 Communications UART to receive data from the terminal (i.e., establishes terminal-plotter communications).
LOCATE-0	Locate	Front Panel (2-1)	Switch Interface (1-10)	Asserted when either LOCATE switch is pressed and causes the processor to move the pen to the respective page boundary corner depending upon the state of the LOWLFT-0 signal line. If LOWLFT-0 is low, the pen moves to the lower left corner of the page boundary; otherwise, the pen moves to the upper right corner of the page.

Table A-1 (cont)

SIGNAL DESCRIPTIONS

Signal	Name	Source	Destination	Description
LOWLFT-0	Lower Left	Front Panel (2-1)	Switch Interface (2-1)	Asserted when either the SET LL or LOCATE LL switch is pressed. This signal causes the processor to execute the command for the lower left boundary. If the SET UR or LOCATE UR switch is pressed, this signal stays high and the processor executes the command for the upper right boundary.
MINXM-1	Minus X-axis Manual	Direction Latch (1-9)	Rate Multiplexer (1-6)	This signal enables the MXRT-1 pulses from the Joystick Rate Generator to be processed as step pulses to the X-axis pen drive motor.
MINYM-1	Minus Y-axis Manual	Direction Latch (1-9)	Rate Multiplexer (1-6)	This signal enables the MYRT-1 pulses from the Joystick Rate Generator to be processed as step pulses to the Y-axis pen drive motor.
MODEM RDATA	Modem Receive Data	Modem (1-1)	Terminal or Plotter (1-1)	Received RS-232 serial data from host.
MODEM TDATA	Modem Transmit Data	Terminal or Plotter (1-1)	Modem (1-1)	RS-232 serial data from terminal or plotter to modem (host).
MOVE-1	Move	Vector Generator PIA (1-5)	Velocity Accumulator (1-5), Axis Multiplexer (1-6)	Asserted by the processor to enable the Vector Generator to perform motion.
MUTE-1	Mute	Data Routing (1-1)	Data Routing (1-1)	MUTE-1 is an AND of the rear panel Switch A (S101) and MUTEREQ-0. This signal prevents the terminal from receiving TERM RDATA.
MUTEREQ-0	Mute Request	PIA (1-10)	Data Routing (1-1)	Asserted by the processor after receiving a Plotter On command. Signal is not present after receiving a Plotter Off command.
MXRT-1	Manual X-axis Rate	Step (1-9)	Rate Multiplexer (1-6)	These pulses are generated from the charging and discharging of the Input Capacitor and their frequency is dependent upon the XJOY level. The MXRT pulses are processed as step pulses to the X-axis pen drive motors.
MYRT-1	Manual Y-axis Rate	Step (1-9)	Rate Multiplexer (1-6)	These pulses are generated from the charging and discharging of the Input Capacitor and their frequency is dependent upon the YJOY level. The MYRT pulses are processed as step pulses to the Y-axis pen drive motors.
NDAC	No Data Accepted	GPIB Listener (1-2), PIA (U315)(1-2)	PIA (U315 and U411)(1-2), GPIB Talker (1-2)	Asserted by a GPIB Listener meaning that it has not yet captured the data bus byte. When the listener has captured the data bus byte, it makes NDAC inactive, telling the talker that it may remove the byte from the data bus.

Table A-1 (cont)

SIGNAL DESCRIPTIONS

Signal	Name	Source	Destination	Description
NMI	Non-Maskable Interrupt	Vector Generator PIA (1-5)	Processor (1-3)	NMI is generated by the Vector Generator PIA and tells the processor the location of the pen as it is moving across the platen. This signal is asserted with each third motor step unless the axis is within five steps of the end of the vector, in which case, NMi is generated with each step.
NRFD	Not Ready For Data	GPIB Listener (1-2), PIA (U315)(1-2)	PIA (U315 and U411)(1-2), GPIB Talker (1-2)	Asserted by a GPIB Listener meaning that it is not yet ready to accept another data byte.
PA0-PA7	Peripheral Data Bus A	PIAs	UART (1-1), GPIB (1-2), Vector Gen (1-5), Misc Interface (1-10), Option 31 (3-1)	Data bus between functional blocks and associated PIA.
PB0-PB7	Peripheral Data Bus B	PIAs	UART (1-1), GPIB (1-2), Vector Gen (1-5), Misc Interface (1-10), Option 31 (3-1)	Data bus between functional blocks and associated PIA.
PEN-0	Pen	Front Panel (2-1)	Switch Interface (1-10)	Asserted when the front panel PEN switch is pressed and causes the processor to assert PEN DOWN-0 to lower the pen to the paper.
PEN DOWN-0	-----	Switch Interface (1-10)	Solenoid Driver (4-1)	Asserted by the processor when drawing (or when PEN-0 is asserted from the front panel PEN switch) to activate the pen solenoid.
PEN PRESENCE-0	-----	Pen Presence Switch (6-1)	Option 31 Front Panel Switches (6-1)	A low on this line indicates that a pen has closed the Pen Presence microswitch while the rotary pen turret was rotating. The processor assumes a pen is located on the rotary pen turret at that position.
PEN SOLENOID	-----	Pen Solenoid Driver (4-1)	Pen Solenoid L1005 (4-1)	Current flowing through this line and the pen solenoid (L1005) causes the pen to be pulled down to the paper.
PEN TYPE-0	-----	Pen Type Switch (6-1)	Option 31 Front Panel Switches (6-1)	A low on this line indicates that a wet-ink pen has closed the Pen Type microswitch while the pen turret was rotating. The processor assumes that a wet-ink pen (only type that will close this switch) is located on the rotary pen turret at that position.
PENS UNCAPPED-0	-----	Pens Uncapped Switch (6-1)	Option 31 Front Panel Switches (6-1)	This signal indicates that the plate containing the pen caps has moved down away from the stored pens. A LED on the Pen Turret Drive circuit board is turned on.

Table A-1 (cont)

SIGNAL DESCRIPTIONS

Signal	Name	Source	Destination	Description
PHASE 1	-----	Clock Generator (1-3)	Processor (1-3)	Phase 1 is one of the two non-overlapping signals to the processor. During Phase 1, the contents of the processor's program counter are transferred to the Address Bus along with an assertion of VMA. At the end of Phase 1, the program counter is incremented by one. Duration of Phase 1 is approximately 480 ns.
PHASE 2	-----	Clock Generator (1-3)	Processor (1-3)	Phase 2 is one of the two non-overlapping timing signals to the processor. During Phase 2, data from memory location addresses is placed on the data bus. At the end of Phase 2, data is latched into the processor. Duration of Phase 2 is approximately 560 ns.
02-1 SYS	Phase 2 (System)	Clock Driver (1-3)	PIA enables (1-1, 1-2, 1-5, 1-10, and 3-1)	Provides the basic synchronization timing for all of the plotter's functional blocks. During Phase 2, data from the PIA is placed on the data bus.
PIACS2-0	PIA Chip Select	PIA Select (1-4)	Each PIA (1-1, 1-2, 1-10, and 3-1)	Decodes addresses in the range of 8000 to 8FFF to become one of the three Chip Select decode lines to each PIA.
PLUSXM-1	Plus X-Axis Manual	Direction Latch (1-9)	Vector Generator (1-5), Rate Multiplexer (1-6)	This signal enables the MXRT-1 pulses from the Joystick Rate Generator to be processed as step pulses to the X-axis pen drive motor. It also becomes XMINUS-1 to program the X Secondary Integrator to count either up or down (counts up if PLUSXM-1 is high).
PLUSYM-1	Plus Y-Axis Manual	Direction Latch (1-9)	Vector Generator (1-5), Rate Multiplexer (1-6)	This signal enables the MYRT-1 pulses from the Joystick Rate Generator to be processed as step pulses to the Y-axis pen drive motor. It also becomes YMINUS-1 to program the Y Secondary Integrator to count either up or down (counts up if PLUSYM-1 is high).
POLARITY A-1 (POLARITY B-1)	-----	Option 31 Interface (3-1)	Motor Coil A Ground Switch (6-2)	The processor sends this signal to establish the polarity of the source voltage on the rotary pen turret stepper motor coil A.
POSA-1, POSB-1, POSC-1, POSD-1	-----	Vector Generator PIA (1-5)	Δ Small Residue Counter (1-6)	These four lines make the complement of the four least-significant bits of the small axis quotient (value stored in the Quotient Storage). These bits are used to make a small correction in the axis with the smallest change at the end of some vectors.
PROMPT-0	Prompt	Prompt Decoder (1-10)	Prompt LED (1-10)	Turns on the PROMPT LED when an address of 8052 has been decoded from the Address Bus and turns off when an address of 8051 is detected.
PULSE A-0 (PULSE B-0)	-----	Option 31 Interface (3-1)	Motor Coil A Voltage Source (6-2)	The processor sends this signal when it wants the rotary pen turret stepper motor coil A to make one step. This causes the coil to be connected to + 12 volts for 13 milliseconds.

Table A-1 (cont)

SIGNAL DESCRIPTIONS

Signal	Name	Source	Destination	Description
RAM R/W-0	RAM Read/Write	I/O Control Buffer (1-3)	RAM (1-4 or 1-4A)	This signal is the OR of the processor BR-1/W-0 and QH from the Clock Generator and permits the processor to write into the RAM only during 02 time.
REN	Remote Enable	-----	-----	Used in some GPIB systems to transfer devices from manual operation to remote control. The plotter does not respond to REN.
ROM ENABLE-0 (ROM ENABLE-1)	-----	System Test Fixture (1-4, 1-4A, 3-1, or 5-1)	ROM (1-4, 1-4A, or 3-1)	Asserted by the System Test Fixture, in trouble-shooting, to disable all of the ROM from responding to the processor.
RRST-0	Remote Reset	External (4-1)	Reset (4-1)	A low on this line discharges C302, causing the comparator U201B to issue a high on the RST-1 line. This initializes the PIAs and causes the processor to initialize the plotter (see RST-1).
RST-1	Reset	Power Supply (4-1)	Processor (1-3)	This signal tells the processor to begin operation by jumping to the restart instruction address in the system firmware. Asserted when unregulated dc falls below minimum for proper regulator functioning.
SAS-1	Slow Axis Step	Slow Axis Overflow	X or Y Secondary Integrator (1-6)	This signal results from an overflow in the Quotient Accumulator (after repeated additions of the Axis Change Quotient in step with FAS-1 pulses). SAS-1 is output as a stepping pulse to the X or Y Secondary Integrator (whichever has the smallest vector component). These pulses occur at 16 times the actual step rate of the motor whose axis is undergoing the smallest change.
SELECT 0-1 (SELECT 1-1)	-----	Option 31 Interface (3-1)	Option 31 Front Panel Switches (6-1)	The processor uses these two lines to select and read the status of the Option 31 front panel switches via the Switch Data Selectors.
SENSE A-1 (SENSE B-1, SENSE C-1)	-----	Option 31 Front Panel Switches (6-1)	Option 31 Interface (3-1)	These three lines are the status of the Option 31 front panel switches as selected by the processor-controlled SELECT lines.
SERIN-0	Serial In	Parallel-to-Serial Shift Register (1-5)	Interrupt Counter (1-6)	Serialized data (complement of a 1 or 3) from the processor to be loaded into the Interrupt Counter (after being converted into parallel form). This number causes the Interrupt Counter to overflow, generating an NMI interrupt to the processor after counting the number of motor steps for which the counter was programmed (1 or 3).
SET-0	Set	Front Panel (2-1)	Switch Interface (1-10)	Asserted when either SET switch is pressed and causes the processor to establish the respective page boundary corner depending upon the state of the LOWLFT-0 signal line. If LOWLFT-0 is low, the lower left corner of the page boundary is set; otherwise, the upper right corner is set.

Table A-1 (cont)

SIGNAL DESCRIPTIONS

Signal	Name	Source	Destination	Description
SI	Serial Input	Data Routing (1-1)	UART (1-1)	Received serial data to the UART.
SLOPOS-0	------	Address Interface (1-5)	Δ Small Residue Counter (1-6)	Loads the Δ Small Residue Counter.
SO	Serial Output	UART (1-1)	Data Routing (1-1)	Transmitted serial data from UART.
SRQ	Service Request	PIA (U315)(1-2)	GPIB Controller (1-2)	Asserted to request action by the GPIB Controller. Generated when an error is detected or when the CALL button is pressed.
TBMT	Transmitter Buffer Empty	UART (1-1)	PIA (U515)(1-1)	Indicates that the UART has transmitted a character and causes the PIA to assert IRQ-0 to the processor. The interrupt causes the processor to transfer another character to the UART for transmission to the host.
TERM RDATA	Terminal Receive Data	Modem or Plotter (1-1)	Terminal (1-1)	RS-232 serial data from host or plotter to terminal.
TERM TDATA	Terminal Transmit Data	Terminal (1-1)	Modem or Plotter (1-1)	Received RS-232 serial data from terminal.
T16CK-0	ϕ2-1/16	Timing (1-5)	Differentiator (1-6), Fast Axis Overflow (1-5), Interrupt Counter (1-6), X and Y Secondary Integrator (1-6), Δ Small Residue Counter (1-6), X-axis Drive (1-7), Y-axis Drive (1-8), Joystick Rate Generator (1-9)	Φ2-1 SYS divided by 16. This signal is the main synchronization for the Vector Generator and the X- and Y-axis drive motors.
T16CK-1	ϕ2-1/16	Joystick Rate Generator (1-9)	Joystick I/F (1-10)	
VELCHG-1	Velocity Change	Axis Multiplexer (1-6)	Differentiator (1-5)	
VMA	Valid Memory Address	Processor (1-3)	PIA Select (1-4)	This signal is asserted by the processor each time the processor places an address on the address bus. This signal is AND'd with the addresses, 8000 to 8FFF, to form PIACS2-0 when the processor addresses a PIA.
XCLEAR-0	-----	Address Interface (1-5)	Joystick I/F (1-10)	Clears the Joystick Interface flip-flops after the processor has checked the Miscellaneous I/F PIA to see which joystick axis moved and updated the pen position registers accordingly.

Table A-1 (cont)
SIGNAL DESCRIPTIONS

Signal	Name	Source	Destination	Description
XJOY	X-axis Joystick	Joystick R1005 (1-9)	+ and — Level Detect (1-9)	This voltage is the wiper arm voltage from the X-axis joystick potentiometer and is used to create the signals to the X-axis pen drive motor.
XLIM-0	X Axis Limit	Front Panel XLIM microswitch (2-1)	Switch Interface (2-1)	Asserted when the pen carriage moves to the lower right corner of the platen during power-up. The signal causes the X-axis motor to shut off and the processor to load the maximum value into the X-axis position register.
XMINUS-1	-----	Vector Generator PIA (1-5), X Direction Latch (1-9)	X Secondary Integrator (1-6), Switch I/F (1-10)	If the pen is to move to the right, XMINUS-1 is low. This loads all zeros in the X Secondary Integrator. Later, the counter starts counting up. If the pen is to move left, XMINUS-1 is high, and ones are loaded into the X Secondary Integrator. The counter then counts down.
XQA-1, XQB-1, XQC-1	-----	X Secondary Integrator (1-6)	Digital-to-Analog (1-7)	Position inputs to the X-axis motor (3 low bits of the secondary integrators).
XSTEP-1 (or XSTEP-0)	-----	X Secondary Integrator (1-6)	Phase Counter (1-7)	Asserted by the X-axis Secondary Integrator after processing 16 FAS or SAS pulses. Causes the pen to move .005 inches.
YCLEAR	-----	Address Interface (1-5)	Joystick I/F (1-10)	Clears the Joystick Interface flip-flops after the processor has checked the Miscellaneous I/F PIA to see which joystick axis moved and updated the pen position registers accordingly.
YJOY	Y-axis Joystick	Joystick R1007 (1-9)	+ and — Level Detect (1-9)	This voltage is the wiper arm voltage from the Y-axis joystick potentiometer and is used to create the signals to the Y-axis pen drive motor.
YLARGE-1	-----	Vector Generator PIA (1-5)	Rate Multiplexer (1-6)	This signal routes FAS and SAS pulses to the appropriate Secondary Integrator. The processor calculates the Axes Change Quotient and sets this signal to indicate which axis has the largest vector component. If the Y-axis is the largest component, this signal is high.
YLIM-0	Y-Axis Limit	Front Panel YLIM microswitch (2-1)	Switch Interface (2-1)	Asserted when the pen carriage moves to the lower right corner of the platen during power-up. The signal causes the Y-axis motor to shut off and the processor to load the minimum value to the Y-axis position register.
YMINUS-1	-----	Vector Generator PIA (1-5), Y Direction Latch (1-9)	Y Secondary Integrator (1-6), Switch I/F (1-10)	If the pen is to move to the front of the plotter, YMINUS-1 is low. This loads all zeros in the Y Secondary Integrator. Later, the counter starts counting up. If the pen is to move back toward the rear of the plotter, YMINUS-1 is high, and ones are loaded into the Y Secondary Integrator. The counter then counts down.
YQA-1, YQB-1, YQC-1	-----	Y Secondary Integrator (1-6)	Digital-to-Analog (1-8)	Position inputs to the Y-axis motor (3 low bits of the secondary integrator).

Table A-1 (cont)

SIGNAL DESCRIPTIONS

Signal	Name	Source	Destination	Description
YSTEP-1 (or YSTEP-0)	-----	Y Secondary Integrator (1-6)	Phase Counter (1-8)	Asserted by the Y-axis Secondary Integrator after processing 16 FAS or SAS pulses. Causes the pen to move .005 inches.
208 kHz	-----	Timing (1-5)	Debounce (1-2)	Used to clock all incoming Transfer Bus and some Management Bus signals through a Contact Bounce Eliminator to eliminate ringing signals.
12.5 MHz	-----	Crystal Controlled Oscillator (1-3)	Shift Register (1-3), Time Base (1-1)	This signal is the source for the processor's Phase 1 and Phase 2 operating clock and also is the source for the UART's baud rate generator clock.

Appendix B

COMMAND SUMMARY

NOTE

This appendix is provided as a quick reference to the service technician in order to test interface communications to the plotter. For further details concerning the commands listed in this appendix, refer to the 4662 Interactive Digital Plotter Programmer's Reference Manual.

These characters appear in Table B-1:

- <ES> is the ASCII character ESCAPE, whose ASCII decimal equivalent (ADE) is 27.
- <AD> is the plotter's device address (A through D, which is determined by the rear panel Switch C).
- <GS> is the ASCII character whose ADE is 29.
- <US> is the ASCII character whose ADE is 31.
- <FF> is the ASCII character whose ADE is 12.
- <ETX> is the ASCII character whose ADE is 3 or any ASCII character other than 0 through 9, +, −, E, e, period, comma, or SPACE.

The commas shown in the arguments in Table B-2 are delimiters and can also be substituted by a SPACE. In Tables B-1 and B-2, bold is used to represent literal rather than symbolic input.

Table B-1

COMMAND SUMMARY (SERIAL INTERFACE)

Command Type	Command	Syntax
Interface Commands	Device On	<ES><AD>**E**
	Device Off	<ES><AD>**F**
	Block Start	<ES><AD>**(**
	Set Turnaround Delay	<ES><AD>**G** Delay Time ir Milliseconds<ETX>
	Block End	<ES><AD>**)** Checksum Value<ETX>
	Set Block Size	<ES><AD>**H** Blocksize in Bytes<ETX>

Table B-1 (cont)

COMMAND SUMMARY (SERIAL INTERFACE)

Command Type	Command	Syntax
Interface Commands (cont)	Set Bypass Cancel Character	<ES><AD>**U** ASCII Character<ETX>
	Set Signature Character	<ES><AD>**S** ASCII Character<ETX>
	Set Prompt Character	<ES><AD>**R** ASCII Character<ETX>
Device Commands	Device Reset	<ES><AD>**N**
	Read Status	<ES><AD>**O** Status Register Number (0-7)<ETX>
	Set Status	<ES><AD>**P** Status Register # (4-7), Value<ETX>
	Size	<ES><AD>**Q**
	Prompt Indicator On	<ES><AD>**K**
	Prompt Indicator Off	<ES><AD>**L**
	Change Pen	<ES><AD>**BP** Pen Number 0 to 8<ETX>
	Programmable Pen Speed	<ES><AD>**BY** Pen Speed 6 to 570 mm/second<ETX>
Graphic Commands	Graph Mode	<GS>
Digitizing (GIN) Mode	Digitizing	<ES><AD>**M**
Alpha Commands	Alpha Mode	<US>
	Home	<FF>
	Alpha Reset	<ES><AD>**V**
	Alpha Scale	<ES><AD>**I** X value, Y value<ETX>
	Alpha Rotate	<ES><AD>**J** Angle in Degrees<ETX>
	Alpha Font	<ES><AD>**T** Font Number<ETX>

Table B-2

BASIC 4051-PLOTTER COMMAND FORMATS (GPIB)

Command	BASIC Language Statement
MOVE	**MOVE**@**1**:X,Y
DRAW	**DRAW**@**1**:X,Y
PRINT	**PRINT**@**1**:"text to be printed"
ALPHA SCALE	**PRINT**@**1,17**:XVALUE,YVALUE
ALPHA ROTATE	**PRINT**@**1,25**:ANGLE
ALPHA FONT	**PRINT**@**1,18**:FONT NUMBER (0 to 7)
ALPHA RESET	**PRINT**@**1,7**:
RESET	Init
HOME	**HOME**@**1**:
PAGE	**PAGE**@**1**:
SIZE	**INPUT**@**1,13**:X,Y,S (where S is the identification word)
SET STATUS WORD	**PRINT**@**1,16**:STATUS WORD NUMBER,STATUS VALUE
READ STATUS WORD	**PRINT**@**1,0**:STATUS WORD NUMBER. Then **INPUT**@**1,32**:X. The status value is then stored in X.
DIGITIZING (GIN)	**GIN**@**1**:X,Y (This format does not provide for Z-axis information). **INPUT**@**1,24**:X,Y,Z (This format provides for X, Y, and Z-axis information).
CALL GIN	**INPUT**@**1,27**:X,Y,Z
PROMPT LIGHT	**PRINT**@**1,26**:0 (off) or 1 (on)
CHANGE PEN	**PRINT**@**1,8**:PEN NUMBER (0 to 8)

Table B-3

SECONDARY ADDRESS FORMAT (GPIB)

Command	Secondary Address Format
Move	<MLA> <MSA= 21> <XCoordinate> <delim> <YCoordinate> <term>
Draw	<MLA> <MSA= 20> <XCoordinate> <delim> <YCoordinate> <term>
Print	<MLA> <MSA= 12> <Character String> <term>
Alpha Scale	<MLA> <MSA= 17> <XSize> <delim> <YSize> <term>
Alpha Rotate	<MLA> <MSA= 25> <Angle> <term>
Alpha Font	<MLA> <MSA= 18> <Font Number from 0 to 14> <term>
Alpha Reset	<MLA> <MSA= 7> <term>
Home	<MLA> <MSA= 23> <term>
Page	<MLA> <MSA= 22> <term>
Size	<MLA> <MSA= 13> <term>
Set Status Word	<MLA> <MSA= 16> <Status Register Number 0-7> <delim> <Value> <term>
Read Status Word	<MLA> <MSA= 0> <term> <MTA> <term>
Digitizing	<MTA> <MSA= 24> <term>
Call GIN	<MTA> <MSA= 27> <term>
Prompt Light	<MLA> <MSA= 26> <0= off; 1= on> <term>
Change Pen	<MLA> <MSA= 8> <Pen Number> <term>

Table B-4

DAB COMMAND FORMAT (GPIB)

Command	DAB Command Format
Move	<MLA> M<XCoordinate> <delim> <YCoordinate> <term>
Draw	<MLA> D<XCoordinate> <delim> <YCoordinate> <term>
Print	<MLA> P<Character String> <term>
Alpha Scale	<MLA> S<XSize> <delim> <YSize> <term>
Alpha Rotate	<MLA> R<Angle> <term>
Alpha Font	<MLA> F<Font Number from 0 to 7>
Alpha Reset	<MLA> A<term>
Home	<MLA> H<term>
Page	<MLA> H<term>
Size	<MLA> I<term>
Set Status Word	<MLA> W<Status Register Number 0-7> <delim> <Value> <term>
Read Status Word	<MLA> V<Status Register Number 4-7> <term>
Digitizing	<MTA> G<term>
Call GIN	<MTA> C<term>
Prompt Light	<MLA> T<0= off;1= on> <term>
Change Pen	<MLA> BP<Pen Number 0-8> <term>
Programmable Pen Speed	<MLA> BY<Pen Speed 6 to 570 mm/second> <term>

Appendix C

INSTRUMENT AND OPTION INSTALLATION

ABOUT THIS APPENDIX

This appendix provides the information necessary for installing and connecting the 4662 Interactive Digital Plotter and each of its options.

PLOTTER INSTALLATION

PLACEMENT OF THE PLOTTER

The plotter can be placed on any flat surface, such as a table or desk, that is at least 20x19 inches (508x483 mm) in size. A larger surface (26x19 inches) is required if the plotter is equipped with Option 31 (multiple pens).

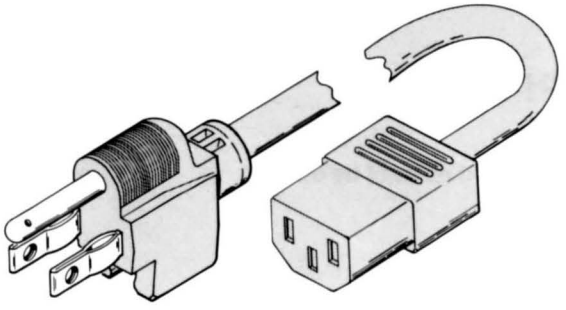
LINE VOLTAGE SELECTION

Before plugging the plotter's line cord into a line voltage source, verify that the plotter is wired internally to accept the available line voltage. A tag near the center of the back panel indicates the voltage for which the plotter is internally wired. If this voltage is different from the available line voltage, proceed with these instructions. Otherwise, skip ahead to "Installing the Plotter into a System."

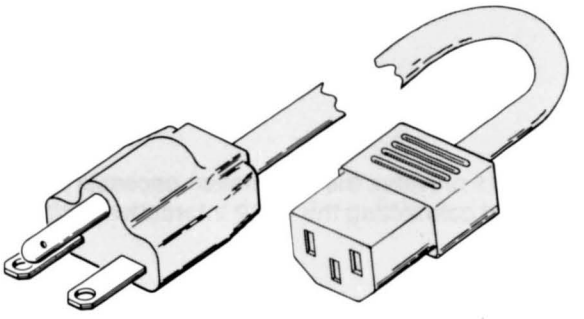
CAUTION

The 4662 must be operated on a single phase power source that has one of its current-carrying conductors (grounding) connected to Safety Earth (ground potential). Operation from power sources that have both current-carrying conductors live with respect to ground is not recommended since only the line conductor has overcurrent (fuse) protection within the instrument. Power sources that are not recommended include phase-to-phase on a multi-phase system or across the legs of a 117-234 volt, single-phase, three-wire system.

The plotter is designed to operate on a 115 or 230 volt nominal line voltage source with a frequency of 48 to 440 Hz. You may select either of two voltage ranges for the 115 or 230 Vac. The ac power connector is a three-wire polarized plug with one lead connected directly to the instrument frame to provide electric shock protection. Connect this plug only to a three-wire outlet which has a safety ground. If the unit is connected to any other power source, the plotter frame must be connected to a safety ground system. The connector configuration and color coding are shown in Figure C-1. If necessary, replace the power cord only with another of the same polarity.



100-120 VAC
(161-0033-00)



200-240 VAC
(161-0099-00)

Power Cord Conductor Identification

Conductor	Color	Alternate Color
Ungrounded (Line)	Brown	Black
Grounded (Neutral)	Blue	White
Grounding (Earthing)	Green-Yellow	Green-Yellow

(2436) 4165-29

Figure C-1. USA Standard Power Cord Sets.

