OPERATING AND SERVICE MANUAL

MODEL 182T OSCILLOSCOPE (Including Option 003)

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed 1529A.

With changes described in Section VII, this manual also applies to instruments with serial numbers prefixed 1507A and 1515A.

For additional important information about serial numbers, see Instrument Identification in Section I.

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SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This manual provides operating and servicing information for the Hewlett-Packard Model 182T Oscilloscope. The manual is divided into eight sections, each covering a specific topic or aspect of the instrument. All schematics are located at the rear of the manual.

1-3. This section contains instrument specifications (table 1-1), a description of features, warranty information, data for manual and instrument identification, and information regarding accessories available for the instrument. Table 1-2 describes the abbreviations used in this manual except for Section VI. The parts list contains a computer printout using computer supplied abbreviations.

1-4. DESCRIPTION.

1-5. The Model 182T is a solid-state, lightweight laboratory and general-purpose oscilloscope mainframe with plug-in capabilities. It is designed to display complex high-frequency waveforms and to measure alternating- and direct-current voltages. Complete specifications are given in table 1-1.

1-6. The Model 182T is a cabinet-type instrument with a built-in tilt stand, carrying handle on top, and feet mounted on both bottom and rear for either bench or upright operation.

1-7. Power consumption, with plug-ins is less than 120 watts at normal line voltage. The instrument is convection cooled and designed to operate within specifications at temperatures between 0°C and 55°C with up to 95% relative humidity at 40°C.

1-8. The instrument contains all power supplies, a dual-output calibrator, a horizontal amplifier, a gate amplifier, and the CRT. Operation at either 115- or 230-Vac is selectable by a switch located on the rear panel of the oscilloscope. Also located on the rear panel are recorder output connectors for use with spectrum analyzer plug-ins. These outputs are dependent upon the spectrum analyzer used and the appropriate plug-in Operating and Service Manual should be refered to.

NOTE

These outputs should not be used when a standard 1800-series plug-in is used.

1-9. The Model 182T is designed to operate with real-time, sampling and TDR, and frequency domain plug-ins.

1-10. A calibrator provides a square-wave signal of approximately 1 kHz with a rise time of less than 3 μs. The calibrator output is available at the front panel at amplitudes of 250 mV and 10 V p-p with an accuracy of ±1%. The signal may be used to check horizontal and vertical deflection factors and to compensate divider probes.

1-11. The oscilloscope horizontal amplifier accepts sweep signals from the time-base plug-in or an external signal. Bandwidth is dc to 5 MHz, dc-coupled, and 5 Hz to 5 MHz with capacitive coupling. Two deflection factor ranges are front panel selectable: 1 V/div (X1), and 0.1 V/div ±5% (X10). In addition, a vernier control provides continuous adjustment between ranges. The maximum external input level is 300 Vdc, ac-coupled, with a dynamic range of ±20 V.

1-12. A beam finder pushbutton control assists the operator in bringing a displaced beam on screen. Its use increases intensity and reduces vertical and horizontal amplifier gain to quickly locate trace position.

1-13. CATHODE-RAY TUBE.

1-14. The Model 182T uses a post-accelerator aluminized CRT with an 8- by 10-major division display area of 133 cm^2. Each division is 1.29 cm with 0.2-division subdivisions provided on the major axes. The internal graticule eliminates display parallax. The standard CRT supplied with this instrument has a P-39 aluminized phosphor.

1-15. WARRANTY.

1-16. This instrument is certified and warranted as stated on the inside front cover of this manual. The CRT is covered by a separate warranty. The CRT warranty and warranty claim form are located at the rear of this manual. Should the CRT fail within the time specified on the warranty, fill out the failure report form on the reverse side of the warranty statement and return it with the CRT in accordance with the shipping instructions. In all correspondence with a Hewlett-Packard Sales/Service Office concerning an instrument, reference the complete serial number and Model of the instrument.

CAUTION

The warranty may be void for instruments having a missing or mutilated serial number tag.

Table 1-1. Specifications

CATHODE-RAY TUBE AND CONTROLS

TYPE: post-accelerator, 21-kV accelerating potential; aluminized P-39 phosphor.

