INSTRUCTION MANUAL

for

DIGITAL INCREMENTAL PLOTTER

MODEL 566

CALCOMP

California Computer Products, Inc.

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INSTRUCTION MANUAL

for

DIGITAL INCREMENTAL PLOTTER

MODEL 566

CALCOMP

305 Muller Avenue

Anaheim, California

NOTICE

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Section 1
General Description

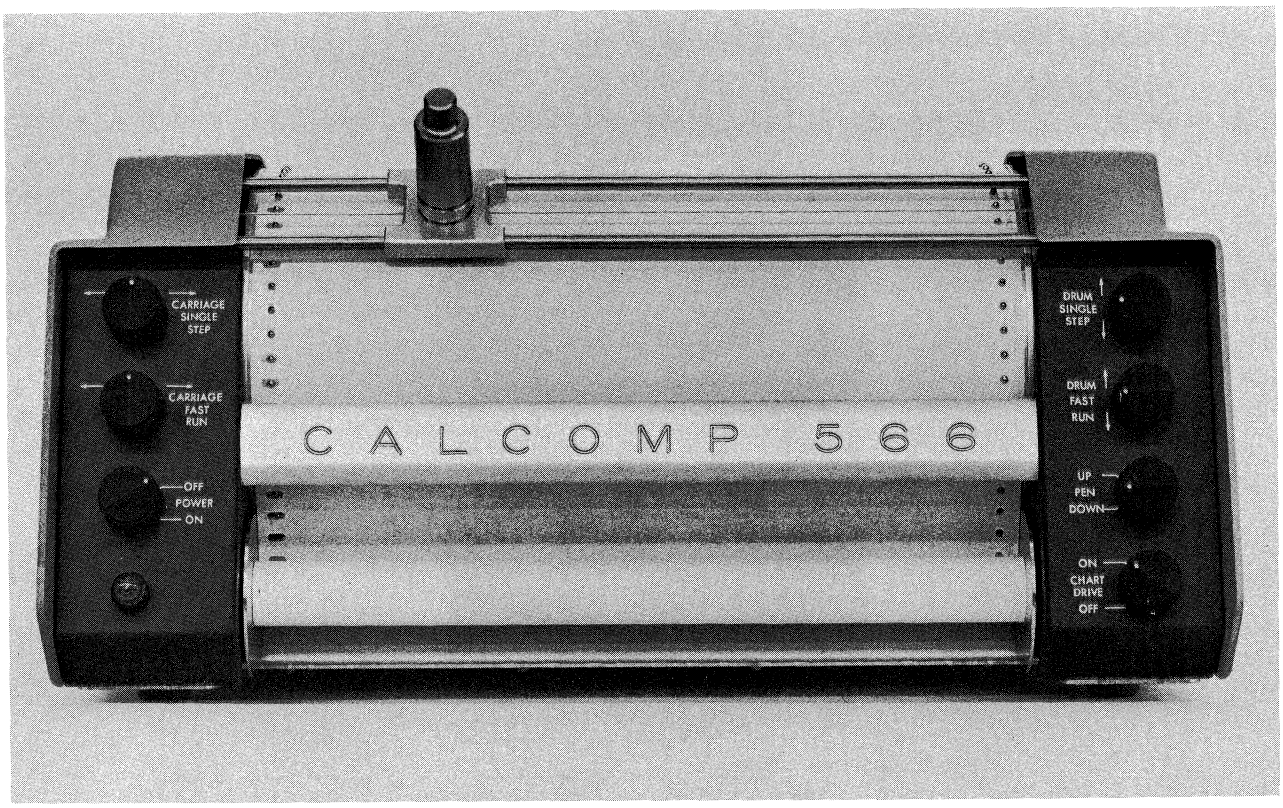


Figure 1-1. CalComp Model 566 Digital Incremental Plotter

1-1 INTRODUCTION

This manual provides operation and service instructions for the Digital Incremental Plotter Model 566, manufactured by California Compuer Products, Inc., Anaheim, California. The manual also contains a detailed description of the theory of operation, a parts list, and a complete set of schematic diagrams.

1-2 FUNCTIONAL DESCRIPTION

An overall view of the complete equipment is shown in Figure 1-1, and a simplified functional diagram in Figure 1-2.

The Model 566 is a high speed two-axis plotter designed for plotting one variable against another. The instrument responds to digital incremental signals from any suitable source. The actual plot is produced by the movement of a pen over the surface of the chart paper. The Y-axis plot is produced by lateral movement of the pen carriage and the X-axis plot by rotary motion of the chart drum. Provision for Z-axis modulation is also incorporated through the use of a pen solenoid which permits the pen to be lifted or lowered to the plotting surface in response to electrical input signals.

The plotter employs a bi-directional rotary step motor on both the X and Y-axis drives. Each step causes the drum or pen carriage to move .005 inch in either a positive or a negative direction. The motors are capable of operating at a rate of 300 steps per second.

A roll paper feed and takeup mechanism is provided which accepts chart paper rolls 12 inches wide by 120 feet long. The feed and takeup mechanism is bi-directional. The paper is driven by sprocket teeth on the drum which engage the sprocket holes on both edges of the paper, thus maintaining accurate registration between the recording pen and the paper. If desired, single sheets of chart paper may be used for plotting instead of the roll paper supplied.

A total of twelve electrical inputs is provided, so that signals of either positive or negative polarity may be used to actuate the plotter in each of the six operating modes: Drum Up, Drum Down, Carriage Left, Carriage Right, Pen Up, and Pen Down. In addition, front panel controls are provided for each of these modes. All electrical inputs, including the signal common, are capacitively coupled inside the plotter, thereby eliminating dependence on absolute voltage levels.

The Model 566 is completely transistorized, with most of the electronic circuitry mounted on a removable etched circuit board and a plug-in power supply assembly. The unit operates from any source of 115 volt, 50 or 60 cycle, single phase power capable of delivering 1.5 amps.

The Digital Incremental Plotter can be used for on-line operation with a number of general-purpose digital computers. A special adapter is used to convert the computer output signals to a form suitable for driving the plotter. (See Appendix A for list of adapters.) When the Model 566 is used as an integral part of the California Computer Products Model 570 or Model 580 Magnetic Tape Plotting System, the special adapter is not required.

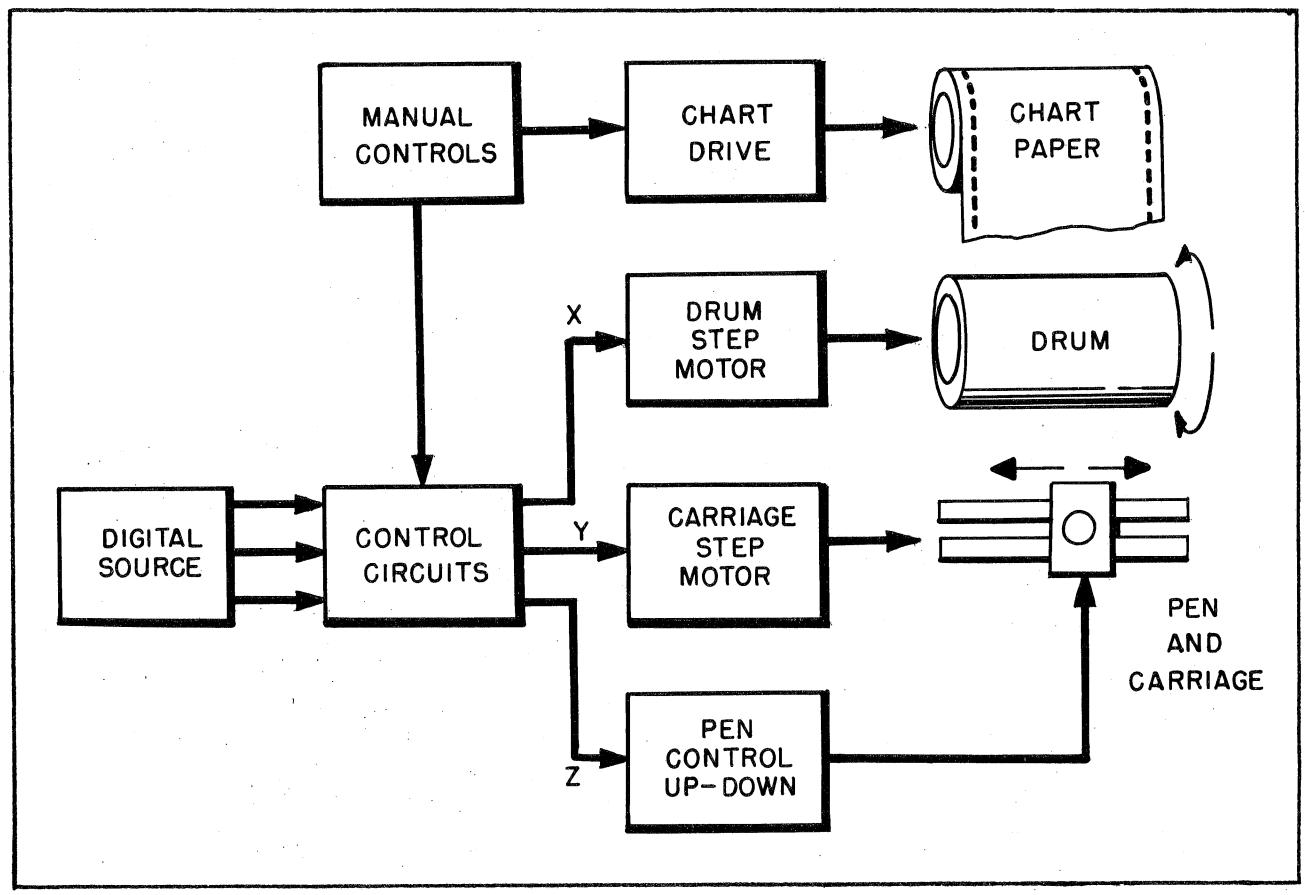


Figure 1-2. Functional Diagram of the Model 566

1-3 SPECIFICATIONS

SPEED:	Drum axis: 300 steps per second maximum Carriage axis: 300 steps per second maximum Pen: 10 operations, 5 up and 5 down per second maximum
STEP SIZE:	.005 inch on both drum and carriage
ACCURACY:	± One step (0.1%) on either axis or over entire 120-foot roll of paper
INPUTS:	Pulses of either positive or negative polarity with amplitude in excess of 10 volts, rise time less than 10 microseconds, minimum width of 4 microseconds, from a source impedance of less than 500 ohms (input circuits may be modified for specific pulse characteristics)
POWER:	105 to 125 volts, 50 or 60 cycles, single phase (1.5 amps at 115 volts)
WEIGHT:	33 pounds
SIZE:	Width - 18 inches Depth - 14¾ inches excluding mating connectors Height - 9¾ inches to top of pen holder
PAPER SIZE:	Roll chart paper - 12 inches wide, 120 feet long, sprocket holes .130 in. dia. and .130 in. by .280 in. on .375 in. centers.

Section 2
Installation

2-1 INTRODUCTION

The Model 566 Digital Incremental Plotter is shipped in a single packing container. Installation of the unit is simple and requires no special tools or test equipment. The Model 566 is completely self contained and may be operated on any level surface that is not subject to excessive vibration.

As described in Appendix A, special adapter units are provided for on-line operation of the Model 566 with a number of general purpose computers. Installation instructions are included in the instruction manuals supplied with the adapters.

2-2 UNPACKING

The Model 566 is shipped completely assembled except for the pen assembly, which is packed separately within the shipping container. A roll of chart paper is installed on the rear chart spool. Separate rolls of chart paper are supplied in a separate box within the shipping container. To unpack the unit, proceed as follows:

a. Remove shipping container cover.

b. Remove the protective liner which surrounds the unit inside the container.

c. Remove the accessory packages; check items against the accessories list in Appendix B of the manual.

d. Lift out the instrument and the attached plywood shipping base.

e. Remove the three screws and washers which fasten the plywood base and spacer blocks to the instrument base.

Note

It is recommended that the shipping container, plywood shipping base, spacer blocks, liner, and accessory boxes be stored for reuse whenever the instrument is transported between operating sites or returned to the factory for service.

2-3 INSPECTION

After unpacking, the instrument should be checked for signs of physical damage in shipment. Make certain that all front panel controls are secure on the control shafts. Check that the pen carriage can be moved freely by hand across its track, and that the drum can be rotated manually on its axis.

2-4 CABLE FABRICATION

A Cannon cable connector is supplied with the unit. This female connector mates with chassis connector P5 on the rear of the Model 566. (See Figure 5-1.) A signal cable of desired length should be fabricated to interconnect the plotter and the digital signal source. Signal nomenclature for the connector is shown in the schematic diagram of Figure 7-5.

2-5 INSTALLATION OF CHART

To install the chart paper shipped on the rear chart spool, pull the end of the paper over the drum so that the sprocket holes on both edges of the paper engage the sprockets on the drum. Guide the chart paper under the carriage rods and behind the tear bar. The end of the chart paper circumscribes the take-up spool from the back and fastens on the spool with scotch tape provided in the accessory kit. Using the DRUM FAST RUN switch, wind a few turns onto the take-up spool.

To remove chart paper, grasp the paper roll and press to the left. This compresses the spring on the idler spool. The roll may then be removed. To insert chart paper, slide the roll onto the idler hub and compress the spring. Slowly release the spring to allow the right side of the roll to slide onto the driver hub. Make certain the key on the driver hub engages the slotted keyway in the paper core.

2-6 INSTALLATION OF PEN

Four different color ballpoint pens are supplied with the recorder: black, blue, red and green. The components of the pen assembly are illustrated in Figure 5-3. To assemble the pen, insert the desired color pen into the plunger, then insert the pen and plunger into the holder and install the threaded cap. Align the key on the holder with the key slots in the carriage and press the pen assembly into the pen mounting. Tighten the knurled nut on the bottom of the pen assembly.

2-7 INSTALLATION PRECAUTIONS

The Model 566 depends upon free circulation of air under the base plate for proper cooling. Do not place the unit on top of any loose papers or cloth. Loose materials of this type can block the ventilating louvres in the base plate and cause overheating. In addition, the unit should not be placed on top of any other heat-producing equipment.

Section 3
Theory of Operation

3-1 INTRODUCTION

This section describes the theory of operation of the Model 566 Digital Incremental Plotter. The operation is described first with reference to the detailed functional block diagram of Figure 3-1. Following this, a detailed circuit description is presented. The schematic diagrams referenced in the detailed circuit description are included in Section 7.

3-2 GENERAL THEORY

The detailed block diagram of Figure 3-1 illustrates the operation of the Model 566 in terms of signal flow and functional circuits. Inputs to the Plotter from the digital signal source consist of drum-up and drum-down, carriage-left and carriage-right, and pen-up and pen-down pulses. These three groups of signals are generally referred to as the X-axis, Y-axis and Z-axis signals, respectively.

The control circuits of the Model 566 are designed so that either positive-going or negative-going pulses can be utilized to produce the incremental stepping action and to control the pen solenoid. Separate signal lines are provided for positive and negative inputs to the control circuits, so that these options may be used in any combination.

The X-axis signals from the digital source are applied to separate one-shot multivibrators which in turn control the action of a reversible ring counter, through suitable diode gating circuits. The ring counter consists of three stages, each of which supplies current to one pair of stator coils in the drum step motor. The design of the ring counter is such that only one pair of coils can receive current at any given time. When an incoming pulse causes one of the one-shots to be triggered, the one-shot causes the ring counter to change state. The direction of change depends upon whether the incoming pulse was a drum up or a drum down signal.

When the ring counter changes state, the step motor current is switched from one pair of coils to an adjacent pair. This causes the motor to rotate one-twelfth of a revolution clockwise or counterclockwise. The drum step motor is connected to the drum through a reduction gear train that causes the drum to move .005 inch for each step of the motor.

Manual positioning of the drum is provided by two front panel controls which allow the drum to be advanced up or down in single steps, or continuously at the rate of 120 steps per second.

The Y-axis signals from the digital source are applied to the carriage control circuit. This circuit and the carriage step motor are identical to the drum control circuit and step motor described above. Front panel controls are also provided for manual positioning of the carriage.

The Z-axis signals from the digital source are utilized to control a pen solenoid which, when energized, lifts the pen off the chart. The incoming pen up and pen down pulse signals are applied to a bistable multivibrator (flip-flop). The flip-flop acts as an electronic switch that controls current to the pen solenoid through suitable control stages and a current driver. Manual control of the pen solenoid is provided by means of a front panel switch.

The remaining functional circuits of the Model 566 are the chart takeup motors and the power supply. The chart motors operate in a stalled condition to maintain proper tension on the chart spools. A front panel on-off switch is provided to allow the chart motors to be disabled when single sheets of graph paper are used in place of the continuous roll. (See operating instructions in Section 4.)

The power supply consists of a silicon bridge rectifier and filter-divider components. The supply provides two positive and three negative output volt-

ages, referenced to a circuit ground that is isolated from the instrument chassis. The output voltages from the power supply are:

+3.0 vdc
+1.5 vdc
−7.5 vdc
−9.0 vdc
−24.0 vdc

3-3 DETAILED THEORY

Circuit schematic diagrams for the Model 566 are included in Section 7. Figure 7-1 illustrates the physical layout of the printed circuit board which contains the drum, carriage, and pen solenoid control circuits. The schematic diagram for the circuit board is divided into three sections, corresponding to the three functional circuits. The drum control, solenoid control, and carriage control circuits are shown in Figures 7-2, 7-3 and 7-4, respectively. The schematic diagram for the main chassis, the control panel and the power supply subassembly is shown in Figure 7-5.

3-4 STEP MOTORS

A simplified schematic diagram of the drum step motor is shown in Figure 3-2. The motor consists of a stator with three pairs of poles arranged symmetrically around a four-pole soft iron rotor. Each of the three pairs of poles has a separate current winding that is controlled by a transistor current driver. The motor advances one-twelfth of a revolution each time the current is switched off in one stator winding and switched on in another winding. The direction of rotation is determined by the sequence in which the windings are energized.

For illustrative purposes, the three pairs of stator windings shown in Figure 3-2 are numbered 1, 2 and 3. The four poles of the rotor are designated a, b, c, and d. Assume that driver stage Q5 is conducting. The circuit is designed so that when Q5 conducts, Q8 and Q11 are cut off. Current therefore flows only in stator winding No. 1. This current creates a magnetic field which holds poles a and c of the rotor in alignment with the No. 1 stator poles. If transistor Q5 is now switched off and Q8 is switched on, the rotor will turn until one pair of its poles is aligned with the poles of stator winding No. 2. Since poles b and d are the closest to the No. 2 stator poles, the rotor will step counterclockwise.

In the above example, if driver stage Q11 were switched on instead of Q8, the rotor would step clockwise until poles b and d were in alignment with the poles of stator winding No. 3.

From the foregoing it can be seen that if the current is continuously switched between windings in a clockwise sequence (i.e. 1-2-3-1-2-3, etc.), the rotor will step counterclockwise. Conversely, if the switching sequence is counterclockwise, the rotor will step clockwise.

The rotor shaft of the drum step motor is coupled to the drum through a reduction gear train. The gear train consists of a 9-tooth pinion on the rotor shaft which engages a 75-tooth gear in the primary gear box on the motor assembly. An 8-tooth pinion, mounted on the same shaft as the 75-tooth gear, rotates at the rate of one revolution per 100 steps of the motor. The 8-tooth pinion drives a 300-tooth gear fastened to the end of the drum.

The mechanical and electrical design of the carriage step motor and its associated circuit are identical to that of the drum step motor, except that the 8-tooth pinion on the carriage step motor drives a 208-tooth gear on the carriage drive pulley. On both motors, the 8-tooth pinion in the primary gear box is mounted off-center. This permits the backlash between the pinion and the drum or carriage gear to be adjusted to zero.

Resistors R13, R11 and R16, shown in Figure 3-2, are current limiters. The corresponding limiting resistors for the carriage step motor are R12, R14 and R15. Across each of these resistors is a capacitor to provide proper wave-shaping and acceleration of the step motor. C13, C14 and C15 are the drum step motor capacitors, and C10, C11 and C12 are the carriage step motor capacitors.

A suppression diode is connected across each of the three windings in both step motors to damp out the high counter-emf generated by the decaying magnetic field when the current is switched off. The suppression diodes, shown in Figure 7-5, are CR14, CR16, and CR18 for the carriage step motor and CR13, CR15 and CR17 for the drum step motor.

3-5 REVERSIBLE RING COUNTERS

The carriage and drum step motors described in the preceding paragraphs are each driven by a reversible three-stage ring counter. The ring counter associated with the drum step motor consists of transistors Q3 through Q11 (Figure 7-2). The ring counter for the carriage step motor consists of transistors Q23 through Q31 (Figure 7-4). Since the two circuits are identical, only the drum ring counter circuit will be described.