The line voltage is selected by jumpers on the transformer within the plotter.

Because this procedure requires removal of the plotter's platen, it may be necessary to realign the platen after it is installed. The complete alignment is described in Section 2. However, Appendix G contains a procedure that approximates the platen alignment procedure very closely.

1. **Follow** the procedure in Appendix G for removing the plotter case and platen.
2. **Measure** the voltage at the power outlet to which the plotter will be connected.
3. **Set** the jumpers on the transformer appropriate to the voltage range measured in Step 2. The transformer location, selectable ranges, and jumper positions for the various line voltage ranges are shown in Figure C-2.

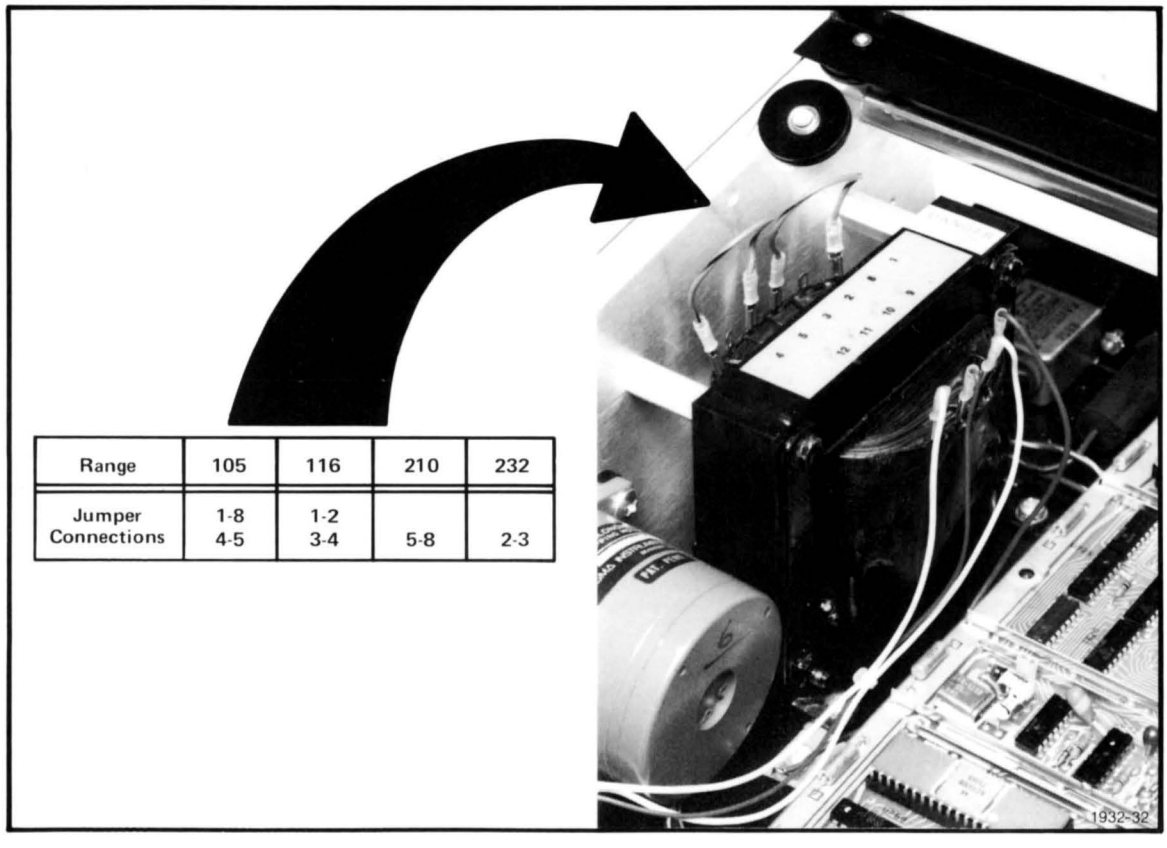
NOTE

When operating with line voltages in the 210- to 232-volt range, the line fuse and the power cord must be changed. The power cord must be replaced with a 220-240 Vac power cord and the fuse value must be changed to a 0.5 A (slow-blow).

For 105 to 116 volt ranges, the line fuse is a 1.0 A (slow-blow).

4. **Change** the line fuse according to the preceding note.
5. **Change** the rear panel line voltage indicator tag to reflect the new value.
6. **Follow** the procedure in Appendix G for replacing the plotter case and platen.

This completes the line voltage selection procedure.



Range	105	116	210	232
Jumper Connections	1-8 4-5	1-2 3-4	5-8	2-3

Figure C-2. Line Voltage Selection.

INSTALLING THE PLOTTER INTO A SYSTEM

Installing the plotter into any system consists of installing the interconnecting cables and setting the four back-panel switches.

RS-232-C System

The plotter has two RS-232-C connection ports on the rear panel. One is for a terminal and the other is for a modem or host computer. These two connections allow the plotter to be "chained" to other serial interface devices. The connector labeled TERMINAL is wired to appear as an active modem, while the connector labeled MODEM is wired to appear as an active terminal. This also permits the plotter to be used alone with either a modem or a terminal.

Simply connect the serial interface cable from a terminal to the plotter connector labeled TERMINAL and/or connect the serial interface cable from a modem (or computer) into the plotter connector labeled MODEM (see Figure C-3).

Four hexadecimal (16-position) switches on the rear panel, labeled SWITCH A, B, C, and D, control several programmable parameters to allow the plotter to conform to various system and/or operator requirements. A small-blade screwdriver is used to set these switches. For a complete description of these switches and some application settings, refer to Rear Panel Controls in Section 2 of the 4662 Operator's Manual.

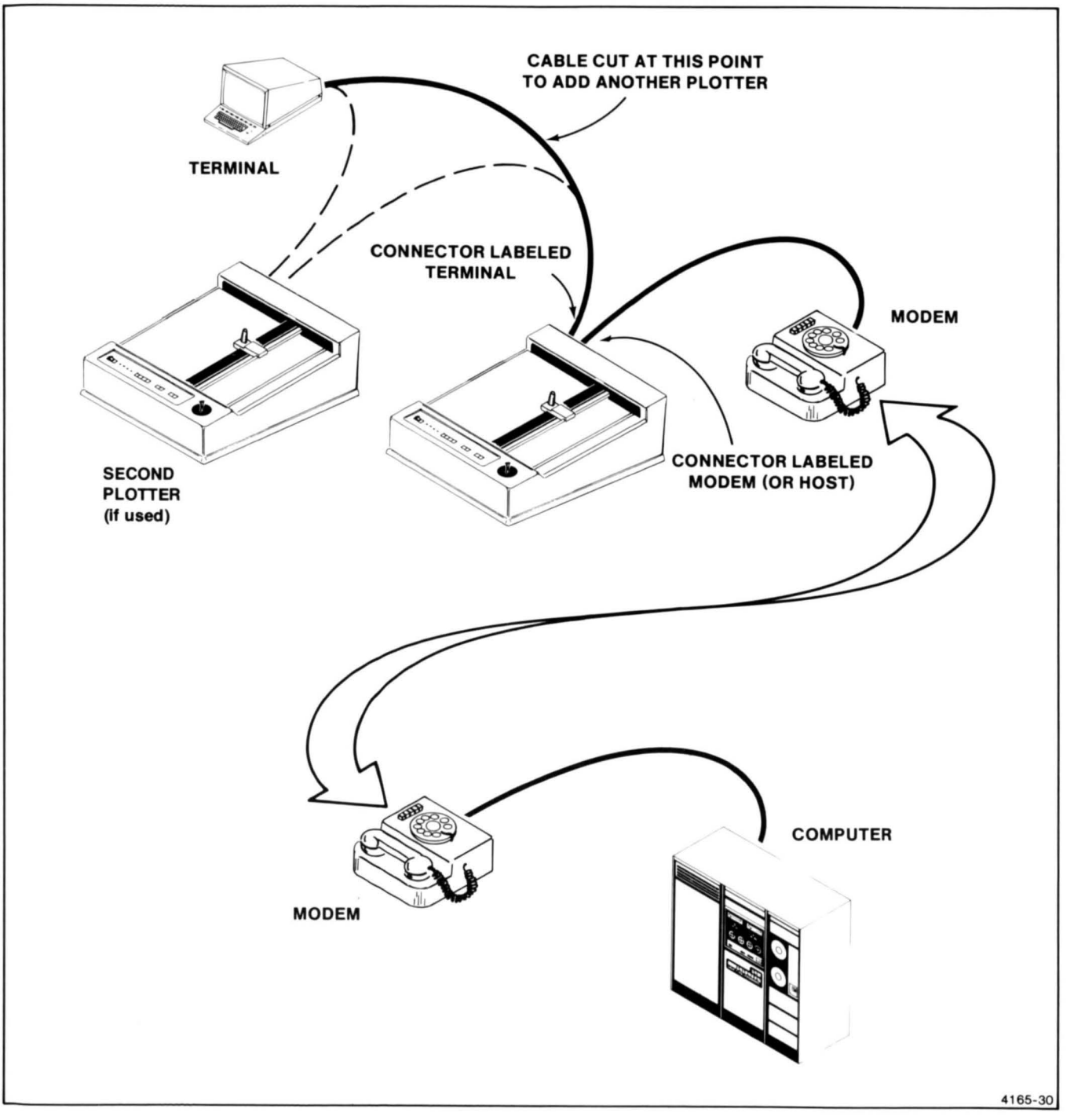


Figure C-3. RS-232-C Connections.

Tektronix 4050 Series Graphic System

The plotter has one GPIB connection port, which permits parallel communicating devices to be linked together sequentially or branched out from a central controller such as the TEKTRONIX 4050 Series Graphic System (see Figure C-4).

Simply connect the GPIB interface cable from the TEKTRONIX 4050 Series Graphic System to the plotter connector labeled PARALLEL INTERFACE J102 (see Figure C-5).

Four hexadecimal (16-position) switches on the rear panel, labeled SWITCH A, B, C, and D, control several programmable parameters to allow the plotter to conform to various system and/or operator requirements. A small-blade screwdriver is used to set these switches. For a complete description of these switches and some application settings, refer to Rear Panel Controls in Section 2 of the 4662 Operator's Manual.

GPIB System

Installing the plotter into a GPIB system is similar to installing the plotter into a TEKTRONIX 4050 Series Graphic System.

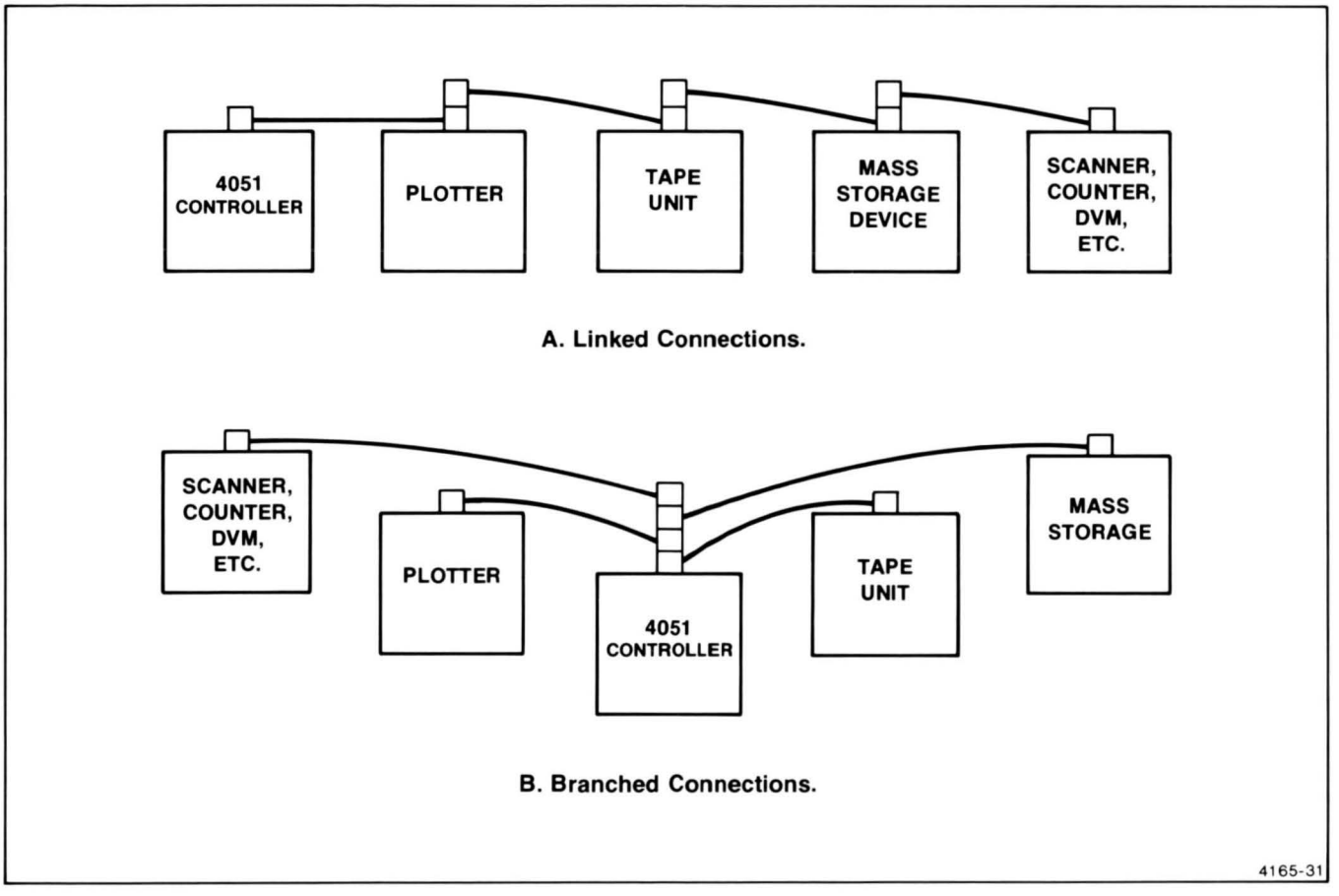


Figure C-4. Two Types of GPIB Connections Using a 4051 Controller.

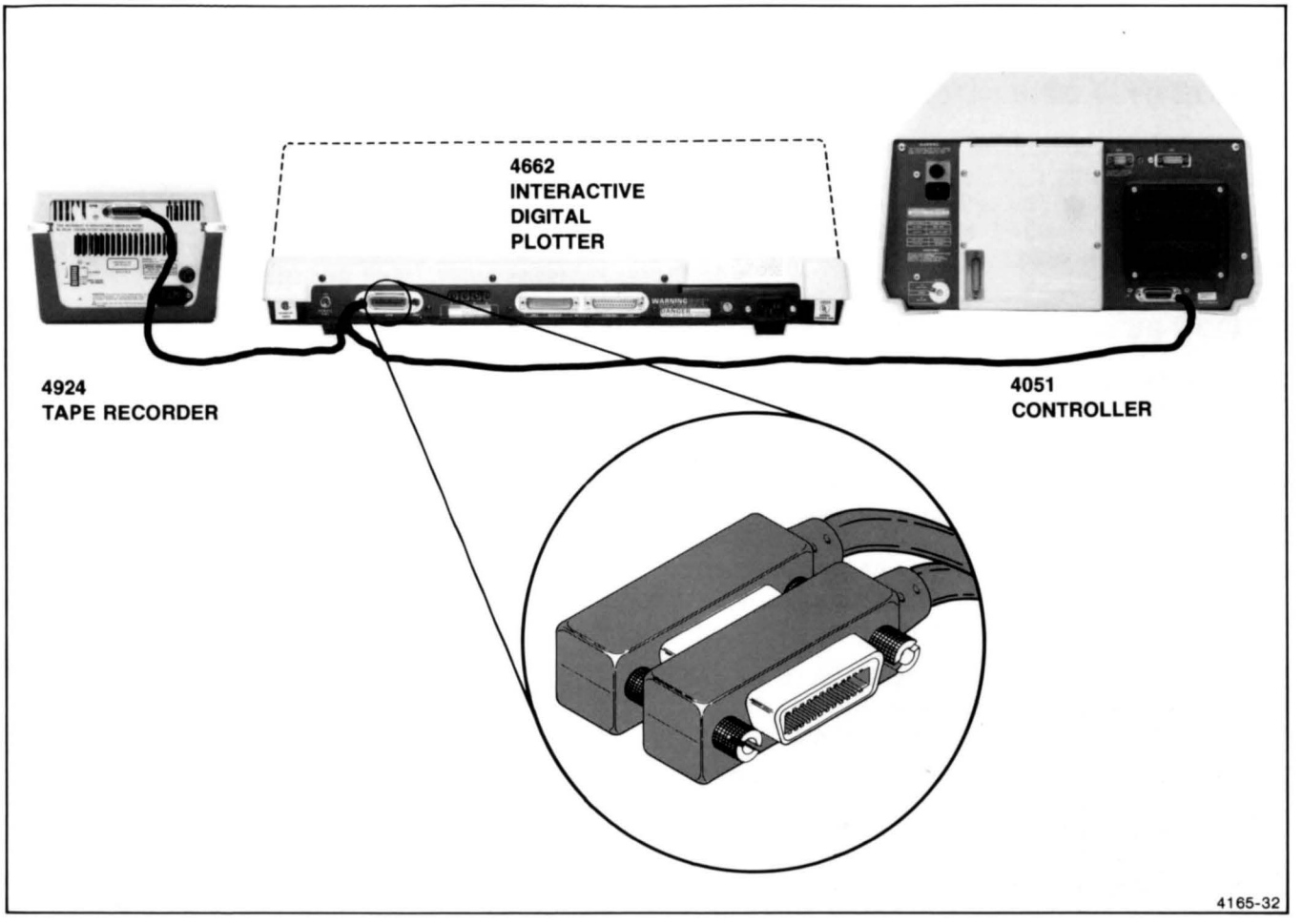


Figure C-5. GPIB Cable Connections.

OPTION INSTALLATION

OPTION 01 — GPIB INTERFACE CABLE

This option requires no installation because it deletes the standard RS-232-C cable from the instrument and adds the GPIB cable. The option does not affect the interfaces as both the GPIB and RS-232-C interfaces are provided in the 4662.

OPTION 20 — 8K BYTE INPUT BUFFER

Option 20 can only be installed on 4662 Main Plotter circuit boards with part numbers of 670-4102-07 or higher (the last two digits must be at least 07).

Because the following procedure requires removal of the plotter's platen, it may be necessary to realign the platen after it is reinstalled. Section 2 provides the complete alignment procedure. However, a procedure approximates the platen alignment procedure very closely in Appendix G.

1. Follow the procedure in Appendix G for removing the platen (it is not necessary to remove the plotter case for plotters not equipped with Option 31).
2. If the plotter is equipped with a Firmware Patch circuit board (670-5120-00, 01, 02, . . .), it will be necessary to remove it. This board (if present) is located near the center of the plotter's Main circuit board and is raised on four spacer posts. Remove connector J105 from the circuit board. Unscrew the four screws holding the circuit board to the four spacer posts. Then move the circuit board aside, exposing the row of RAM devices and sockets (see Figure C-6).
3. The standard instrument has four RAM devices in sockets U243, U244, U341, and U342 (in the center of the row of sockets). Notice that memory is added such that it expands from the center out. If the full 8K RAM capacity of Option 20 is to be installed, simply install the 12 RAM devices (156-1461-00) in the following sockets on the plotter's Main circuit board:

   U41, U42, U141, U142, U241, U242, U441, U442, U443, U541, U542, and U543.

   If less than 8K of RAM is desired, RAM devices are added such that they expand out from the center on both sides equally (see Figure C-6). Be sure that the RAM devices are oriented properly with respect to their number one pins.

   NOTE

   No special straps are added or changed. The plotter's firmware automatically detects the additional memory.

4. Replace the Firmware Patch circuit board (if removed in Step 2). Be sure to reconnect J105.
5. Follow the procedure in Appendix G for replacing the plotter case and platen.

This completes the installation of Option 20.

OPTION 31 — MULTIPLE PENS

See Appendix J for Option 31 installation procedures.

OPTION 48 — 220 VOLT 50 HZ

Refer to the Line Voltage Selection procedure earlier in this appendix for instructions for changing the internal wiring to accept 220 volt line sources.

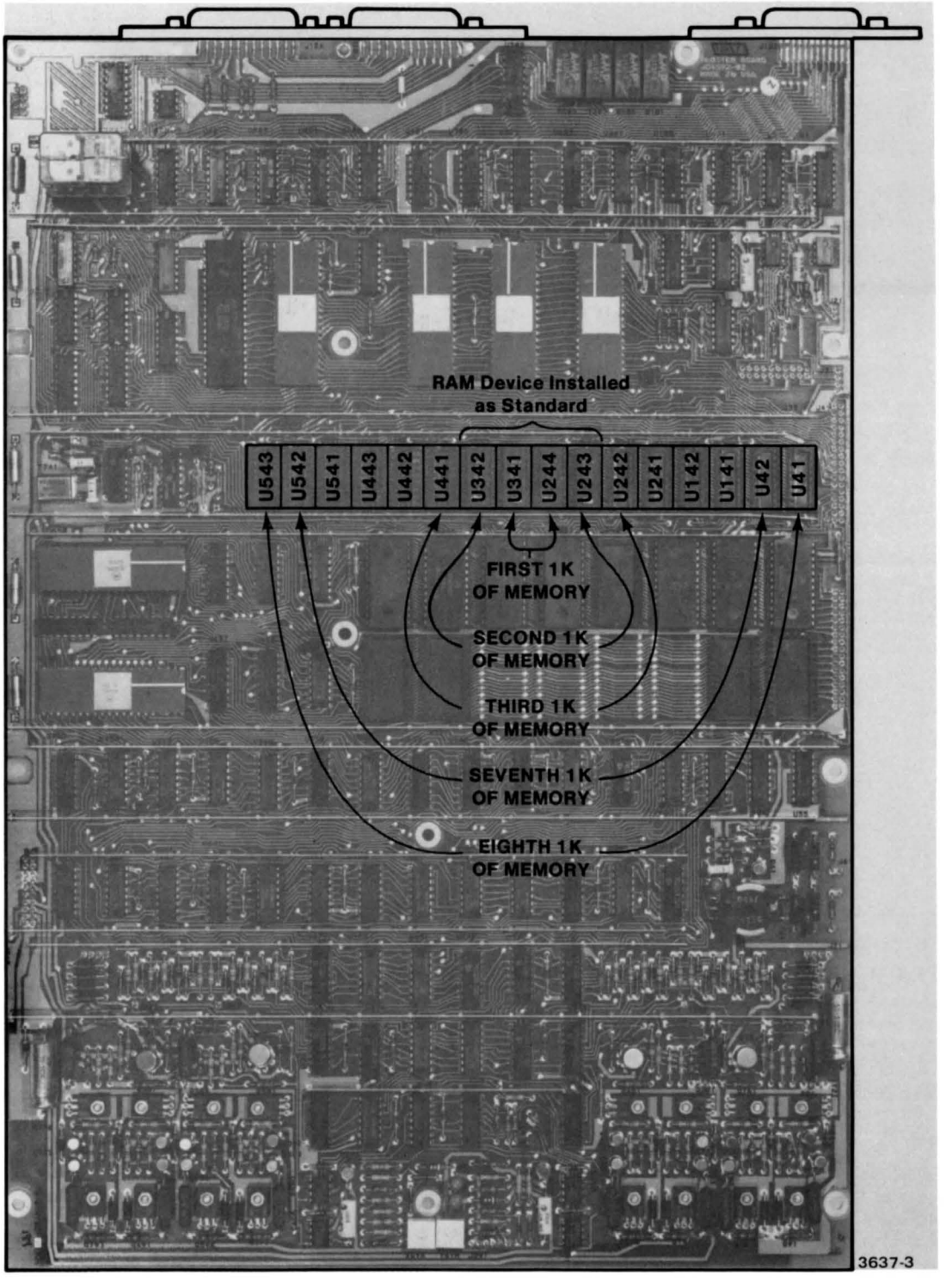


Figure C-6. Plotter's RAM Locations.

Appendix D

STRAPS AND JUMPERS

INTRODUCTION

Wire jumpers or straps are provided in some electrical circuits to permit you to select certain plotter features or tests. Jumpers or straps connect two square pins, thereby bridging the otherwise open connection (see Figure D-1). Usually the jumpers are arranged so that when one desired setting is enabled, the other possible circuit configurations are disabled. This automatically happens when a jumper is moved from one pair of square pins (disabling that circuit) to another set of square pins (enabling another circuit).

However, some plotter straps are placed in the circuitry for proper operation and must not be moved. These straps are also discussed in the following diagrams and tables.

This appendix discusses straps that can be set on the plotter circuit board, the System Memory circuit board, and the Pen Turret Drive circuit board (this last board is only on plotters equipped with Option 31). The Firmware Patch circuit board, Front Panel Switch circuit board, and the Power Supply circuit board do not contain any straps.

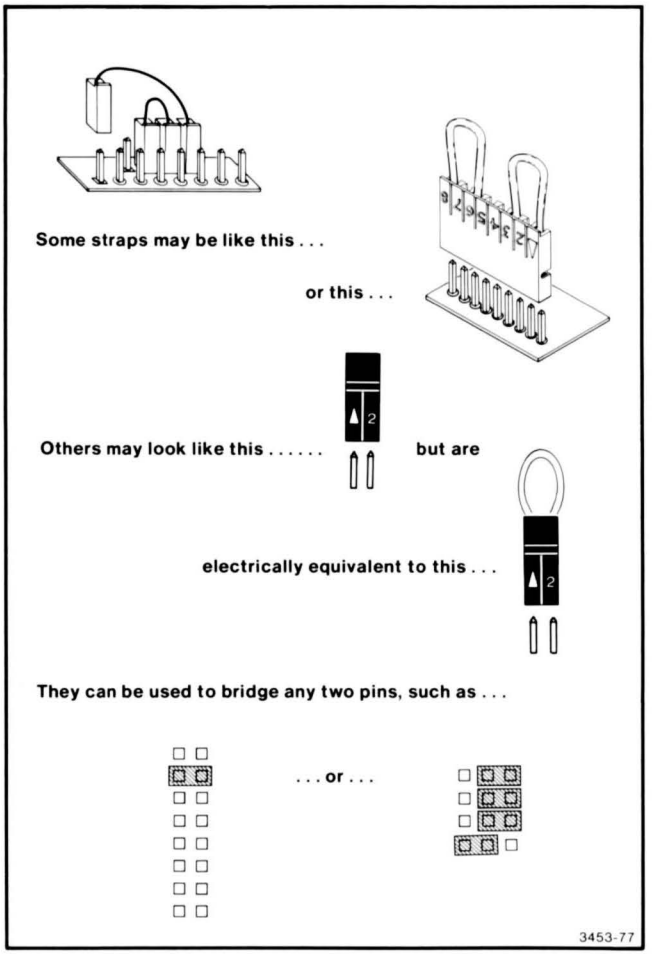


Figure D-1. Example of Jumpers or Straps.

PLOTTER CIRCUIT BOARD STRAPS

All of the straps on the Plotter circuit board are shown in Figure D-2. A summary of these straps and their normal factory settings follows.

XCK

This strap couples the 12.5 MHz Master Clock signal from the Crystal-Controlled Oscillator to the remainder of the plotter. If removed, the plotter's timing can be driven by an external clock, for example during troubleshooting tests.

Normally, this strap is installed and is not modified.

PROM ADDRESS

The PROM ADDRESS strap selects which logic level of the BA14 address line is used in the PROM Decoder U551. If the PROM ADDRESS strap is set in the "1" position, the addresses of the PROM devices overlay the same addresses as the ROM (E000 to FFFF).

Normally, this strap is installed as shown, setting the PROM addresses in the range A000 to BFFF. These addresses are just below the system ROM addresses.