Graticule: 8- x 10-div graticule; 0.2-div subdiv on major axes; 1 div = 1.29 cm. Front-panel recessed screwdriver adjustment aligns trace with graticule. Scale control illuminates graticule for viewing with hood or taking photographs.

BEAM FINDER: returns trace to CRT screen regardless of setting of horizontal, vertical, or intensity controls.

INTENSITY MODULATION (Z-AXIS INPUT): approx +2 V, >50 ns pulse width (< 10-MHz sine wave) will blank trace of normal intensity. Input R, approx 5k ohms. Maximum input voltage, ±20 V (dc + pk ac).

CALIBRATOR

TYPE: approx 1-kHz square wave, <3 μs rise time.

VOLTAGE: two outputs, 250-mV p-p and 10 V p-p into >1 megohm; accuracy, ±1%.

HORIZONTAL AMPLIFIER

EXTERNAL INPUT:

Bandwidth: dc-coupled, dc to 5 MHz; ac-coupled, 5 Hz to 5 MHz.

Deflection Factor: X1, 1 V/div; X10, 0.1 V/div. Vernier provides continuous adjustment between ranges. Accuracy, ±5%.

Dynamic Range: ±20 V.

Maximum Input: ±300 V (dc + pk ac).

Input RC: 1 megohm shunted by approx 30 pF.

INTERNAL SWEEP:

Sweep Magnifier: X10; accuracy ±5%.

OUTPUTS

four rear-panel BNC connectors provide recorder outputs for use with spectrum analyzer plug-ins.

GENERAL

WEIGHT: (without plug-ins) net, 26-1/2 lb (12.02 kg); shipping, 38-1/2 lb (17.46 kg).

DIMENSIONS: see outline drawing.

ENVIRONMENT:

Temperature: 0°C to 55°C.

Humidity: up to 95% relative humidity at 40°C.

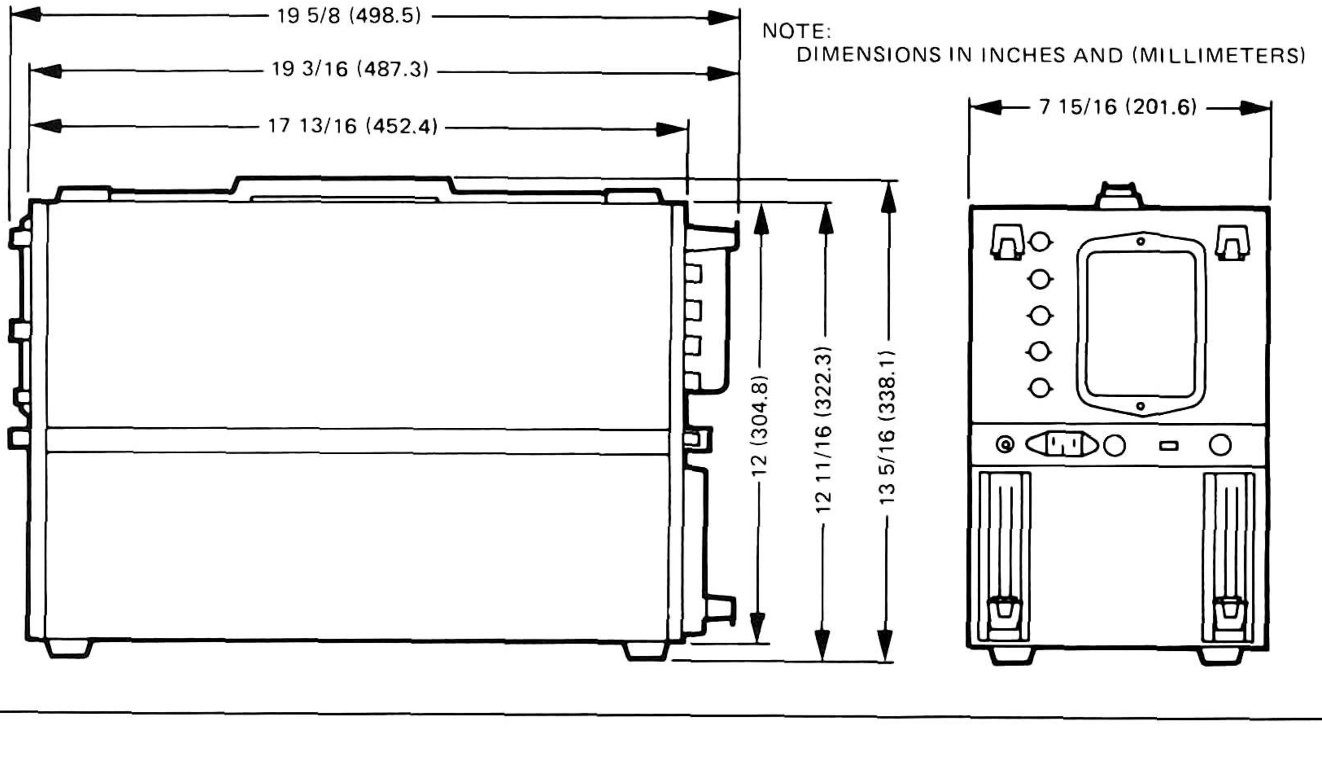
Altitude: up to 15 000 ft (4.6 km).