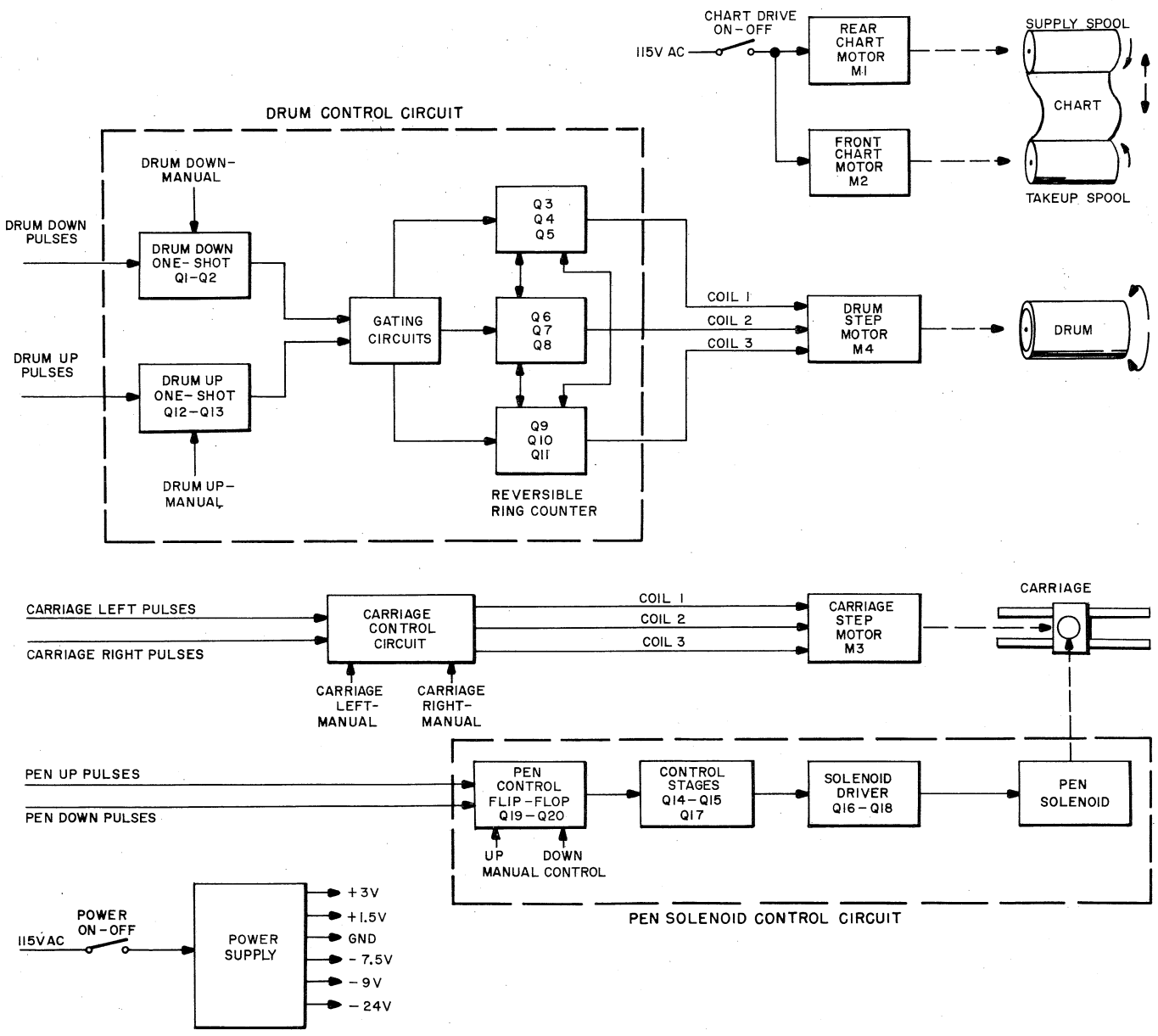


Figure 3-1. Detailed Block Diagram

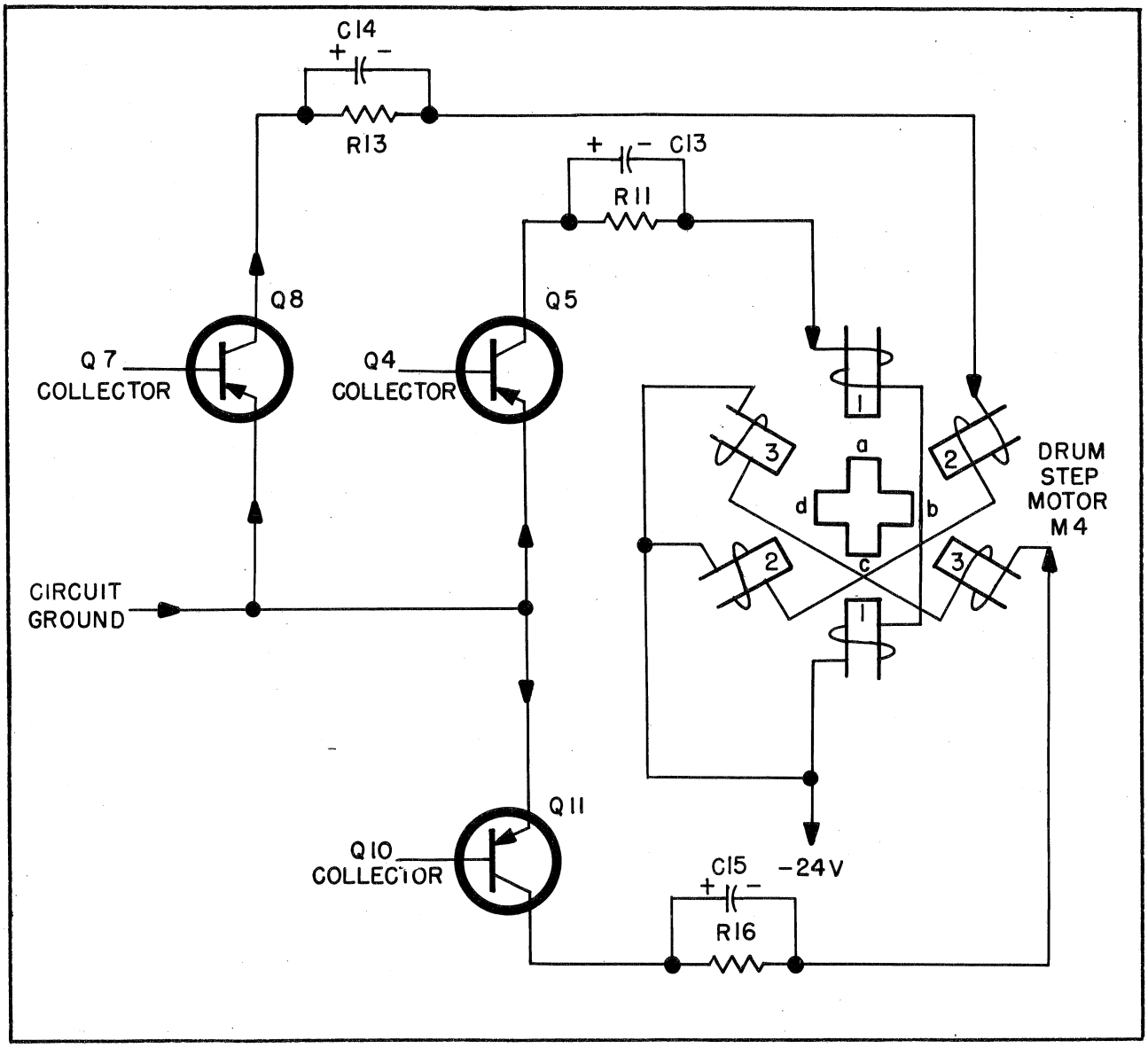


Figure 3-2. Step Motor Drive Circuit, Simplified Schematic

Referring to Figure 7-2, assume that transistor current driver Q5 is conducting, supplying current to coil 1 of the drum step motor. Since only one driver stage can be in conduction at any given time, Q8 and Q11 are cut off. In the absence of a clock pulse from the drum up or drum down one-shot multivibrator, the ring counter is held in this state in the following manner:

Control stage Q3, an NPN transistor, is non-conducting, since its emitter is connected to −7.5 volts and its base is returned to −9 volts through R16-R35 and R17-R30. The base potential is held at approximately −8.5 volts. Since no collector current can flow in Q3, the base of Q4 is held at approximately +3 volts, through resistor R19. The emitter of Q4, a PNP transistor, is returned to +1.5 volts. Thus, Q4 is also non-conducting. Since there is no collector current through Q4, the base of Q5 is biased negative with respect to its emitter and Q5 conducts.

Since the emitter of Q5 is at ground potential, and the step motor coil is returned to −24 volts (see Figure 3-2), the collector of Q5 will be at approximately ground potential while this stage is conducting. Diode CR8 conducts, since its cathode is returned to −9 volts through resistor R32. The bases of Q6 and Q9 are therefore returned to ground po-

tential through CR8 and resistors R24 and R33, respectively. Both Q6 and Q9 are thus driven into conduction. The collector current of Q6 is supplied from the base of Q7 and the collector current of Q9 is supplied from the base of Q10. Consequently, Q7 and Q10 are saturated. The bases of Q8 and Q11 are at approximately +1.5 volts, and the emitters are at ground potential, hence these transistors are cut off.

Assume that with the ring counter in the state described above, a drum down clock pulse is applied at pin R of connector P1. Pin R is normally at approximately −7 volts, and is driven positive to essentially ground potential during the clock pulse period of approximately 1500 microseconds. This positive-going pulse is applied to the cathodes of diodes CR6, CR10 and CR12, but will affect only CR10. The anodes of CR6 and CR12 are returned to −9 volts through resistors R14-R35 and R28-R30 respectively. Thus, these diodes were initially cut off and will remain cut off during the clock pulse period. However, CR10 was initially conducting, since its associated resistor R22 is returned to ground potential through diode CR8 and conducting driver stage Q5. Capacitor C6 is therefore initially charged to −7 volts .The positive-going clock pulse at the cathode of CR10 cuts off the diode and C6 discharges through R26 and the base-to-emitter circuit of Q6. At the end of the clock pulse, when the voltage at pin R returns to −7 volts, the clock pulse is capacitively coupled through C6, causing a negative-going pulse to appear at the base of Q6. This negative pulse cuts off Q6, which in turn cuts off Q7 and allows Q8 to conduct, supplying current to coil 2 of the drum step motor.

The collector of Q8 is now at ground potential, and resistors R17 and R31 are therefore returned to ground potential through diode CR11. This causes both Q3 and Q9 to conduct. Q4 and Q10 also conduct, switching Q5 off and keeping Q11 cut off in the manner described previously. Gating diodes CR6 and CR10 are now cut off and CR12 is conducting. Thus, if another drum down clock pulse is applied to the circuit, capacitor C9 will drive the base of Q9 negative and Q11 will conduct.

The gating diodes associated with the clock drum up signal input at pin U of P1 are CR7, CR9 and CR13. The action of this circuit is the same as that of the clock drum up circuit, except that the counter changes state in the reverse direction when a clock pulse is applied at pin U.

3-6 ONE-SHOT (CLOCK PULSE) MULTIVIBRATORS

The clock drum up and clock drum down signals which control the ring counter circuit described above are provided by one-shot multivibrator circuits. A separate multivibrator is provided for the drum up and drum down functions, and for the carriage left and carriage right functions. The multivibrators for these four functions, shown schematically in Figures 7-2 and 7-4, are Q1 - Q2, Q12 - Q13, Q21 - Q22, and Q32 - Q33, respectively. Since all four circuits are identical, only the drum down circuit will be described in detail.

The purpose of the one-shot multivibrator is to provide isolation between the digital signal source and the ring counter circuits, and to provide a time delay during which the circuit will not accept another step signal. This delay period, equal to 1500 microseconds, protects the ring counter against double stepping due to transients or noise.

As shown in Figure 7-2, either a positive-going or a negative-going signal may be used to trigger the drum down multivibrator. In the absence of an input signal from the digital source, transistor Q1 is normally conducting and Q2 is cut off. The regenerative cycle may be initiated by applying a negative pulse to the base of Q1, cutting off this stage, or by applying a positive pulse to the base of Q2, driving this stage into conduction. Conventional cross-coupling holds Q1 cut off and Q2 in conduction for a period of time determined by the RC time constant of C2 and R5. This period is set to a nominal value of 1500 microseconds. When the base potential of Q1 decays to a value equal to the emitter potential, this stage again conducts and its negative-going collector voltage cuts off Q2. The circuit then remains in its original state until another trigger pulse is received.

Assume that a negative input signal is to be used to trigger the multivibrator. Negative-going pulses from the digital source are applied to pin Y of connector P1. Resistor R1 and capacitor C36 form a voltage divider and r-f filter across the input signal line. The negative signal is coupled by capacitor C1 to the junction of resistors R4 and R3 which form a voltage divider between +3 and −7.5 volts. The voltage divider establishes a bias level at the cathode of diode CR3 which determines the minimum signal amplitude required to trigger the multivibrator.

Diodes CR1 and CR2 function as positive and negative clamps to prevent very large voltage spikes from damaging the circuit components. When such spikes occur, R1 also functions as a current limiter.

If a positive input signal is to be used to trigger the multivibrator, the pulses from the digital source are applied to pin W of connector P1. Resistor R12 and capacitor C30 are equivalent to R1 and C36 in the negative input circuit. Diode CR5 functions as a negative clamp, equivalent to CR2, and the base-to-emitter diode action of Q2 serves as a positive clamp, equivalent to CR1. The voltage divider action of R10 and R11 determines the anode potential for CR4, which establishes the minimum pulse amplitude required to trigger the multivibrator.

When the multivibrator is triggered, Q1 is cut off for a period of 1500 microseconds. This causes the voltage at the junction of R7 and R8 to rise from approximately −7 volts to essentially ground potential for the same 1500-microsecond period. This comprises the clock drum down signal output, which is connected from pin Z through an external jumper to pin R at the input to the ring counter circuit.

Manual drum step signals are applied to the multivibrator circuit through diode CR5. The manual input signal may consist of either a single positive-going pulse, or a continuous series of 120-cps positive-going pulses. (See subsection 3-8).

The operation of the carriage left and carriage right one-shot multivibrators is identical to that of the drum up and drum down multivibrators. However, the multivibrator output (clock) signals are connected to the carriage ring counter through left and right limit switches. (See Figure 7-5.) The limit switches disconnect the associated multivibrator output whenever the carriage has reached the left or right limit of travel, and thus prevent further stepping action in that direction.

3-7 PEN SOLENOID CONTROL CIRCUIT

The schematic diagram for the pen solenoid control circuit is shown in Figure 7-3. In this circuit a bi-stable multivibrator, or flip-flop, is used for current control instead of the one-shot multivibrators used in the step motor control circuits. The flip-flop, consisting of transistors Q19 and Q20, remains in the state to which it was set by the last signal pulse, until another signal pulse causes it to change state. The flip-flop triggering circuit is designed so that pulses of either polarity may be used to set the flip-flop to either state.

In the normal, or pen-down state, Q19 is conducting and Q20 is cut off. The flip-flop can be switched to the pen-up state by applying a negative trigger pulse at the base of Q19 or a positive trigger pulse at the base of Q20. Q19 will then be held cut off by the negative voltage at the collector of Q20, and Q20 will be held in conduction by the positive voltage at the collector of Q19. The flip-flop will then remain in the pen-up state until a positive trigger pulse is applied to the base of Q19 or a negative pulse to the base of Q20.

The input trigger circuits for the pen control flip-flop are similar to those used for the delay multivibrators in the drum and carriage control circuits. For example, in the pen-up negative input circuit, R64 and C38 form a voltage divider and r-f filter circuit. The negative signal is coupled by capacitor C14 to the junction of voltage divider resistors R68 and R69. These resistors establish the bias level for diode CR25, which determines the minimum signal amplitude required to trigger the flip-flop. Diodes CR24 and CR23 function as positive and negative clamps to protect the circuit against large voltage spikes. The input circuits for pen-down positive, pen-up positive, and pen-down negative signals are similar.

Manual pen up and pen down signals are applied to the flip-flop through diodes CR30 and CR26, respectively. Both of the manual inputs consist of a single positive-going pulse. (See subsection 3-9.)

The output voltage from the pen control flip-flop, obtained from the junction of resistors R73 and R74, is applied to the base of the driver transistor Q18. When the flip-flop is in the pen-down state, Q20 is cut off and this voltage is approximately +3 volts. Q18 is therefore biased off. When the flip-flop changes state, Q20 conducts and the base of Q18 becomes negative. Q18 is driven into conduction and supplies current to the pen solenoid.

The driver transistor Q18 performs a dual function in the pen control circuit. It supplies current to actuate transistor Q14, and it supplies a continuous holding current to keep the solenoid retracted as long as the flip-flop remains in the pen-up state. When Q18 is first driven into conduction(its collector voltage changes very rapidly from a negative potential to ground potential. This causes a large positive pulse to be coupled through capacitor C13 to the cathode of diode CR20. Transistor Q14 is normally biased on by the voltage divider action of R54, CR20 and R53, which maintains a negative potential at the base. When the positive pulse appears at the cathode of CR20 , the diode is cut off and the base of Q14 then becomes positive, since resistor R54 is returned to +3 volts. Transistor Q14 is therefore cut off, and

its collector voltage goes negative. Since the collector is tied to the base of Q16, this negative voltage now causes Q16 to conduct. Q16 supplies a surge of current to the pen solenoid through pin J of P1. This initial surge is sufficient to overcome inertia and lift the pen from the paper. Q14 remains cut off and Q16 conducts for a period determined by the RC time constant of C13 and R53. The voltage at the cathode of CR20 decreases exponentially as C13 charges, and when the cathode becomes more negative than +1 volt, diode CR20 will again conduct and Q14 will be driven into conduction. The collector current of Q14 produces a voltage drop across resistors R55 and R56 which cuts off Q16. At this time, only the holding current is supplied to the solenoid, through the collector of Q18, resistor R63, and diode CR22. The nominal value of holding current is approximately 35 ma.

From the foregoing, it will be seen that if the pen and its solenoid are removed from the carriage while the circuit is in the pen-up state, only the holding current will be supplied to the solenoid when the pen is replaced. This will also occur if the flip-flop assumes the pen-up state when power is first applied. The pen therefore will remain down even though the flip-flop is in the pen-up state and pen-up signals will have no effect. In this event, the manual control must be turned first to PEN DOWN, and then to PEN UP. The pen-down signal will reset the flip-flop to the down state, and the pen-up signal will set it to the up state. As the flip-flop switches back to the pen-up state, the initial surge of current supplied by Q16 will lift the pen.

Transistors Q15 and Q17 with their associated components comprise a protection circuit which automatically resets the flip-flop to the pen-down state if a short circuit occurs at the pen solenoid. Transistor Q17 is normally conducting. Its base is biased positive with respect to the emitter by the action of R62 and R59 which form a voltage divider between ground and −7.5 volts. The emitter of Q17 establishes the emitter potential of Q15. Transistor Q15 is normally cut off by the positive bias applied to its base, which is tied to the base of Q16. If a short circuit occurs at the solenoid, Q16 will conduct and its emitter will be at some negative potential determined by the voltage drop across parallel resistors R58 and R60. This causes the bases of both Q16 and Q15 to be driven negative and when the base of Q15 is more negative than the emitter voltage established by Q17, Q15 will conduct. This causes a postive-going pulse to be coupled to the base of Q19, which has the same effect as a pen-down signal. The flip-flop is therefore reset to the pen-down state and current is cut off from the solenoid. During the short period required for this action to occur, the current through Q16 is limited to 600 ma. by the action of R58 and R60.

3-8 DRUM AND CARRIAGE MANUAL CONTROL CIRCUITS

The manual controls for the drum and carriage control circuits are shown in the schematic diagram of Figure 7-5. Separate controls are provided for single and continuous stepping (fast run) of both the drum and the carriage. Since the drum and carriage controls are identical, only the drum controls will be described in detail.

The DRUM SINGLE STEP switch S7 is a spring loaded three-position wafer switch that permits the drum to be manually advanced upward or downward in single steps. In the neutral or off position, shown in Figure 7-5, both the drum up input and the drum down input signal lines to the one-shot multivibrators are returned to −24 volts. The return path for the drum up input is from pin K of J1, through pin 12 of P3 and J3, through terminal 10 of wafer 7B on switch S7, through terminals 10 and 2 of wafer 8B on switch S8, to the −24 volt bus. The drum down input is returned to −24 volts through a similar path, from pin X of J1. If switch S7 is momentarily turned to the UP position, the drum up manual input line is disconnected from −24 volts and connected through terminal 1 of wafer 7B to resistor R8, which is returned to circuit ground through resistor R2. This causes a positive-going pulse to appear at J1-K, which triggers the drum up one-shot multivibrator in the manner described in subsection 3-6. Conversely, if S7 is turned to the Down position, the drum down manual input at J1-X will be connected to R8 through terminal 9 of wafer 7A, causing the drum down multivibrator to be triggered. The RC network of R8-R2-C6 acts as a filter to prevent switching transients from causing double triggering. These components are also connected to the carriage single step circuit associated with switch S5.