NOTE

Some early model plotters may have this strap in the opposite position. However, if Option 31 is installed, this strap must be changed to the "1" position.

TS-0

The TS-0 strap (labeled + 50 on the circuit board) connects the 14-ms pulse (occuring every eight milliseconds) to the PIA for use by the processor for such functions as RS-232 turnaround delay, pen up/down settling time, and front panel switch scanning and switch debouncing.

Normally, this strap is installed and is removed only for troubleshooting purposes.

TS-1

This strap, which is not labeled on the circuit board), is not used and is reserved for future use.

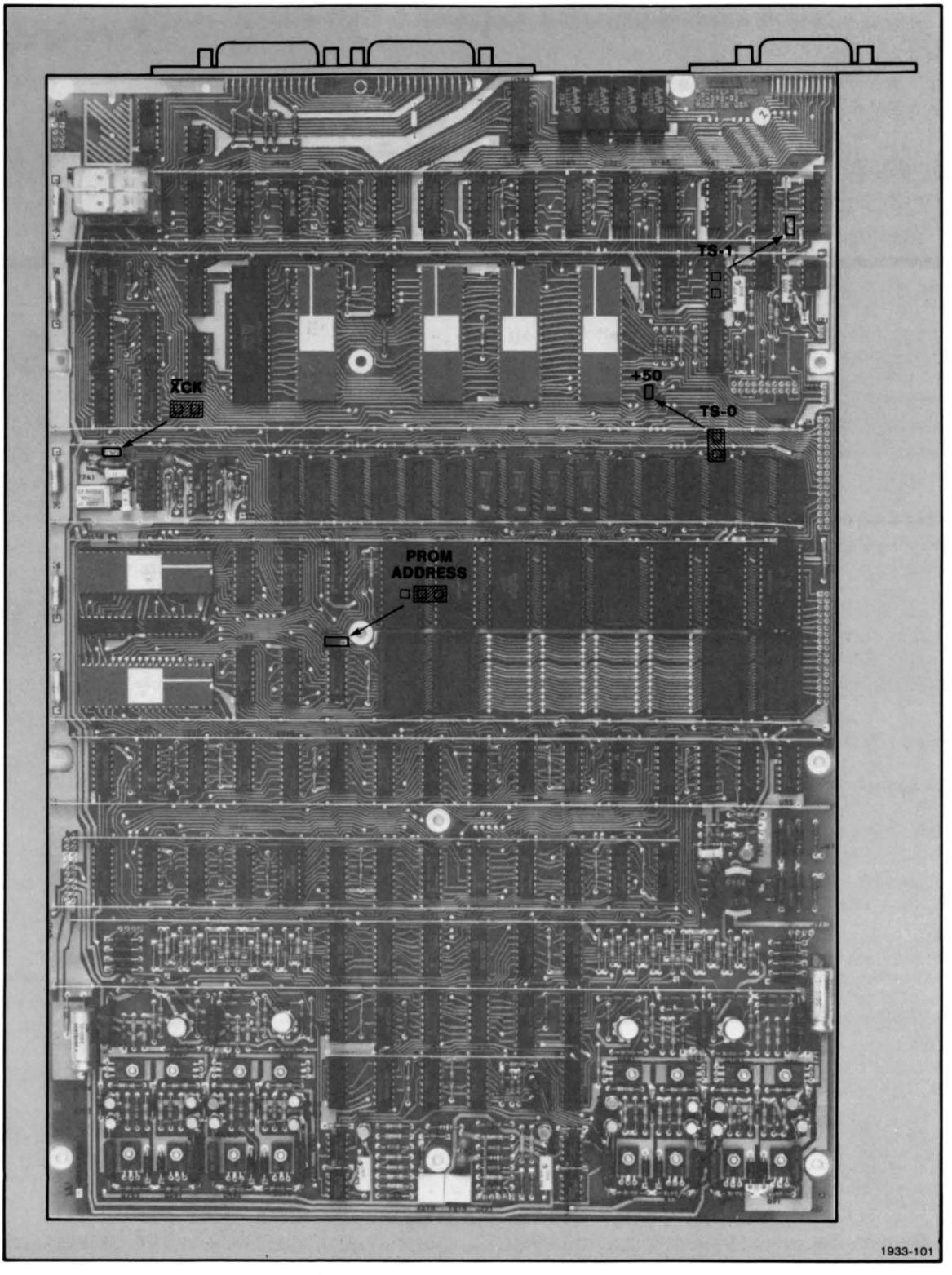


Figure D-2. Plotter Circuit Board Straps.

SYSTEM MEMORY CIRCUIT BOARD STRAPS

All of the straps on the System Memory circuit board are shown in Figure D-3.

J241, J242, J244 — OFFSET

Three straps are used by the processor to calculate the amount of electrical platen shift needed to cause fully engaged pen exchanges between the rotary pen turret and the pen carriage when using Option 31. The three straps can be set to provide eight different settings (i.e., these settings can represent the binary numbers 0 to 7). Each successive binary number causes the electrical location of the platen to shift to the right .020 inches (0.5 mm), when viewing the front of the plotter. These straps are used to adjust the travel of the pen carriage when it moves toward the rotary pen turret in pen exchanges.

Normally, the OFFSET straps are set for a binary count of four (1-0-0) as shown in both Figure D-3 and Schematic 3-1.

Choosing a smaller binary number (0 to 3) causes the pen carriage to travel more to the left, whereas a higher binary number (5 to 7) causes the pen carriage to travel less to the left.

W41, W51, W61, AND W71

These four groups of straps permit the installation of either 2732 or 2532 type PROMs on the System Memory circuit board. These straps alter the pin configurations of the sockets to match that of the PROM devices. W41 corresponds to U141, W51 to U151, W61 to U161, and W71 to U171.

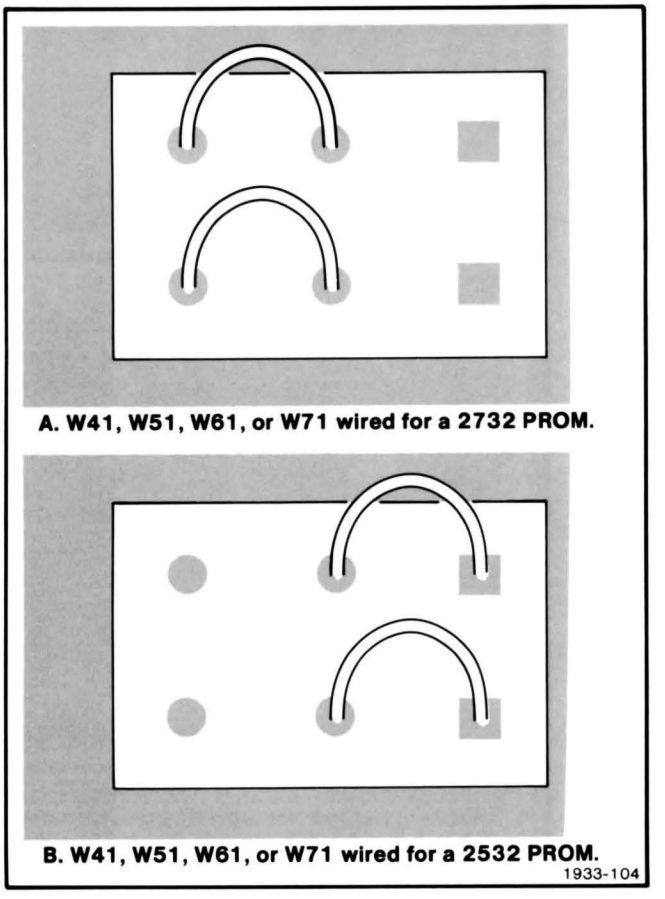
For each device, the corresponding pair of straps must be set as shown in Figure D-4.

Normally, 2732 PROMs are used and Schematic 3-1 reflects this.

J391 — FONT

The font strap programs the plotter to draw slightly different variations of the resident character set in fonts 1, 2, 3, and 4. Refer to the circuit description of the System Memory circuit board in Section 5 for a detailed description of the two font variations.

Normally, this strap is set for the NEW font style.



A. W41, W51, W61, or W71 wired for a 2732 PROM.

B. W41, W51, W61, or W71 wired for a 2532 PROM.

1933-104

Figure D-4. W41, W51, W61, and W71 Straps.

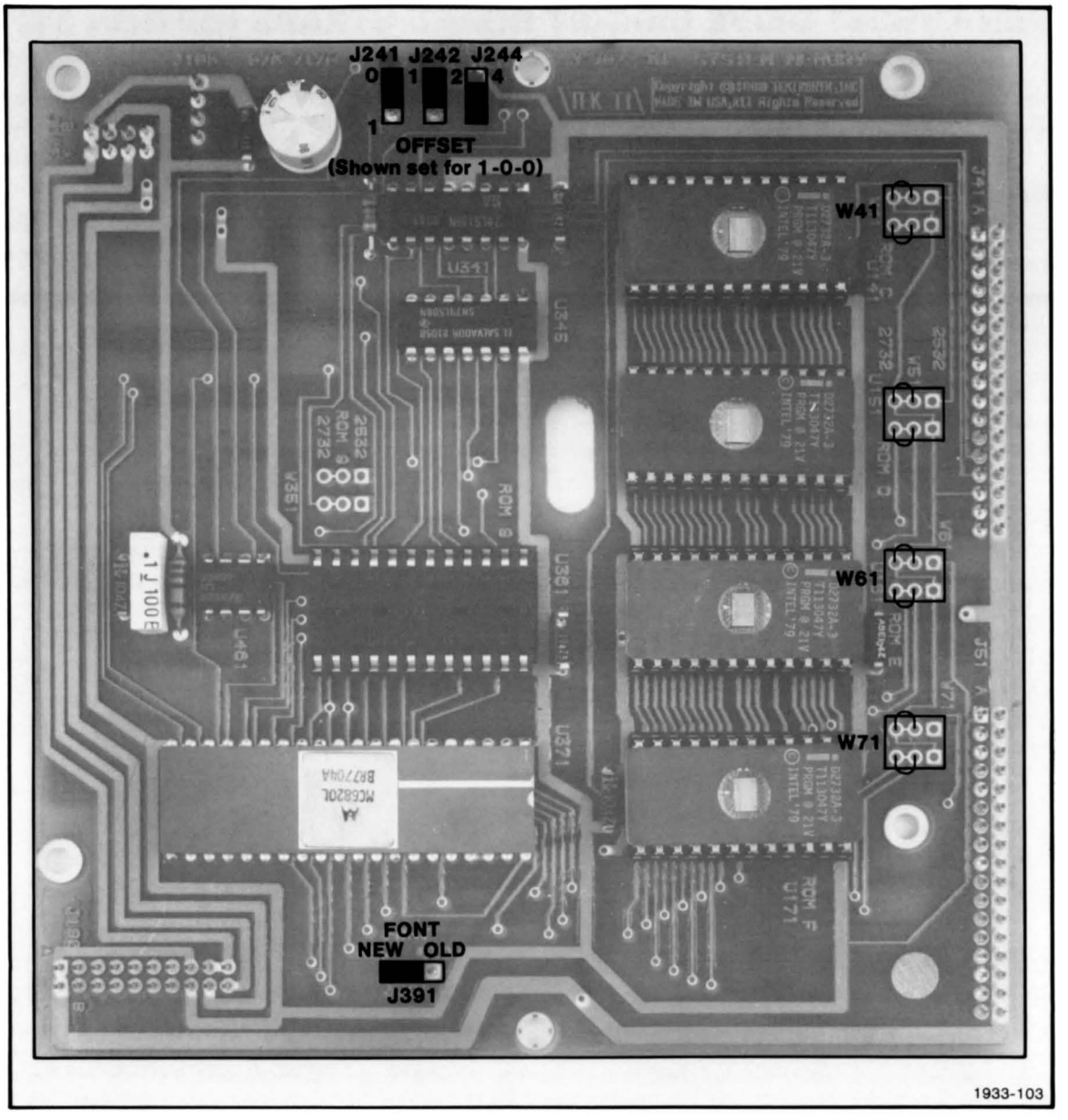


Figure D-3. System Memory Circuit Board Straps.

PEN TURRET DRIVE CIRCUIT BOARD STRAPS (OPTION 31)

The strap on the Pen Turret Drive circuit board is shown in Figure D-5.

J95 — CALIBRATE-NORMAL

This strap is used to reprogram the functions of the eight PEN CONTROL switches so that they can provide functions useful for calibration. When the strap is placed in the CAL (calibrate) position, the processor programs the eight front panel PEN CONTROL switches to take the following functions:

Switch 1 — Energizes motor — places a "hold" voltage on the rotary pen turret motor to prevent it from turning easily.

Switch 2 — Rotates rotary pen turret counterclockwise from the Pen #1 exchange-point to the optical-sensor adjustment location.

Switch 3 — De-energizes the rotary pen turret motor — releases the "hold" voltage from the rotary pen turret motor.

Switch 4 — Causes the processor to read the OFFSET straps on the System Memory circuit board without cycling the power off and then on again.

Switch 5 — Causes the rotary pen turret to close and then rotate to the Pen #1 exchange-point and remain there.

Switch 6 — Not used.

Switch 7 — Causes the plotter to sequentially exchange all eight pens, one through eight. The pen carriage picks up Pen 1, then deposits it, picks up Pen 2, deposits it, picks up Pen 3, and so on, through Pen 8. Then the process repeats with Pen 1 again.

Switch 8 — Stops the automatic pen exchange sequence started by pressing Switch 7.

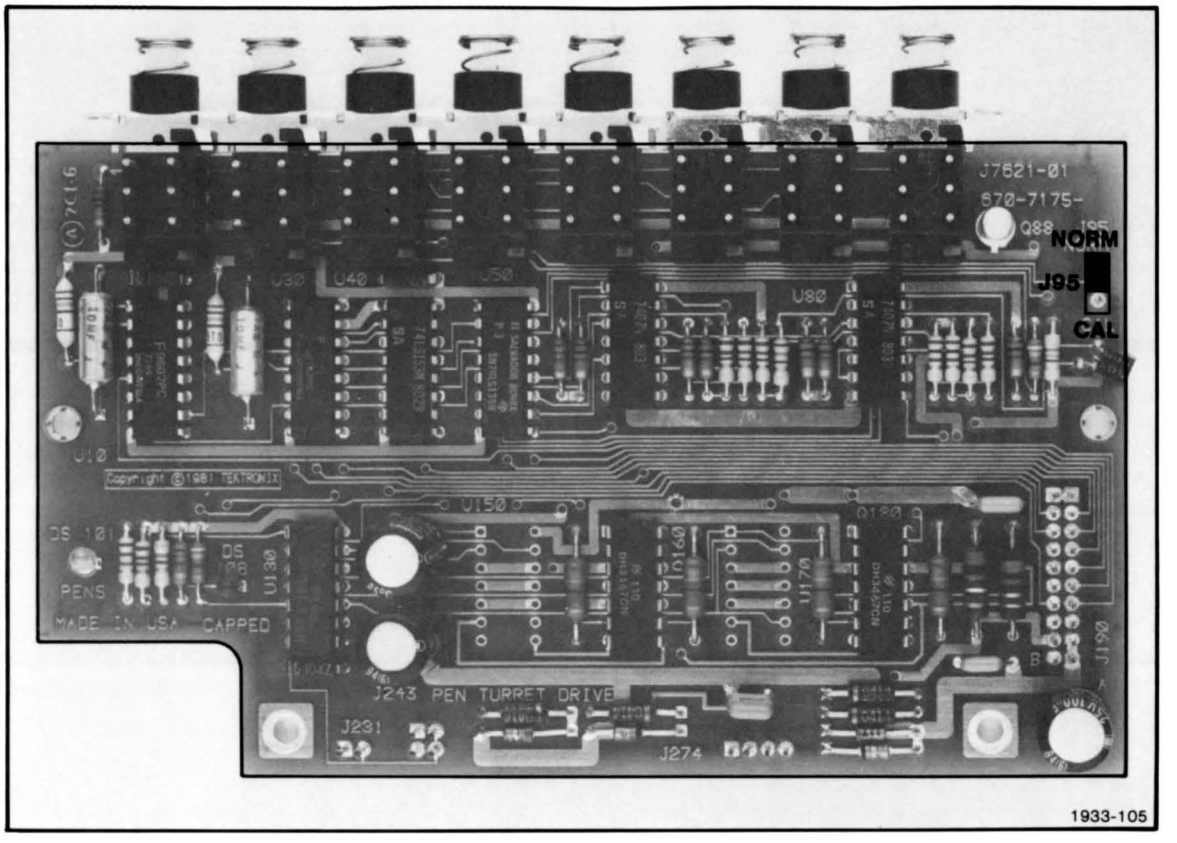


Figure D-5. Pen Turret Drive Circuit Board Straps.

Appendix E

PLOTTER FIRMWARE LOCATIONS

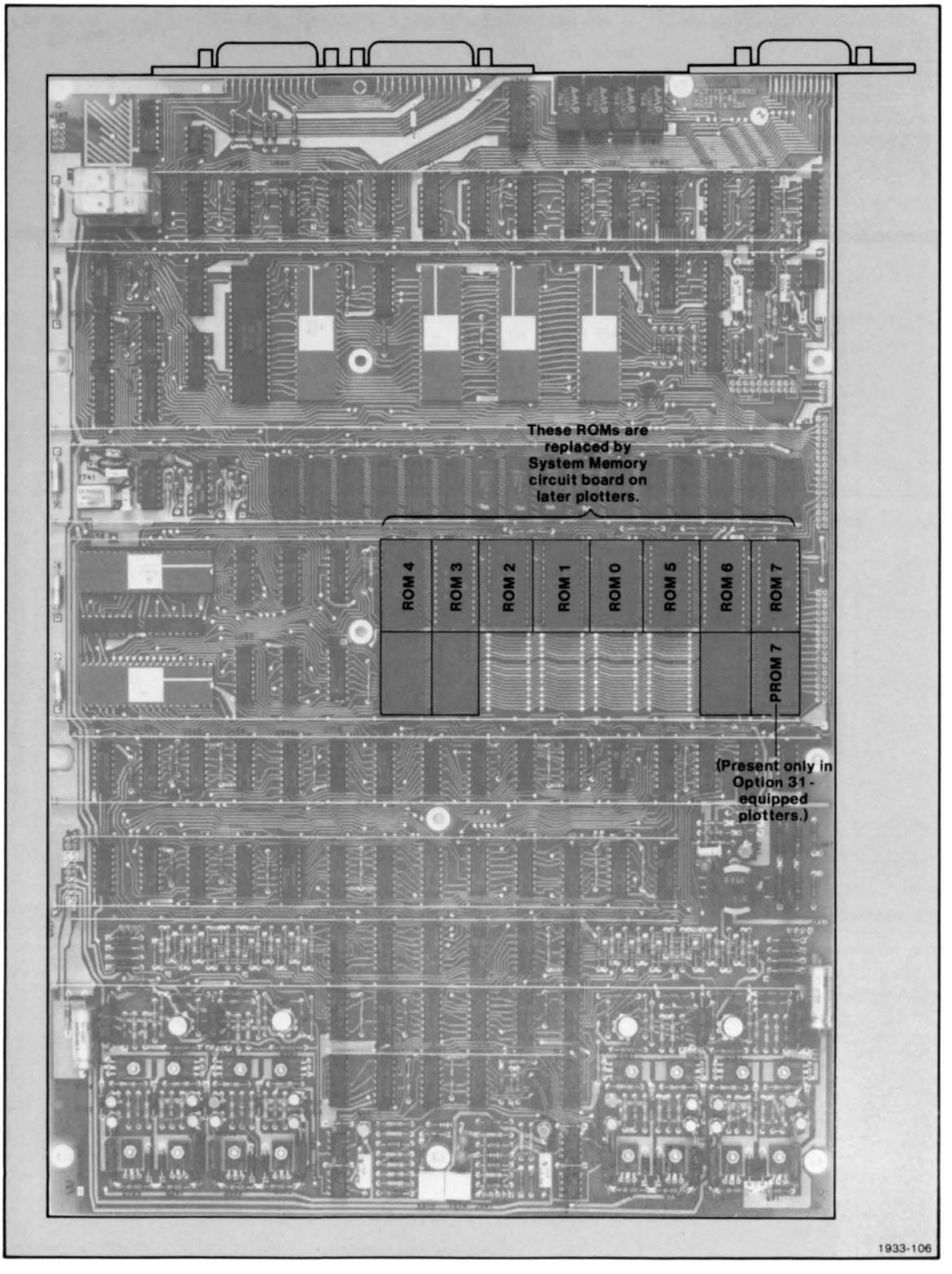


Figure E-1. Plotter Circuit Board ROM Locations.

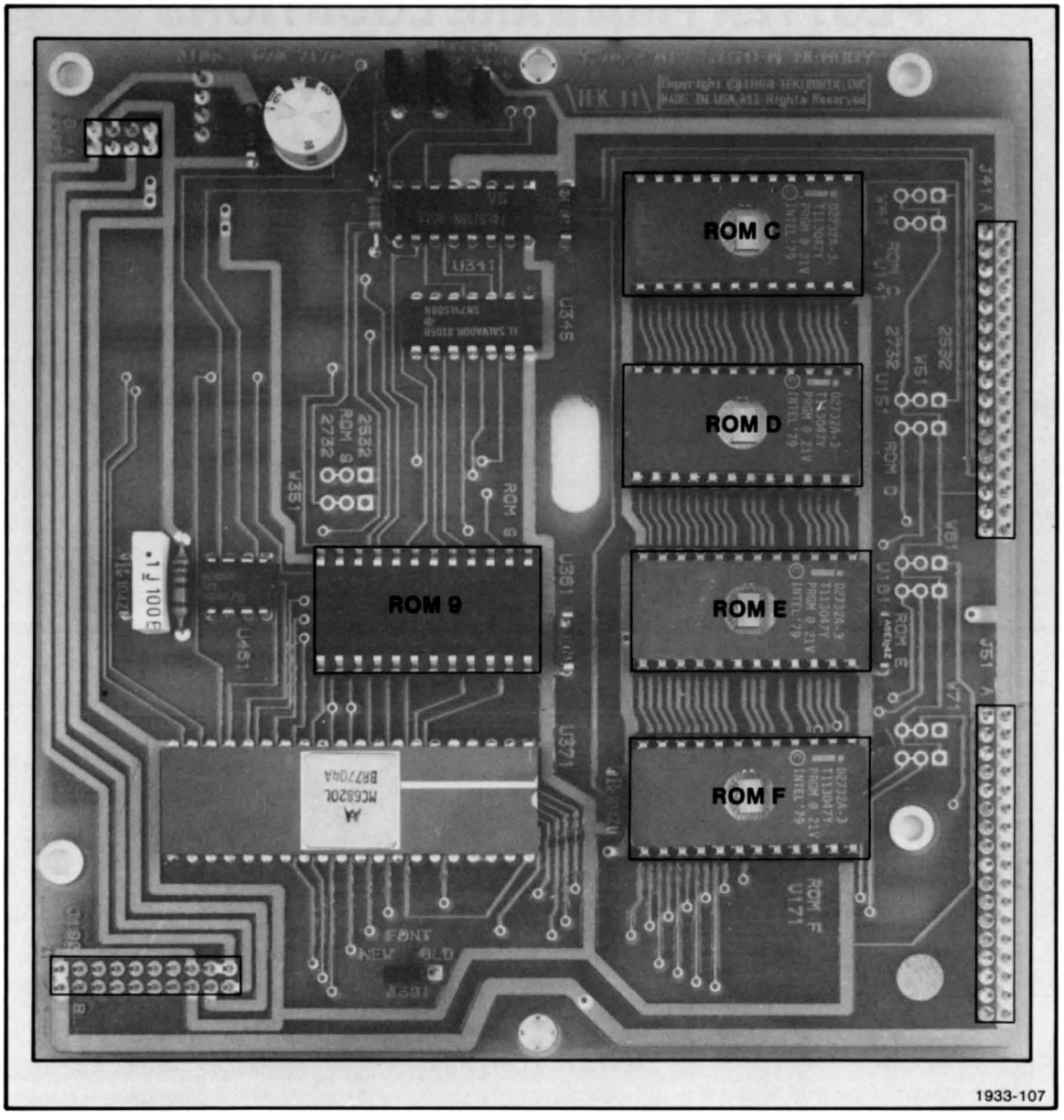


Figure E-2. System Memory Circuit Board ROM Locations.

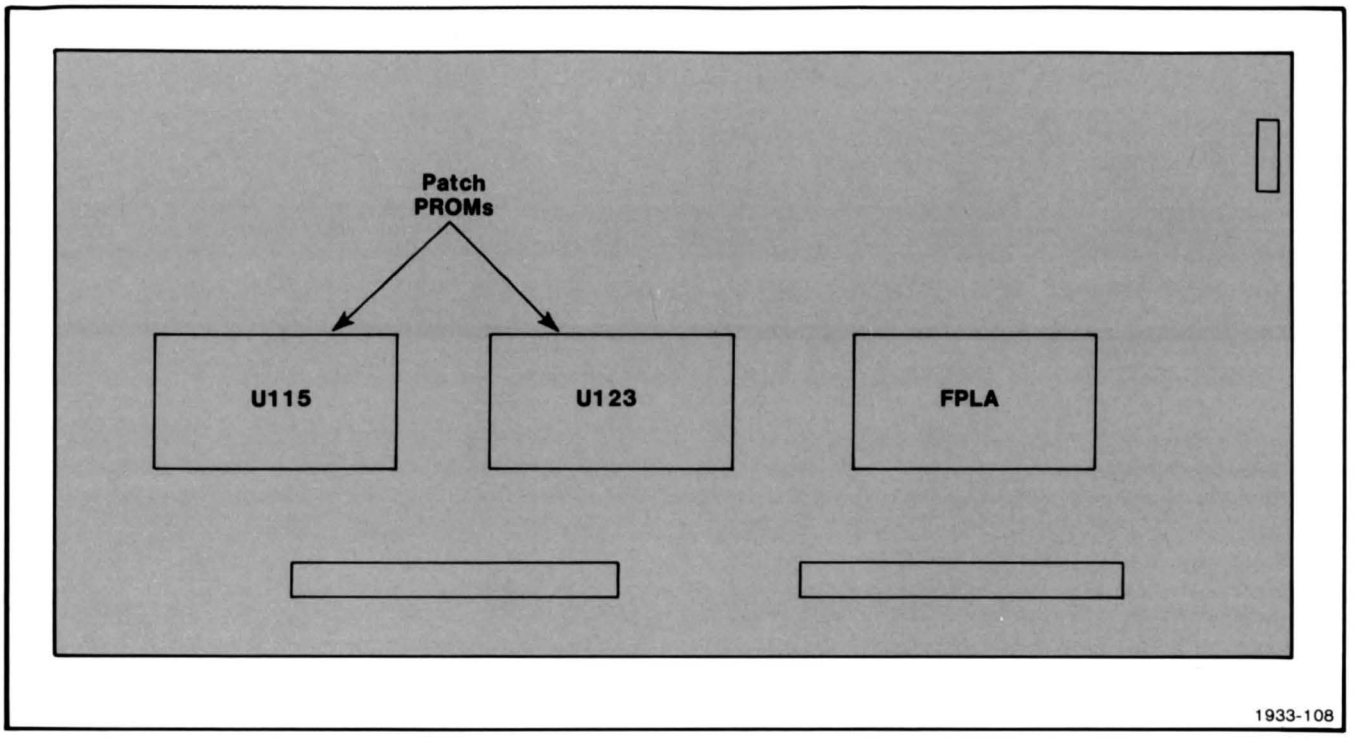


Figure E-3. Firmware Patch Circuit Board EPROM Locations.

Appendix F

SPECIFICATIONS, ACCESSORIES, AND SUPPLIES

The following tables list specifications and accessories and supplies available for the 4662 Interactive Digital Plotter. The specifications are listed for your information only and are not verifiable. Information on options, supplies, and accessories are subject to change.