Vibration: vibrated in three planes for 15 minutes each with 0.010-inch excursion, 10 to 55 Hz.

POWER: 115 V or 230 V ±10%, 48 to 440 Hz. Approx 120 watts with plug-ins at normal line voltage, 200 VA max.

ACCESSORIES FURNISHED: blue plastic light filter, 115 volt power cord, altermate 230 volt fuse package.

OPTIONS: refer to Section VII for listing of options.



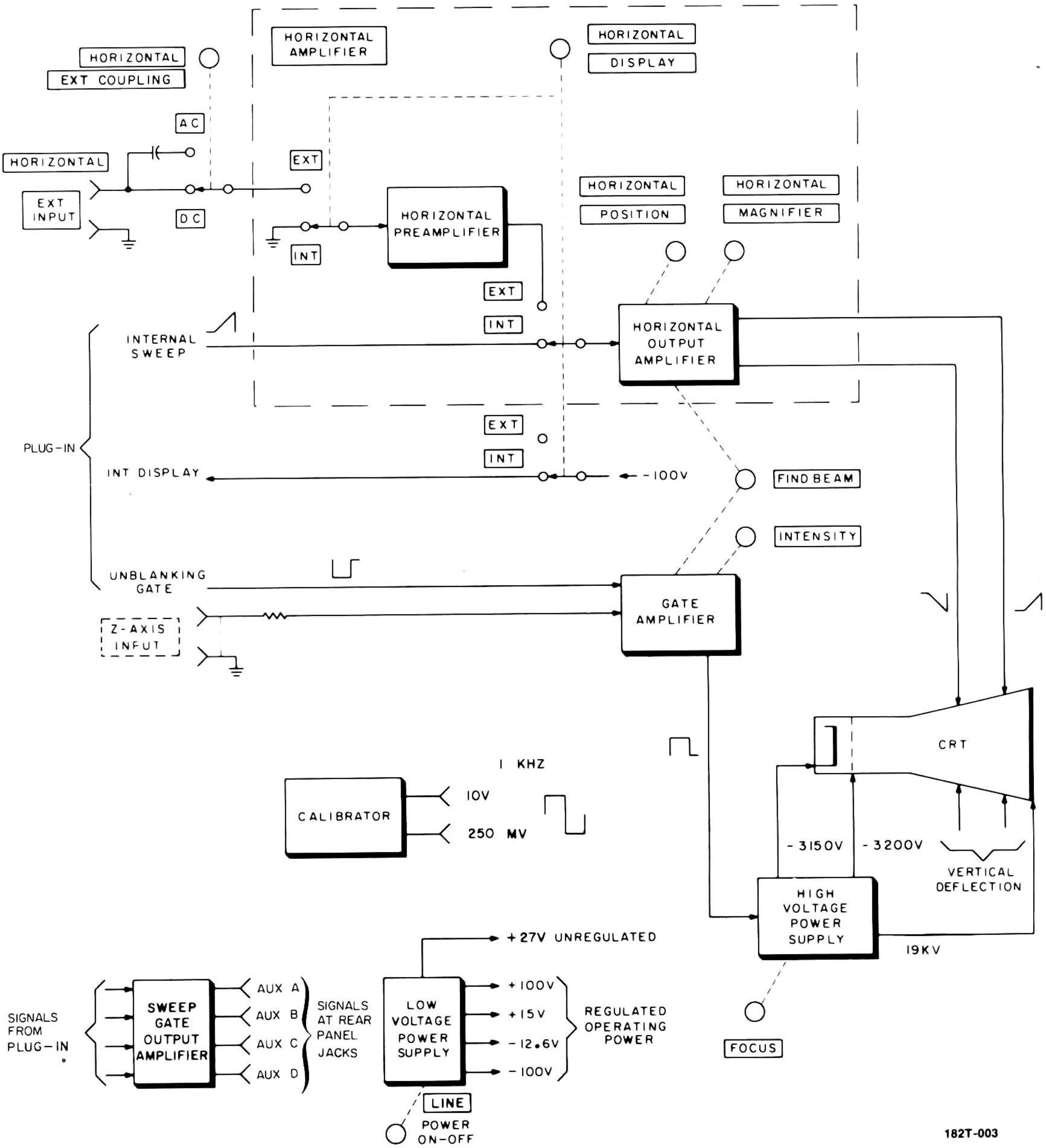


Figure 4-1. Overall Block Diagram

SECTION IV

PRINCIPLES OF OPERATION

4-1. INTRODUCTION.

4-2. This section provides circuit theory analysis of the Model 182T oscilloscope. Refer to the overall block diagram (figure 4-1) and the schematics in Section VIII.

4-3. GENERAL DESCRIPTION.

4-4. The Model 182T is an X-Y axis display instrument designed for use with real time, sample and TDR, and spectrum analyzer plug-ins. The instrument contains the CRT and its controls, low voltage and high voltage regulated power supplies, a horizontal amplifier, and a gate amplifier.

4-5. To obtain a useful display on the CRT, three signals are necessary: vertical deflection, horizontal deflection, and intensity. The signal required for vertical deflection (Y-axis) of the CRT is supplied by the plug-ins. This signal is connected directly to the CRT vertical deflection plates. The horizontal (X-axis) deflection signal is also generated by the plug-ins. It is further amplified by the oscilloscope horizontal amplifier before being applied to the CRT horizontal deflection plates.

4-6. An unblanking gate signal, synchronized to the start of the horizontal sweep, is developed in the plug-ins and amplified by the gate amplifier. The signal from the CRT control grid, unblanking the viewing area of the CRT.

4-7. Signals for horizontal deflection and intensity modulation can also be applied to the oscilloscope from an external source other than the plug-ins. External input jacks are provided for this purpose.