The DRUM FAST RUN switch S8 is a detent three-position wafer switch that permits the drum to be continuously stepped in either direction at the rate of 120 steps per second. When the switch is in the neutral or off position, both the drum up and drum down lines are returned to −24 volts through the

circuit paths described in the preceding paragraph. If switch S8 is set to the UP position, the drum up input line is disconnected from −24 volts at terminal 2 of wafer 8B and is connected to resistor R4, through terminal 3 of wafer 8B and pin 14 of J3 and P3. Resistor R4 is connected to the unfiltered output of the bridge rectifier circuit, which provides a continuous series of pulses that vary sinusoidally from −40 volts to approximately +4 volts, at the rate of 120 cycles per second. Diode CR4, capacitor C1, and resistor R1 function as a waveshaping circuit. Capacitor C1 charges through CR4 on the negative voltage excursion, and discharges through R1 on the positive excursion. This effectively isolates the fast-run signal line from AC line and switching transients. If switch S8 is set to the DOWN position, the action is identical, except that the drum down input line is connected to resistor R4 through terminal 1 of wafer 8A. Resistor R4 functions as a current limiting and voltage dropping resistor. Resistor R9 performs the same function for the carriage fast run circuit associated with switch S6.

3-9 PEN SOLENOID MANUAL CONTROL CIRCUIT

The manual control circuit for the pen solenoid is shown in the schematic diagram of Figure 7-5. The PEN UP/DOWN switch S9 is a spring-loaded three-position wafer switch identical to the DRUM SINGLE STEP and CARRIAGE SINGLE STEP switches S5 and S7. Operation of the switch is the same as for the drum and carriage switches. For example, when switch S9 is momentarily turned to the UP position, then pen-up input line at J2-V is disconnected from −24 volts at terminal 10 of wafer 9B and is connected to ground potential at R8, through terminal 1 of wafer 9B.

3-10 AC POWER DISTRIBUTION AND DC POWER SUPPLY

The Model 566 Digital Incremental Plotter is designed to operate from a source of 115-volt, 50 or 60 cps, single-phase primary power. Power is applied to connector J7 (Figure 7-5) mounted on the rear of the main assembly. One side of the a-c line is routed through a 2 amp. fuse F1 and the Power ON/OFF switch S3 to a cooling fan B1 and power transformer T1. The other side of the a-c line is connected directly to the fan and the transformer. A front panel indicator lamp DS1 is illuminated whenever switch S3 is ON.

The cooling fan B1, mounted on the power supply subassembly, draws air in from the underside of the instrument and directs it over the silicon rectifiers, the step motors, and the chart motors.

Power transformer T1 supplies alternating current to the silicon rectifiers CR1 through CR4, which are connected in a conventional bridge circuit. The bridge rectifier provides a total d-c output voltage of approximately 27 volts. Circuit ground is established at a point 3 volts below the positive side of the output. Filtering is provided by choke L1 and electrolytic capacitors C2 and C3. Diodes CR7, CR8, CR9, CR19, CR11 and CR12, Zener diode CR10, and resistor R3 comprise a voltage divider network across the output. D-c supply voltages are obtained at +3, +1.5, −7.5, −9, and −24 volt taps on the divider network. Zener diode CR10 provides close regulation of the −7.5 volt supply which is used as a bias reference in the transistor circuits associated with the various control functions.

Chart take-up motors M1 and M2 are 115-volt two-phase motors which normally operate in a stalled condition to maintain the proper tension on the roll of chart paper. When CHART DRIVE switch S4 is ON, one winding of each motor is connected directly across the a-c line. The second winding of each motor is connected to the a-c line through a phase-shifting network which supplies current in the correct phase relationship to produce a torque on the armature. The phase-shifting networks consist of R6 and C8 for the rear take-up motor, and R7 and C9 for the front takeup motor. A filter network, consisting of R5 and C7, is connected across the contacts of CHART DRIVE switch S4. The purpose of this circuit is to prevent switching transients from feeding back through the power circuits and producing a false step signal.

All input signals to the Model 566 are connected to the instrument at P5, mounted on the rear of the main chassis. The −24 volt and circuit ground buses from the internal power supply are also terminated at P5 to permit their use as reference potentials in external equipment. Capacitor C5 provides isolation between the circuit ground bus for the Model 566 and the external circuit ground whenever such isolation is required for protection of the equipment. A chassis ground is also provided, at pin 14 of P5.

Section 4
Operating Instructions

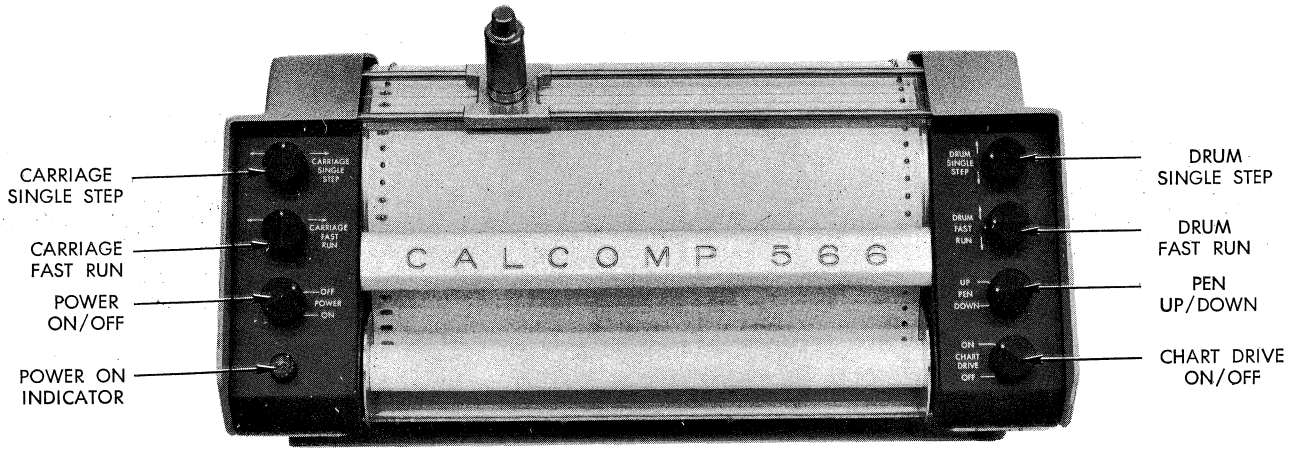


Figure 4-1. Model 566 Control Panel

4-1 INTRODUCTION

This section includes functional descriptions of all front panel controls for the Model 566 Digital Incremental Plotter, instructions for preparation of the plotter for use, and operational checkout procedures. Since operation of the Model 566 is automatic, detailed operating instructions are not required.

4-2 CONTROL FUNCTIONS

As shown in Figure 4-1, seven operating controls and one indicator lamp are mounted on the front panel of the instrument. Their functions are described in the following paragraphs.

4-3 POWER ON/OFF

The POWER ON/OFF switch connects 115-volt a-c power from connector J7 on the rear panel of the recorder to the cooling fan and the power supply transformer. A neon indicator, located directly below the switch, is lighted when the switch is ON.

Note

If desired, a-c power to the Model 566 may be supplied through the signal connector P5, utilizing two of the spare pins. If this modification is installed, the two wires connected to J7 should be unsoldered and connected to P5. DO NOT connect jumpers from J7 to P5, since this would result in the presence of a-c line voltage on the exposed prongs of J7.

4-4 CARRIAGE FAST RUN

The CARRIAGE FAST RUN switch allows the pen carriage to be stepped rapidly to the left or right at the rate of 120 steps per second where using 60 cps power, or 100 steps per second where using 50 cps power. The switch may be used to move the carriage to any desired area of the graph, or for operational checkout of the carriage control circuits and the carriage step motor.

4-5 CARRIAGE SINGLE STEP

The CARRIAGE SINGLE STEP switch allows the pen carriage to be moved in single step (.005 inch) increments either to the left or right. This control, in

combination with the DRUM SINGLE STEP control, permits the operator to accurately align the carriage on a point or fixed coordinate on the paper.

4-6 CHART DRIVE ON/OFF

The CHART DRIVE ON/OFF switch allows the operator to disable the front and rear chart take-up motors. This permits the use of single sheets of chart paper in place of the paper rolls supplied with the instrument.

4-7 PEN UP/DOWN

The PEN UP/DOWN switch provides a means of manually raising and lowering the pen from the surface of the drum.

Note

When the instrument is first turned on, or if the pen is removed and replaced when the carriage is in the UP position, the pen may remain down even when the switch is turned to UP position. When this occurs, turn the switch first to DOWN position, then to UP position. (See Theory of Operation, subsection 3-7.)

4-8 DRUM FAST RUN

The DRUM FAST RUN switch allows the drum to be stepped rapidly up or down at the rate of 120 steps per second. The switch is used in the same manner as the CARRIAGE FAST RUN control to move the pen to any desired area of the chart, or for operational checkout of the drum control circuits and the drum step motor.

4-9 DRUM SINGLE STEP

The DRUM SINGLE STEP switch allows the drum to be moved in single step (.005 inch) increments either up or down. This control, in combination with the CARRIAGE SINGLE STEP control, permits the operator to accurately align the pen on a point or fixed coordinate on the chart.

4-10 OPERATING PROCEDURES

Operating procedures for the Model 566 consist of loading the chart paper, performing an operational checkout, and aligning the carriage with the zero axis of the chart. These procedures are described in the following paragraphs. After they have been accomplished, the instrument may be connected to the digital signal source for automatic plotting of the desired data.

4-11 INSTALLATION OF CHART ROLL

To install a roll of chart paper in the instrument, proceed as follows:

a. Set POWER switch to OFF.

b. Remove the pen assembly from the carriage by loosening the knurled nut at the bottom of the pen holder and lifting the assembly out of the carriage.

CAUTION

Use care not to drop the pen assembly or any of its parts. The assembly is constructed of soft steel to close tolerances for optimum performance.

c. Rotate the right rear paper spool by hand until the drive key is pointing upward.

d. Hold the new roll of chart paper so that the key slot in the core is pointing upward. Place the roll against the spring-loaded left rear idler spool and force the spool to the left.

e. Lower the paper roll into the paper well and slide the right end onto the drive spool. Make certain the drive key engages the key slot in the core.

f. Install a paper roll core on the two front spools below the drum, in the same manner as the paper roll.

g. Pull the end of the paper over the drum so that the sprocket holes on both edges of the paper engage the sprockets on the drum. Guide the chart paper under the carriage rods and behind the tear bar. The end of the chart paper circumscribes the take-up spool from the back and fastens on the spool with scotch tape provided in the accessory kit. Using the DRUM FAST RUN switch, wind a few turns onto the take-up spool.

4-12 INSTALLATION OF SINGLE SHEET CHART PAPER

Single sheets of chart paper, 8½ by 11 inches or 11 by 17 inches, may be used for plotting in place of the chart paper roll. To install a single sheet of chart paper, proceed as follows:

a. Set POWER and CHART DRIVE switches to OFF.

b. Remove the pen assembly from the carriage.

c. Slide the chart paper sheet under the carriage rods onto the drum surface.

d. Fasten the top edge of the paper to the drum with two or three short pieces of tape. Rotate the

drum by hand, keeping the paper smooth and flat against the drum surface. Fasten the bottom edge of the paper in the same manner as the top.

4-13 OPERATIONAL CHECKOUT

The following procedure is intended to provide an overall check of the operation of the Model 566 prior to the start of automatic recording. If a malfunction is encountered at any point in the checkout procedure, refer to Section 5 for troubleshooting data.

a. Install the pen assembly in its carriage.

b. Set POWER and CHART DRIVE switches to ON.

c. Set DRUM FAST RUN to UP position. Check that the pen traces a vertical line on the chart paper.

d. Turn the PEN switch to DOWN, then UP. Check that the pen lifts off the drum surface.

e. Set the PEN switch to DOWN position, then set the DRUM FAST RUN to DOWN position. Check that the pen again traces a vertical line on the chart paper.

f. Set the CARRIAGE FAST RUN switch to the left position. Check that the pen traces a horizontal line on the chart and that the carriage step motor stops when the carriage reaches its limit of travel. Repeat with the CARRIAGE FAST RUN switch in the right hand position.

g. Alternately operate the CARRIAGE SINGLE STEP and DRUM SINGLE STEP switches. Check that both the carriage and the drum move one step only each time one of the switches is operated.

h. Move the carriage near the left margin of the chart paper. Set CARRIAGE FAST RUN switch to the right position and DRUM FAST RUN to DOWN position. Allow the instrument to run until the carriage reaches the right side of its track, then return both switches to OFF (center) position. Check that the pen traces a 45 degree line on the chart. Check the line carefully for any evidence of discontinuity.

i. Operate the DRUM SINGLE STEP switch several times to reposition the pen either above or below its position at the end of step h.

j. Set CARRIAGE FAST RUN switch to the left position and DRUM FAST RUN switch to the UP position. Allow the instrument to run until the carriage reaches the left side of the track, then return both switches to OFF position. Check that the pen again traces a 45 degree line on the chart and that this line is exactly parallel to the line traced in step h.

k. Repeat steps h through j, changing the switch positions to produce two 45 degree lines at right angles to the first two. Again check for discontinuities and make certain the two lines are parallel.

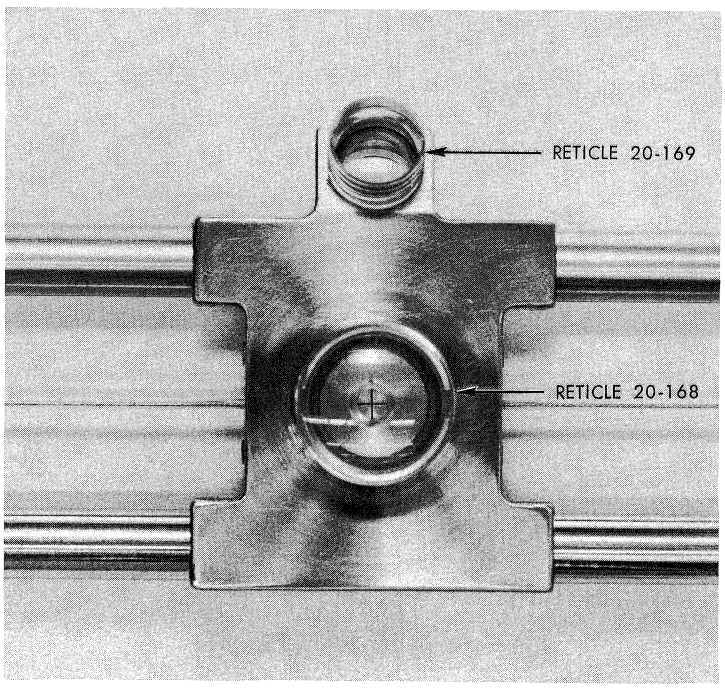


Figure 4-2. Reticle Adjustment

4-14 RETICLE ADJUSTMENT

Two alignment reticles are provided to permit manual alignment of the carriage to the desired zero point. (See Figure 4-2.)

4-15 RETICLE 20-168 ADJUSTMENT

To adjust Reticle 20-168, proceed as follows:

a. Remove the pen assembly from the carriage.

b. Insert the reticle into the hole in the center of the carriage.

Note

Reticle should be rotated as inserted, to prevent damage to O-ring.

c. Rotate the reticle until the cross hairs are parallel with the horizontal and vertical planes of the plotter.

d. Position the carriage and the drum by use of FAST RUN controls to the approximate plot-zero point. Use SINGLE STEP controls to accurately position the cross hairs on the plot-zero point.

e. Remove the reticle and replace the pin assembly in the carriage.

4-16 RETICLE 20-169 ADJUSTMENT

To adjust Reticle 20-169, proceed as follows:

a. Place reticle in the receptacle on the carriage.

Note

Reticle need not be removed during the operation of the plotter.

b. Rotate the reticle until the cross hairs are parallel with the horizontal and vertical planes of the plotter.

c. The intersection of the cross hairs is exactly one inch in the plus X direction from the penpoint.

d. Position the carriage in the same manner as shown in 4-15 d above, the difference being that intersection of the reticle cross hairs is one inch from the zero point of the plot.

4-17 AUTOMATIC OPERATION

After the installation of chart paper, the operational checkout, and the reticle adjustment described in preceding paragraphs, the Model 566 is ready for use. Connect the digital source to P5 on the rear panel of the recorder and set the POWER switch to ON.

Note

Do not turn power off, then on again, during a recording; this can introduce a plotting error of one step in any direction.

4-18 REMOVAL OF CHART PAPER

The roll of chart paper or single sheet of chart paper should be removed in the reverse sequence to the installation procedure described above. If a single sheet of chart paper is used, any remaining tape adhesive should be cleaned from the drum surface with acetone or a good commercial grade of cleaning solvent.

Section 5
Maintenance

5-1 INTRODUCTION

This section includes all necessary instructions for maintenance, troubleshooting and repair of the Model 566 Digital Incremental Plotter. This instrument is constructed of the highest quality materials and the most reliable electronic components. In normal use, with reasonable care, the instrument will provide years of reliable operation with minimum service or repair.

Figures 5-1 and 5-2 show the Model 566 disassembled to the extent required for normal maintenance.

5-2 ROUTINE MAINTENANCE

Routine maintenance of the Model 566 is limited to periodic cleaning and operational checkout. No lubrication is required. A small amount of light grease or Vaseline may be used on the threaded portion of the pen carriage to facilitate removal and installation of the pen assembly. Use caution to prevent any lubricant from getting on the electrical spring contacts in the key slots on the carriage.

Since the operational checkout described in Section 4 is normally performed at the start of each recording run, this portion of the routine maintenance schedule may be omitted if the instrument is in frequent use. If the plotter is used infrequently, it is recommended that an operational checkout be performed at least once a week.

The carriage rods, the drum surface, and the metal plunger inside the pen assembly should be cleaned periodically. The intervals at which cleaning should be performed will be determined by the operating environment and the frequency of use. All normal cleaning can be accomplished with a soft, dry cloth. If necessary, the cloth may be moistened with acetone or cleaning solvent to remove foreign matter. The inside of the pen assembly plunger (Figure 5-3) should be cleaned by pushing one corner of the cloth through the center. If the plunger is clogged, it should be dipped in cleaning solvent and then wiped dry.

CAUTION

Use care to avoid damage to the teflon insulation on the carriage drive cable. This cable supplies −24 volt power to the pen solenoid.

5-3 DISASSEMBLY

The Model 566 plotter is easily disassembled for maintenance or repair. Normal disassembly is limited to removal of the cover, plotter circuit board, and plug-in power supply. No special instructions are required for removal of individual components on the main assembly, the circuit board, or the power supply.

CAUTION

Do not attempt to remove or replace the steel cables used for mechanical drive on the carriage assembly. Proper installation and adjustment of these cables requires special tools and fixtures. If a cable breaks or requires replacement, return the instrument to the factory for service.

To disassemble the unit, proceed as follows:

a. To remove the cover, unscrew six screws (designated "A" in Figure 5-4) from the base plate.

CAUTION

Remove only those screws designated "A" in Figure 5-4. Removal of screws other than those designated "A" will cause mechanical misalignment or damage.