Table F-1

PHYSICAL SPECIFICATIONS

Characteristics	Standard 4662	With Option 31
Height	8 in (203 mm)	8 in (203 mm)
Width	20.375 in (517 mm)	25.75 in (654 mm)
Depth	19.5 in (495 mm)	19.5 in (495 mm)
Weight	30 lbs 4 oz (13.8 kg)	35 lbs (16 kg)
Shipping Weight	45 lbs 14 oz (20.8 kg)	46 lbs (21 kg)

Table F-2

ELECTRICAL SPECIFICATIONS

Characteristic	Specification (Standard and Option 31 Equipped 4662)
Input Power	90W maximum, 60W typical
Line Voltage	115 or 230 volts nominal. Line voltages are strappable within the plotter to select 105, 116, 210, or 232 volts (±14%).
Line Frequency	48 to 66 Hz
Line Fuse	1 amp (slow-blow) when operating in the 115 volt range. 0.5 amp (slow-blow) when operating in the 230 volt range.

Table F-3

ENVIRONMENTAL SPECIFICATIONS

Characteristic	Specification (Standard and Option 31 Equipped 4662)
Temperature	−55 to +75 degree C. (non-operating) 0 to +50 degree C. (operating)
Altitude	To 50,000 feet (15240 m) (non-operating) To 15,000 feet (4572 m) (operating)

Table F-4

PERFORMANCE SPECIFICATIONS

Characteristic	Specification
Plotting Area (see Figure F-1)	X-Axis — 15 in (381 mm) Y-Axis — 10 in (254 mm) Can be increased to 15.35x10.23 in (390x260 mm).
Scaling	The plotter will scale incoming data that is intended for full-scale plotting into any size page within the plotting area.
Plotting Accuracy	± 0.0025 in (0.06 mm) or ± .4% of vector length, whichever is larger.
Repeatability	The plotter will return to any previously-plotted point within ± 0.0025 in (0.06 mm). With Option 31, within ± 0.012 inch (0.3 mm) after pen exchange.
Vector Linearity	Geometry — The mean vector line will not deviate more than 0.0007 inch (0.02 mm), per inch of line length, from a straight line drawn between two points. Line Aberrations — Short term non-linearities of a vector will not deviate more than ± 0.005 in (0.127 mm) from the mean vector.
Plotting Rate	Fast Speed — 16 in per second (400 mm/sec) at axial, 22 in per second (559 mm/second) maximum. Maximum rate achieved after about 100 ms, or about 1.3 in (33 mm) of pen travel. Slow Speed — approximately 0.5 of fast speed. Programmable Speed (Option 31 only) — limits the maximum pen velocity from 10 mm/sec to 570 mm/sec (0.4 in/sec to 22.4 in/sec) in 10 mm/sec (0.4 in/sec) steps (i.e., there are 57 speeds).
Joystick Moves (Manual)	The pen may be moved by using the front panel joystick at vector rates variable from 0.015 in/second to 4 inches/second (0.38 mm/sec to 101.6 mm/sec).
Point Plotting Rate	Pen action rate (up/down) is approximately 10 points/second maximum. Plotted points per second decreases for an increasing distance between points.
Data Resolution	0.005 in (0.127 mm)
Motor Drive Resolution	Approximately 8 times the data resolution (0.000625 in or 0.016 mm)

Table F-5

STANDARD ACCESSORIES AND SUPPLIES

Part	Tektronix Part Number[a]
Power Cord	161-0066-00
RS-232-C Cable	012-0829-00
4662 Interactive Digital Plotter Operator's Manual	070-4165-00
4662 Interactive Digital Plotter Programmer's Reference Manual	061-2642-00
4662 Interactive Digital Plotter Programmer's Reference Guide	070-2556-00
Paper, 100 sheets, 279x419 mm (11x16.5 in) linear grid, 10x10 lines to the in	006-1698-00
Digitizing Reticle — Standard 4662	214-2409-01
Digitizing Reticle — Option 31	119-1432-01
Pens, Fiber-Tip — Standard 4662 (Pkgs of 3)	
Red	016-0589-00
Green	016-0589-01
Black	016-0589-02
Blue	016-0589-03
Pens, Fiber-Tip — Option 31 Two 9-pen pkgs (one pen each of nine colors)	016-0687-00

[a]See Figure F-2 telephone numbers for use when ordering.

Table F-6

OPTIONAL ACCESSORIES AND SUPPLIES

Part	Tektronix Part Number
4662 Interactive Digital Plotter Service Manual	070-1933-00
GPIB Interface Cable (2 meters) (supplied with Option 01 unit)	012-0630-01
Replacement Pen Caps (Option 31 only)	200-2630-00
Pen Adapters (Option 31 only)	103-0229-00
Dust Cover	
Standard 4662	016-0345-00
Option 31 Equipped 4662	016-0462-00
Transparency Kit	020-0595-00

(continued)

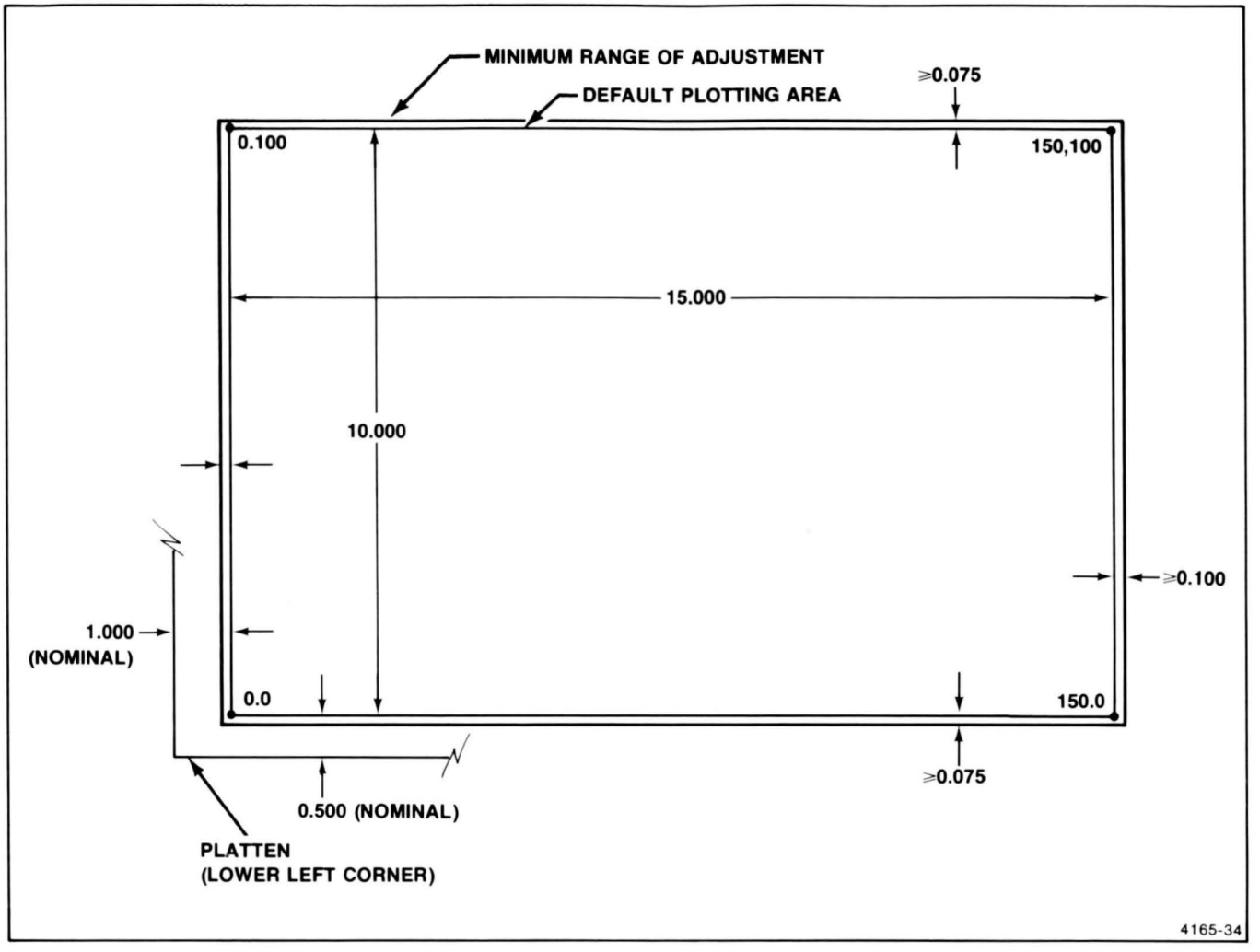


Figure F-1. Plotting Area.

Table F-6 (cont)

OPTIONAL ACCESSORIES AND SUPPLIES

Part	Tektronix Number
RS-232-C Interface Cable	012-0829-00
Remote CALL Foot/Hand Switch	131-0771-00
Paper	
Linear, 10x10 to 1 cm, 279x419 mm (11x16.5 in) pkg of 100 sheets	006-1699-00
Semilog, 10x3 cycles, 279x419 mm (11x16.5 in) pkg of 100 sheets	006-1700-00
Semilog, 10x2 cycles, 279x419 mm (11x16.5 in) pkg of 100 sheets	006-1701-00
Full-log, 2x3 cycles, 279x419 mm (11x16.5 in) pkg of 100 sheets	006-2410-00
Blank, 279x419 mm (11x16.5 in) pkg of 100 sheets	006-1702-00
Transparent Film	
Preframed Polyester Film (pkg of 100 sheets)	006-3309-00
Pens	
Water-Soluble Fiber-Tip for Standard 4662	
Black	016-0386-00
Brown	016-0386-01
Red	016-0386-02
Orange	016-0386-03
Yellow	016-0386-04
Green	016-0386-05
Blue	016-0386-06
Purple	016-0386-07
Magenta	016-0386-08
Water-Soluble Fiber-Tip for Option 31	
9 pen packages (one pen each of nine colors)	016-0688-00
Permanent-Ink Fiber-Tip for Standard 4662	
Black	016-0648-00
Brown	016-0648-01
Red	016-0648-02
Orange	016-0648-03
Yellow	016-0648-04
Green	016-0648-05
Blue	016-0648-06
Purple	016-0648-07
Magenta	016-0648-08

Part	Tektronix Number
Permanent-Ink Fiber-Tip for Option 31	
Black	016-0418-00
Brown	016-0418-01
Red	016-0418-02
Orange	016-0418-03
Yellow	016-0418-04
Green	016-0418-05
Blue	016-0418-06
Purple	016-0418-07
Magenta	016-0418-08
Solvent for Permanent Ink	006-3380-00
Plastic Hard-Nib Pens (Option 31 only)	
Black	016-0668-00
Red	016-0668-01
Green	016-0668-02
Blue	016-0668-03
Wet-Ink Pens for Standard 4662	
TB-0, 0.014 in diameter (0.35 mm)	016-0448-00
TB-1, 0.018 in diameter (0.46 mm)	016-0449-00
TB-2, 0.022 in diameter (0.56 mm)	016-0450-00
Replacement Wet-Ink Pen Tips for Standard 4662	
TB-0, 0.014 in diameter (0.35 mm)	016-0445-00
TB-1, 0.018 in diameter (0.46 mm)	016-0446-00
TB-2, 0.022 in diameter (0.56 mm)	016-0447-00
Wet-Ink Pens for Option 31	
PL3 0.01 in (0.3 mm) diameter	016-0444-01
PL5 0.02 in (0.5 mm) diameter	016-0442-01
PL8 0.03 in (0.8 mm) diameter	016-0443-01
Replacement Wet-Ink Pen Tips for Option 31	
PL3 0.01 in (0.3 mm) diameter	214-2706-00
PL5 0.02 in (0.5 mm) diameter	214-2706-01
PL8 0.03 in (0.8 mm) diameter	214-2706-02
Replacement Wet-Ink Pen Parts Kit (1 cap, 1 body section, 2 plain nuts, and 6 ink cartridges)	006-2968-01

(continued)

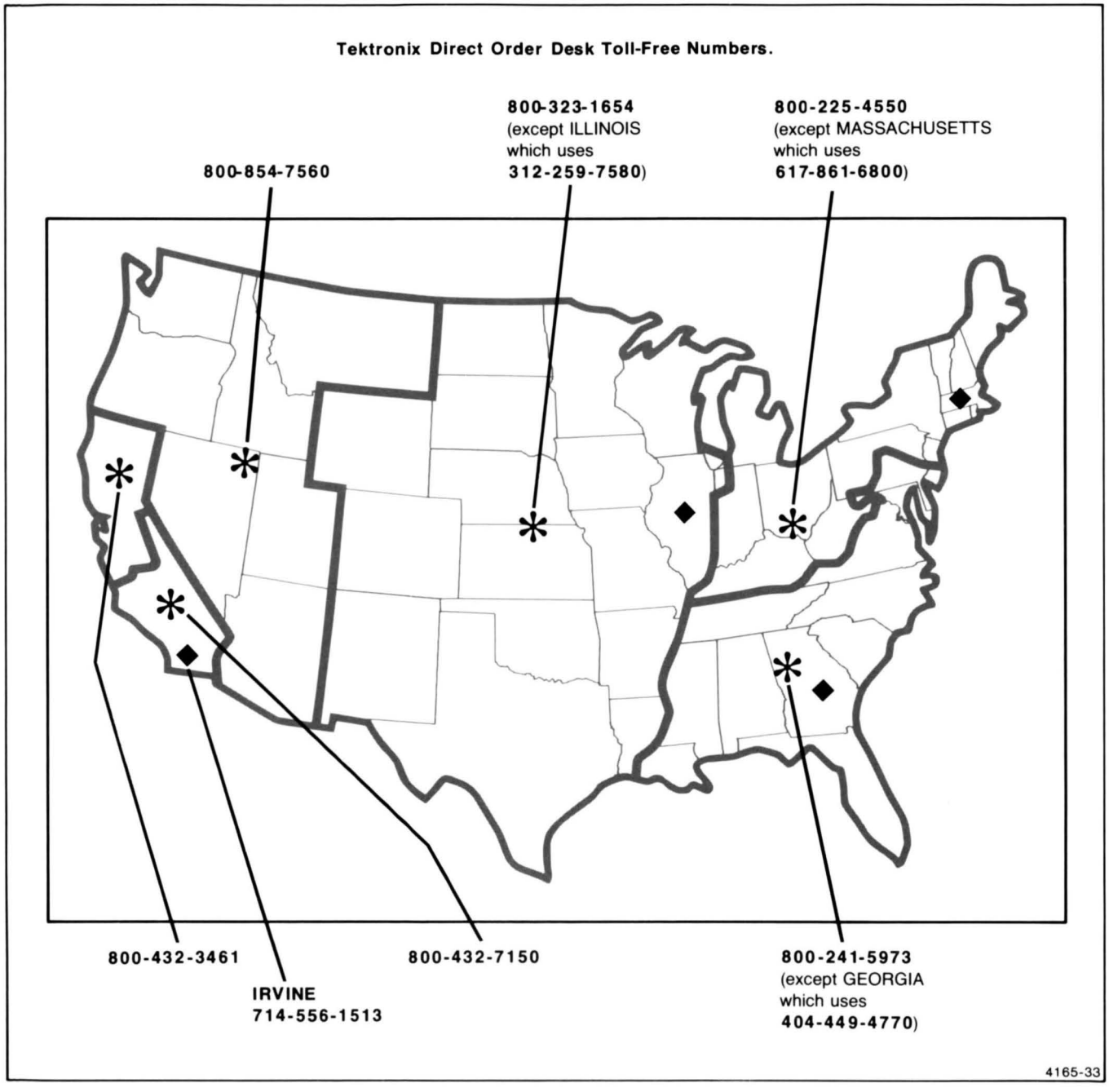


Figure F-2. Telephone Numbers for Ordering Supplies.

Table F-6 (cont)

OPTIONAL ACCESSORIES AND SUPPLIES

Part	Tektronix Number
Extra Ink Cartridges (1 each)	016-0649-00
Inks for Wet-Ink Pens (3/4 oz squeeze bottle)	
For Films	
Brown	016-0423-00
Green	016-0424-00
Blue	016-0425-00
Red	016-0426-00
Black	016-0427-00
For Paper	
Black	016-0428-00
Wet-Ink Cleaning and Maintenance Systems	
Ultasonic Cleaning Tank	002-1555-00
Cleaning Fluid (5.2 oz with strainer)	002-0920-01
Cleaning Fluid (8 oz)	002-1556-00
Cleaning Fluid (16 oz)	002-0920-00
Pressure/Suction Cleaning Bulb	002-1560-00
Magnifying Instrument	002-1558-00
Pen Storage Humidifier	002-1559-00

Part	Tektronix Number
Miscellaneous	
Colored Background Film	
Yellow (pkg of 25 sheets)	006-3381-00
Blue (pkg of 25 sheets)	006-3382-00
Bar Graph Adhesive Strips	006-3383-00
Color Adhesive Film	
Red (pkg of 10 sheets)	006-3384-00
Green (pkg of 10 sheets)	006-3385-00
Transfer Symbols	
Red (1 sheet)	006-3386-00
Black (1 sheet)	006-3387-00
Pencil Knife	006-3388-00

[a] **See Figure F-2 for telephone numbers for use in ordering.**

Appendix G

PLOTTER CASE AND PLATEN REMOVAL/INSTALLATION PROCEDURE

These instructions are used prior to nearly every maintenance activity described in this manual. In the interest of space and to avoid having to repeat this basic procedure, the instructions are given here. When requested by other maintenance procedures in this manual, these procedures (or portions thereof) should be followed.

Because the following procedures require removal of the plotter's platen, it will be necessary to realign the platen after it is reinstalled. The alignment procedure is described in Section 2. However, a very close approximation can be achieved with either of the following procedures, which can be used when parts other than the platen are being replaced.

If you are disassembling the plotter for adjustments (Section 2) or if you are installing a new platen (Section 3), disregard first eight steps of Removing the Plotter Case and Platen procedure for either the Standard or Option 31 Equipped 4662. These eight steps contain the approximation method for placing the platen back in its original position and are unnecessary.

If you are following the adjustment procedures in Section 2, the platen is installed as part of the adjustment procedure; therefore, it is necessary to follow only the Plotter Case Replacement procedure (for either the Standard or Option 31 Equipped 4662).

If you are installing a new platen, perform Steps 1-5 of the Platen Replacement procedure (for either the Standard or Option 31 Equipped 4662) plus the Section 2 adjustment procedures listed in Table 3-1.

REMOVING THE PLOTTER CASE AND PLATEN — STANDARD 4662

This procedure removes plotter's platen and/or case for maintenance work. If the plotter is being adjusted, skip to Step 9. **This procedure will not work for Option 31 equipped plotters.** If you plotter is equipped with Option 31, use the procedure under the heading "Removing the Plotter Case and Platen — Option 31 Equipped Plotter."

1. **Turn** the plotter's power on.
2. **Replace** the pen with the digitizing crosshair cursor (354-0537-00).
3. **Press** the plotter's LOCATE LOWER LEFT switch momentarily. The pen carriage will travel to the lower left corner of the platen and remain there.
4. **Tape** (using the smallest amount of tape necessary and applying the tape as near the edge of the platen as possible) a small piece of paper (one or two inches square) with a small dot on it so that the dot is centered under the crosshair cursor.
5. **Press** the plotter's LOCATE UPPER RIGHT switch. The pen carriage will travel to the upper right corner of the platen and remain there.
6. **Tape** a small piece of paper with a dot on it under the crosshair cursor in a manner similar to Step 4.

7. **Press** the LOCATE LOWER LEFT and LOCATE UPPER RIGHT switches alternately to verify that the crosshair cursor centers itself over the two dots. These two dots will be used to approximate the correct position of the platen when reassembling the plotter later.
8. **Press** the front panel LOAD switch to move the pen carriage to the upper corner.
9. **Turn** the POWER switch off and disconnect the power cord and any attached interface cables.

WARNING

Hazardous voltages are exposed when the Plotter case or platen are removed, unless the Plotter is disconnected from the power source.

10. **Remove** the six hex-socket cap screws (5/64" socket) holding the plotter case to the frame. There are three screws on the front panel and three screws on the rear panel (see Figure G-1).

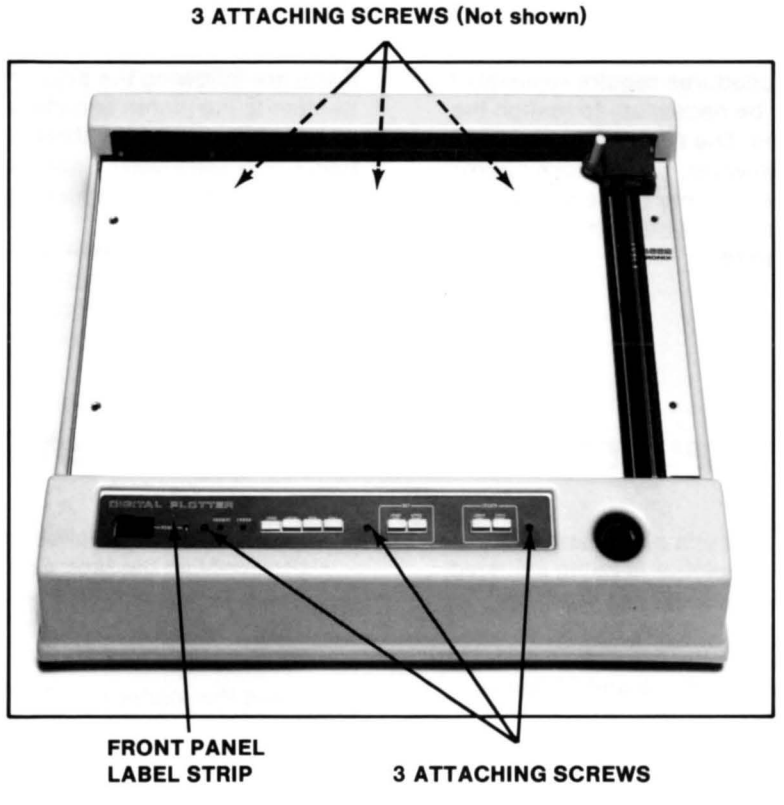


Figure G-1. Plotter Case Attaching Screws.

11. **Remove** the plotter case and the front panel label strip.
12. **Remove** the four hex-socket cap screws (1/16" socket) holding the platen (see Figure G-2).
13. **Lift** the trim strip located on the right side. Then, move carriage to right edge of the platen.

CAUTION

The platen has a two-wire cable connecting it to the main Plotter circuit board. Therefore, use care in the next step to avoid damaging this cable and its connector.

NOTE

Some plotters may have thin metal shims under one or more corners of the platen. Do not lose these shims during the next step. When the plotter is reassembled, be sure the shims are placed back under the same corners.

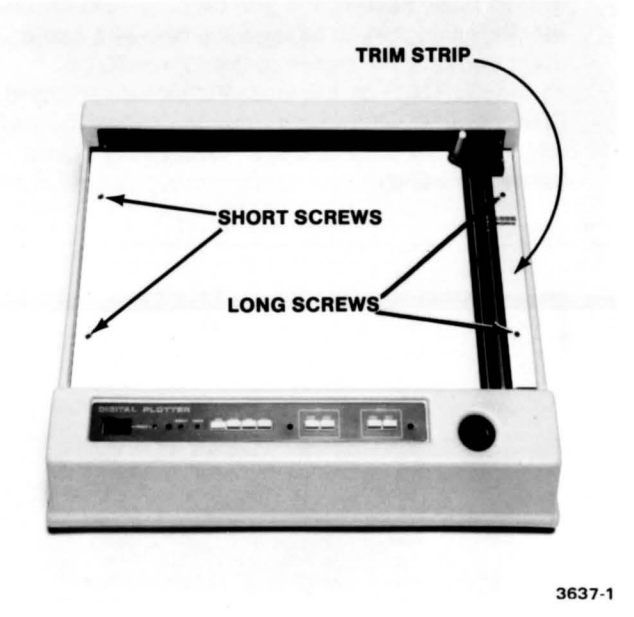


Figure G-2. Platen and Trim Strip Attaching Screws.

14. **Lift** the platen at the left bottom edge and slide it to the left until it clears the pen carriage. **STOP!** Lift the platen slightly to expose the two-wire cable that connects the platen to the high voltage connector (J61) on the main Plotter circuit board. Disconnect the two-pin harmonica connector from the connector pins, and then remove the platen (see Figure G-3).

The interior of the plotter is now accessible for maintenance. To restore the plotter back to operation, follow the instructions "Replacing the Plotter Case and Platen — Standard 4662."

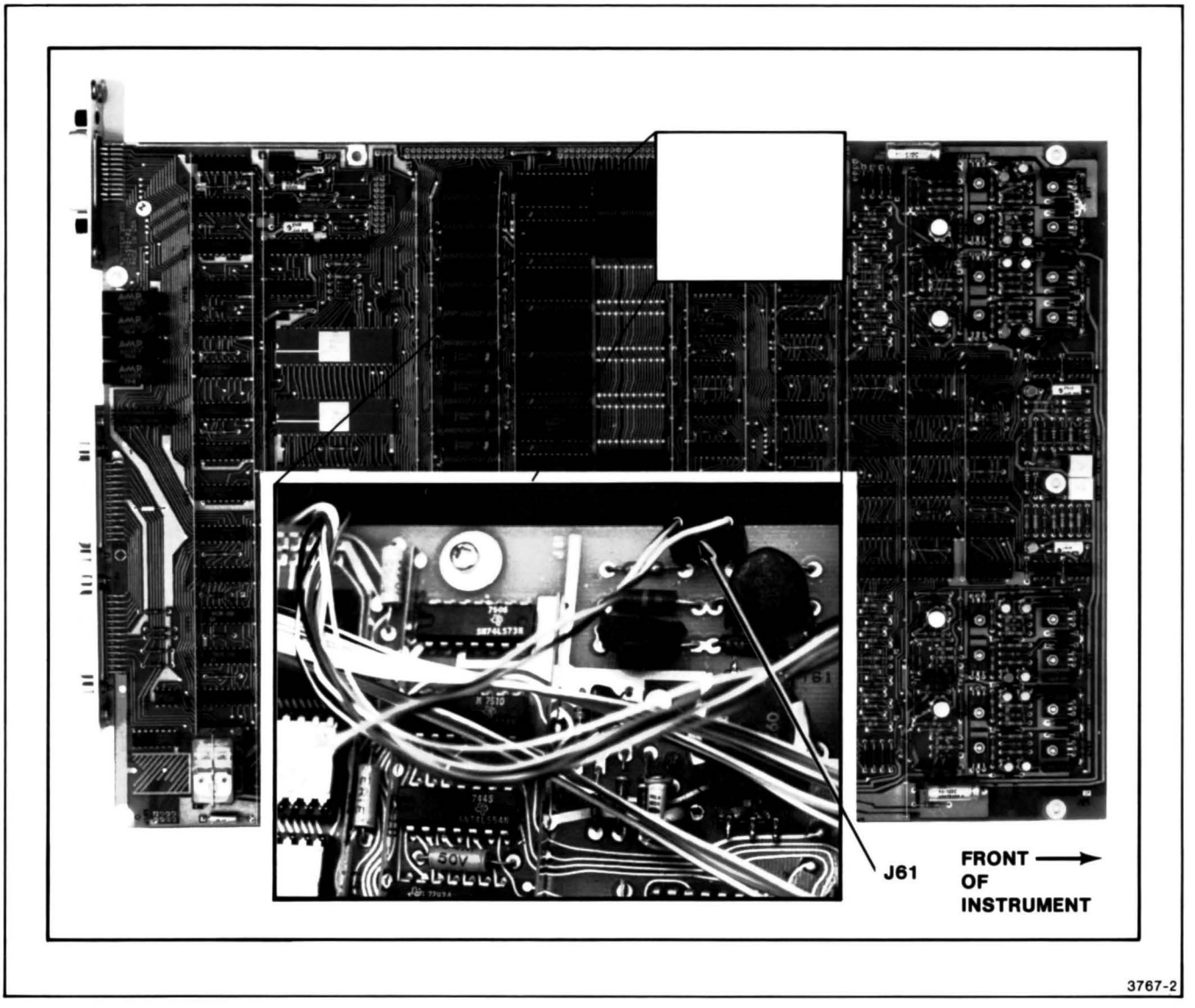


Figure G-3. Platen Connector Position.