4-8. INPUT POWER. With power applied to the power transformer primary windings, several secondary voltages are produced. They are rectified, filtered and regulated, as required, and used as the dc source of power for the various circuits of the oscilloscope and for operation of the plug-ins.

4-9. HORIZONTAL DEFLECTION. The horizontal amplifier may be used with either internal or external signal sources. Positioning the HORIZONTAL DISPLAY switch to INT arranges the circuitry to operate from signals supplied from the plug-in. In this condition, —100 V is applied to the plug-in. allowing it to operate and produce both a sweep signal and an unblanking gate signal.

4-10. The sweep signal from the plug-in is coupled to the oscilloscope horizontal output amplifier where it is converted to a differential signal, amplified, and applied to the CRT horizontal deflection plates.

4-11. Horizontal position of the X-axis sweep signal is controlled at the input stage of the horizontal output amplifier. A two section potentiometer, mechanically interconnected, is used to provide both fine and coarse positioning controls from a single knob.

4-12. Horizontal amplifier gain is controlled by the MAGNIFIER switch. Two settings can be selected: X1 or X10. With X1 selected, the sweep speed corresponds to the selected plug-in sweep speed. In X10 operation the sweep speed is ten times that selected at the time base plug-in.

4-13. The unblanking gate signal from the plug-in is coupled to the gate amplifier where it is summed with the current from the INTENSITY control. The resulting signal is amplified and coupled through the high voltage supply to the CRT control grid to set the intensity of the displayed signals.