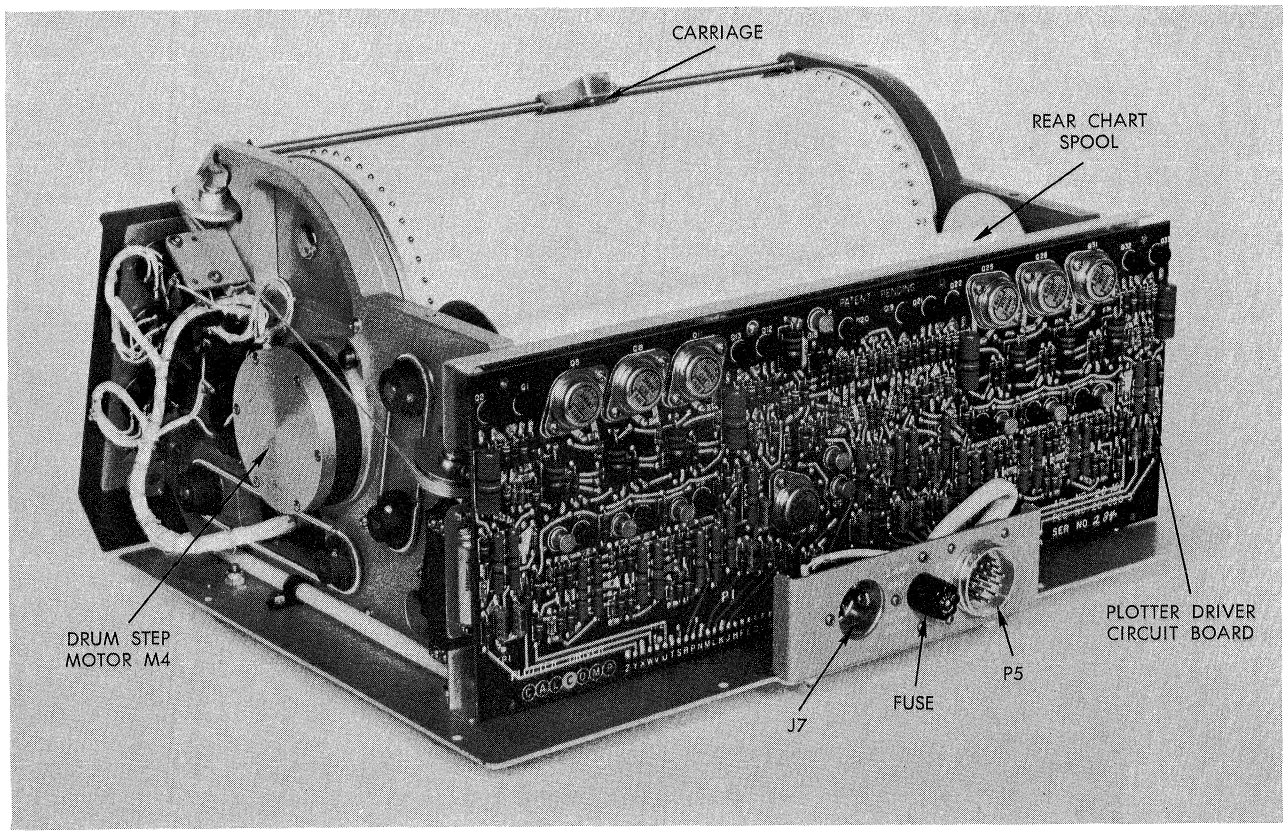


Figure 5-1. Rear Oblique View, Cover Removed

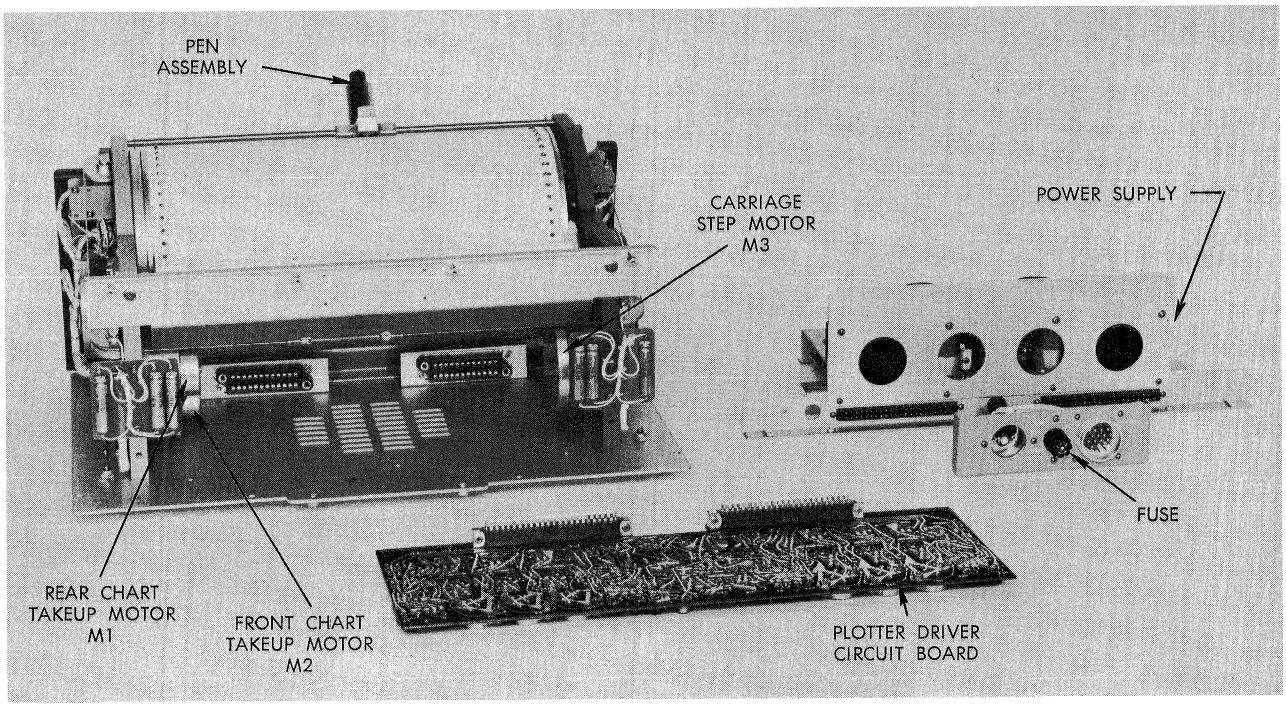


Figure 5-2. Rear View, Plug-In Assemblies Removed

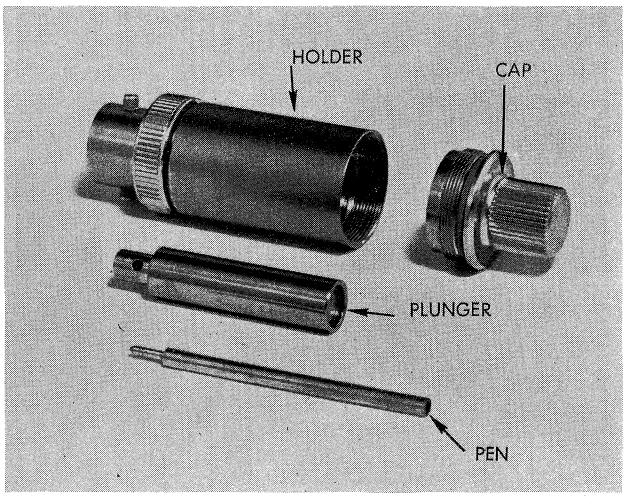


Figure 5-3. Pen Assembly

b. To remove the plotter circuit board, remove six round head screws which fasten the circuit board to mounting standoffs on the main chassis and the power supply chassis. Disengage the assembly from connectors J1 and J2 on the power supply chassis.

c. To remove the power supply chassis, unscrew five screws (designated "B" in Figure 5-4) from the base plate. Then, unscrew the two screws (designated "C" in Figure 5-4) which fasten the connector bracket to the rear of the base plate. Next, remove the two screws (designated "D" in Figure 6-2) which fasten the extended tabs on the power supply chassis to the base. The power supply chassis may now be removed by pulling straight back.

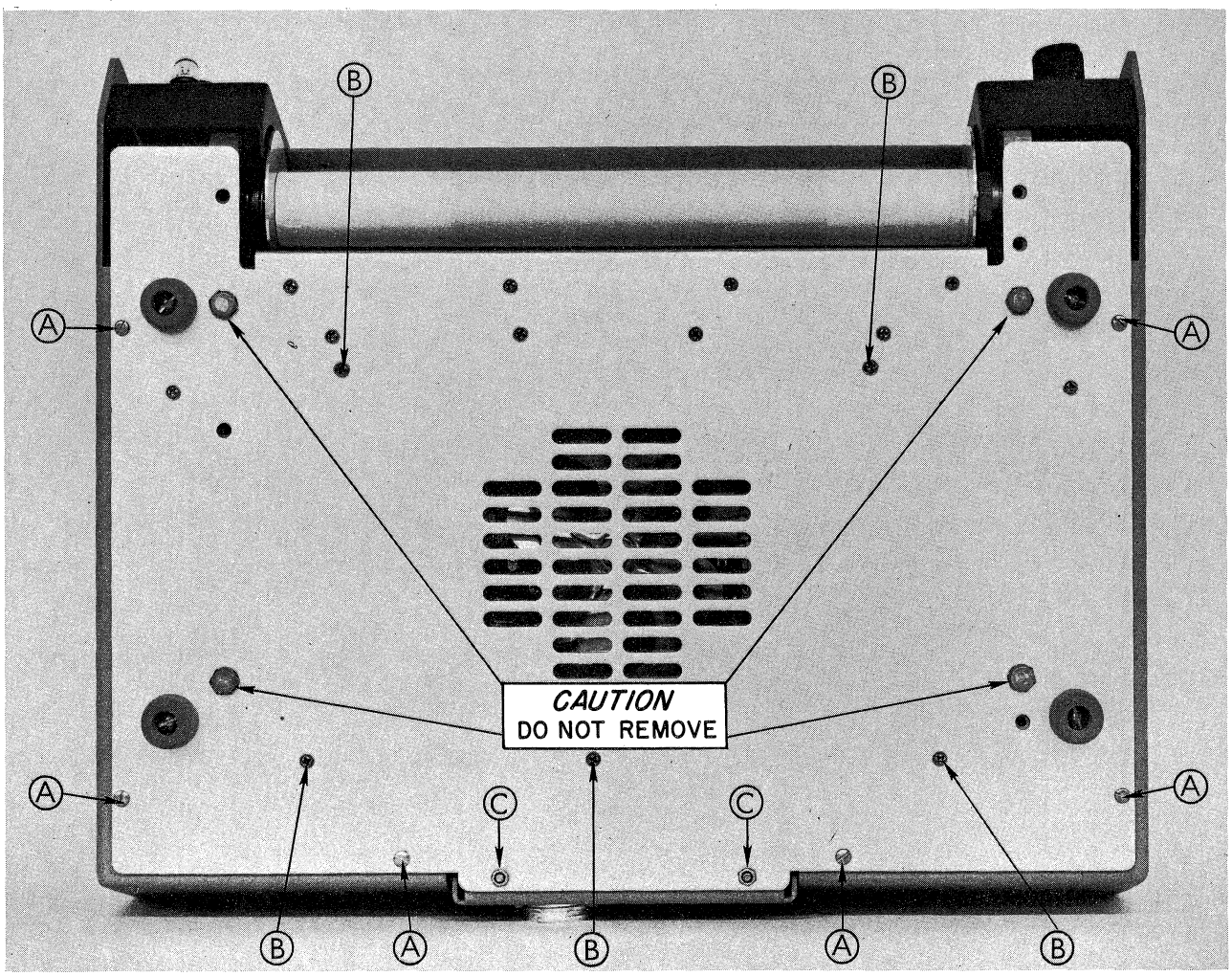


Figure 5-4. Location of Cover and Power Supply Mounting Screws

Note

See Section 6 for additional illustrations of the plotter circuit board and power supply assemblies. Individual circuit components on the circuit board are identified by reference designations printed on the back side of the board (not shown).

5-4 TROUBLESHOOTING

The isolation of trouble in the Model 566 plotter requires a comprehensive understanding of the theory of operation described in Section 3. Most troubles can be quickly isolated to one functional circuit by performing the operational checkout described in Section 4. Following this, the trouble can be isolated to a single stage by performing systematic checks of voltages and waveforms at the test points listed in Figure 5-5. A guide to trouble analysis is given in Table 5-1.

TABLE 5-1
TROUBLESHOOTING GUIDE

SYMPTOM	PROBABLE CAUSE
Unit inoperative; neon power indicator does not light	(1) Fuse F1 blown; check for short circuit, then replace fuse (2) Defective POWER switch S3 (3) Defective wiring or connector J7
Unit inoperative; neon power indicator lights	(1) Defective power transformer T1 (2) Defective power supply component; make voltage and continuity checks; see Fig. 7-5.
Both chart drive motors inoperative	(1) Defective CHART DRIVE switch S4 (2) Defective a-c wiring
One chart drive motor inoperative	(1) Defective motor; check continuity of windings (2) Defective phase-shift component, R6-C8 or or R7-C9
Drum step motor inoperative, carriage operation normal; or carriage motor inoperative, drum operation normal	(1) Defective step motor; check continuity of windings (2) Open current limiting resistor or shorted diode; check continuity; see Figure 7-5 (3) Defective drive transistor or ring counter stage; check waveforms per Figure 5-5
Drum step motor or carriage step motor inoperative in one direction only; operation normal in opposite direction	(1) Defective one-shot circuit; check waveforms (2) Defective input trigger circuit; check waveforms and continuity
Discontinuities in plotting, or inaccurate plotting	(1) Improper adjustment of step motor; see subsection 5-6 (2) Double stepping due to noise on input signal line: check for excessive power supply ripple; check for defective switching filter components, loose connections, bad solder joints
Operation normal on automatic plot, abnormal on manual operation	Defective control switch or associated wiring
Operation normal on manual, abnormal on automatic plot	Defective input trigger circuit or associated wiring
Pen control circuit inoperative	(1) Defective solenoid; check continuity between key pins on pen assembly (2) Defective flip-flop or current control circuit; check waveforms

Note

Waveforms illustrated in Figure 5-5 may be obtained using the manual FAST RUN controls, or a square wave generator connected to the appropriate pins on P5. The square wave generator must be used to obtain the waveforms shown for the pen control circuits.

No special tools are required for troubleshooting the Model 566. The following test equipment is recommended:

(1) Laboratory type oscilloscope
(2) 20,000 ohm-per-volt multimeter
(3) Square wave generator, 600 ohms or less output impedance, less than 5 microseconds rise time, 10 volts output (Hewlett-Packard HP 211A or equivalent)

CAUTION

Use extreme care when performing tests on the instrument with power on and the cover removed. Accidental short circuits between terminals on the printed circuit board can burn out a diode or transistor. Use care also to avoid shorting the carriage drive cable or its idler pulley to the chassis. −24 volts d-c is present on the cable and the pulley when power is on.

5-5 REPAIR AND REPLACEMENT

With the exception of replacement and adjustment of the drum and carriage step motors described in the following paragraphs, no special instructions are required for repair or replacement of components in the Model 566. Detailed parts lists for the main assembly, the circuit board, and the power supply are given in Section 6.

CAUTION

Do not attempt to replace either of the steel cables used for mechanical drive of the carriage assembly. If replacement is required, return the instrument to the factory for service.

5-6 STEP MOTOR REPLACEMENT AND ADJUSTMENT

Location of the carriage and drum step motors, M3 and M4 respectively, is shown in Figures 5-1 and 5-2. To replace either of the step motors, proceed as follows:

a. Disconnect power from the instrument. Remove the cover, circuit board, and power supply in accordance with subsection 5-3.

b. Clip lacing twine from the step motor leads to separate them from the wiring harness. Remove the orange, red, and brown wires from the three limiting resistors mounted on the side of the main assembly. Note these connections carefully so that the new motor can be connected properly. Disconnect the remaining black wire from the standoff insulator.

c. Remove the two allen head cap screws which mount the motor to the main assembly. Lift out the motor and primary gear train.

Note

The step motor and its primary gear train are matched at the factory and must be replaced as a complete assembly.

d. Place the new motor and gear train assembly in position, holding the motor so that the protruding pinion gear is below the center axis of the motor.

CAUTION

Use care when sliding the motor into position to avoid damaging the plastic gear which mates with the pinion. Do not force the pinion into mesh.

e. Install, but do not tighten, the two allen cap screws which mount the motor to the main assembly.

f. Carefully rotate the motor case clockwise until the pinion meshes with the plastic gear. Maintain clockwise pressure while tightening the two cap screws. This will prevent backlash in the gear train.

g. Rotate the drum or the carriage drive pulley by hand. Either should move freely, but with perceptible resistance. There should be no perceptible backlash when the drum or carriage is rocked back and forth. If the resistance is excessive, loosen the cap screws and rotate the motor slightly counterclockwise. If backlash is present, rotate the motor slightly clockwise. Again tighten the cap screws.

h. Connect the lead wires from the new motor to the three resistors and the standoff insulator. Make certain the connections are the same as those on the defective motor removed in step h:

Brown—top terminal
Red—center terminal
Orange—bottom terminal

i. Lace the motor leads to the wiring harness. If necessary, assemble the power supply and circuit board to the main assembly.

j. Connect a-c power to the unit and perform the operational checkout in accordance with the Operation Instructions, 4-13. Discontinuities in the 45-degree line, drawn with the CARRIAGE FAST RUN and DRUM FAST RUN controls on, indicates that the motor is skipping steps because of excessive drag. Loosen the cap screws and rotate the step motor slightly counterclockwise. If the operation is excessively noisy, or if the pen overshoots on incremental steps, this indicates backlash. Loosen the cap screws and rotate the motor slightly clockwise.

k. When checkout is completed satisfactorily, make certain the step motor mounting cap screws are tight, then replace the cover on the unit.

Note

For a more accurate check of the step motors, reduce the a-c line voltage to 105 vac and connect a square-wave generator to the appropriate pins on P5. The drum and carriage should be capable of continuous stepping action at 300 cps.

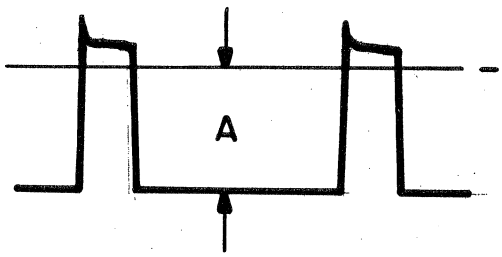
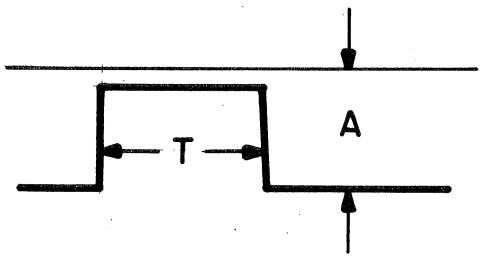
VOLTAGE OR WAVEFORM	TEST POINT	NOTES
POWER SUPPLY		
0 vdc	TP1	Circuit ground
−7.5 vdc	TP4	Limits: −6.1 to −7.8 vdc
−9.0 vdc	TP5	Limits: 1.2 volts or more negative with respect to TP4
+1.5 vdc	TP2	Limits: +1.25 to +1.75 vdc
+3.0 vdc	TP6	Limits: +2.5 to +3.3 vdc
−24 vdc	TP3	Limits: −18 to −24 vdc; no-load ripple less than 4 v peak-to-peak; load ripple less than 10 v peak-to-peak
DRUM AND CARRIAGE CONTROL		
	Base of Q2, Q13, Q22, Q33; triangular pad directly below each transistor	One-shot cutoff bias Scope: 1 v/cm vert. 2 ms/cm horiz. A = greater than 0.6v
	Collector of Q1, Q12, Q21, Q32; top of 1.5K resistor below each transistor	One-shot collector Scope: 5 v/cm vert. 500 us/cm horiz. T = 1200 to 1800 usec. A = approx. 7v

Figure 5-5. Test Point Voltages and Waveforms (Sheet 1 of 4)

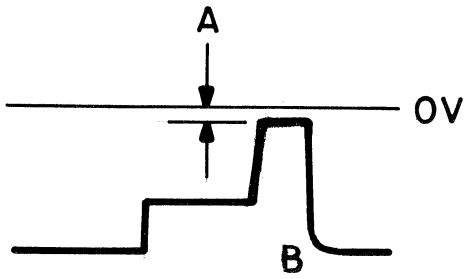
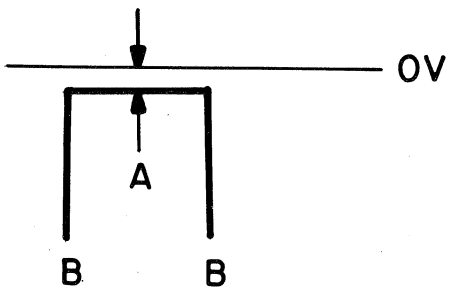
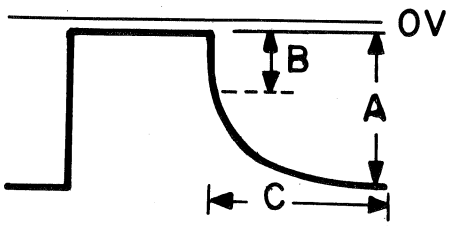
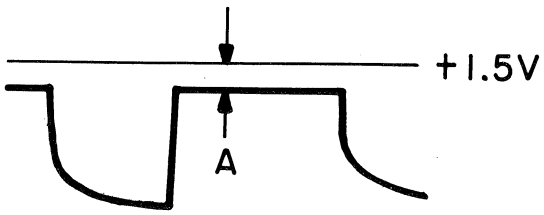
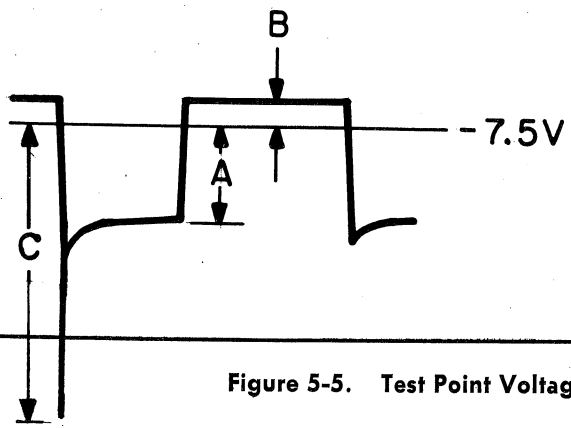
VOLTAGE OR WAVEFORM	TEST POINT	NOTES
	Bottom end of capacitors C4 thru C9, and C21 thru C26 (12 measurements)	Gating waveforms Scope: 5 v/cm vert. 2 ms/cm horiz. A = less than 2 v B: no overshoot at this point
	Case (collector) of Q5, Q8, Q11, Q25, Q28, Q31	Power transistor saturation Scope: 0.5 v/cm vert. 2 ms/cm horiz. A = less than 0.3 v B: off-scale
	Same as above	Power transistor full waveform Scope: 10 v/cm vert. 2 ms/cm horiz. A = approx. 24 v B = approx. 8 v C = approx. 5 ms
	Collector of Q4, Q7, Q10, Q25, Q27, Q30; top of 560 ohm 2 watt resistor	Inner stage saturation Scope: 1 v/cm vert. 2 ms/cm horiz. A = less than 0.3 v
	Base of Q3, Q6, Q9, Q23, Q26, Q29	Ring Counter NPN waveform Scope: 1 v/cm vert. 2 ms/cm horiz. A = more than 1.0 v B = less than 0.3 v C = approx. 6 v