REMOVING THE PLOTTER CASE AND PLATEN OPTION 31 EQUIPPED 4662

If the plotter is being completely adjusted, skip to Step 9.

1. **Turn** the plotter's power on.
2. **Replace** the pen with the digitizing crosshair cursor (119-1432-01).
3. **Press** the plotter's LOCATE LOWER LEFT switch momentarily. The pen carriage will travel to the lower left corner of the platen and remain there.
4. **Tape** (using the smallest amount of tape necessary and applying the tape as near the edge of the platen as possible) a small piece of paper (one or two inches square) with a small dot on it so that the dot is centered under the crosshair cursor.
5. **Press** the plotter's LOCATE UPPER RIGHT switch. The pen carriage will travel to the upper right corner of the platen and remain there.
6. **Tape** a small piece of paper with a dot on it under the crosshair cursor in a manner similar to Step 4.
7. **Press** the LOCATE LOWER LEFT and LOCATE UPPER RIGHT switches alternately to verify that the crosshair cursor centers itself over the two dots. These two dots will be used to approximate the correct position of the platen when reassembling the plotter later.
8. **Use** the joystick to move the pen carriage to the upper-left corner of the platen.

WARNING

Hazardous voltages are exposed when the Plotter case or platen are removed, unless the Plotter is disconnected from the power source.

9. **Turn** the POWER switch off and disconnect the power cord.
10. **Remove** the eight hex-socket cap screws (5/64" socket) holding the plotter case to the frame. Five screws are located on the front panel and three are located on the rear (see Figure G-4).

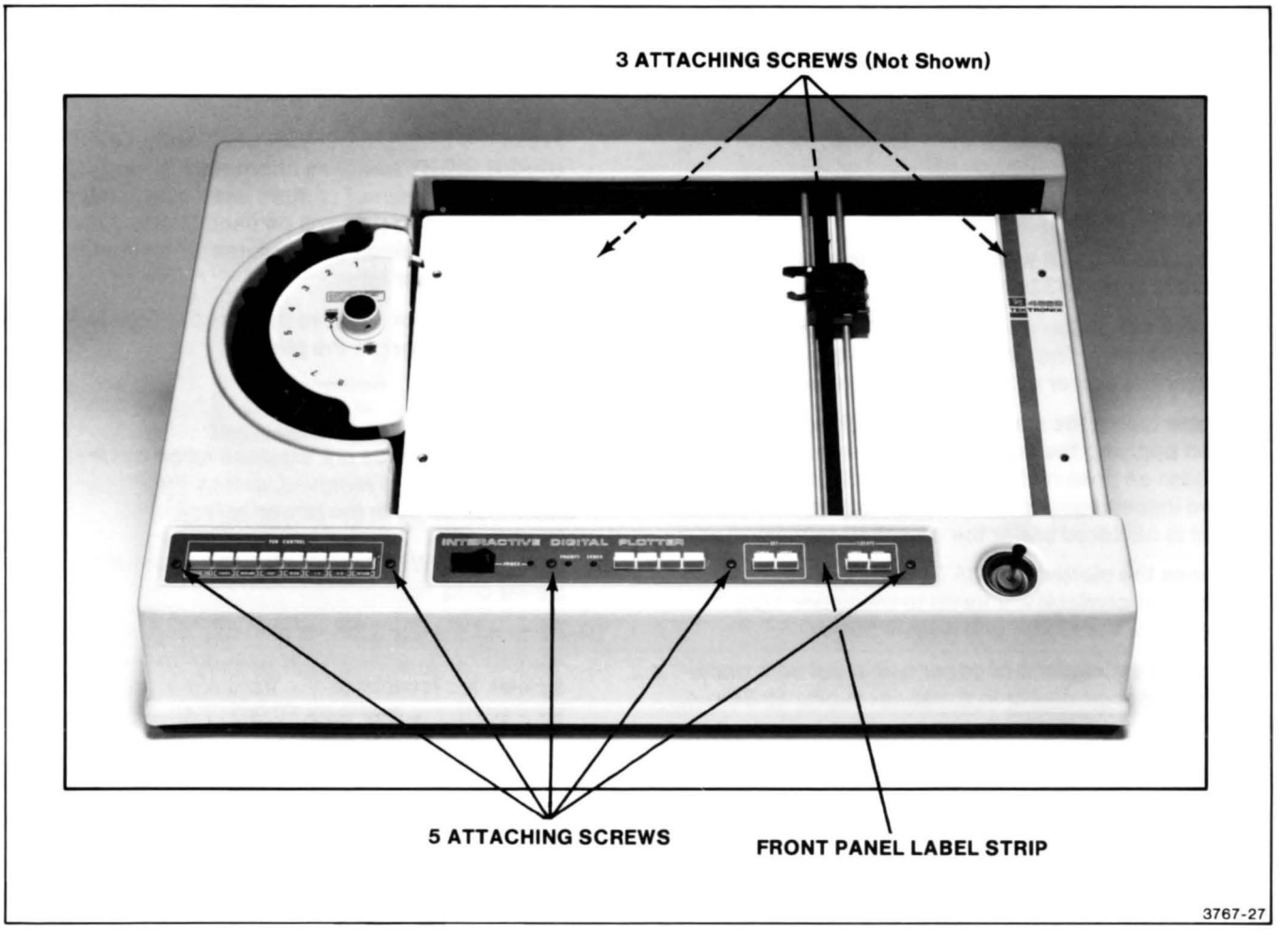


Figure G-4. Plotter Case Attaching Screws (Option 31).

11. **Remove** the case and both front panel label strips The plotter case lifts straight up.

12. **Remove** the four hex-socket cap screws (1/16" socket) holding the platen (see Figure G-5).

13. **Lift** the trim strip located on the right side.

14. **Slide** the Y-axis arm to the left if it is not already there.

CAUTION

The platen has a two-wire cable connecting it to the main Plotter circuit board. Therefore, use care in the next step to avoid damaging this cable or the connector.

15. **Lift** the right edge of the platen and slide it out from under the Y-axis arm and pen carriage. **STOP!** Lift the right edge of the platen to enable you to disconnect the two-pin harmonica connector (J61) from the main Plotter circuit board (see Figure G-3). Then, remove the platen.

The interior of the plotter is now accessible for maintenance. To restore the plotter back to operation, follow the instructions "Replacing the Plotter Case and Platen — Option 31 4662."

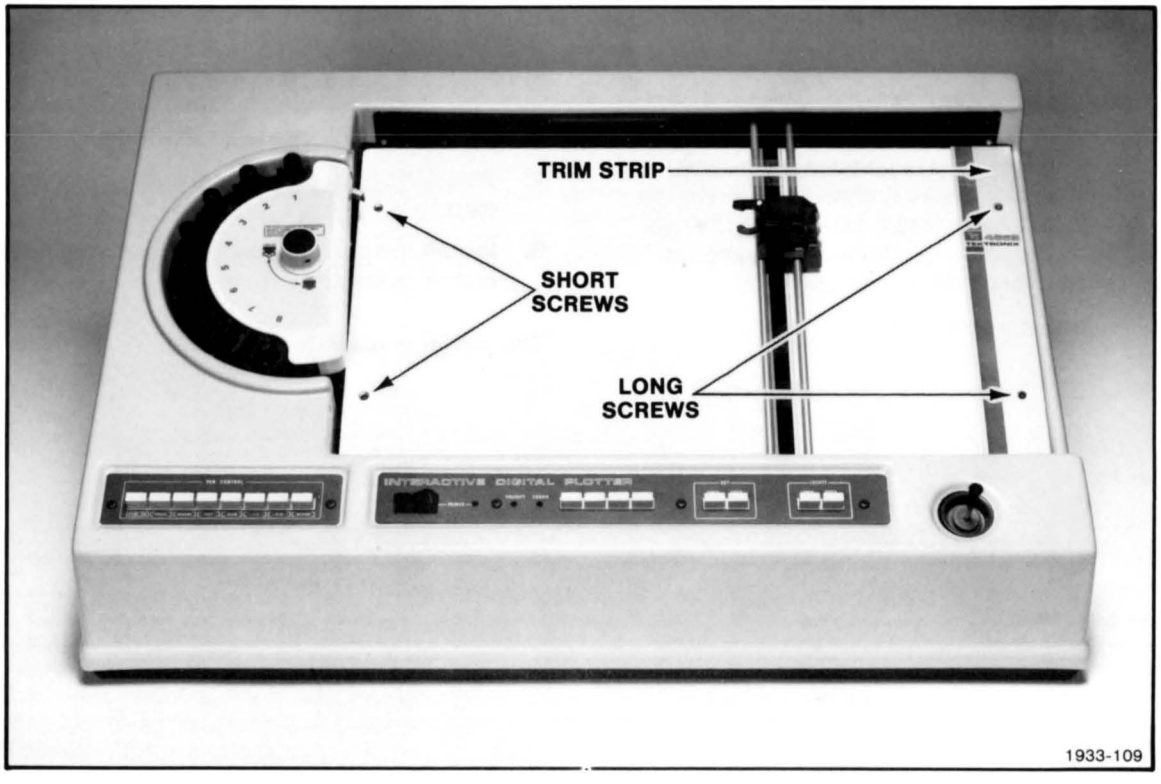


Figure G-5. Platen and Trim Strip Attaching Screws (Option 31).

REPLACING THE PLOTTER CASE AND PLATEN — STANDARD 4662

PLATEN REPLACEMENT

This procedure is not necessary if you did not remove the platen; for example, you may not have removed the platen to perform some parts replacement procedures, If you adjusted the plotter, you replaced and positioned the platen earlier.

1. **Position** any platen shims removed earlier on the frame in the same locations as they were removed.
2. **Ensure** that the Y-axis arm and pen carriage are on the right edge of the plotter and slide the platen partially back into the plotter case.
3. **Reconnect** the platen connector to J61 on the main Plotter circuit board, making certain that the wires will not interfere with the pen drive cables (see Figure G-3).
4. **Slide** the platen into place on the frame.
5. **Verify** that the insulation strip is in place over the wire connection on the top surface of the platen and place the trim strip in position on the right edge of the platen. Install (but do not tighten) the four hex-socket cap screws. Notice that the two longer screws go through the trim strip and the platen on the right side (see Figure G-2).
6. **Turn** the plotter's power on.
7. **Press** the LOCATE UPPER RIGHT switch and position the platen such that the dot on the paper taped to the platen is located directly under the crosshair cursor.
8. **Press** the LOCATE LOWER LEFT switch and in a similar manner position the platen so that the dot on the paper taped to the platen is located directly under the crosshair cursor.
9. **Press** the LOCATE UPPER RIGHT and LOCATE LOWER LEFT switches alternately to verify that the crosshair cursor centers itself over the two dots.
10. **Tighten** the four screws holding the platen.
11. **Align** the platen using the procedure in Section 2 if necessary.

PLOTTER CASE REPLACEMENT — STANDARD 4662

1. **Place** the plotter case on the frame.
2. **Place** the front panel label strip in position on the case.
3. **Install** the six hex-socket screws that hold the plotter case (see Figure G-1).

The plotter is ready for operation.

REPLACING THE PLOTTER CASE AND PLATEN OPTION 31 EQUIPPED 4662

PLATEN REPLACEMENT

This procedure is not necessary if you did not remove the platen; for example, you may not have removed the platen to perform some parts replacement procedures. If you adjusted the plotter, you replaced and positioned the platen earlier.

1. **Position** any platen shims removed earlier on the frame in the same locations as they were removed.
2. **Move** the Y-axis arm to the left side of the plotter and connect the platen connector to J61 on the main Plotter circuit board (see Figure G-3).
3. **Slide** the left end of the platen under the Y-axis arm and onto the frame (or shims). Make certain that the wires to the platen will not interfere with the pen drive cables or are not pinched between the frame and the platen and also that the front paper guide strip and the X-axis cable are not tangled.
4. **Verify** that the insulation strip is in place over the wire connection on the top surface of the platen and place the trim strip in position on the right edge of the platen (see Figure G-5).
5. **Install** (but do not tighten) the four hex-socket cap screws that hold the platen to the frame. Notice that the two longer screws go through the trim strip and the platen on the right side (see Figure G-5).
6. **Turn** the plotter's power on.
7. **Press** the LOCATE UPPER RIGHT switch and position the platen such that the dot on the paper taped to the platen is located directly under the crosshair cursor.
8. **Press** the LOCATE LOWER LEFT switch and in a similar manner position the platen so that the dot on the paper taped to the platen is located directly under the crosshair cursor.
9. **Press** the LOCATE UPPER RIGHT and LOCATE LOWER LEFT switches alternately to verify that the crosshair cursor centers itself over the two dots.
10. **Turn** the plotter's POWER off.
11. **Tighten** the four screws holding the platen.

PLOTTER CASE REPLACEMENT

1. **Place** the plotter case on the frame.
2. **Position** the two front panel label strips in position on the plotter case.
3. **Install** the eight hex-socket cap screws holding the plotter case to the frame (see Figure G-4).

The plotter is ready for operation.

Appendix H

MAJOR OVERHAUL OF OPTION 31

After four or five years (depending upon the frequency of the plotter's use), you must replace several mechanical parts of the Multiple Pen (Option 31) assembly in order to ensure reliable operation.

The following parts are to be replaced (see Section 3 for parts assembly/disassembly procedures):

Qty	Part #	Part Name
1	386-4690-00	Pen Capping Plate
1	384-1622-00	Cam Shaft
1	358-0670-00	Bushing
1	407-2743-00	Component Bracket
1	214-3218-00	Pen Holder Hub
8	200-2630-00	Pen Caps

The following parts should also be replaced only if they are worn or damaged:

Qty	Part #	Part Name
1	198-4501-00	Pen Sensing Switch Assembly
8	214-3314-00	Spring (in Penkeeper)
1	351-0690-00	Spring Guide
8	352-0640-00	Pen Keeper
1	352-0635-01	Pen Holder Assembly

Perform the following assembly/disassembly procedures (refer to Section 3 of this manual):

1. **Remove** the Option 31 mechanism.
2. **Remove** the Pen Capping Plate, including the Rotary Pen Turret drive motor and/or belt.
3. **Perform** the lubrication procedure for Option 31 (see Section 2).
4. **Move** the Helical Compression Spring, OPTICAL Switch, and PEN SENSE Switch to the new component bracket.
5. **Move** the pen keepers from the old pen holder hub to the new one.
6. **Reverse** the Pen Capping Plate procedure, using the new parts on the assembly.

Also perform the following adjustments (refer to Section 2):

1. **Adjust** the Y-axis Pen Drive Cable tension.
2. **Adjust** the X-axis Pen Drive Cable tension.
3. **Align** the X-axis, Platen, and Orthogonality.
4. **Set** the Lower Bushing clearance.
5. **Set** the Motor Belt tension.
6. **Place** the Option 31 back in the plotter by replacing the four mounting screws removed earlier.
7. **Align** the Pen Caps.
8. **Adjust** the Rotary Pen Turret.
9. **Adjust** the PEN SENSE switch.
10. **Set** the Rotary Pen Turret Exchange Point.
11. **Adjust** the X-axis Pen Exchange position.
12. **Perform** a final check, and replace the cover.

In addition, replace the eight pen caps (200-2630-00) each time the plotter is serviced.

Appendix I

TROUBLESHOOTING GUIDE

Table I-1 and the accompanying illustrations provide a list of possible plotter malfunction symptoms and some corrective action. The table is not totally inclusive and may not list every possible corrective action for a symptom. However, the table may help the technician get started in finding a solution for a particular plotter malfunction.

NOTE

The Diagnostics Test Fixture (067-0831-01) and the System Test Fixture (067-0746-00) are used to test and troubleshoot the 4662 Interactive Digital Plotter. These test fixtures should be used in conjunction with the test fixture manuals to completely service the plotter.

Table I-1

TROUBLESHOOTING GUIDE

Symptom	Likely Causes	Corrective Action
No plotter motion when plotter is powered-up.	One or more fuses blown.	Check the following fuses: F1001, F351, F352, F431, and F551.
Continuous bell at power-up.	Defective memory.	Check memory devices (it is best to use Diagnostic Test Fixture on this problem).
Option 31 rotary pen turret does not close (if open) on power-up.	Incorrect detent spring position.	Hold the rotary pen turret with one hand and turn the knob CCW until you hear a click.
Pen is not picked up after selection although rotary pen turret rotates and closes, and the bell sounds (Option 31).	Pen is not being sensed.	Check pen for proper seating and/or adjust pen sense switch.
Rotary pen turret loses position during opening (Option 31).	(1) Pens are too long.	(1) Replace pen.
	(2) Cam mechanism is worn excessively.	(2) Overhaul the Option 31 mechanism (see Appendix H).
	(3) Circuit failure.	(3) Use Diagnostic Test Fixture to test.
Drops pen during pen pick-up or loses X-position (Option 31).	Option 31 is not calibrated; pen holder, pen carriage, or pen adapter is damaged.	Calibrate Option 31 and/or replace damaged part.
Pen bouncing (Figure I-1)	Incorrect pen height (pen actuator mechanism is out of adjustment).	Adjust (see Pen Actuator Adjustment in Section 2).
	Pen not correctly mounted in pen adapter (Option 31) or pen holder (standard plotter).	Reseat pens.
	Dirty or scratched pen carriage.	Remove and replace damaged parts, lubricate, and reassemble.
	Worn or damaged pen solenoid stop.	Replace.

Table I-1 (cont)

TROUBLESHOOTING GUIDE

Symptom	Likely Causes	Corrective Action
Line width modulation (Figure I-2).	Lubricant on X-axis shaft is dirty or missing.	Relubricate (see Section 2).
	Pen holder pivots are too tight.	Loosen the two set screws holding the pen holder to the pen carriage.
	Damaged X or Y pen drive cables or pulleys.	Replace cables or pulleys.
	Defective X or Y pen drive motor.	Replace motor.
Alpha letters are hooked or distorted (Figure I-3).	X and Y pen drive cables are not tensioned properly.	Tension X and Y pen drive cables (see Section 2).
	Pen holder set screws are too loose.	Tighten the two set screws holding the pen holder to the pen carriage.
	Pen carriage slide tension is out of adjustment.	See Pen Carriage Slide Tension Adjustment (Section 2).
	Pen holder is damaged.	Replace.
Missed pen exchanges (Option 31).	Incorrect pen turret position adjustment.	See X-Axis Pen Exchange Position adjustment (Section 2).
	Incorrect pen height.	Adjust (see Section 2).
	Damaged X- or Y-axis pen drive cable or pulleys.	Replace cable or pulleys.
	Defective lubricant on X-axis shaft or pen solenoid shaft.	See Lubrication (Section 2).
	Damaged pen holder or helper springs.	Replace pen holder or helper springs.
	Incorrect limit switch adjustment.	See Limit Switch Adjustment (Section 2).
	Incorrect X-axis pen exchange position.	See X-Axis Pen Exchange Position.
	Incorrect belt tension.	See Motor Belt Tension (Section 2).
	Pens catching on rubber pen caps.	(1) Replace pens if they are too long. (2) Replace pen caps (see Section 3). (3) If the pen still catches, replace pen capping plate (see Section 3).
Plotter fails to sense pen in the pen carriage (Option 31).	Pens not seated properly.	Reseat pens.
	Incorrect rotary pen turret exchange point.	See Setting Rotary Pen Turret Exchange Point (Section 2).
	Limit switches out of adjustment.	See Limit Switch Adjustment (Section 2).
	Pen switch out of adjustment or defective.	See Pen Sense Switch Adjustment (Section 2).
	Defective optical interruptor or multiplexing circuitry.	Replace (see Section 3) or trace signal to defective components.
Pens in rotary pen turret drag on platen during pen exchanges (Option 31).	Incorrect pen turret height.	See Rotary Pen Turret Height Adjustment (Section 2).
	Pen is incorrect length.	Replace pen.

Table I-1 (cont)

TROUBLESHOOTING GUIDE

Symptom	Likely Causes	Corrective Action
Plots show X-axis shift after pen exchanges (Option 31).	Defective lubrication on X-axis shaft or pen solenoid.	Relubricate (see Section 2).
	Incorrect offset strap position (System Memory circuit board).	See Adjust X-Axis Pen Exchange Position (Section 2).
	Damaged X or Y pen drive pulleys or cable.	Replace (see Section 3).
	Defective X or Y pen drive motor.	Replace (see Section 3).
Pens drag on platen in the "PEN UP" position.	Incorrect pen height.	See Pen Actuator Adjustments (Section 2).
	Platen incorrectly shimmed.	See Pen Actuator Adjustments (Section 2).
	Damaged platen.	Replace.
	Pen is too long.	Replace.
Pens dry out quickly when stored in rotary pen turret while plotting (Option 31). (Note that pens, especially wet ink pens, should not be stored in the rotary pen turret except while plotting).	Worn or damaged pen caps.	Replace (see Section 3).

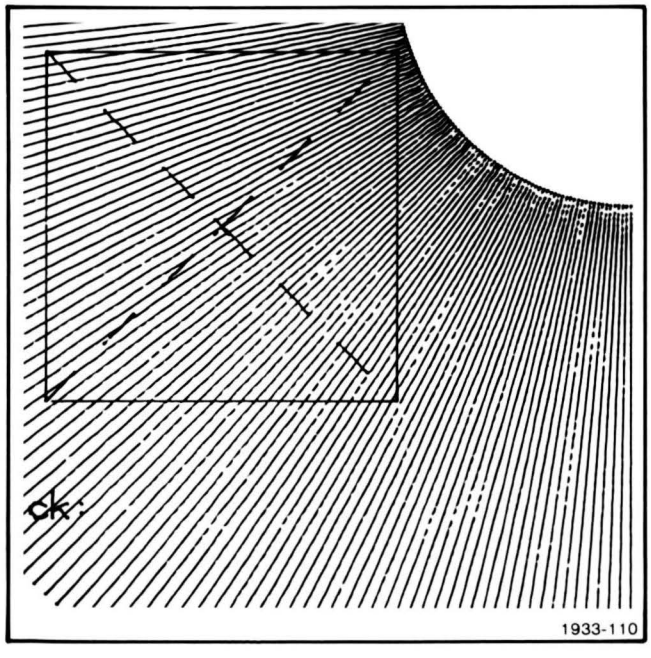


Figure I-1. Example of Pen Bouncing.

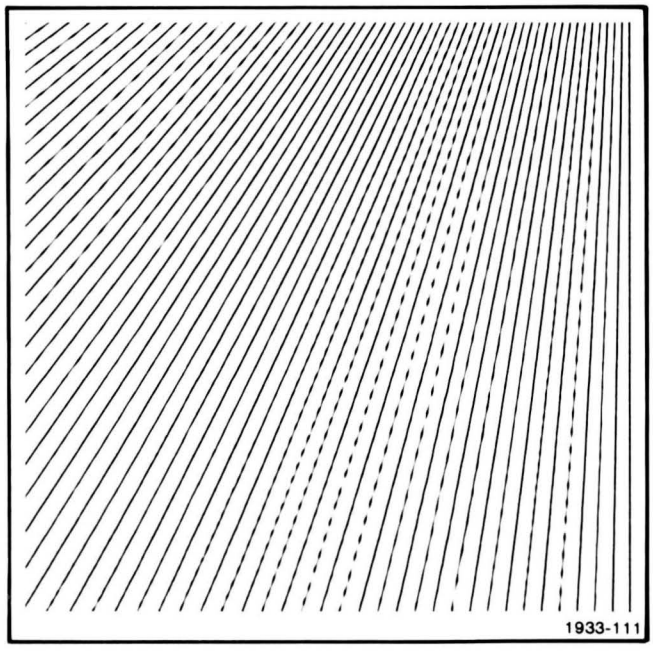


Figure I-2. Example of Line Width Modulation Problems.

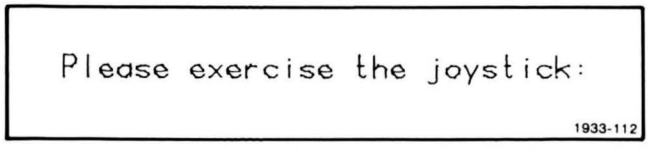


Figure I-3. Example of Distorted Alphanumeric Characters.

Appendix J

OPTION 31 INSTALLATION

INTRODUCTION

This appendix details the steps required to install Option 31 in a TEKTRONIX 4662 Interactive Digital Plotter.

The 4662 Option 31 installation procedure consists of the following steps:

1. Remove the standard plotter case and platen.
2. Install the Option 31 mechanical assembly.
3. Replace the diodes in the power supply.
4. Install the System Memory circuit board, if necessary.
5. Calibrate the basic 4662 plotter.
6. Calibrate Option 31.
7. Install a new plotter case.

This installation guide gives detailed instructions for the above-listed steps.

Option 31 requires a System Memory circuit board (670-7176-00, 01, 02 . . .), which is standard in all current model 4662 plotters. For older model plotters the System Memory circuit board must be installed as part of the Option 31 installation.

The System Memory circuit board will also replace the Fimware Patch circuit board (670-5120-00) installed in some older model plotters.

For Option 31 to work properly, the plotter must be properly adjusted and in good condition. Therefore, you must replace all worn or defective mechanical parts and perform a complete plotter adjustment. You will find the complete plotter adjustment procedure in this appendix. Perform the adjustment after installing the 4662 Option 31.

CAUTION

Do not test the operation of Option 31 until requested to do so after alignment of the plotter (which follows the installation of Option 31). Mechanical damage to the plotter may result from initial misalignment of moving components.

EQUIPMENT REQUIRED

Tektronix part numbers are nine-digit numbers in parentheses following the item listing.

Allen Wrenches
.050" Standard Allen Wrench Driver
Phillips Screwdriver (or Pozidriv®)
3/16" Nutdriver
Push-Pull Scale (fish weighing scale) (003-0762-00)
1/4" Open-End Wrench
Needle-Nose Pliers
Pen Turret Height Gauge (003-1238-00)
.004" Feeler Gauge (003-1291-00)
.040" Feeler Gauge
Digitizing Reticle (119-1472-00)
Calibration Overlay (334-4717-00)
IC Puller
Thread Adhesive (such as Loctite® #222, 006-2517-00)
Front Panel Extender Cable (198-3848-00)
Platen Shims
  .005" (361-0855-00)
  .010" (361-0857-00)
  .020" (361-0856-00)
Lubricant (such as Zeniplex® #2) (006-3684-01)

PREPARING THE PLOTTER FOR INSTALLATION

REMOVING THE PLOTTER CASE AND PLATEN — Standard 4662

1. **Turn** the POWER switch off and disconnect the power cord and any attached interface cables.

WARNING

Hazardous voltages are exposed when the Plotter case or platen are removed, unless the Plotter is disconnected from the power source.

2. **Remove** the six hex-socket cap screws (5/64" socket) holding the Plotter case to the frame. There are three screws on the front panel and three screws on the rear panel (see Figure J-1).
3. **Remove** the plotter case and the front panel label strip.
4. **Remove** the four hex-socket cap screws (1/16" socket) holding the platen (see Figure J-2). Discard the two short screws.