4-14. An externally applied signal for horizontal deflection may be connected to the EXT INPUT jack. The EXT VERNIER controls the externally applied signal and provides a variable gain adjustment for setting the X-axis display size. The EXT COUPLING switch provides for either direct (DC) or capacitive (AC) coupling of the external input signal. The external signal is coupled to a pre-amplifier, differentially amplified by the output amplifier, and applied to the CRT for horizontal deflection. Positioning and horizontal gain controls also function with external input signals.

4-15. CIRCUIT DETAILS.

4-16. INPUT AC POWER. Input line power is supplied by a detachable three conductor power cord. This cord has a standard plug for wall outlet connection providing an electrical ground. Both sides of the line power are filtered immediately at the power input connector.

4-17. The line power transformer has two primary windings. SELECTOR switch A4S1 connects these windings in parallel for 115 V operation and in series for 230 V operation. When set for use with a 115 V source of line power, fuse A4F1 protects against excessive input current. When operated on 230 V line power, fuse A4F2 is also placed in the primary power circuit. With the front panel LINE toggle switch, A2S1, in the

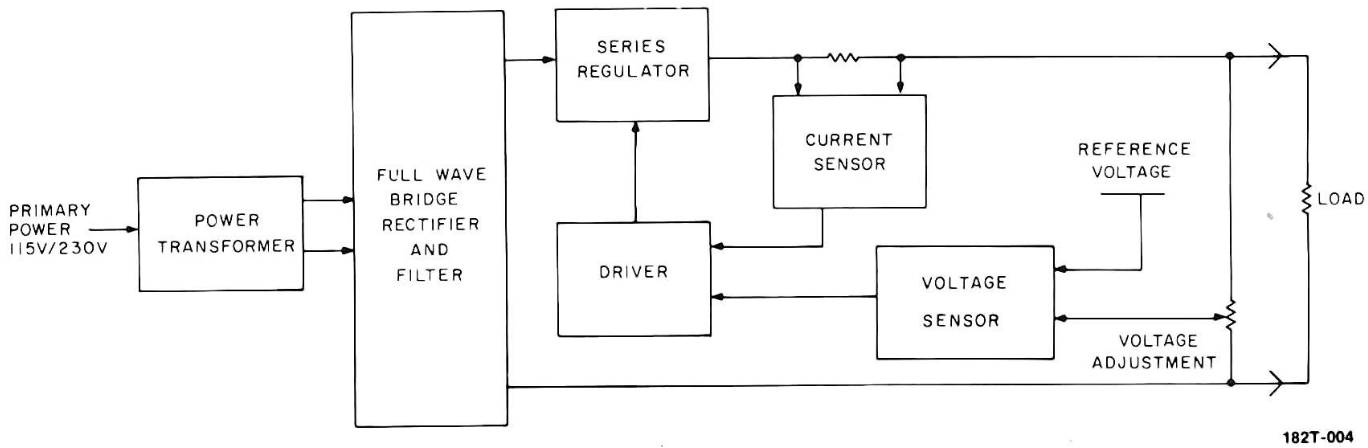


Figure 4-2. Simplified Low-voltage Power Supply

ON position, power is applied to the low-voltage power supply transformer and LINE lamp A2DS1 lights.

4-18. LOW-VOLTAGE POWER SUPPLY. The low-voltage power supply produces four regulated voltages for use throughout the oscilloscope and the plug-ins: +100 V, —100 V, +15 V and —12.6 V. Each supply is referenced to the +100 V supply for regulation purposes with the +100 V supply referenced to a 9-volt temperature-compensated zener diode A1A2VR2. The +100 V and —100 V supplies are also foldback current limited, providing short-circuit protection.

4-19. A simplified block diagram of a typical low-voltage power supply is shown in figure 4-2. Unregulated alternating power is supplied by the transformer, bridge rectified, and filtered. Changes in output voltage caused by input voltage variation or load changes are detected by the voltage sensor. Compared against a voltage reference, changes in output voltage are detected and applied as feedback to the driver, which controls the series regulator. The series regulator acts as a variable resistance and operates to increase its series resistance if the output voltage is high or decreases resistance when the output voltage is low. The action of the series regulator is to maintain output voltage at a constant level.

4-20. Current sensing takes place simultaneously with voltage sensing. If the load current increases above a certain level, the current sensor detects the increase as a voltage drop across the series resistor. This increased voltage drop causes the driver to bias the series regulator off.