Figure 5-5. Test Point Voltages and Waveforms (Sheet 2 of 4)

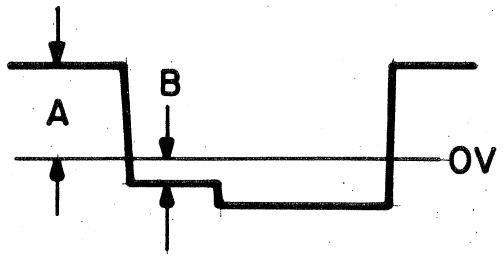
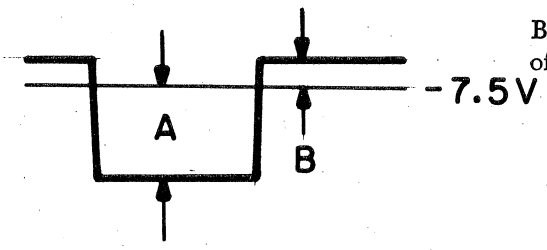
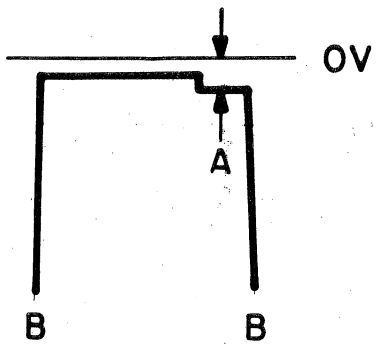
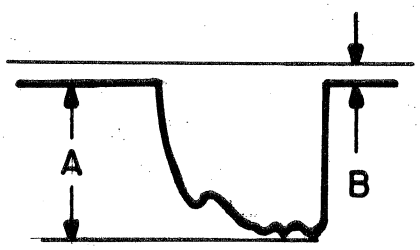
VOLTAGE OR WAVEFORM	TEST POINT	NOTES
PEN CONTROL		
	Base of Q18; bottom of 1.5K resistor	Q18 cutoff bias Scope: 1 v/cm vert. 50 ms/cm horiz. Square-wave generator: 5 cps A = greater than 0.7 v B = less than 0.3 v
	Base of Q19; collector of Q15	Flip-flop saturation Scope: 0.5 v/cm vert. 50 ms/cm horiz. Square-wave generator: 5 cps A = greater than 0.7 v B = less than 0.3 v
	Collector of Q18; top of 560 ohm 2 watt resistor	Driver saturation Scope: 0.5 v/cm vert. 50 ms/cm horiz. Square-wave generator: 5 cps A = less than 0.3 v B: off scale
	Collector of Q14; top of 3.3K resistors below 560 ohm resistor	Q14 collector voltage Scope: 1.0 v/cm vert. 20 ms/cm horiz. Square-wave generator: 5 cps A = approx. 3 v B = less than 0.3 v

Figure 5-5. Test Point Voltages and Waveforms (Sheet 3 of 4)

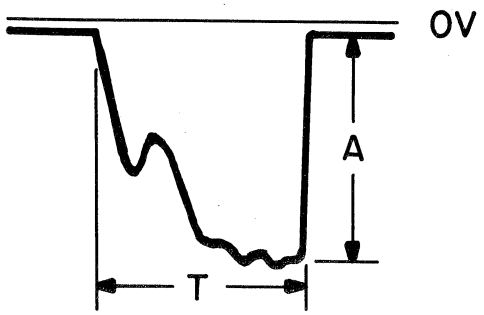
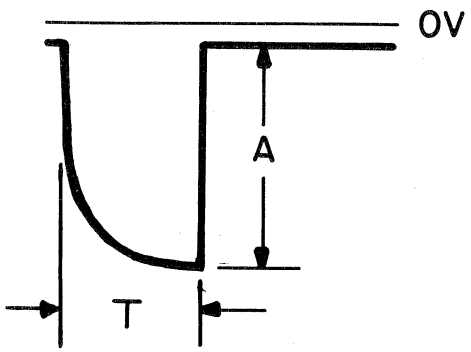
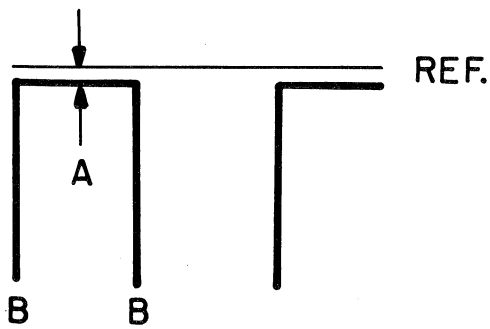
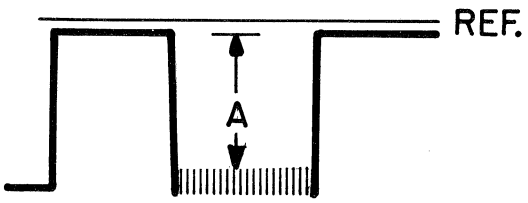
VOLTAGE OR WAVEFORM	TEST POINT	NOTES
	Top of 10 ohm resistors R58 and R60	Driver current waveform Scope: 0.5 v/cm vert. 20 ms/cm horiz. Square-wave generator: 5 cps T = 40 to 60 ms A = greater than 0.8 v
	Same as above	Driver short-circuit current Scope: 1.0 v/cm 50 usec/cm Square-wave generator: 5 cps Short out CR22 to obtain waveform; when short is removed, waveform should be same as that shown above and pen should lift and lower normally T = less than 100 usec A = approx. 3.5 v
	Case (collector) of Q16	Driver saturation Scope: 0.5 v/cm vert. 20 ms/cm horiz. Square-wave generator: 5 cps Ref: ungrounded end of R58-R60 A = less than 0.3 B: off scale
	Same as above	Driver full waveform Scope: 10 v/cm vert. 50 ms/cm horiz. Square-wave generator: 5 cps Ref: same as above A = approx. 24 v

Figure 5-5. Test Point Voltages and Waveforms (Sheet 4 of 4)

Section 6
Parts List

6-1 INTRODUCTION

This section provides a listing of all detail parts in the Model 566 Digital Incremental Plotter. Replacement parts can be obtained from the manufacturer at the following address:

California Computer Products, Inc.
Marketing Department
305 North Muller Ave.,
Anaheim, California

When ordering replacement parts, give the complete description as listed in this section, together with the part number. Vendor items may be obtained either from California Computer Products, Inc., or from the vendor. (See vendor list below.) Commercial items can usually be obtained from any electronic parts distributor.

The general layout, and location of major items, for the circuit board and power supply assemblies are shown in Figures 6-1, 6-2 and 6-3. For location of all detail parts on the main assembly and the power supply, refer to the assembly drawings included as Figures 7-6 and 7-7 in Section 7. (Location of parts on the plotter circuit board assembly are printed on the back side of the circuit board).

6-2 VENDOR LIST

The following is a list of vendors referenced by code number in the parts lists.

1 Accurate Rubber & Plastic Co.
Santa Monica, Calif.

2 Allen-Bradley Corp.
Milwaukee, Wisconsin

3 All Metal Corp.
Garden City, N. Y.

4 Amphenol Electronics Corp.
Chicago, Illinois

5 Barber Colman
Rockford, Illinois

6 Bradley Semiconductor Corp.
New Haven, Conn.

7 Bristol Motors
Los Angeles, Calif.

8 Cannon Electric Co.
Los Angeles, Calif.

9 CBS-Hytron
Los Angeles, Calif.

10 Clevite Transistor Products
Waltham, Mass.

11 Mallory & Co.
Indianapolis, Indiana

12 Dale Products
Columbus, Nebraska

13 Delco Radio Corp.
Kokomo, Indiana

14 Dialight Corp.
Brooklyn, N. Y.

15 Elastic Stop Nut Corp.
Union, N. J.

16 Erie Resistor Corp.
Erie, Pennsylvania

17 General Cement Co.
Los Angeles, Calif.

18 General Electric Co.
Syracuse, N. Y.

19 General Electric Supply Co.
Los Angeles, Calif.

20 The General Industries Co.
Elyria, Ohio

21 Grayhill, Inc.
La Grange, Illinois

22 Lane Spring Co.
Los Angeles, Calif.

23 Littelfuse Inc.
Des Plaines, Illinois

24 Westinghouse Electric Co.
Van Nuys, Calif.

25 McCarron Electric Co.
Monterey Park, Calif.

26 Micro Switch Div.
Minneapolis Honeywell Inc.
Freeport, Illinois

27 Ward-Leonard Electric Co.
Mount Vernon, N. Y.

28 Smith, H. H. Co.
Brooklyn, N. Y.

29 Spec-Tronics Co.
Van Nuys, Calif.

30 Sprague Electric Co.
North Adams, Mass.

31 Timken Roller Bearing Co.
Canton, Ohio

32 Truarc Retaining Rings
Div. Waldes Kohinoor Inc.
Long Island City, N. Y.

33 U. S. Engineering Co.
Van Nuys, Calif.

34 Winchester Electronics Inc.
Norwalk, Conn.

35 Ed Maltby Co.
Los Angeles, Calif.

36 Industrial Products, Inc.
North Hollywood, Calif.

37 Seastrom Mfg. Co.
Glendale, Calif.

38 Alpha Wire Corp.
New York, N. Y.

TABLE 6-1
PARTS LIST FOR MAIN ASSEMBLY PART NO. 10003-101

INDEX (FIG. 7-6)	ITEM	QUANTITY	PART NO.	REF. DESIG.	VENDOR CODE
1	Rod, carriage	2	20-009	—	—
2	Cover	1	20-012	—	—
3	Pulley	2	20-013	—	—
4	Pulley	2	20-014	—	—
5	Support	8	20-026	—	—
6	Shaft	4	20-029	—	—
7	Panel, RH	1	58-031	—	—
8	Panel, LH	1	58-032	—	—
9	Spring	2	20-033	—	—
10	Bracket	1	20-108	—	—
11	Cabinet	1	20-041	—	—
12	Pan, paper	1	20-043	—	—
13	Actuator	2	20-046	—	—
14	Bracket	2	20-048	—	—
15	Support, RH	1	58-053	—	—
16	Support, LH	1	58-055	—	—
17	Base	1	20-056	—	—
18	Cover	1	20-060	—	—
19	Shield	2	20-061	—	—
20	Angle, RH	1	20-070	—	—
21	Angle, LH	1	20-071	—	—
22	Support	2	20-074	—	—
23	Shaft	1	20-077	—	—
24	Spring	1	20-093-3	—	—
25	Spring	1	20-093-5	—	—
26	Drum shaft subassembly	1	20-096	—	—
27	Push rod subassembly	1	20-097-11	—	—
28	Drive pulley subassembly	1	10001-203	—	—
29	Idler pulley subassembly	3	20-099	—	—
30	Step motor	2	10001-301	M3, M4	— —
31	Idler spool, paper roll	2	20-102	—	—
32	Drive spool, paper roll	2	20-103	—	—
33	Carriage subassembly	1	58-104	—	—
34	(not used)			—	—
35	Holder, bearing	4	20-106	—	—
36	Washer spring	4	20-109	—	—
37	Knob	3	20-110-5	—	—
38	Knob	4	20-110-3	—	—
39	(not used)			—	—
40	Wire list	1	58-004	—	—
41	Pulley subassembly	1	20-128	—	—

TABLE 6-1 (CONT'D)
PARTS LIST FOR MAIN ASSEMBLY PART NO. 10003-101

INDEX (FIG. 7-6)	ITEM	QUANTITY	PART NO.	REF. DESIG.	VENDOR CODE
42	Drum assembly	1	10002-203	—	—
43	Power supply assembly (see Table 6-2)	1	20-131	—	—
44	Holder	1	20-133-1	—	—
45	Holder	1	20-133-2	—	—
46	Terminal strip	1	20-143	—	—
47	Nylon ball 5-32 dia.	4		—	35
48	Board assembly	1	20-151	—	—
49	Stand off	4	20-038	—	—
50	Terminal board	1	58-150-11	—	—
51	Motor	2	830(201-HX)	M1, M2	7 —
52	(not used)				
53	(not used)				
54	Switch	2	V3-47	S1, S2	26 —
55	Washer, keyed	5	12C1087	—	21
56	Lamp assembly	1	145-5036-997	—	14
57	Lamp	1	NE-2D	DSI	14
58	(not used)				
59	Snap ring, beryllium copper, 3/16 in. external	2	5100-18	—	32
60	Snap ring, stainless steel, 1/2 in. external	1	5100-50-W	—	32
61	Snap ring, stainless steel, 5/16 in. external	2	5100-31-W	—	32
62	Resistor	6	RH-25	R11 thru R16	12
63	Set screw, socket hd, 8-32 x 3/16, cup point	2	—	—	3 *
64	Set screw, socket hd, 10-32 x 1/4, cup point	8	—	—	3 *
65	Set screw, socket hd, 1/4-20 x 1/2, cup point	2	—	—	3 *
66	Bumper, rubber	4	BH-2096W	—	1
67	Washer, fiber	16	2150	—	28
68	Stand off	2	765	—	34*
69	Bearing, class No. 3	1	A4050	—	31
70	Lockwasher	9	1145G	—	28
71	Spring, cad plated	1	167A	—	22*
72	Cable clip	2	774	—	—
73	(not used)	—	—	—	—
74	Lug	4	5708	—	—
75	Nut	4	22M-02	—	15*
76	Nut	1	22M-40	—	15*
77	Screw, hex hd	4	AN4C4A	—	—
78	Screw, cap, 10-32 x 1/2	8	—	—	3 *
79	Screw, binder hd, 6-32 x 7/16	8	—	—	3 *
80	Screw, hex hd	6	AN3C3A	—	—

* Commercial item

TABLE 6-1 (CONT'D)
PARTS LIST FOR MAIN ASSEMBLY PART NO. 10003-101

INDEX (FIG. 7-6)	ITEM	QUANTITY	PART NO.	REF. DESIG.	VENDOR CODE
81	Screw, fillister hd	4	AN515C4R4	—	—
82	Screw, truss hd, 10-32 x 5/8	4	—	—	3 *
83	Nut, plain, 4-40	16	—	—	3 *
84	Nut, plain, 6-32	10	—	—	3 *
85	Screw	4	AN505C4R5	—	—
86	Terminal board	1	58-150-21	—	—
87	Screw	24	AN515C4R5	—	—
88	Screw	26	AN515C4R6	—	—
89	Screw	4	AN515C4R10	—	—
90	(not used)				
91	Screw	30	AN515C6R6	—	—
92	Screw	4	AN515C4R8	—	—
93	Screw	3	AN515C6R12	—	—
94	(not used)				
95	Lockwasher	52	AN936A4	—	—
96	Lockwasher	41	AN936A6	—	—
97	Lockwasher	14	AN936A10	—	—
98	Lockwasher	4	AN936A416	—	—
99	Washer	6	AN960C4	—	—
100	Washer	18	AN960C6	—	—
101	(not used)				
102	Tear bar	1	10003-203	—	—
103	(not used)				
104	Push-rod subassembly	1	20-097-21	—	—
105	Shield	1	20-170	—	—
106	Stud	4	20-132	—	—
107	Harness	1	20-173	—	—
108	Harness	1	20-174	—	—
109	Lug	8	Z-10	—	36
110	Set screw 8-32 x 1/4	2		—	3
111	Button	1	1712	—	17
112	Clamp	1	20-145	—	—
113	Name plate	1	10-116	—	—
114	Rivet	4	MS16535-32	—	—
115	(not used)				
116	Cable subassembly	1	58-101	—	—
117	Washer	4	5602-85-62	—	—
118	Washer, spring	4	67-064	—	—
119	Washer	4	67-188	—	—

*Commercial item

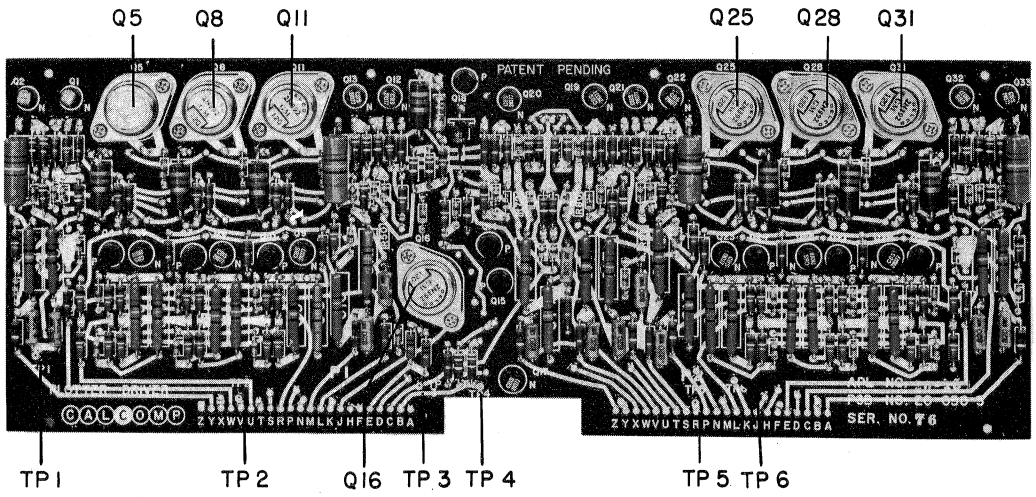


Figure 6-1. Plotter Driver Circuit Board

TABLE 6-2
PARTS LIST FOR PLOTTER DRIVER CIRCUIT BOARD PART NO. 20-151

Note

Detail parts may be located by means of reference designations printed on the reverse side of the circuit board.