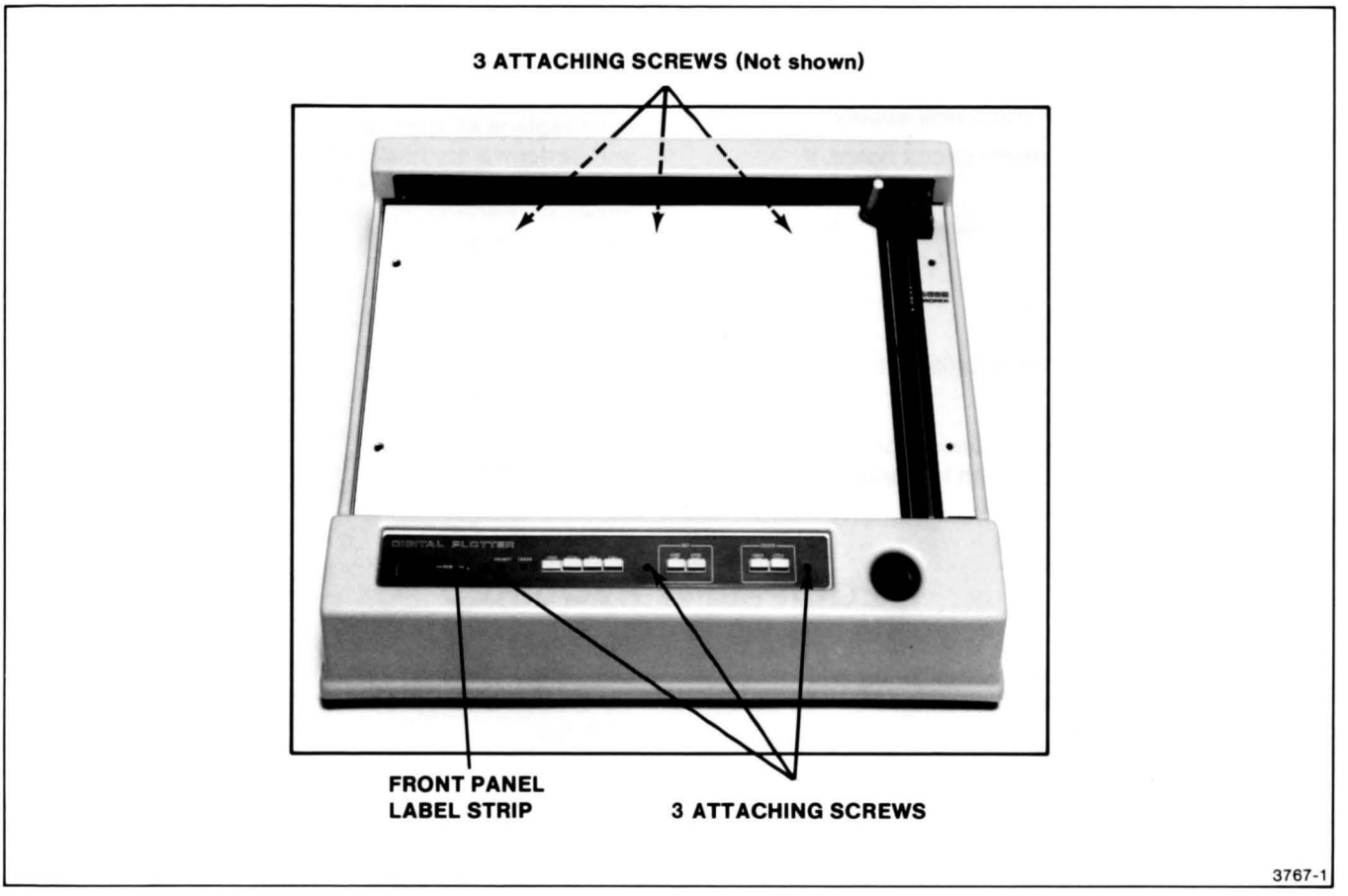


Figure J-1. Plotter Case Attaching Screws.

5. **Lift** the trim strip located on the right side. Then, move carriage to right edge of the platen.

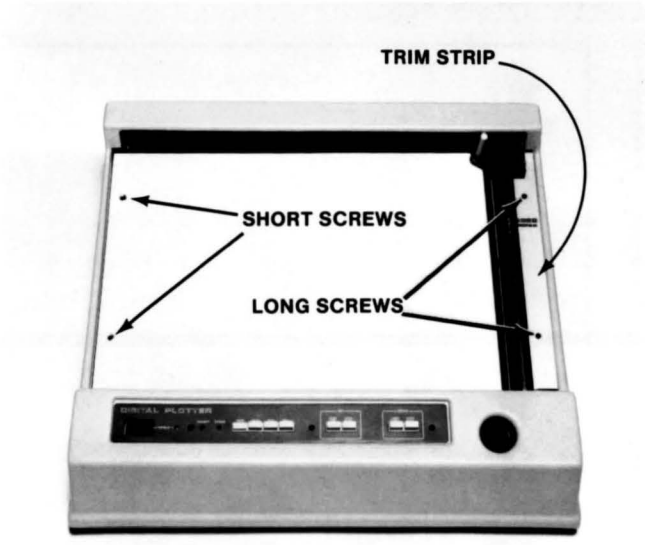
CAUTION

The platen has a two-wire cable connecting it to the main Plotter circuit board. Therefore, use care in the next step to avoid damaging this cable and its connector.

NOTE

Some plotters may have thin metal shims under one or more corners of the platen. Do not lose these shims during the next step. When the plotter is reassembled, be sure the shims are placed back under the same corners.

6. **Lift** the platen at the left bottom edge and slide it to the left until it clears the pen carriage. STOP! Lift the platen slightly to expose the two-wire cable that connects the platen to the High Voltage Connector (J61) on the main Plotter circuit board. Disconnect the two-pin harmonica connector from the connector pins. Then, remove the platen (see Figure J-3).



3637-1

Figure J-2. Platen and Trim Strip Attaching Screws.

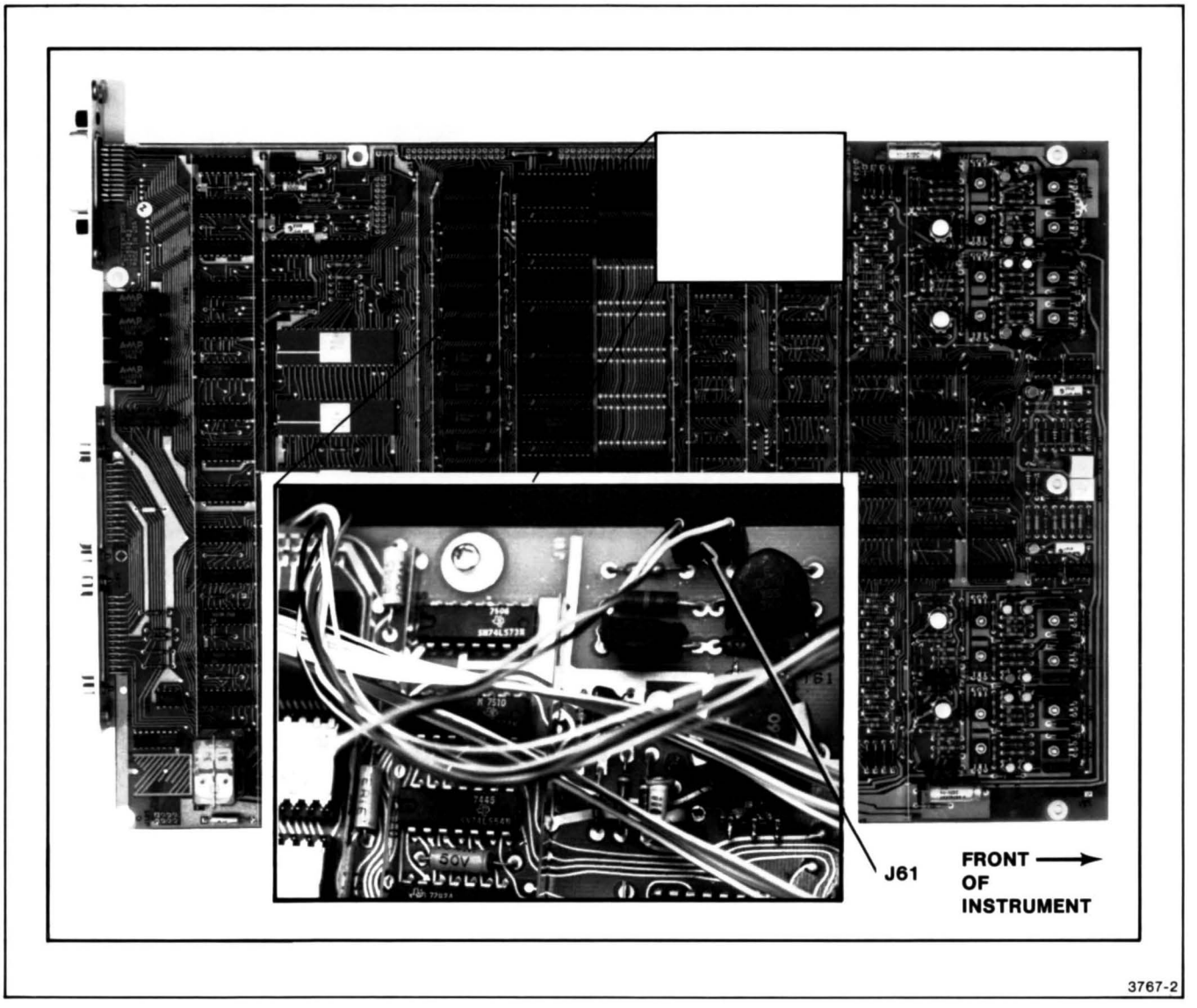


Figure J-3. Platen Connector Position.

POWER SUPPLY DIODE REPLACEMENT

Refer to Appendix K for the procedure to replace the diodes in the power supply.

MECHANICAL CHECK OF THE PLOTTER

1. **Check** the entire length of both the X- and Y-axes pen drive cables for worn spots, broken wire strands, and kinks. If any cable shows signs of wear, replace it (see Section 3). The cable tension will be adjusted later in this procedure.
2. **Check** all cable pulleys for excess wear and worn or tight bearings. Replace as necessary.

Y-AXIS ARM PULL TEST

NOTE

For Option 31 to work properly, the plotter must be adjusted and in good condition. This means that the pen drive cables cannot be worn, kinked, or loose, pulley bearings must be in good condition, and the plotter must be properly lubricated (lubrication procedures follow). The following Y-axis arm pull test is designed to indicate the mechanical condition of the plotter, but it is not sufficient to verify the plotter's overall mechanical condition.

1. **Hook** the push-pull scale (or fish weighing scale) over the Pen Actuator Bar, as shown in Figure J-4. Use the push-pull scale to pull the Y-axis arm back and forth across the platen. If the force required to move the Y-axis arm is greater than 24 ounces (1.5 lbs or 681 grams), Option 31 may not work. To lessen that force, try replacing the pen drive cables, pulleys, X-axis pen drive motor, or linear bearing, or lubricating the X-axis shafts.

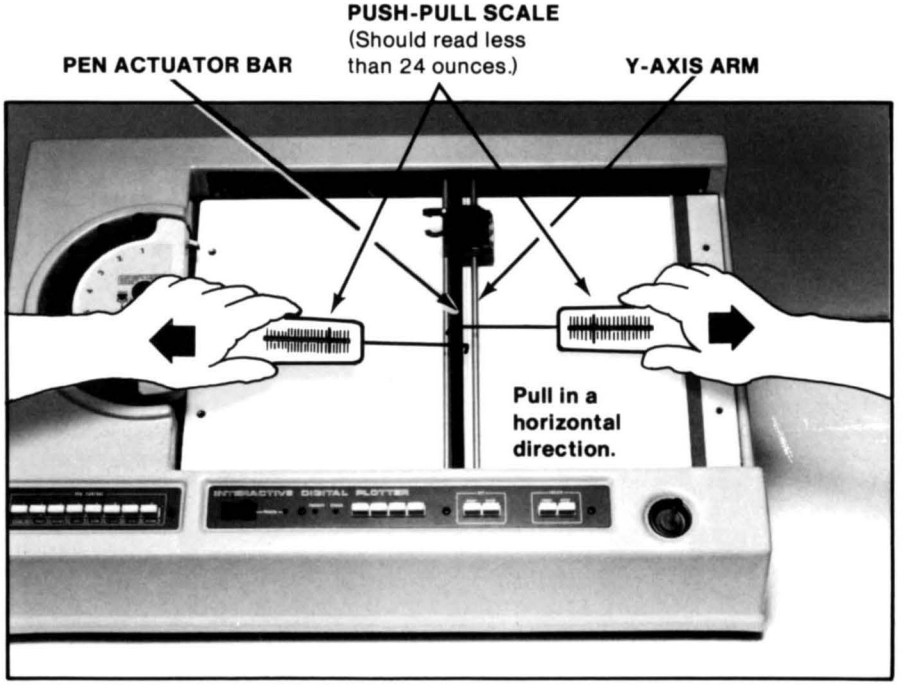


Figure J-4. Y-Axis Arm Pull Test.

OPTION 31 INSTALLATION

1. **Find** the three screws on the underside of the plotter that hold the plotter's left side chassis to its base. Replace them, one at a time, with 212-0008-00 screws (see Figure J-5). However, leave the screws loose — the screw heads should protrude about 1/4" (6 mm).
2. **Remove** the front screw that holds the debris catcher to the plotter's left side chassis (see Figure J-5). This screw is located at the right of the pen actuating solenoid (viewing the left side of the chassis) and near the POWER switch. Do not discard this screw as it will be used later.
3. **Remove** the screw and washer that holds the top rear portion of the plotter's main transformer to the plotter's left side chassis (see Figure J-5). Do not discard this screw as it will be used later.
4. **Loosen** (but do not remove) the screws that hold the triangular side brace and the switch bracket to the Option 31 mounting plate (see Figure J-6).

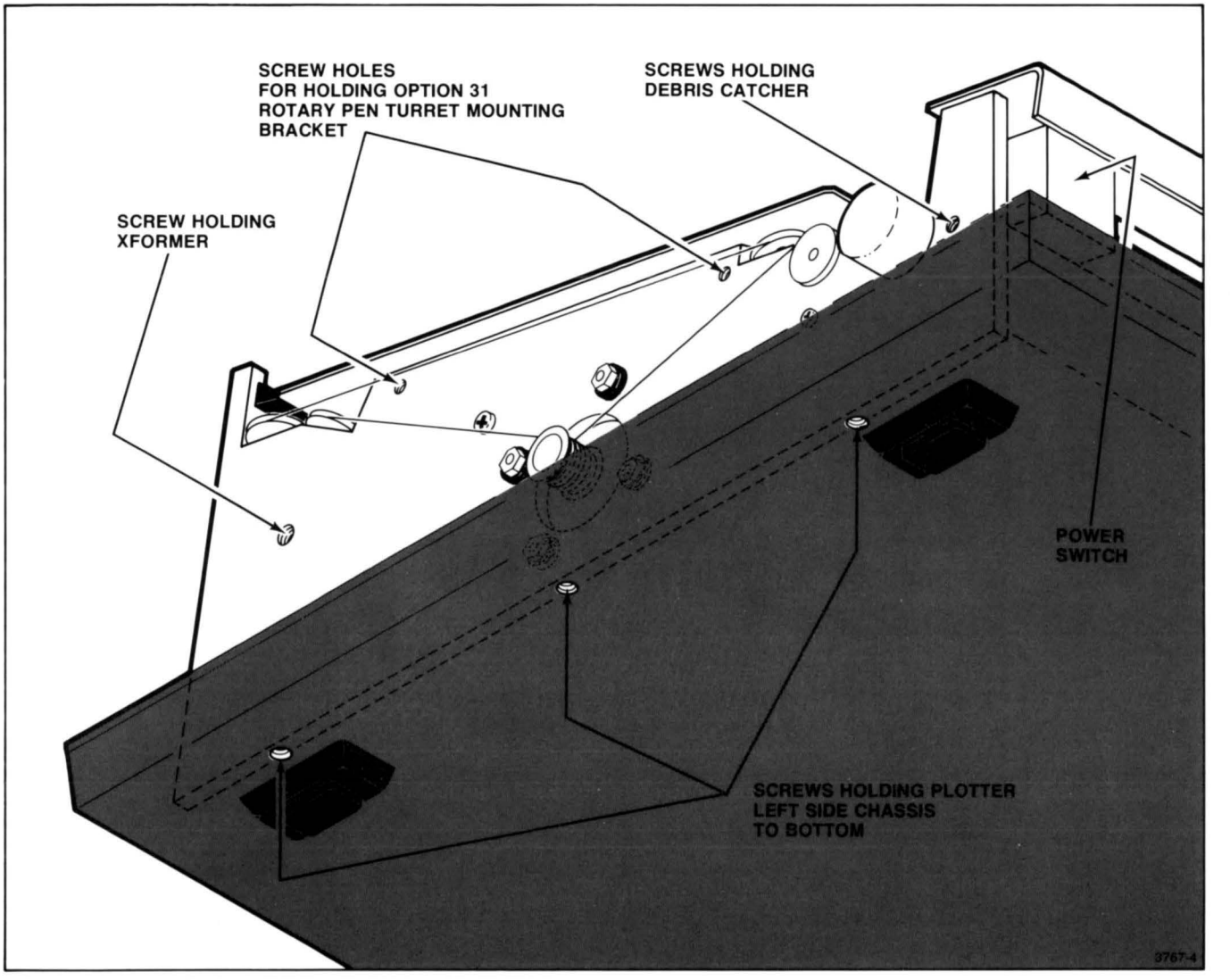


Figure J-5. Option 31 Mounting Screw Locations.

CAUTION

When installing the rotary pen turret assembly during the next two steps, you will guide a portion of the mounting bracket between two X-axis cables on the plotter's left side. Do not scratch or damage these cables.

5. **Slide** the Option 31 assembly onto the three screws (replaced in Step 1) on the underside of the plotter. The Option 31 mounting plate should fit tight against the left side of the plotter. Now tighten the three bottom screws.

CAUTION

When performing the following step, make sure that the plastic turret base does not protrude above the plotter's left side frame. If the base does protrude, you will not be able to properly replace the platen.

6. **Install** two 212-0023-00 screws to hold the rotary pen turret to the plotter's left side chassis (see Figure J-5). Install these screws just below the upper X-axis drive cable and on each side of the rotary pen turret. Apply upward pressure on the rotary pen turret mounting bracket as you tighten the screws.

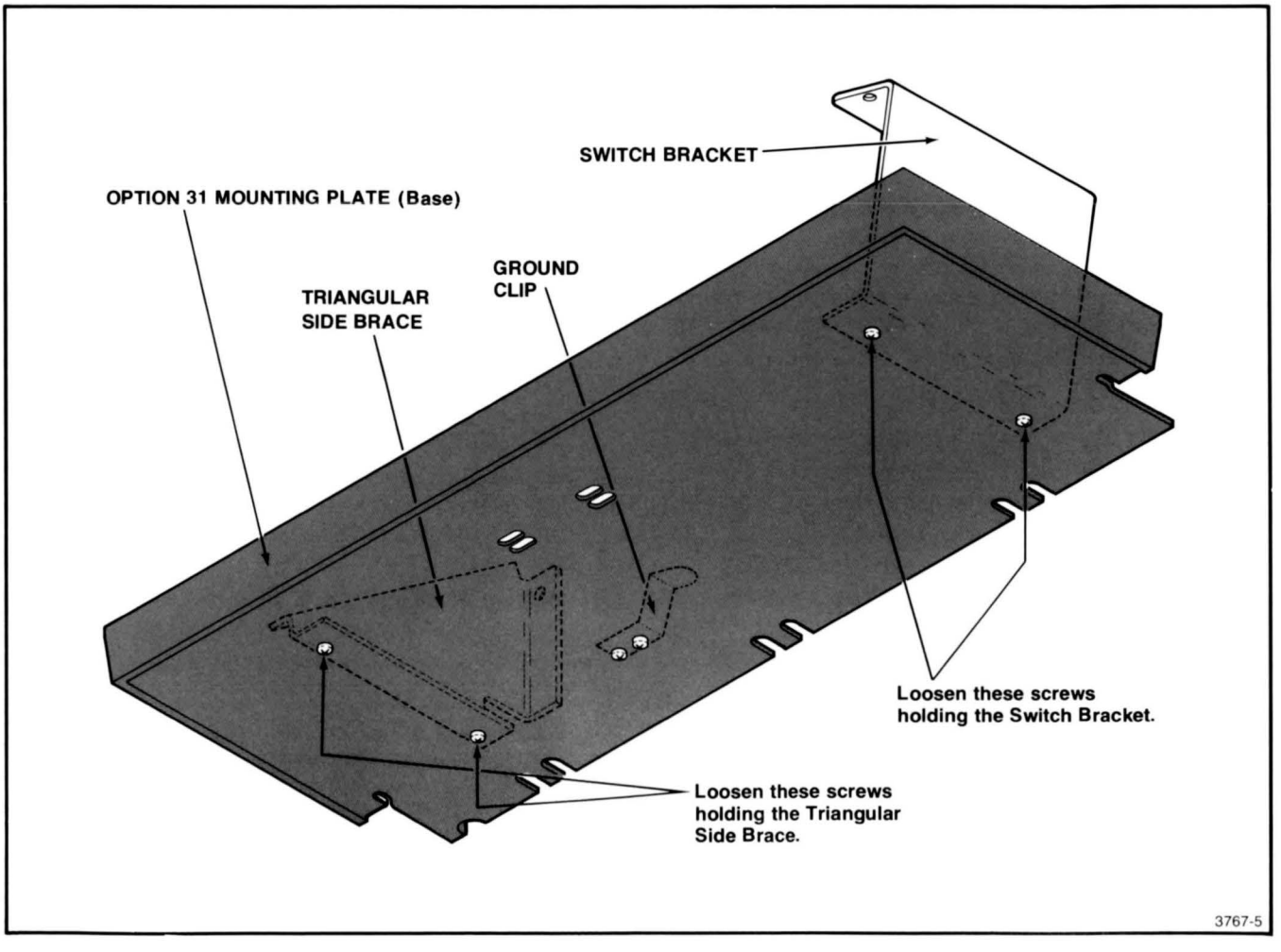


Figure J-6. Option 31 Support Screw Locations.

CAUTION

Be careful not to pinch the Pen Solenoid wires in the next step. Also, ensure that the ends of the pen drive cables do not electrically short out components on the Pen Turret Drive circuit board.

7. **Replace** the screws removed in Steps 2 and 3. These screws attach portions of the Option 31 mechanical assembly to the plotter's chassis.
8. **Tighten** the screws holding the triangular side brace and switch bracket to the Option 31 mounting plate (loosened in Step 4).
9. **Ensure** that the ground clip is installed on the Option 31 base plate and that the lower end of the main rotary pen turret shaft fits squarely in the ground clip's top pocket. Also, ensure that there is lubrication between the lower end of the rotary pen turret shaft and the ground clip. Use the lubrication specified in the list of equipment at the beginning of this procedure.

SYSTEM MEMORY CIRCUIT BOARD INSTALLATION

To install Option 31, the 4662 Interactive Digital Plotter must be equipped with a System Memory circuit board. Your plotter may have been shipped with either a Firmware Patch circuit board (670-5120-00, 01, 02 . . .), a System Memory circuit board (670-7176-00, 01, 02 . . .), or neither. If you have either of these circuit boards, you will find them located on spacer posts above the main plotter circuit board and near the main power transformer.

- If the plotter contains a Firmware Patch circuit board, first follow the procedures for removing the Firmware Patch circuit board; then follow the procedures for installing the System Memory circuit board.
- If the plotter does not contain either a Firmware Patch circuit board or a System Memory circuit board, proceed to the System Memory circuit board installation procedures.
- If the plotter already contains a System Memory circuit board, install the EPROM (160-1527-00) in the socket of U51 (see Figure J-7). Ensure that the strap located next to U551 is set to the "1" position (the strap should be on the two square pins closest to U452). Then, proceed to the Final Assembly procedure.

Firmware Patch Circuit Board Removal

1. **Remove** the flat ribbon-cables from J41 and J51 of both the Firmware Patch circuit board and the main Plotter circuit board.
2. **Remove** the cable that connects both J105 of the Firmware Patch circuit board and J105 of the main Plotter circuit board.
3. **Remove** the Firmware Patch circuit board by removing the two screws that hold the Firmware Patch circuit board to spacer posts located near connectors J41 and J51. It is not necessary to remove the two screws on the left side of the Firmware Patch circuit board.
4. **Remove** the two newly exposed spacer posts from the Plotter circuit board. Simply unscrew these spacer posts from the spacer posts supporting the main Plotter circuit board.

System Memory Circuit Board Installation Procedure

1. **Remove** the protective cover connector, if present, from J51 of the Plotter circuit board. J51 is one of the two large connectors along the right edge of the Plotter circuit board and is the one located closest to the front of the circuit board.
2. **Remove** the ROMs from U45, U50, U145, U250, U345, U445, and U450 (see Figure J-7) and discard.
3. **Install** the EPROM (160-1527-00) in the socket of U51 (see Figure J-7). Ensure that the strap located next to U551 is set to the "1" position (the strap on the two square pins closest to U452).
4. **Remove** the three screws that hold the main Plotter circuit board near U515, U551, U725. Some of these screws may have already been removed earlier when the Firmware Patch circuit board was removed.
5. **Install** three spacer posts (129-0763-00) in the same location as the screws removed in Step 4. Place a lockwasher (210-0004-00) between the spacer post and the circuit board. Install a black spacer post (129-0888-00) to the System Memory circuit board. Mount the post on the bottom of the board in the mounting hole near J190. Use one of the 211-0244-00 screws to attach the post.
6. **Install** the System Memory circuit board into the plotter using either the three screws removed in Step 4 or three 211-0244-00 screws. Orient the System Memory circuit board so that the connectors J41 and J51 face to the right (when viewing the front of the plotter) and so that the post near J190 hooks over the edge of the main Plotter circuit board near U652.
7. **Install** one 7" (180 mm) flat cable between J41 of the System Memory circuit board and J41 of the main Plotter circuit board.

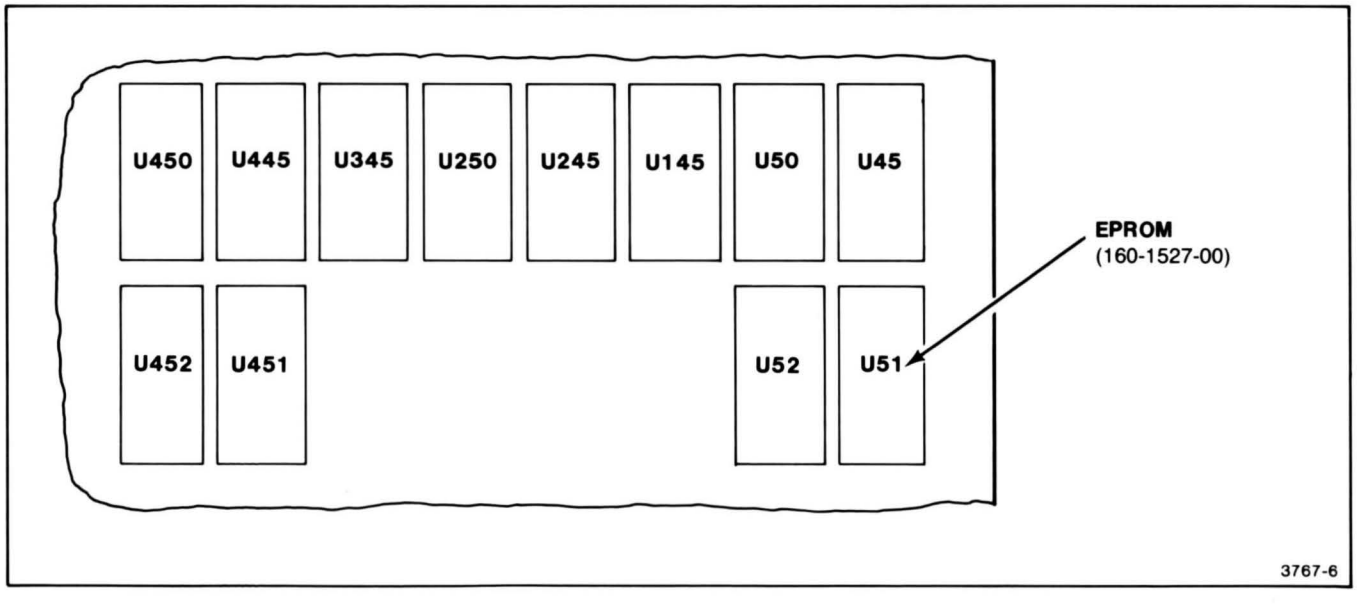


Figure J-7. EPROM Installation Details.