INDEX	ITEM	QUANTITY	PART NO.	REF. DESIG.	VENDOR CODE
1	Circuit board, etched, black epoxy glass laminate, .093 x 16-1/16 in., with 2 oz. copper both sides	1	20-050-3	—	29
2	Terminal, test point	6	12016-B	TP1 thru TP6	33
3	Connector, electrical	2	20-092	P1, P2	4
4	Screw, RH, 6-32 x 3/8	14	COML	—	—
5	Nut, plain, 6-32	14	COML	—	—
6	Washer, flat, No. 6	14	COML	—	—
7	Bus wire, No. 24 AWG ,2 ft.	As req'd	COML	—	—
8	Sleeving, No. 24 AWG, 6 ft.	As req'd	COML	—	—
9	Transistor	17	2N377	Q1, Q2 Q3, Q6, Q9, Q12, Q13, Q17, Q19, Q20, Q21, Q22, Q23, Q26, Q29, Q32, Q33,	9*
10	Transistor	9	2N525	Q4, Q7, Q10, Q14, Q15, Q18, Q24, Q27, Q30,	18*
11	Transistor	7	2N392	Q5, Q8, Q11, Q16, Q25, Q28, Q31,	13
12	Diode	50	CTP803 or equiv.	CR1 thru CR20, CR22 thru CR51	10*
13	Diode	1	1N536 or equiv.	CR21	18*
14	Resistor, 10 ohm ±5%, 1/2 W	2	EB1005	R58, R60	2*
15	Resistor, 22K ±5%, 1/2 W	4	EB2235	R5, R44 R92, R131	2*
16	Resistor, 15K ±5%, 1/2 W	4	EB1535	R4, R43 R91, R130	2*
17	Resistor, 1K ±5%, 1/2 W	7	EB1025	R1, R40 R61, R64, R86, R88, R127	2*

* Commercial item

TABLE 6-2 (CONT'D)
PARTS LIST FOR PLOTTER DRIVER CIRCUIT BOARD PART NO. 20-151

INDEX	ITEM	QUANTITY	PART NO.	REF. DESIG.	VENDOR CODE
18	Resistor, 2.2K ±5%, 1/2 W	8	EB2225	R12, R51, R66, R73, R76, R84, R99, R138	2*
19	Resistor, 3.3K ±5%, 1/2 W	18	EB3325	R8, R9, R10, R47, R48, R49, R55, R56, R57, R59, R71, R79, R95, R96, R97, R134, R135, R136	2*
20	Resistor, 1.5K ±5%, 1/2 W	19	EB1525	R7, R18 R25, R30, R32, R35, R36, R46, R62, R74, R77, R94, R105, R112, R117, R119, R122, R123, R133	2*
21	Resistor, 10K ±5%, 1/2 W	42	EB1035	R6, R14, thru R17, R19, R21, thru R24, R26, R28, R29, R31, R33, R34, R37, R38, R45, R53, R54, R68, R83, R93, R101 thru R104, R106, R108 thru R111, R113, R115, R116, R118, R120, R121, R124, R125, R132	2*
22	Resistor, 6.8K ±5%, 1/2 W	10	EB6825	R3, R42, R69, R70, R75, R78, R81, R82, R90, R129	2*
23	Resistor, 560 ohm ±5%, 2 W	7	HB5615	R20, R27, R39, R63, R107, R114, R126	2*

* Commercial item

TABLE 6-2 (CONT'D)
PARTS LIST FOR PLOTTER DRIVER CIRCUIT BOARD PART NO. 20-151

INDEX	ITEM	QUANTITY	PART NO.	REF. DESIG.	VENDOR CODE
24	Capacitor, 6.8 mfd ±20% 35 V	1	150D685 x 0035B1	C13	30*
25	Capacitor, 0.1 mfd ±20%, 200 V	4	65P10402	C2, C11, C19, C28	30*
26	Capacitor, 0.01 mfd ±20%, 200 V	24	65P10302	C1, C3 thru 10, C12, C14 thru C18, C20 thru C27, C29	30*
27	Capacitor, 820 uuf, 500 V	12	GP820	C30 thru C41	16

* Commercial item

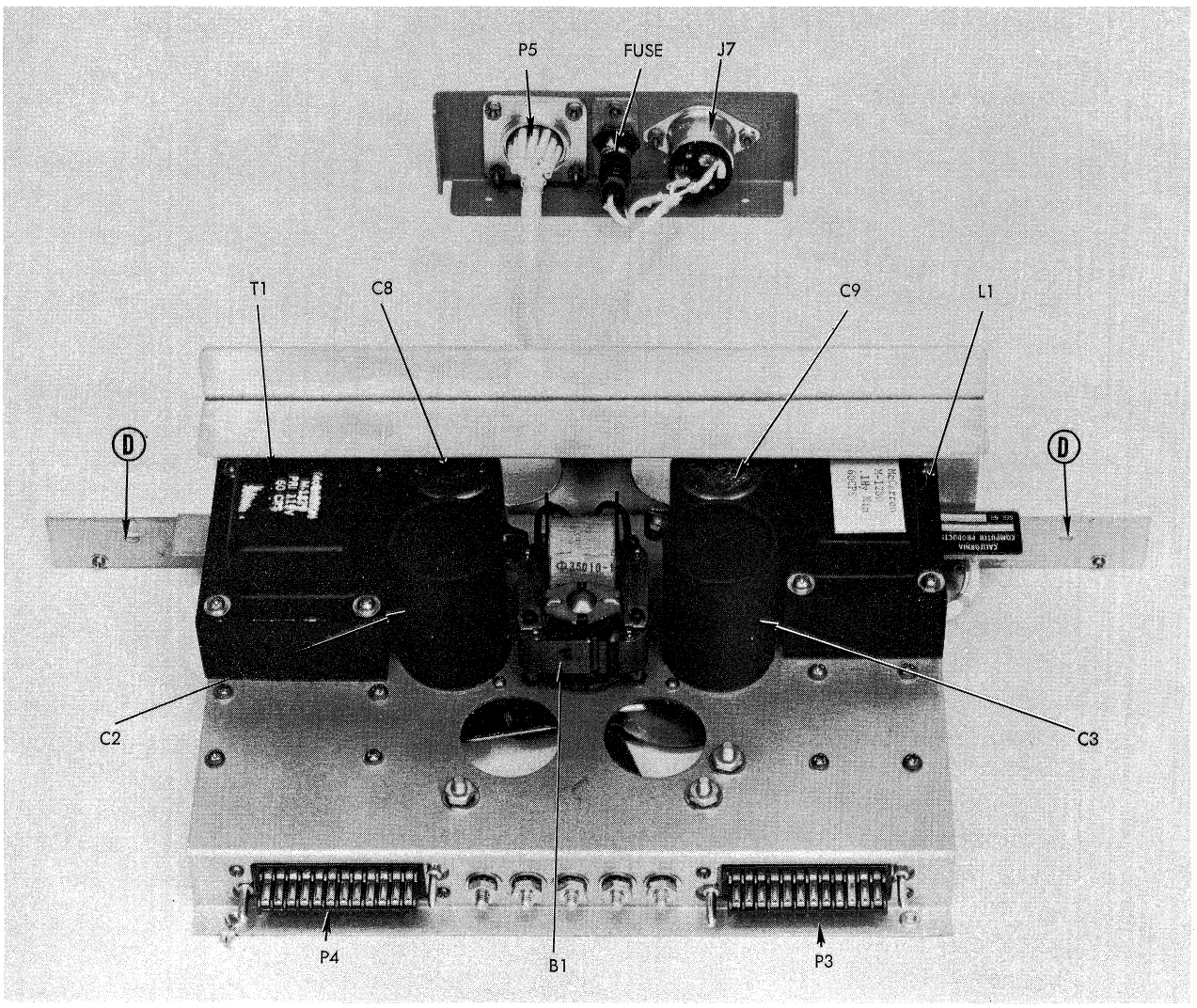


Figure 6-2. Power Supply, Top View

TABLE 6-3
PARTS LIST FOR POWER SUPPLY ASSEMBLY PART NO. 20-131

INDEX	ITEM	QUANTITY	PART NO.	REF. DESIG.	VENDOR CODE
1	Chassis		20-035	—	—
2	Stand off	2	20-038	—	—
3	Terminal board assembly (see Table 6-4)	1	20-142	TB1	—
4	Terminal board assembly (see Table 6-5)	1	20-141	TB2	—
5	Diode	8	1N2547 or BY322	CR1 thru CR4, CR7, CR8, CR9, CR19	6*
6	Transformer	1	M-1279	T1	25*
7	Choke	1	M-1280	L1	25*
8	Fuse, 3AG 2 amp slo-blo	1	313002	F1	23*
9	Fuse holder	1	342004	—	23*
10	Motor	1	35010-1	B1	20

* Commercial item

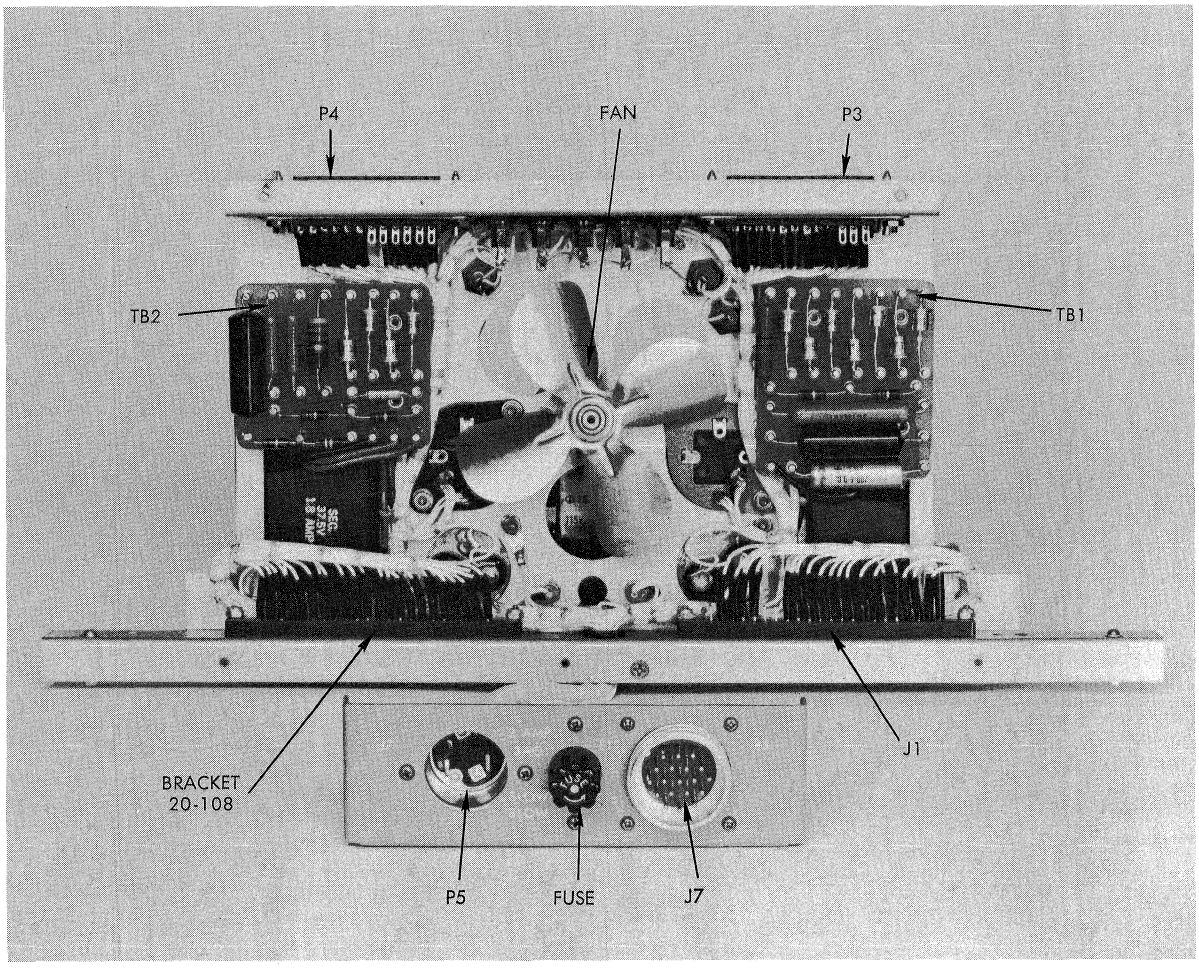


Figure 6-3. Power Supply, Bottom View

TABLE 6-3 (CONT'D)
PARTS LIST FOR POWER SUPPLY ASSEMBLY PART NO. 20-131

INDEX	ITEM	QUANTITY	PART NO.	REF. DESIG.	VENDOR CODE
11	Fan	1	YAR-3301	—	5
12	Connecter, electrical	2	26-159-24	P3, P4	4*
13	Connecter, electrical	2	143-022-01	J1, J2	4*
14	Connector, electrical	1	SK-19-32SL	P5	—
15	Terminal, insulated	2	1417	—	33
16	Capacitor, 1.0 mfd, 330 vac	2	RP3301	C8, C9	11
17	Capacitor, 500 mfd, 50 vdc	2	WP065	C2, C3	11
18	Clamp	2	VR-3	—	24*
19	Sleeve	2	CE-5	—	11*
20	Grommet	1	1041	—	17*
21	Grommet	1	1043	—	17*
22	Connector, electrical	1	GE343-5	—	19*
23	(not used)		GE4343-5	—	—
24	Screw	14	AN515C4-R5	—	—
25	(not used)			—	—
26	Screw	4	AN515C4-R8	—	—
27	Screw	2	AN515C6-R3	—	—
28	Screw	8	AN515C6-R4	—	—
29	Washer	8	AN960C4L	—	—
30	Washer	9	AN960C6L	—	—
31	Lockwasher	15	AN936A4	—	—
32	Lockwasher	25	AN936A6	—	—
33	Nut	14	AN340-C4	—	—
34	Nut	4	AN365-440	—	—
35	(not used)			—	—
36	Screw	10	AN515C6R6	—	—
37	Nut	3	6-32	—	—
38	Screw, 82° flat head	1	AN505C6R6		28
39	Clamp	1	774		
40	Sleeve - White	1	PVC105-2		38
41	Sleeve - white	1	PVC105-10		38
42	Lug	2	1021-C		17
43	Lug	1	7458		17
44	Nameplate	1	10-216	—	—
45	Shield	1	58-160	—	—
46	Screw	4	AN515C6R4	—	—
47	Bracket	1	58-019	—	—
48	Sleeve	1	20-131-3		38

* Commercial item

TABLE 6-4
PARTS LIST FOR TERMINAL BOARD ASSEMBLY PART NO. 20-142

INDEX	ITEM	QUANTITY	PART NO.	REF. DESIG.	VENDOR CODE
1	Terminal board	1	20-072	TB1	—
2	Capacitor, .1 mfd, 400 vdc	1	4TMP1	C5	30*
3	Capacitor, 200 mfd, 6 vdc	1	30D137	C4	30*
4	Diode, type 1N536	6	1N536	CR6, CR11 CR12, CR13, CR15, CR17	24*
5	Diode, Zener	1	1M6.8Z10	CR10	6*
6	Resistor, 270 ohm 10%, 1/2 w	1	EB2710	R8	2*
7	Resistor, 1 meg 10%, 1/2 w	1	EB1050	R2	2*
8	Capacitor, 0.033 mfd 20%, 200 vdc	1	65P33302	C6	30*
9	Resistor, 125 ohm, 10 w	1	COML 10XM125	R3	27
10	Buss wire	1	24AWG x 18"		
11	Sleeving	1	22AWG x 18"		

* Commercial item

TABLE 6-5
PARTS LIST FOR TERMINAL BOARD ASSEMBLY PART NO. 20-141

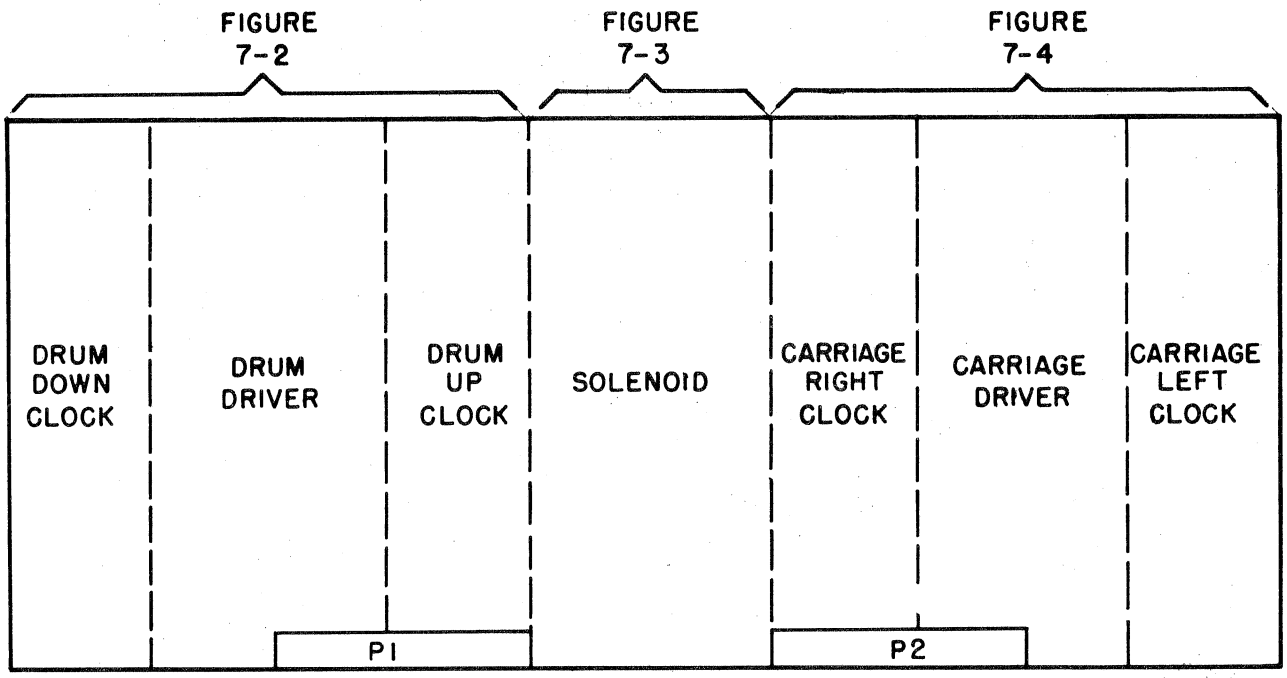
INDEX	ITEM	QUANTITY	PART NO.	REF. DESIG.	VENDOR CODE
1	Diode, type 1N536	4	1N536	CR5, CR14, CR16, CR18	6*
2	Resistor, 360 ohm 5%, 2 w	1	EB3615	R1	2*
3	Resistor, 450 ohm, 5 w	2	5X450	R6, R7	—
4	Resistor, 1K 10%, 1/2 w	1	EB1020	R5	2*
5	Resistor, 100K 10%, 1/2 w	1	EB1040	R10	2*
6	Resistor, 270 ohm 10%, 1/2 w	2	EB2710	R4, R9	2*
7	Capacitor, 6.8 mfd, 35 vdc	1	150D 685 x0035 B2	C1	30*
8	Terminal board	1	20-141	TB2	—
9	Capacitor, 0.1 mfd, 400 vdc	1	4TMP1	C7	30
10	Buss wire	1	24AWGx12"	—	—
11	Sleeving	1	22AWGx12"	—	—

* Commercial item

Section 7
Diagrams

This section of the manual contains a complete set of schematic diagrams for the Model 566 Digital Incremental Plotter. Figure 7-1 illustrates the physical layout of the circuit board assembly, and identifies the portions of the circuit board included in the schematic diagram of Figures 7-2, 7-3 and 7-4. Figure 7-1 also lists the general notes applicable to the above diagrams. Figure 7-5 is a schematic diagram of the main chassis assembly, including the control panel, interconnecting wiring and the power supply assembly.

Figures 7-6 and 7-7 show the locations of detail parts on the main assembly and the power supply assembly. Index numbers on these illustrations are the same as those listed in Tables 6-1 and 6-3. Figure 7-8 shows the locations of electronic parts on the main assembly and the power supply terminal boards.



PLOTTER CIRCUIT BOARD LAYOUT
(COMPONENT SIDE)

NOTES (FIGURES 7-2, 7-3 AND 7-4)

1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTOR VALUES ARE IN OHMS ±5%, 1/2 WATT

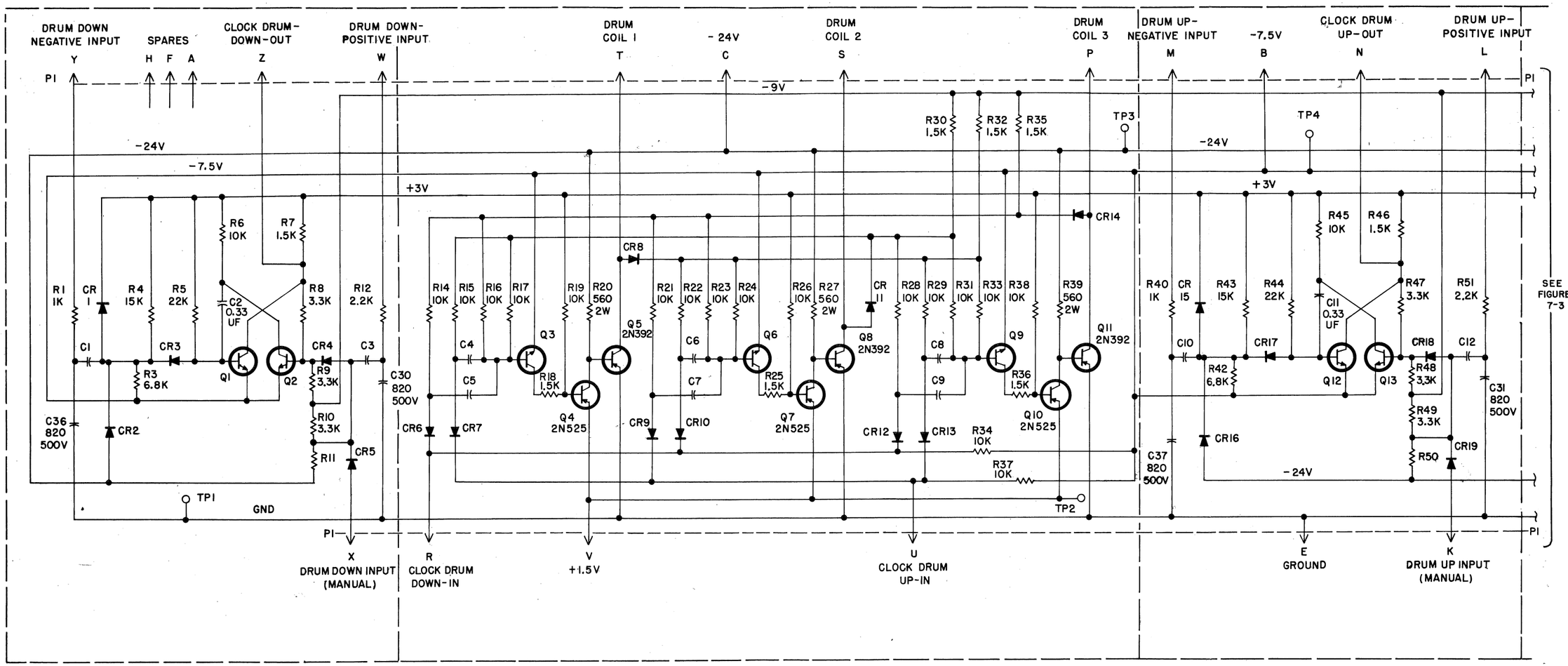
   ALL DIODES ARE LD-171, CTP 803 OR IN99
   ALL CAPACITORS ARE .01UF ± 20% 200V

2. REFERENCE DESIGNATIONS R2, R13, R41, R52, R65, R67, R85, R87, R89, R100, R128 AND R139 ARE NOT USED

3. R11, R50, R72, R80, R98 AND R137 ARE NOT REQUIRED.

4. C30, C31, C32, C33, C34, C35, C36, C37, C38, C39, C40 AND C41 ARE LOCATED OUT OF SEQUENCE.

Figure 7-1. Circuit Board Layout



SEE FIGURE 7-1 FOR NOTES

Figure 7-2. Drum Step Motor Control Circuits, Schematic Diagram

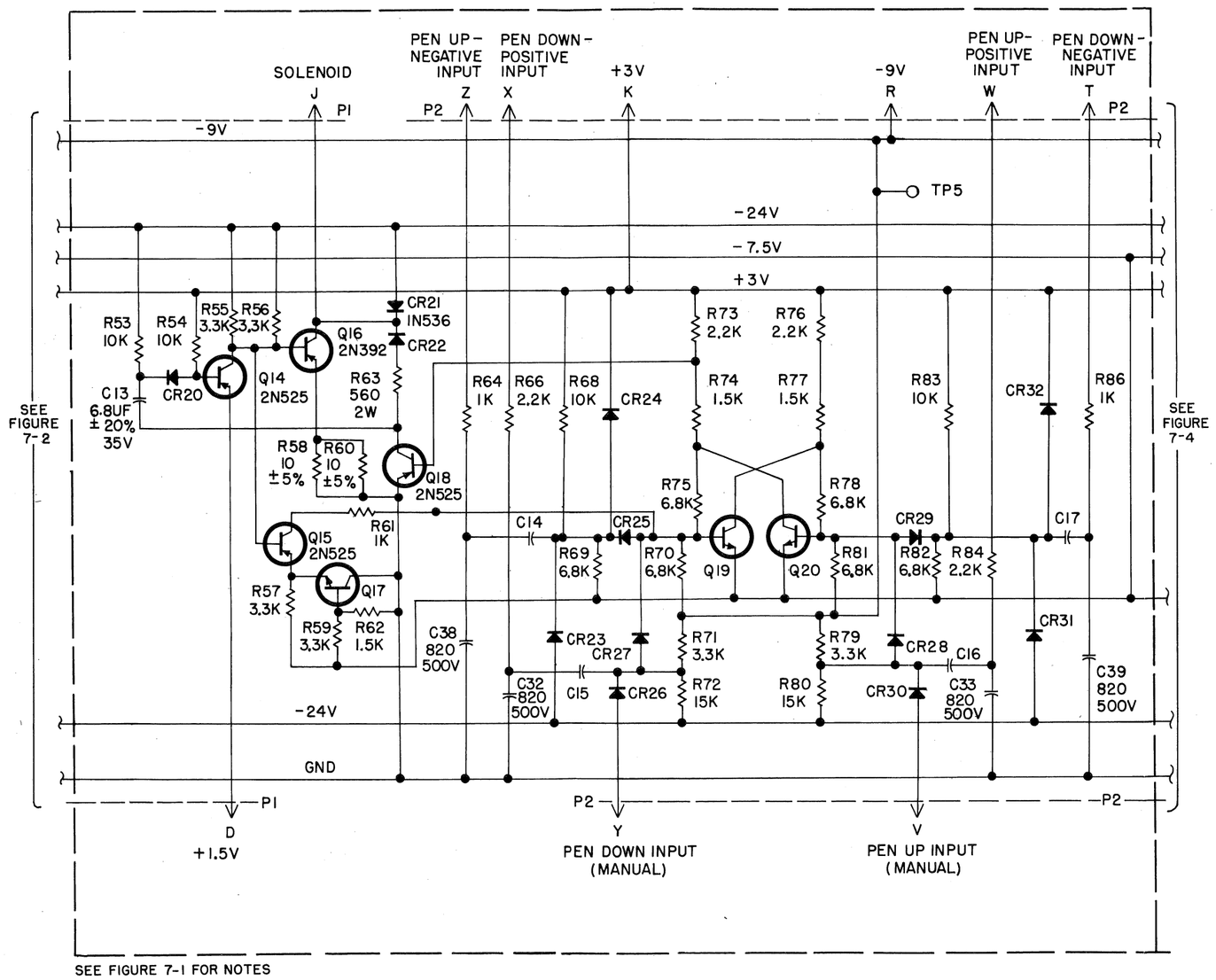


Figure 7-3. Pen Solenoid Control Circuits, Schematic Diagram

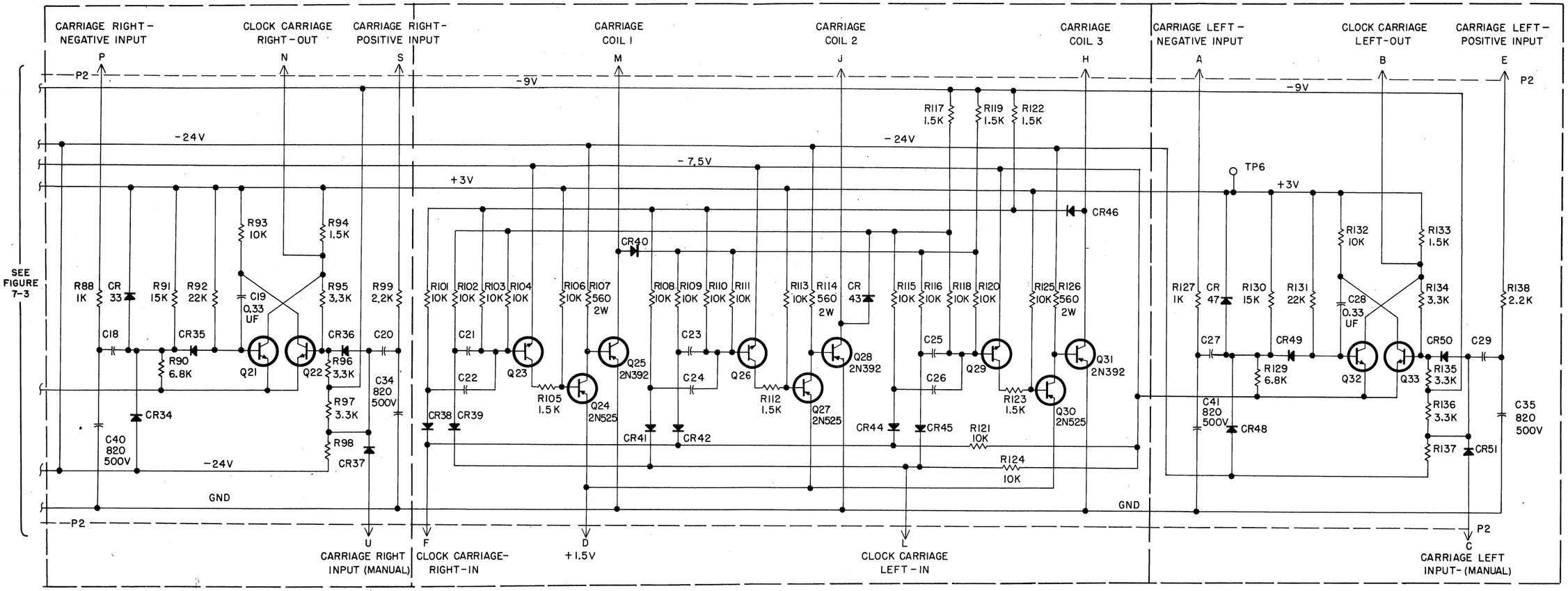
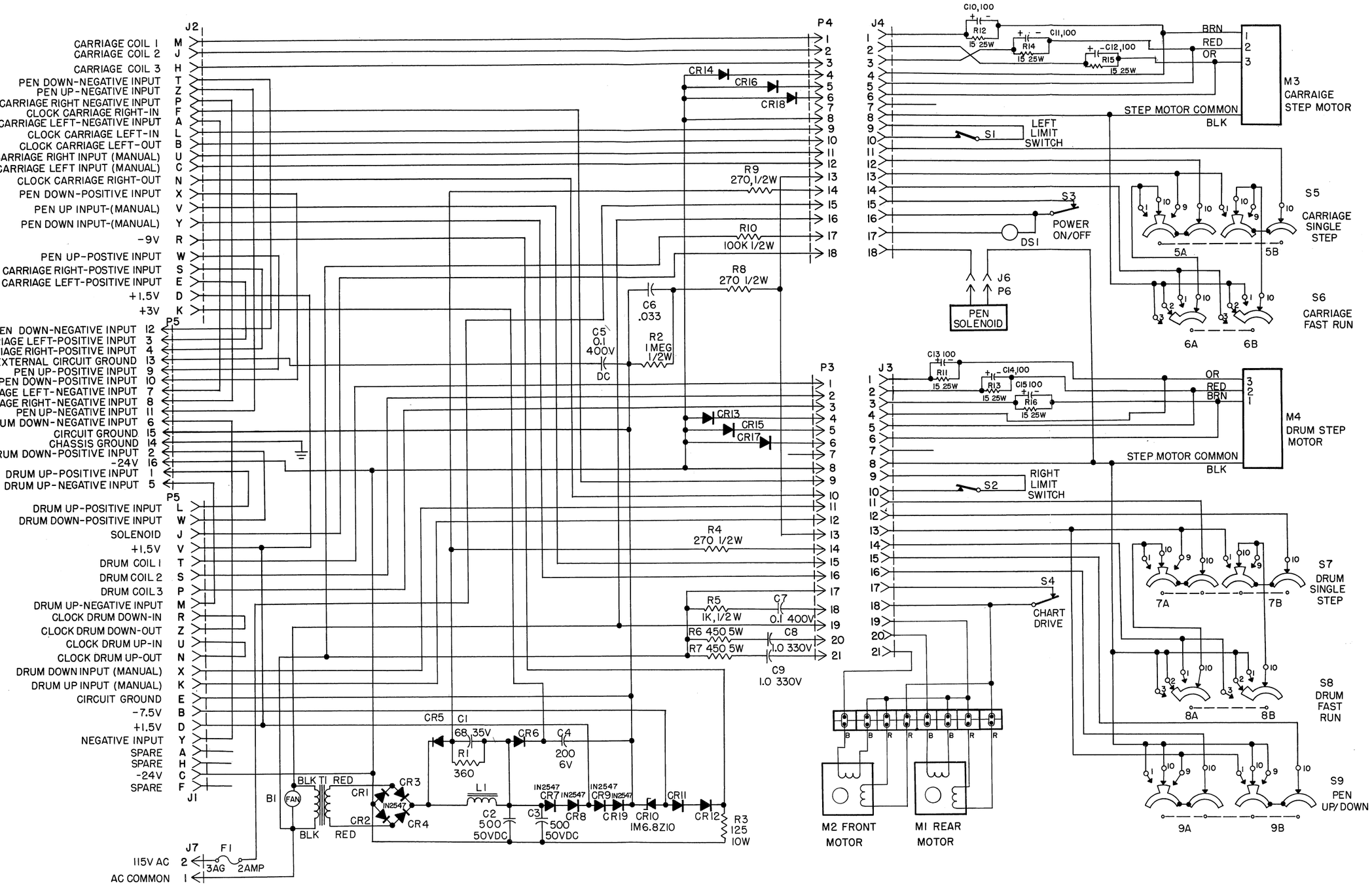


Figure 7-4. Carriage Step Motor Control Circuits, Schematic Diagram



NOTES:
1. DIODE CR19 IS OUT OF SEQUENCE
2. UNLESS OTHERWISE SPECIFIED, ALL RESISTOR VALUES ARE IN OHMS CAPACITOR VALUES ARE IN MICROFARADS ALL DIODES ARE IN536

Figure 7-5. Main Assembly, Schematic Diagram

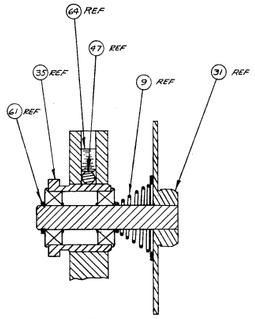
	119	4	67-188	WASHER				
	118	4	67-064	WASHER- SPRING				
23	117	4	5602-85-62	WASHER	FIBER		COML	
	116	1	58-101	CABLE - SUB-ASSY				
	114	4	MS16535-32	RIVET				
	113	1	10-116	NAMEPLATE				
	112	1	20-145	CLAMP				
20	111	1	1712	BUTTON			COML	
13	110	2	8-32X1/4	SET SCREW	STAINLESS	HEX SOCKET CUP POINT		
22	109	8	Z-10	LUG			COML	
	108	1	20-174	HARNESS				
	107	1	20-173	HARNESS				
	106	4	20-132	STUD				
	105	1	20-170	SHIELD				
	104	1	20-097-21	PUSH ROD SUB-ASSY				
	102	1	10003-203	TEAR BAR				
	100	18	AN960C6	WASHER				
	99	6	AN960C4	WASHER				
	98	4	AN936A416	L' WASHER				
	97	14	AN936A10	L' WASHER				
	96	41	AN936A6	L' WASHER				
	95	52	AN936A4	L' WASHER				
	93	3	AN515C6R12	SCREW				
	92	4	AN515C4R8	SCREW				
	91	30	AN515C6R6	SCREW				
	89	4	AN515C4R10	SCREW				
	88	26	AN515C4R6	SCREW				
	87	12	AN515C4R5	SCREW				
	86	1	58-150-21	TERM BOARD				
	85	4	AN505C4R5	SCREW				
3	84	10	6-32	NUT PLAIN	CRES	SMALL PATTERN	COML	
3	83	16	4-40	NUT- PLAIN	CRES		COML	
12	82	4	10-32 X5/8	SCREW-TRUSS HD	CRES	PHILLIPS RECESS	COML	
	81	4	AN515C4R4	SCREW				
	80	6	AN3C3A	SCREW-HEX HD				
13	79	8	6-32 X 7/16	SCREW-BINDER HD	SLOTTED-CRES		COML	
13	78	8	10-32X1/2	SCREW-CAP	HEX SOCKET-CRES		COML	
	77	4	AN4C4A	SCREW-HEX HEAD				
5	76	1	22M-40	NUT			COML	
8	75	4	22M-02	NUT			COML	
20	74	4	5708	LUG			COML	
15	72	2	774	CABLE CLIP	NYLON	5/16 DIA I.D.	COML	

ITEM NO	REQD	PART OR IDENTIFING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SIZE, DESCRIPTION & SPECIFICATION	ZONE

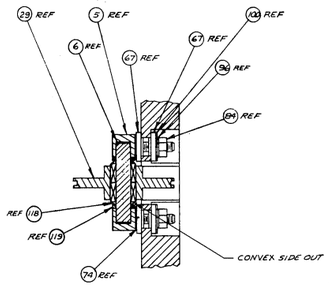
LIST OF MATERIAL OR PARTS LIST

10	71	1	167A	SPRING	CAD PLATE		COML
15	70	9	1145	L' WASHER			COML
17	69	1	A4050	BEARING			CLASS#3
16	68	2	765	STAND-OFF			COML
15	67	16	2150	WASHER	FIBER		COML
14	66	4	BH-2096W	BUMPER	RUBBER GREY		COML
19	65	2	1/4-20X1/2	SET SCREW	STEEL	HEX SOCKET, CUP POINT	
18	64	6	10-32X1/4	SET SCREW	STEEL	HEX SOCKET, CUP POINT	
13	63	2	8-32X3/16	SET SCREW	STEEL	HEX SOCKET, CUP POINT	
12	62	6	RH-25	RESISTOR	15 OHM		COML
11	61	2	5100-31-W	SNAP RING	STAINLESS	5/16 EXTERNAL	COML
11	60	1	5100-50-W	SNAP RING	STAINLESS	1/2 EXTERNAL	COML
11	59	2	5100-18	SNAP RING	BERY COPPER	3/16 EXTERNAL	COML
10	57	1	NE-2D	LAMP			COML
10	56	1	145-5036-937	LAMP ASSY			COML
8	55	5	12C1087	KEYED WASHER			COML
9	54	2	V3-47	SWITCH			COML
7	51	2	830(201-HX)	MOTOR			115V 75RPM
	50	1	58-150-11	TERM BOARD			
	49	4	20-038	STAND-OFF			
	48	1	20-151	BOARD-ASSY			
21	47	4		NYLON BALL	NYLON	5/32 DIA	GRADE 2
	46	1	20-143	TERM STRIP			
	45	1	20-133-2	HOLDER			
	44	1	20-133-1	HOLDER			
	43	1	20-131	POWER SUPPLY			
	42	1	10002-203	DRUM ASSY			
	41	1	20-128	PULLY-SUB-ASSY			
	40	1	58-004	WIRE LIST			
	38	4	20-110-3	KNOB			
	37	3	20-110-5	KNOB			
	36	5	20-109	WASHER-SPRING			
	35	4	20-106	HOLDER-BEARING			
	33	1	58-104	CARRIAGE SUB-ASSY			
	32	2	20-103	SPOOL -DRIVE			
	31	2	20-102	SPOOL - IDLER			
	30	2	10001-301	STEP MOTOR			
	29	3	20-099	IDLER PULLEY SUB-ASSY			
	28	1	10001-203	DRIVE PULLEY SUB-ASSY			
	27	1	20-097-11	PUSH ROD SUB-ASSY			
	26	1	20-096	DRUM SHAFT			
	25	1	20-093-5	SPRING			
	24	1	20-093-3	SPRING			
	23	1	20-077	SHAFT			
	22	2	20-074	SUPPORT			
	21	1	20-071	ANGLE-L.H			
	20	1	20-070	ANGLE-R.H			
	19	2	20-061	SHIELD			
	18	1	20-060	COVER			
	17	1	20-056	BASE			
	16	1	58-055	SUPPORT L.H			
	15	1	58-053	SUPPORT R.H			
	14	2	20-048	BRACKET			
	13	2	20-046	ACTUATOR			
	12	1	20-043	PAN-PAPER			
	11	1	20-041	CABINET			
	10	1	20-108	BRACKET			
	9	2	20-033	SPRING			
	8	1	58-032	PANEL-L.H.			
	7	1	58-031	PANEL-R.H.			
	6	4	20-029	SHAFT			
	5	8	20-026	SUPPORT			
	4	2	20-014	PULLEY			
	3	2	20-013	PULLEY			
	2	1	20-012	COVER			
	1	2	20-009	ROD-CARRIAGE			
ITEM NO	1		10003-101	PLOTTER-566			