8. **Install** a second 7" flat cable between J51 of the System Memory circuit board and J51 of the main Plotter circuit board.

CAUTION

Some Plotter circuit boards (670-4102-00, 01, 02 . . .) do not have a square solder pad under the Pin 1 square pin of J105. Refer to Figure J-8 for the location of Pin 1 when doing the next step. Failure to orient this cable correctly will result in damage to the circuit board and/or the power supply when power is applied.

9. **Attach** the 5" (127 mm) cable between J105 on the System Memory circuit board and J105 of the main Plotter circuit board. Make sure that Pin 1 of the cable connects to Pin 1 of the connectors.

FINAL OPTION 31 ASSEMBLY

1. **Install** a cable clamp (343-0775-00) on the inside of the plotter's bottom chassis in front of the Power Supply circuit board (see Figure J-9).

CAUTION

When installing the cable connector to J190 of the Pen Turret Drive circuit board in the next step, observe the location of Pin 1 as shown in Figure J-9. If you see the letter "A" printed on the circuit board (indicating Row A for J190) do not let it confuse you; it does not indicate Pin 1. Damage to the circuit board and/or the power supply may occur if the power is applied and this cable is incorrectly connected.

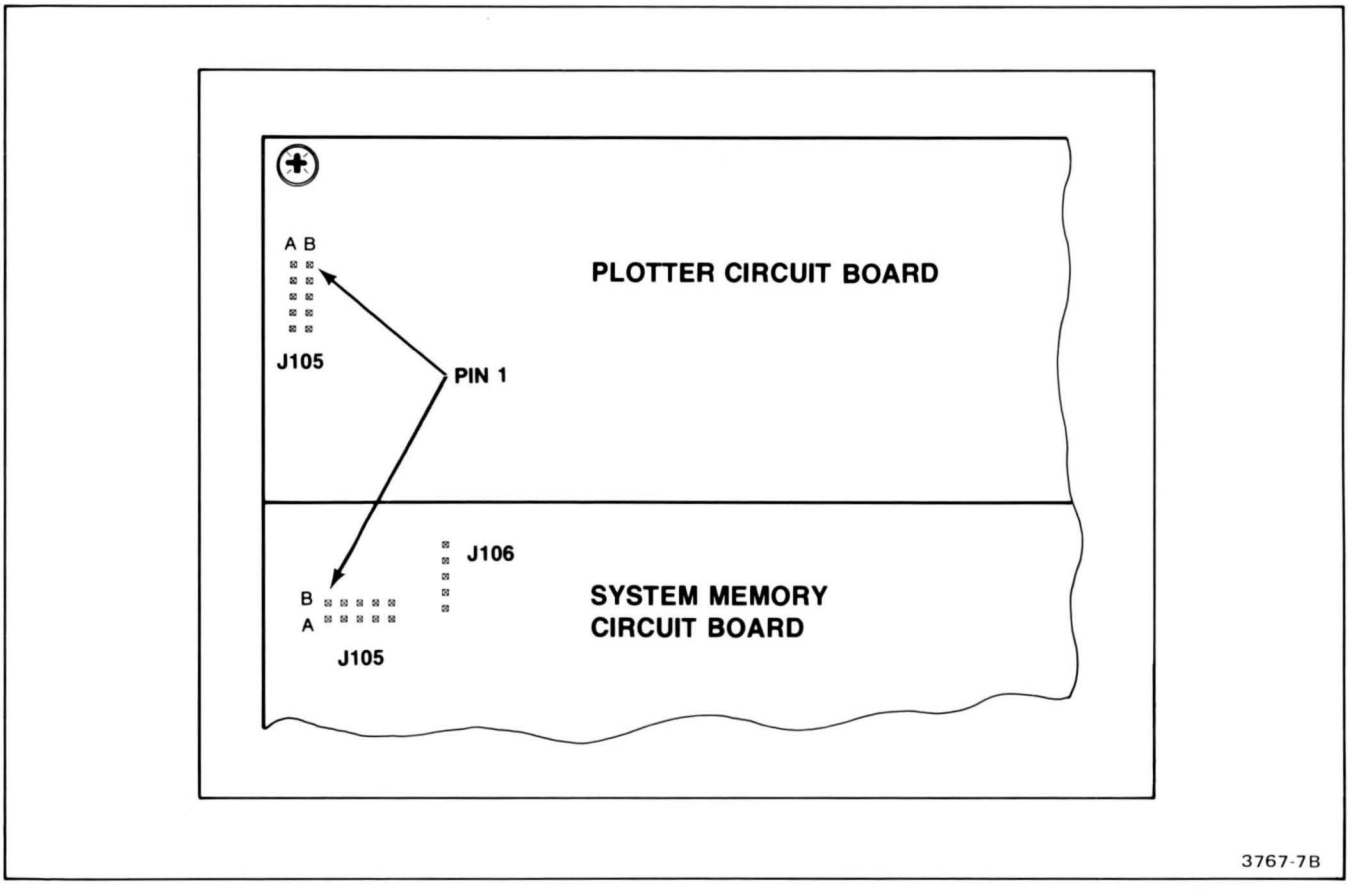


Figure J-8. J105 Pin 1 Locations.

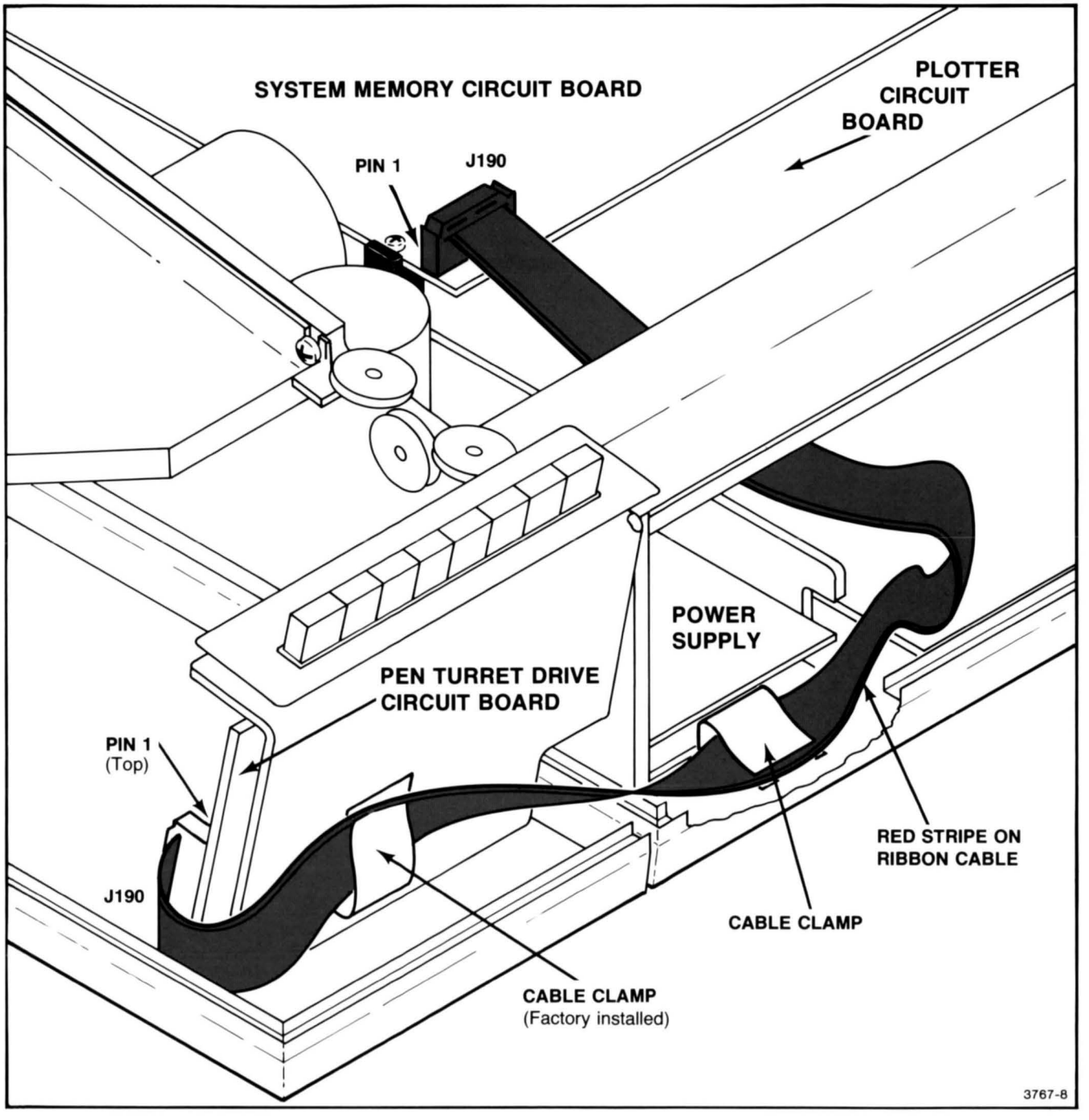


Figure J-9. J190 Connector and Cable Mounting Details.

2. **Feed** the flat ribbon cable from J190 on the Pen Turret Drive circuit board to J190 on the System Memory circuit board. Dress this cable neatly as shown in Figure J-9.
3. **Use** a .050" Allen wrench to loosen (do not remove) the two set screws that hold the pen holder to the pen carriage and remove the pen holder (see Figure J-10).
4. **Remove** and discard the two Pozidriv® screws holding the thin metal spring. Do not remove the spring.
5. **Place** a pivot adapter (103-0239-00) over the thin metal spring so that the holes line up with those in the spring. This will place the new pen holder pivots just above the old pivots.
6. **Place** a lockwasher (210-0053-00) on each of two screws (211-0118-00) and then install these screws in the same location as the screws removed in Step 4.
7. **Tighten** the two screws loosened in Step 3 until they just become snug against the new pivot adapter. These set screws are on the old pivot adapter.
8. **Use** two set screws (213-0022-01) to attach the new pen holder (352-0635-01) to the new pivot adapter. Tighten both set screws evenly until you feel some friction when lifting the pen holder **(do not overtighten).** Then, loosen each set screw until the pen lifter moves easily up and down with no binding and with minimal play.
9. **Lubricate** the two set screws holding the pen holder.

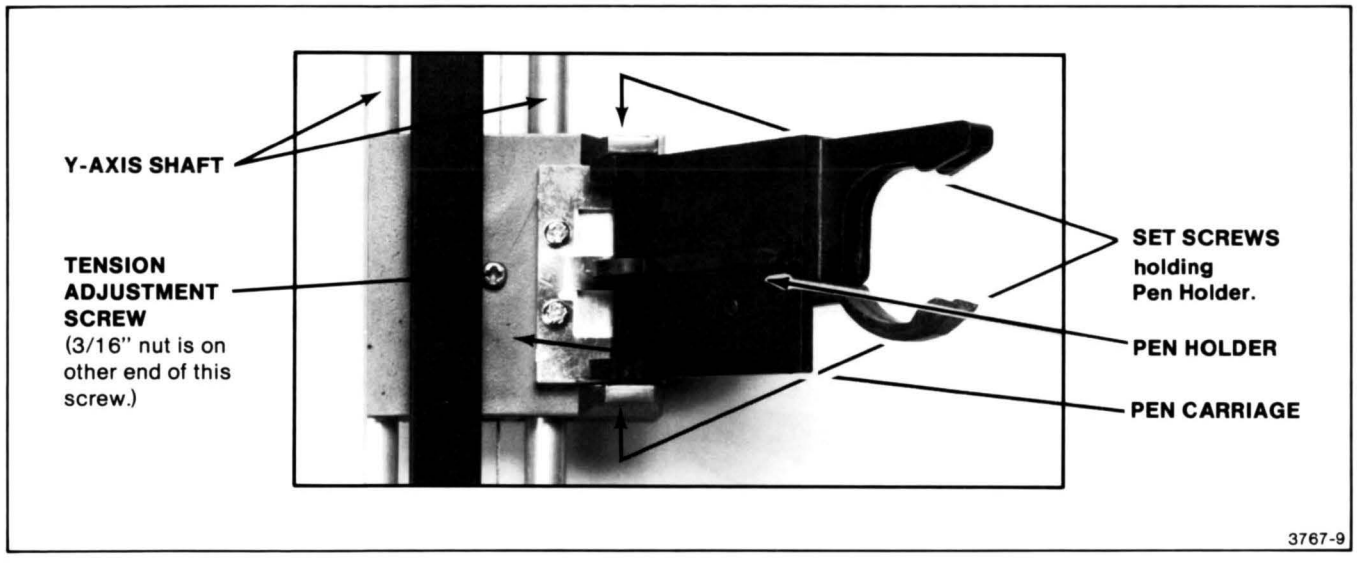


Figure J-10. Pen Carriage Slide Tension Adjustment and Pen Holder Mounting Details.

MAIN PLOTTER ADJUSTMENT PROCEDURE

CAUTION

Do not attempt to test the operation of Option 31 until requested to do so in this procedure. Mechanical damage to the plotter may result from misalignment of moving components.

WARNING

Ensure that the plotter's power is off and disconnect the line cord.

1. **Perform** the following plotter adjustments. Refer to Section 2 for the procedure for each adjustment.

- Pen Carriage Slide Tension Adjustment
- X-Axis Shaft Lubrication
- Pen Drive Cable Tension Adjustments
- Platen Installation (preliminary for alignment)
- X-Axis Symmetry Control
- Y-Axis Symmetry Control
- Joystick Electrical Center Adjustment
- Pen Actuator Adjustments
- Aligning the X-Axis Platen, and Orthogonality
- Limit Switch Adjustment

2. **Repeat** the Y-Axis Arm Pull Test performed earlier to verify that the force required to move the Y-axis arm back and forth across the platen is less than 24 ounces (681 grams). If a greater force is required to move the Y-axis arm, Option 31 may not operate once installed. To correct the problem, try replacing cable pulleys, linear bearing, X-axis pen drive motor, or worn X-axis pen-drive cable.

OPTION 31 ADJUSTMENT PROCEDURE

PRELIMINARY MECHANICAL CHECKS

Turn the rotary pen turret knob first fully counterclockwise (CAP) and then fully clockwise. Notice that for the first 90 degrees of clockwise knob rotation (to UNCAP), the rotary pen turret does not turn. Instead, this motion causes the pen capping plate to lower and uncap the pens. The turret should rotate smoothly when you turn the knob. You should not feel any binding or roughness.

OPTION 31 ADJUSTMENTS

Perform the following Option 31 plotter adjustments. Refer to Section 2 for the procedure for each adjustment.

- Rotary Pen Turret Height Adjustment
- Pen Senser Switch Adjustment
- Setting Rotary Pen Turret Exchange Point
- Adjusting X-Axis Pen Exchange Position

FINAL CHECKS AND ASSEMBLY

1. **Press** PEN CONTROL 3, which de-energizes the rotary pen turret motor.
2. **Remove** the digitizing reticle and replace the pen cap in the rotary pen turret's Pen Position 1.
3. **Thread** seven pens into the pen adapters (an eighth pen was previously threaded). Firmly seat the pens into the adapters.
4. **Load** manually all eight pens (in adapters) into the rotary pen turret.
5. **Rotate** the rotary pen turret knob fully counter-clockwise (CAP).
6. **Ensure** that no pen is located in the pen carriage.
7. **Remove** the Calibration Overlay from the platen.
8. **Press** the PEN CONTROL 7 switch, which causes the plotter to sequentially exchange each pen starting with Pen 1. After Pen 8 has been exchanged, the cycle will start over with Pen 1. Permit this process to cycle three or four times.
9. **Press** the PEN CONTROL 8 switch to stop the automatic pen exchange cycle. Because the plotter stores several commands before executing them, there may be several more pen exchanges after pressing PEN CONTROL 8.
10. **Press** in and lock down the plotter's LOAD switch.
11. **Press** the plotter's LOAD again to release it to the up position.
12. **Make** sure there is a pen in the pen carriage.
13. **Press** the PEN CONTROL 7 SWITCH. When the cycle starts, the pen in the pen carriage should be stored in the empty position in the rotary pen turret. If not, the pen sense switch needs adjusting (refer to the Pen Sense Switch Adjustment).
14. **Press** the PEN CONTROL 8 switch to stop the automatic exchange cycle.
15. **Turn** off the plotter's power.
16. **Move** the Pen Turret Drive circuit board strap from CAL to NORM.
17. **Place** the replacement plotter case (380-0663-00) on the frame after transferring the line voltage tag from the old plotter case to the back of the replacement plotter case.
18. **Position** the two front panel label strips in position on the plotter case.
19. **Install** the eight hex-socket cap screws holding the plotter case to the frame (see Figure J-11).
20. **Turn** the plotter's power on and allow the plotter to initialize.
21. **Ensure** that all pen positions on the rotary pen turret have pens. Leave the pen carriage empty.
22. **Press** the PEN CONTROL 1 switch. The pen carriage should pick up the pen in Pen Position 1.
23. **Press** the PEN CONTROL 2 switch. The pen carriage should store the pen in Pen Position 1 and then pick up the pen in Pen Position 2.
24. **Continue** repeating Step 23, however, press the next higher switch and work up to and including eight.
25. **Press** the STORE function (hold the PEN CONTROL 1 switch until the plotter's bell sounds — approximately two seconds. The plotter will store the pen carriage pen in Pen Position 8.
26. **Test** the LOAD functions. Press the LOAD switch to the locked-down position and then press the PEN CORTROL 6. The rotary pen turret should rotate until the first four pens are positioned out over the platen.
27. **Press** the PEN CONTROL 7 switch. The rotary pen turret should rotate until the last four pens are positioned out over the platen.
28. **Press** the PEN CONTROL 8 switch. The rotary pen turret should rotate back to the Stored position and the pen capping plate should raise to cap the pens.
29. **Load** a sheet of paper (11 x 17") on the platen. (Press LOAD, position the paper, and then release the LOAD switch.)

30. **Press** a PEN CONTROL switch corresponding to a rotary pen turret position containing a pen.
31. **Press** and hold the CALL switch until the plotter's bell sounds twice (approximately two seconds). The plotter will draw the self-test pattern, which you can examine to determine the electro-mechanical condition of the plotter. Refer to the Troubleshooting Guide in the 4662 Service Manual for any assistance in interpreting and correcting any problems in the quality of the self-test pattern.
32. **Press** and hold the PEN CONTROL 1 switch until the plotter's bell sounds (approximately one second). This will store the pen.
33. **Press** the LOAD switch and remove the paper.
34. **Press** the LOAD switch to release it to the up position.
35. **Turn** the plotter's power off.

This completes the installation and testing of Option 31 for the 4662.

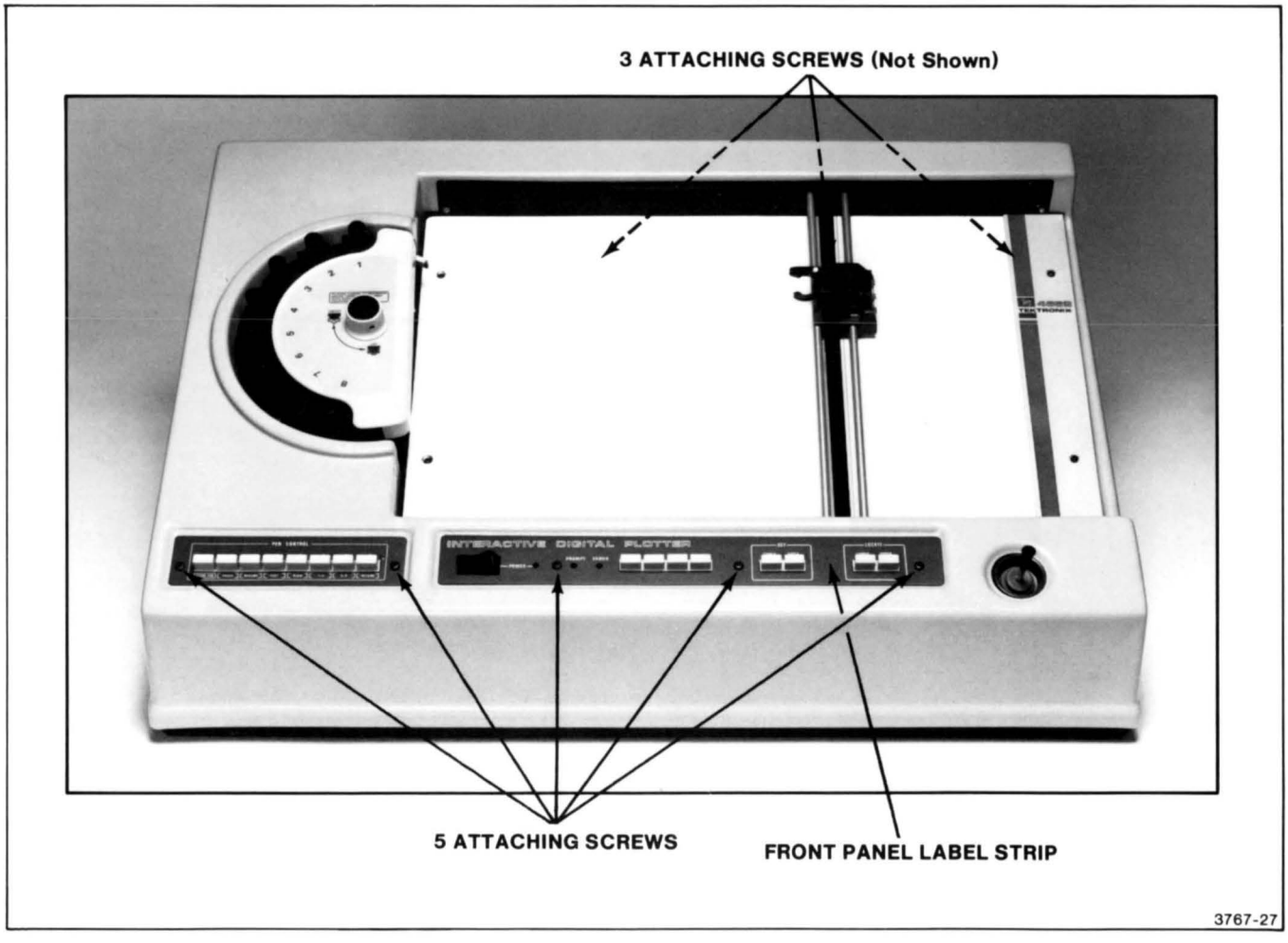


Figure J-11. Plotter Case Attaching Screws (Option 31).

Appendix K

POWER SUPPLY DIODE/FUSE REPLACEMENT

Use the following procedure if the Power Supply circuit board is either a J-4581-00 or a J-4581-01. If the number on the Power Supply circuit board is J-4581-02, 03, etc., disregard the following procedure.

1. **Remove** the plotter case and platen following Steps 1-6 of the "Removing the Plotter Case and Platen — Standard 4662" procedure (if not already done). This procedure is located in Appendix G.
2. **Disconnect** connectors J10, J11 (unmarked), and J12 from the Power Supply circuit board. J11 has two wires going to the pen actuating solenoid.
3. **Remove** the four screws on the bottom of the plotter that hold the power supply assembly to the plotter's bottom chassis.
4. **Remove** the two screws on the plotter's left side chassis that hold the debris catcher (protective circuit board cover). See Figure J-5 (in Appendix J).
5. **Lift** up the left end of the debris catcher and lift the power supply assembly out of the plotter.
6. **Unsolder** and remove the four diodes shown in Figure K-1.

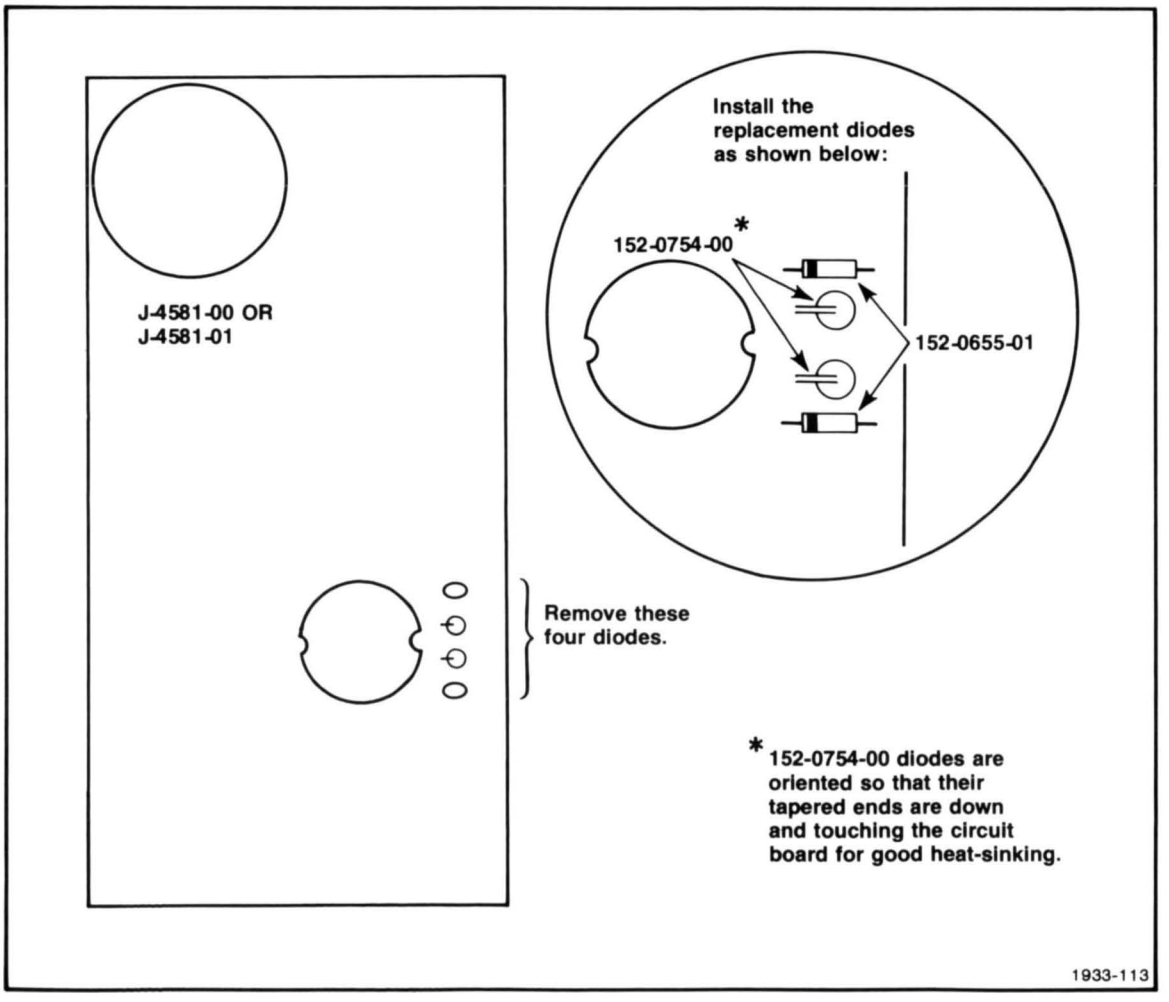


Figure K-1. Power Supply Circuit Board Showing the Four Diodes.