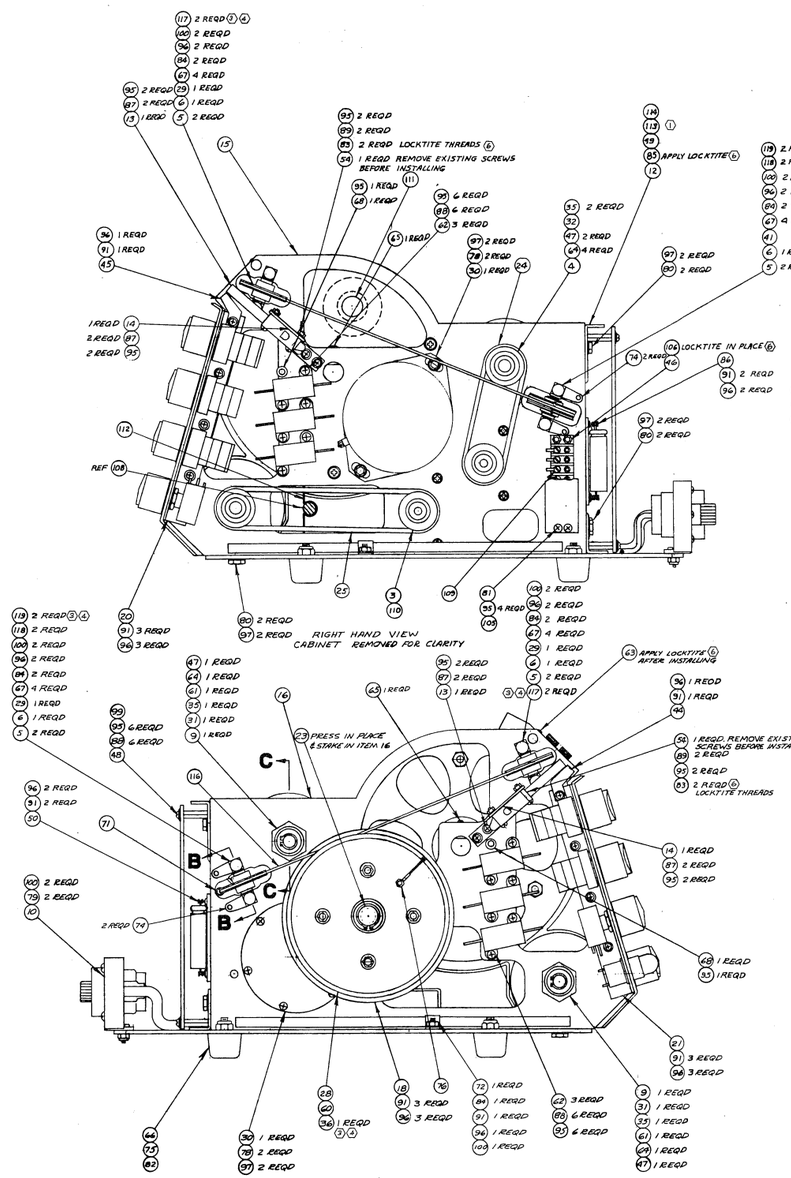
List of Materials for Model 566

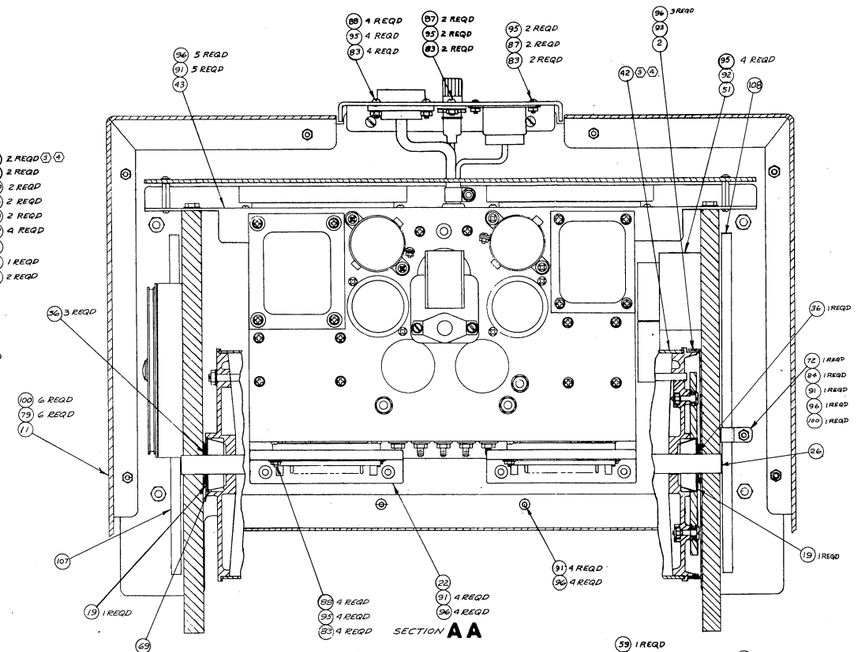


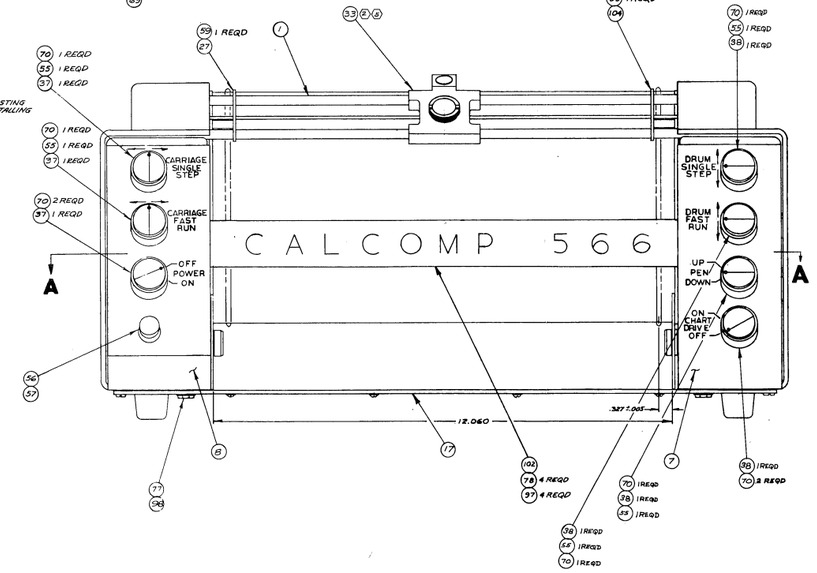
SECTION **C-C**
TWICE SIZE
SHOWING DETAIL OF
ASSY AT THIS LEVEL ONLY



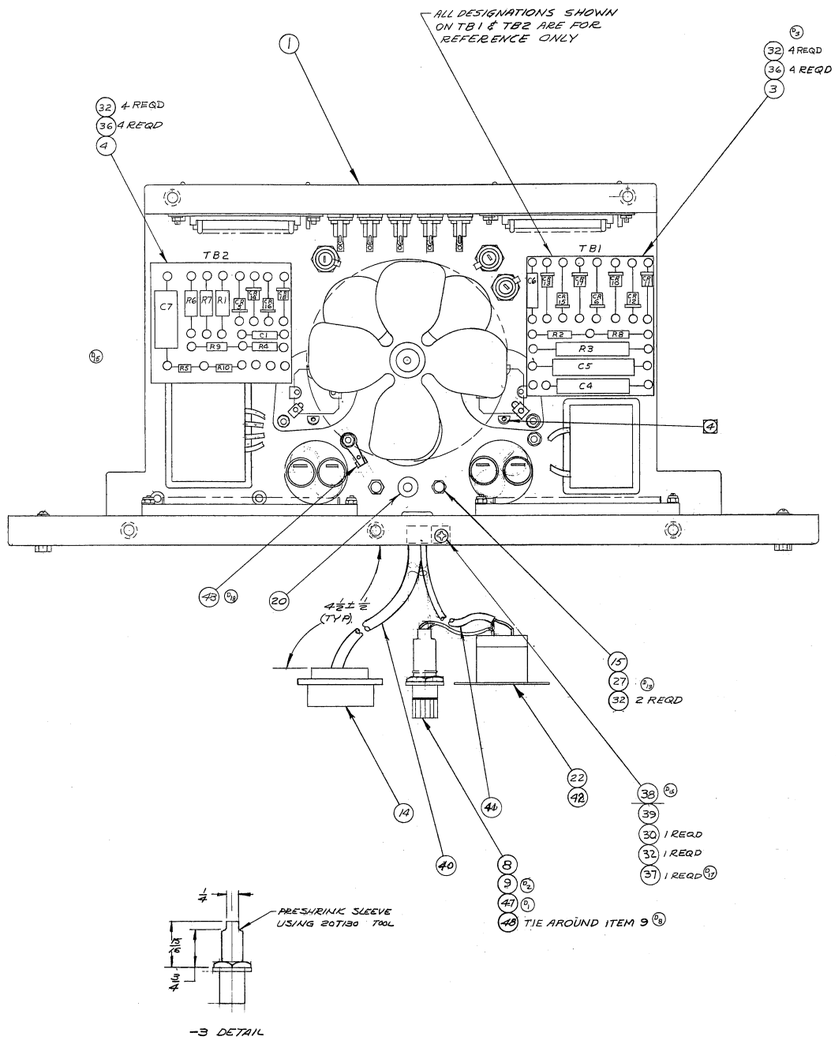
SECTION **B-B**
TWICE SIZE
SHOWING DETAIL OF
ASSY AT THIS LEVEL ONLY

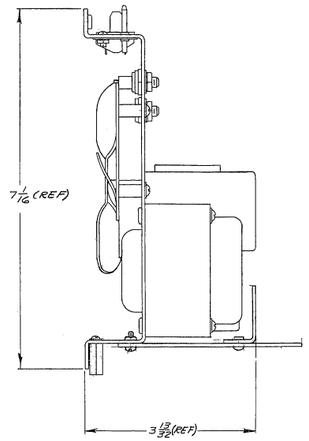


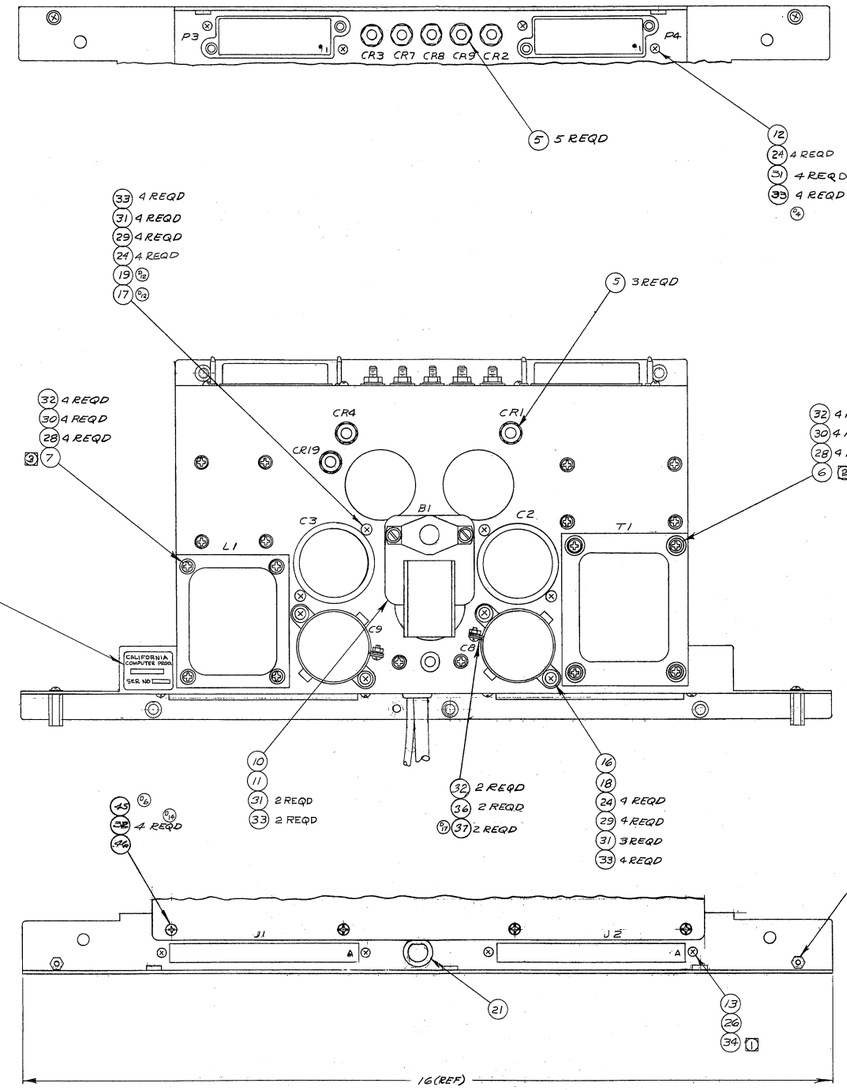




(117) 2E. SEASTROM MFG CO., GLENDALE, CAL.
(100) 24. INDUSTRIAL PRODUCTS INCORP., NORTH HOLLYWOOD, CAL
(6) 23. D. MALTBY CO. LOS ANGELES, CAL.
(29) 22. GENERAL CEMENT, ROCKFORD, ILL.
(19) 21. LAKE SPRING CO, LOS ANGELES, CAL.
(18) 20. ELASTIC STOP NUT CORP, UNION, N.J.
(17) 19. TIMKEN ROLLER BEARING CO., CANTON, OHIO.
(16) 18. WINCHESTER ELECTRONICS INC. NORWALK, CONN.
(12) 17. H.H. SMITH, BROOKLYN, N.Y.
(14) 16. ACCURATE RUBBER & PLASTIC CO., SANTA MONICA, CAL
(12) 15. ALL METAL, GARDEN CITY, N.Y.
(16) 14. DALE PRODUCTS, COLUMBUS, NEBR.
(1) 13. TRUARC RETAINING RINGS, DIV. OF WALDES KOHINOOR INC. LONG ISLAND CITY N.Y.
(8) 12. DIALIGHT CORP, BROOKLYN, N.Y.
(8) 11. MICRO SWITCH, DIV OF MINNEAPOLIS HONEYWELL, FREEPORT, ILL.
(8) 10. GRAYHILL INC., LA GRANGE, ILL.
(7) 9. BRISTOL MOTORS, LOS ANGELES, CAL.
(4) 8. AMERICAN SEALANTS CO., HARTFORD, CONN "LOCKTITE" GRADE E (2-1) OR EQUIV
(3) 7. CHESEBROUGH-PONDS INC. "VASELINE" OR EQUIV
(4) 6. LOCKREY CO., SOUTHAMPTON, N.Y. "LIQUI-MOLY" N V GREASE OR EQUIV
(3) 5. APPLY MOLI-DISULFIDE GREASE TO GEARS & CARRIAGE CABLE IDLER PULLEY WASHERS
(2) 4. APPLY WHITE PETROLEUM JELLY TO CARRIAGE THREADS
(1) 3. METAL IMPRESSION STAMP USING 1/8 HIGH CHARACTERS
MODEL: 566 PART NO: 10003-YOY SERIAL NO ———
VOLTS: 115 AMPS: 1.4 CYCLES: 60 PHASE: 1
2. COML. HARDWARE MAY BE SUBSTITUTED FOR AN HARDWARE
1. REF: W/L 58-004
NOTE: UNLESS OTHERWISE SPECIFIED







6. BEND THIS NEGATIVE LUG OUT, OTHER 3 IN AS SHOWN. BEND POSITIVE LUG OUT.
5. EDGE OF CHOKE TO BE FLUSH WITH EDGE OF CHASSIS
4. EDGE OF TRANSFORMER TO BE FLUSH WITH EDGE OF CHASSIS.
3. NUTS SHOULD BE LEFT APPROX. 1/2 TURN LOOSE SO THAT CONNECTOR FLOATS
2. COML HARDWARE MAY BE SUBSTITUTED FOR AN & MS HARDWARE
1. APPLY DESIGNATIONS APPROX WHERE SHOWN USING 1/8 HIGH BLACK CHARACTERS
NOTE: UNLESS OTHERWISE SPECIFIED

Figure 7-7. Power Supply Assembly, Location of Parts

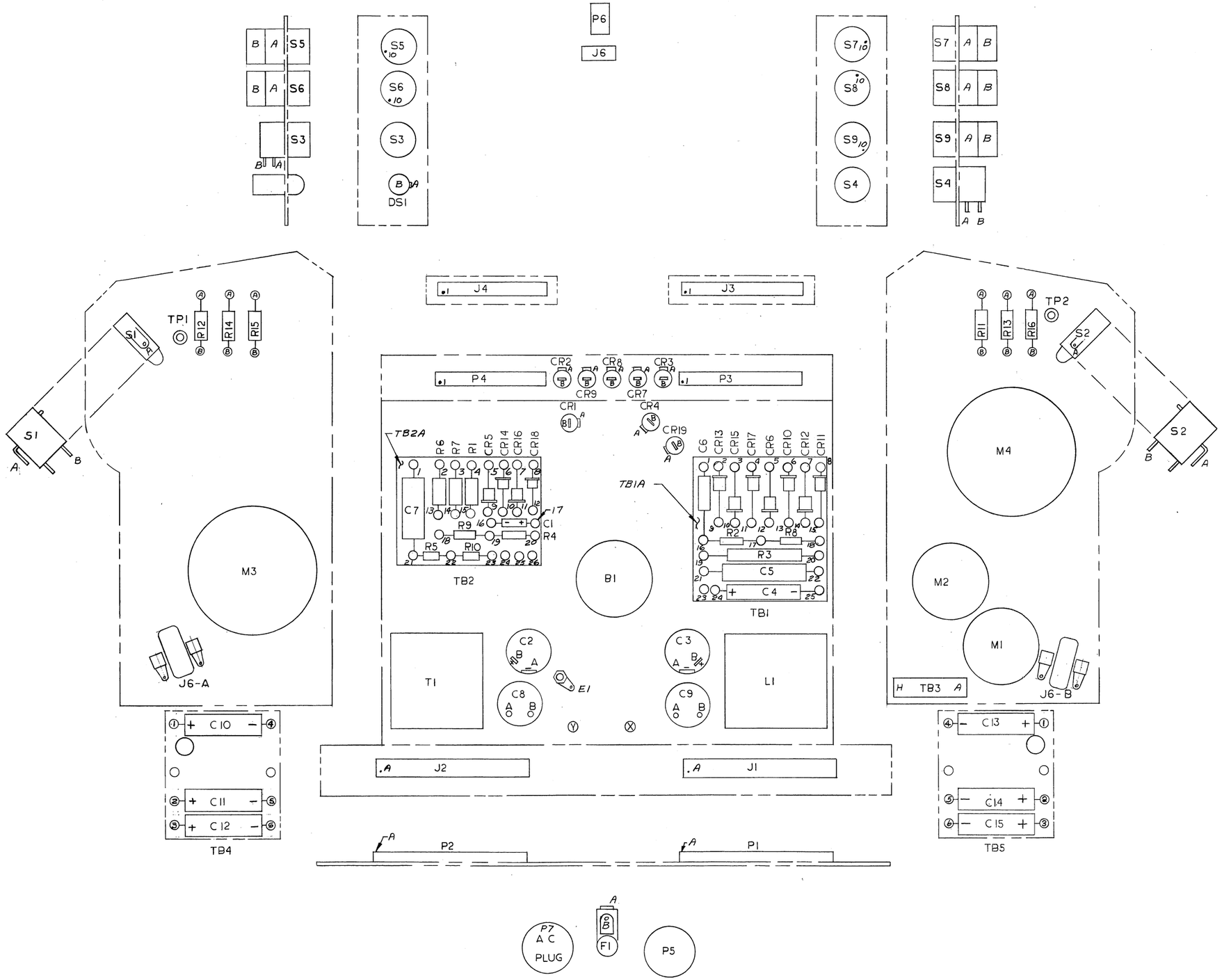


Figure 7-8. Main Assembly, Location of Electronic Parts

APPENDIX A

Interface Equipment

On-Line System Interfaces

Computer Manufacturer	Computer Model	Interface Supplied by Manufacturer	Interface Supplied by CalComp
Advanced Scientific	ASI 420	X	
	ASI 210	X	
Autonetics	Recomp II	X	
	Recomp III	X	
Bendix	G 15	X	
	G 20	X	
Burroughs	B-205		X
	B-5000		X
Computer Control	DDP-19	X	
Control Data	160A, 160	X	
	924	X	
Digital Equipment	PDP-1	X	
General Electric	225	X	
General Precision	LGP-30		X
	RPC-4000		X
IBM	1401		X
	1620		X
Honeywell	H-400	X	
	H-800	X	
Monroe	Monrobot XI		X
National Cash Register	315		X
Packard Bell	PB-250	X	
Philco	S2000	X	
RCA	301	X	
Ramo Wooldridge	TRW-130	X	
UNIVAC	SS80/90, I, II	X	
Scientific Data Systems	SDS 920	X	
	SDS 910	X	

UNIVERSAL PLOTTER ADAPTER

The CalComp Model 100-1A Universal Plotter Adapter is designed to couple any CalComp Digital Incremental Plotter to any IBM (or compatible) computer which uses the IBM 729 or IBM 7330 series Magnetic Tape Transports.

DIGITAL DATA TERMINAL EQUIPMENT

The CalComp Digital Data Terminal Equipment provides high-speed digital plotting of digital computer outputs at remote locations through the medium of telephone communication.

Transmitter	Model 610
Transceiver	Model 600
Receiver	Model 620

APPENDIX B

Accessories

ACCESSORIES SUPPLIED

The following accessory equipment is supplied by the manufacturer with each Model 566 Digital Incremental Plotter:

ITEM	QTY.	PART NO.
Paper roll core (installed on bottom paper spool)	1	20-152
Chart paper roll olive drab (installed on rear paper spool)	1	02 olive drab
Chart paper roll—clear (boxed)	1	00 clear
Chart paper roll—orange-red (boxed)	1	02 orange-red
Pen holder assembly	1	20-105
including: body	1	20-117
top	1	20-118
plunger	1	20-079
(1mm)		
Ballpoint pen (1 mm) - black	2	20-1200
Ballpoint pen (1 mm) - blue	2	20-1206
Ballpoint pen (1 mm) - red	2	20-1202
Ballpoint pen (1 mm) - green	2	20-1205
Reticle - small	1	20-169
Reticle - large	1	20-168
Accessory box	1	20-149
Cable connector	1	Cannon SK-19-21C-1/2
AC line cord - plastic (10 ft.)	1	Belden 1737-S
Instruction manual	1	
Scotch tape	1 roll	

OPTIONAL ACCESSORIES

The following optional accessories for the Model 566 may be obtained from the manufacturer:

ITEM	PART NO.
Plot display attachment	
Pen assembly including:	93-001
Solenoid assembly	93-008
Locking nut	93-022
Armature	93-011
Insert contact	93-018
Cushion washer	93-025
Adapter, carriage	93-007
Acetograph Pen Set/7 Interchangeable Point sections in 7 line widths	3075-S7
Rapido-Eze Pen Cleaner 2½ ozs.	3068
Drawing Ink — Black ¾ ozs.	3080F
Drawing Ink — Green ¾ ozs. Art No.	5951
Drawing Ink — Brown ¾ ozs. Art No.	5961
Drawing Ink — Red ¾ ozs. Art No.	5941
Drawing Ink — Blue ¾ ozs. Art No.	5921
Extra Extra Fine Pen Point	00
Extra Fine Pen Point	0
Fine Pen Point	1
Medium Pen Point	2
Medium Broad Pen Point	2½
Broad Pen Point	3
Extra Broad Pen Point	4

For further information, write to:

Marketing Department
California Computer Products, Inc.
305 Muller Avenue
Anaheim, California