7. **Solder** the two replacement diodes (152-0754-00) in the same holes as shown in Figure K-1. Be sure to orient the diodes as shown.
8. **Solder** the other two replacement diodes (152-0655-01) in the same manner in the two center positions. Orient the diodes as shown.
9. **Turn** the circuit board assembly over and orient the assembly as shown in Figure K-2. A few earlier-style power supplies have solid base plates, which necessitates removing the base plate before proceeding to the next step.
10. **Cut** the conductive foil run as shown in Figure K-2.

NOTE

Use a 15 watt soldering iron to prevent damage to the fuse in the following step.

11. **Solder** the 5A fuse (159-0059-00) across the cut as shown in Figure K-2. It may be necessary to scrape through the protective coating to bare metal to ensure a good solder connection.
12. **Replace** the Power Supply circuit board assembly by reversing Steps 2-5 (also Step 9 if appropriate).

This completes the power supply diode replacement and fuse installation procedure. Skip back to the procedure "Mechanical Check of the Plotter" located in Appendix J.

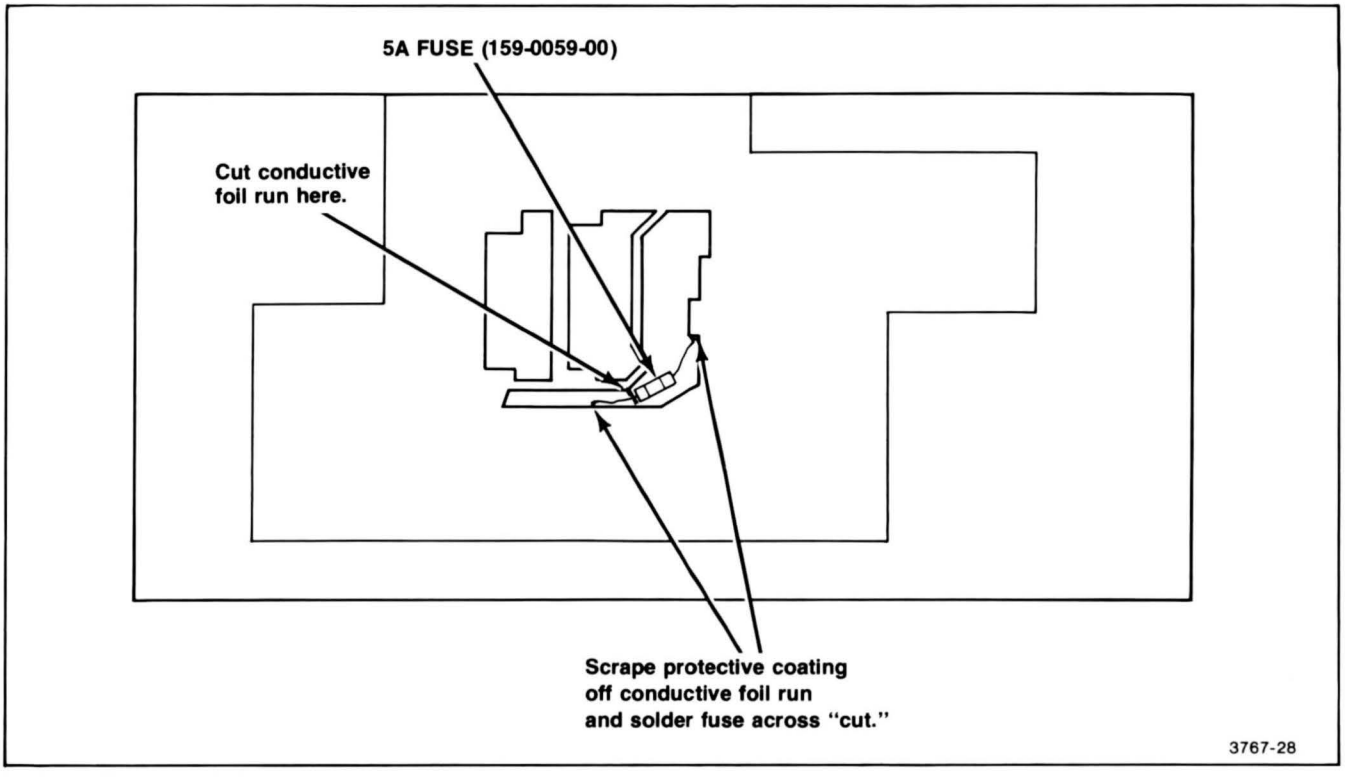


Figure K-2. Power Supply Circuit Board Showing the Fuse (Underside of Circuit Board).

Appendix L

REAR PANEL CONTROLS

For a description of the rear panel switches and how to set them, refer to the 4662 Operator's manual.

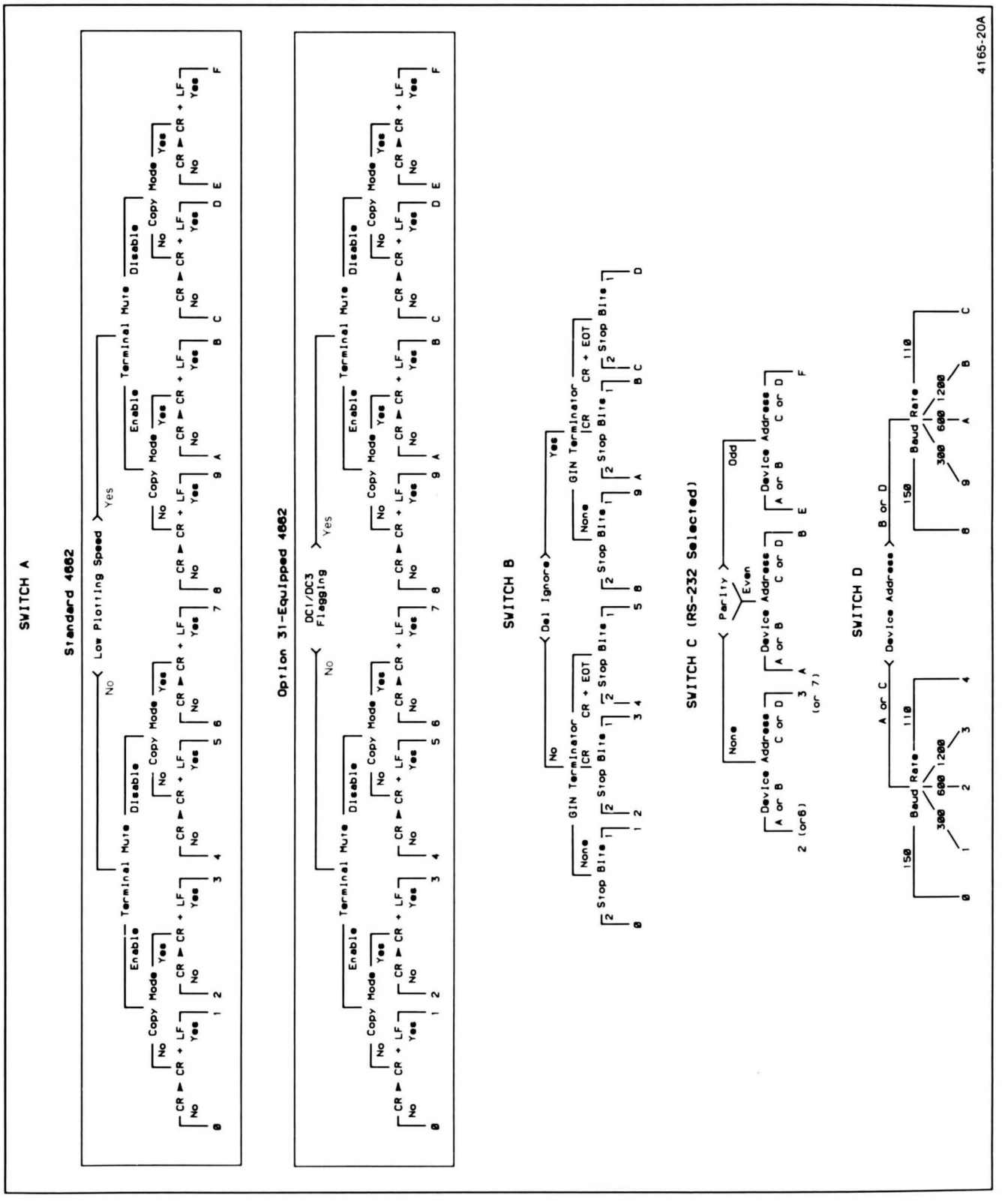


Figure L-1. RS-232-C Rear Panel Switchable Option Settings.

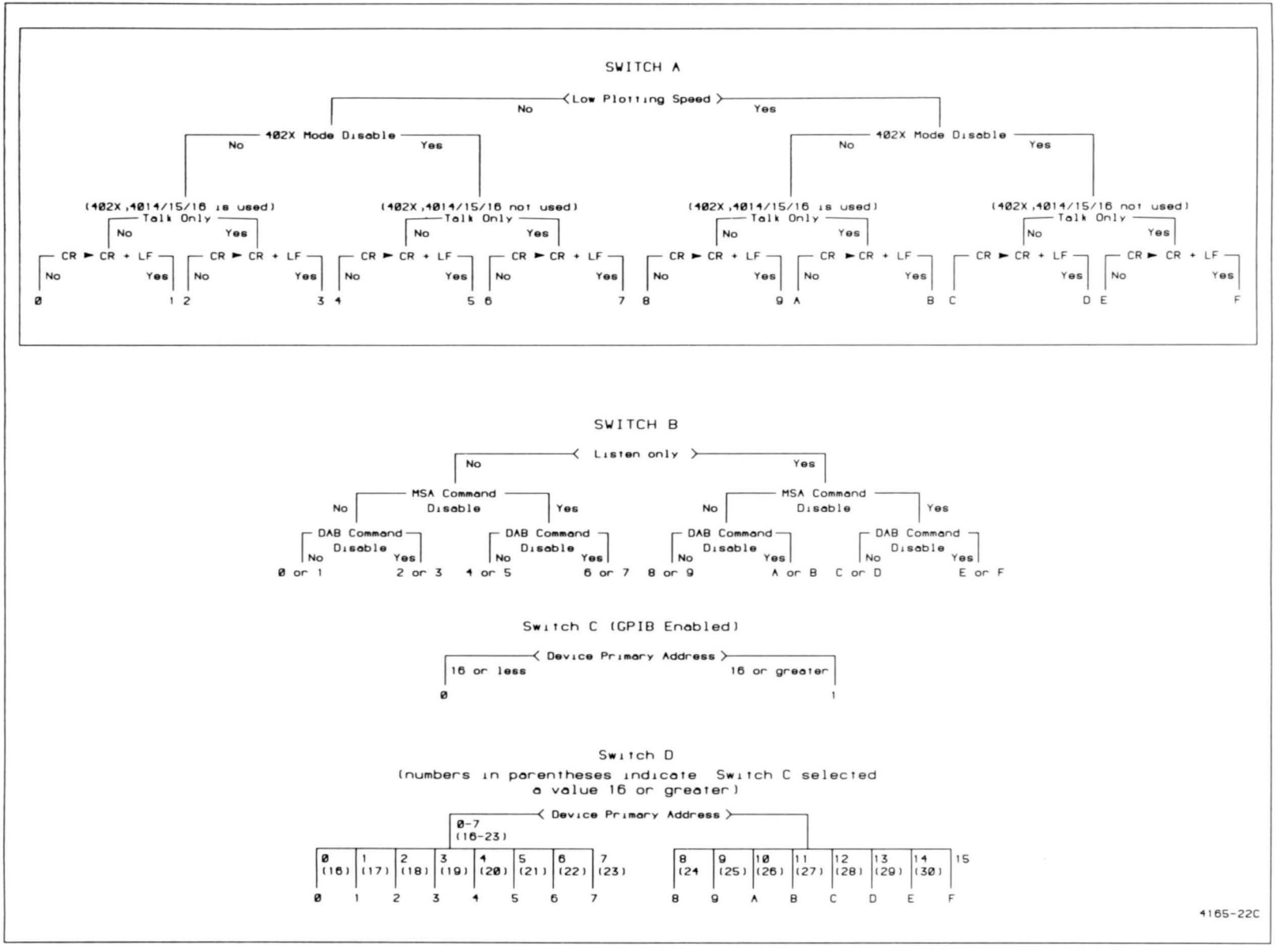


Figure L-2. GPIB Rear Panel Switchable Option Settings.

NOTE: Switches S101, S105, S201, and S205, labeled A, B, C, and D on the rear panel, are encapsulated, four-section spdt units. The following table depicts the combinations of switch closures for all sixteen switch positions, where 0 = Low Level on pull up resistor and 1 = High Level on pull up resistor. For example, switch S105, section B-4 (pin 6 & 11) is closed in positions 0 through 3 and 8 through B.

Pos	S101 A-8 (pin 7 & 10) A-4 (pin 6 & 11) A-2 (pin 14 & 3) A-1 (pin 15 & 2) AAAA 8421	S105 B-8 (pin 7 & 10) B-4 (pin 6 & 11) B-2 (pin 14 & 3) B-1 (pin 15 & 1) BBBB 8421	S201 C-8 (pin 7 & 9) C-4 (pin 6 & 12) C-2 (pin 14 & 3) C-1 (pin 15 & 2) CCCC 8421	S205 D-8 (pin 7 & 10) D-4 (pin 6 & 11) D-2 (pin 14 & 3) D-1 (pin 15 & 2) DDDD 8421
0	0000	0001	1100	0000
1	0001	0000	1101	0001
2	0010	0011	1110	0010
3	0011	0010	1111	0011
4	0100	0101	1000	0100
5	0101	0100	1001	0101
6	0110	0111	1010	0110
7	0111	0110	1011	0111
8	0000	1001	0100	1000
9	1001	1000	0101	1001
A	1010	1011	0110	1010
B	1011	1010	0111	1011
C	1100	1101	0000	1100
D	1101	1100	0001	1101
E	1110	1111	0010	1110
F	1111	1110	0011	1111

1933 52A

Figure L-3. Switch Closures for all Positions.

SEMICONDUCTOR DEVICES

TRANSISTORS

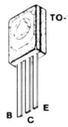
Plotter Circuit Board
Q61
Q82
Q83
Q182
Q183
Q282
Q283
Q482
Q483
Q582
Q583
Q585
Q586
Q588
Q589
Q788
Q787

Power Supply Circuit Board
Q402
Q403
Q404
Q452
Q601

Plotter Circuit Board
Q285
Q591

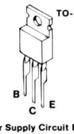
Plotter Circuit Board
Q275
Q276
Q661

Power Supply Circuit Board
Q201

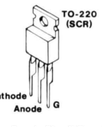


Plotter Circuit Board
Q81
Q91
Q94
Q181
Q191
Q193
Q281
Q481
Q581
Q584
Q587
Q593
Q596
Q691
Q785
Q793

Power Supply Circuit Board
Q51
Q451
Q501
Q651

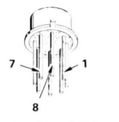


Power Supply Circuit Board
Q301
Q401



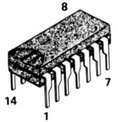
Power Supply Circuit Board
Q151

INTEGRATED CIRCUITS

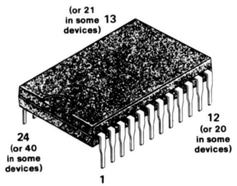


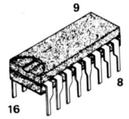
Plotter Circuit Board
U75
U277
U575
U680

Power Supply Circuit Board
U151
(Same numbering system except it has 10 pins — Pin 10 is under index tab)



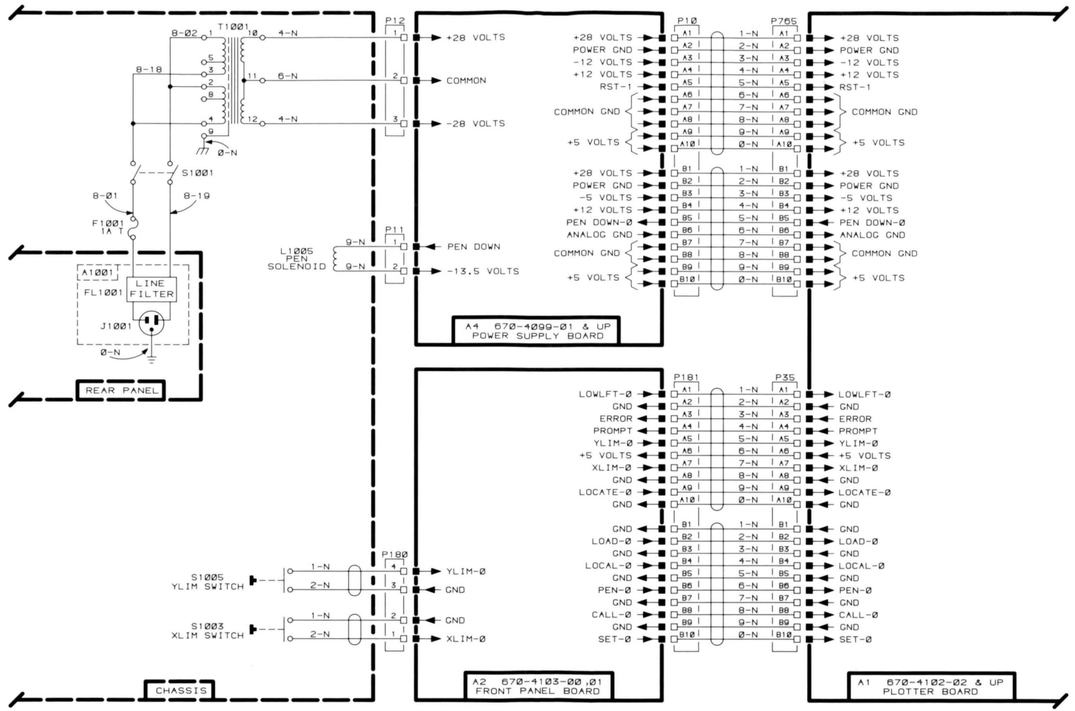
14-pin IC's



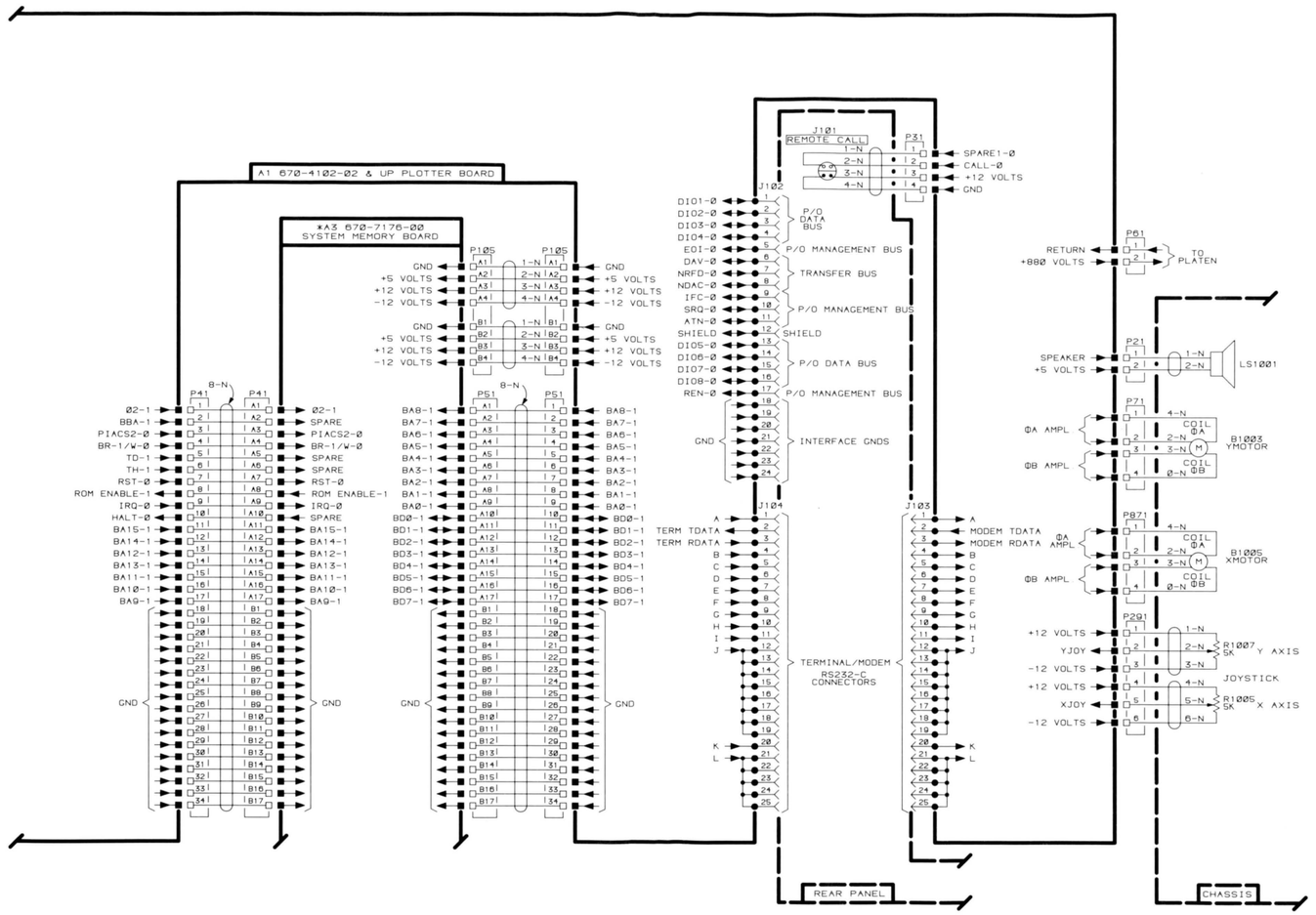


16-pin IC's

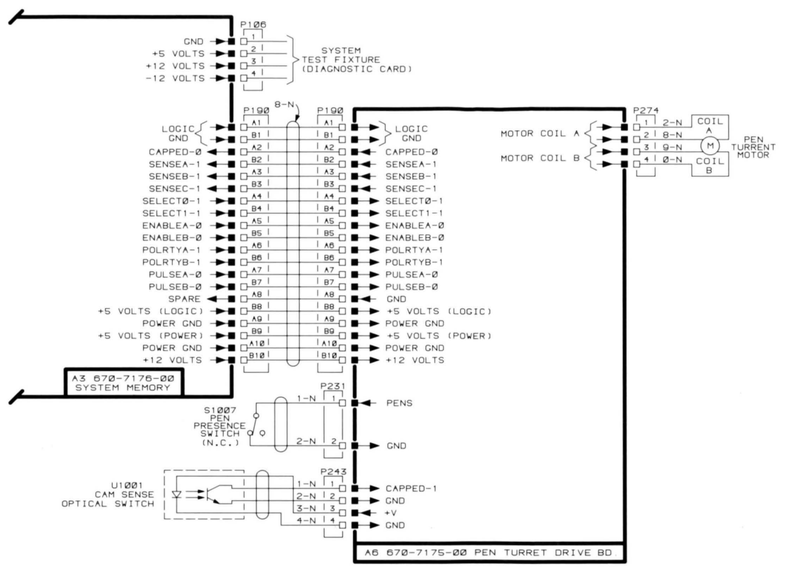
1933-119A



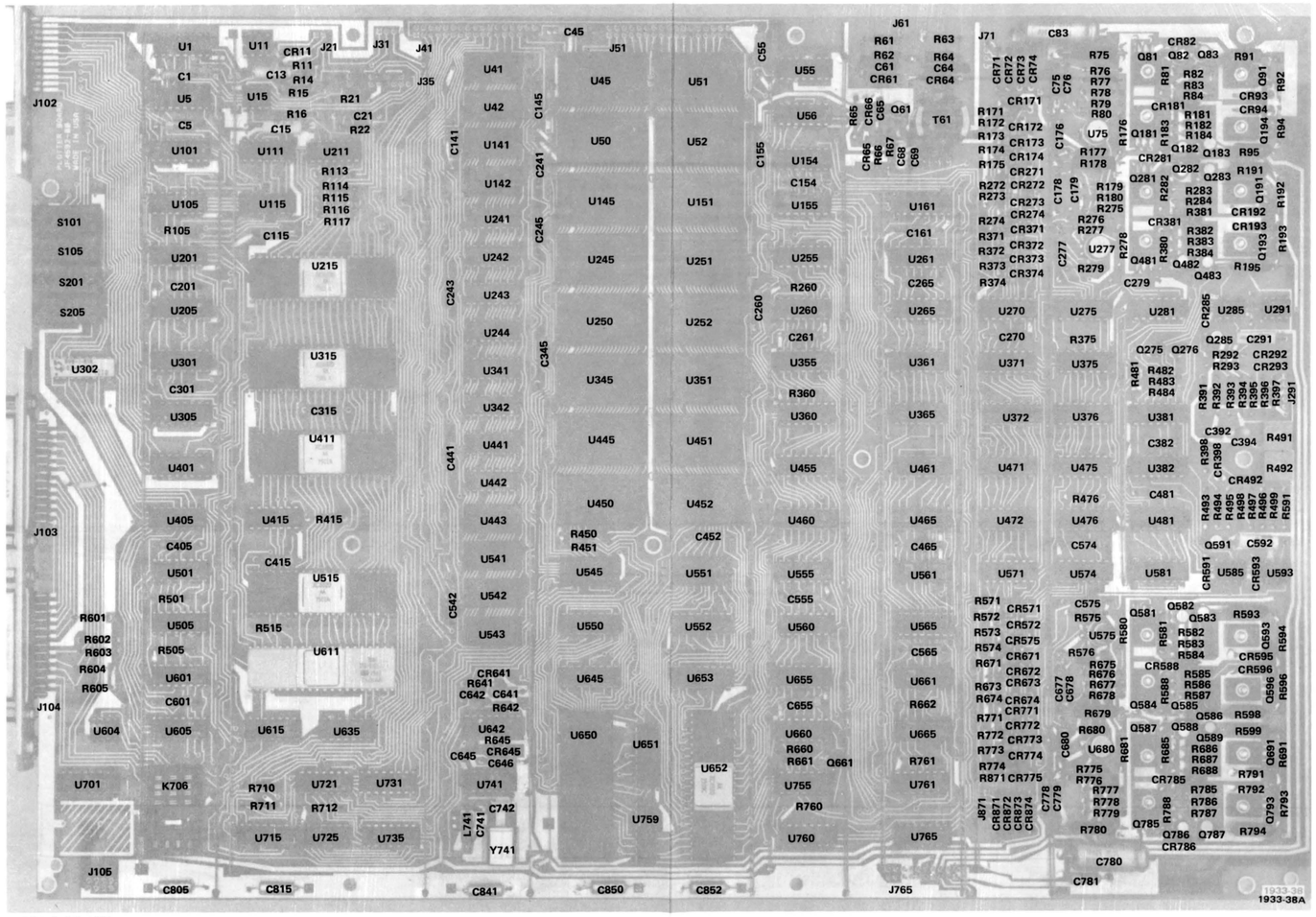
INSTRUMENT:	NOTES:	DIAGRAM:	SHEET:
4662		SYSTEM INTERCONNECT	1 OF 2



INSTRUMENT:	NOTES:	DIAGRAM:	SHEET:
4662	* A5 FIRMWARE PATCH BOARD (670-5120-00) MAY BE PRESENT IN PLACE OF A3 IN SOME EARLY MODELS; HOWEVER, A5 IS NOT COMPATIBLE WITH OPTION 31.	SYSTEM INTERCONNECT	2 OF 2



INSTRUMENT:	NOTES:	DIAGRAM:	SHEET:
4662 OPT. 31		OPTION 31 INTERCONNECT	1 OF 1



REV. B JUL 1978

Plotter Board (670-4102-00,01,02) Component Locations.

PLOTTER BOARD
COMPONENT LOCATIONS