4-21. The +100 V supply is used throughout the LVPS as a reference for the other supplies. It is both voltage and current regulated. Refer to the LVPS schematic while reading the following explanation.

4-22. One of the secondary outputs of A1T1 is coupled to a full-wave bridge rectifier consisting of A1A1 CR5-CR8. The rectified voltage is filtered by A1C1, and applied through fuse A1F1 to the regulator assembly. Fusing protects the rectifiers and transformer if a regulator malfunction results in excessive current flow. The regulator supplies sufficient current to the load to keep the output voltage at a constant +100 volts. Series regulator A1Q1 controls load current in order to maintain the output voltage at +100 V. Variations in output voltage due to changes in load or input line voltage are sensed by differential comparator A1A2Q3 and Q4. If the output of the +100 V supply changes, the full amount of the voltage change is applied to A1A2Q3 by A1A2VR2 while A1A2Q4 senses only a small part of the change in output voltage. The +100 V adjustment potentiometer A1A2R11 set the operating point of A1A2Q4. The output of the differential comparator is coupled to driver A1A2Q1, amplified, and used to control series regulator A1Q1.

4-23. A current limiting function is also part of the +100 V supply operation. All current furnished by the supply flows through A1A2R4. As the current requirements increase to the limit of the supply capability, the voltage drop across A1A2R4 causes A1A2Q2 to conduct. Since the collector of A1A2Q2 and the output of differential comparator A1A2Q3/Q4 are coupled to drive A1A2Q1, the amount of current flowing as well as voltage variations control the operation of series regulator A1Q1.

4-24. Resistors A1A2R2 and A1A2R3 are used in conjunction with A1A2R4 for current foldback operation. When current exceeds capability in a current foldback circuit, the output voltage will begin to drop and the load will receive less current. If the output of the supply is short-circuited, the output current wi be limited to considerably less than the current availa ble at full loading.

4-25. The +100 V supply is protected from turn-o and turn-off voltage transients by diodes A1A2CR and A1A2CR2. Diode A1A2CR3 provides reverse vol age protection for A1A2C3.

4-26. A separate supply is used as a current sourc for A1A2Q3/Q4. This supply is used only in the LVP regulator. The ac voltage from pins 11 and 12 of A1T is bridge rectified by A1A1CR1-CR4 and filtered b A1A1C1. The supply output is zener regulated b

A1A2VR1 to approximately 5 volts more positive than the +100 V output.

4-27. The +15-volt supply provides three voltages. Approximately 30 Vac p-p is furnished for plug-in synchronization; an unregulated +27 V is furnished for operation of the HV oscillator; and a regulated +15 V is produced for use in the mainframe and plug-ins.

4-28. The secondary voltage developed by the power transformer at pins 13 and 14 is rectified by full-wave bridge A1A2CR9-A1A2CR12 and filtered by A1C2. Diode A1A1CR21 provides reverse voltage protection. Series regulator A1Q2 controls the amount of load current in order to maintain the output voltage at +15 V. Variations in output voltage are sensed by differential comparator A1A2Q7 and A1A2Q8. A reference voltage derived from the +100 V regulated supply is applied to A1A2Q7, while A1A2Q8 samples any change in output voltage due to load changes. The +15 V adjustment potentiometer A1A2R20 sets the operating point of A1A2Q8. The output of the differential amplifier is coupled to driver A1A2Q5 and used to control the series regulator.

4-29. Load current flows through A1A2R13. The voltage drop across this resistor is used to control the conduction of A1A2Q6, which has its collector coupled to driver A1A1Q5. Both current variations sensed by A1A2Q6 and voltage changes sensed by the differential amplifier are coupled to driver A1A1Q5 to control series regulator A1Q2. Protection from turn-on or turn-off transients is provided by A1A2CR4. Fuse A1F2 protects the +15 V rectifier and transformer in the event of a regulator short circuit.

4-30. The —12.6-volt supply operates in a manner similar to the +15 V supply. Changes in output voltage are sensed by differential comparator A1A2Q11 and A1A2Q12 and coupled to driver A1A2Q9 which controls the conduction of series regulator A1Q3. Current limiting action is provided by A1A2R22 and A1A2Q10. Fuse A1F3 protects against damage due to regulator failure and A1A2CR5 is used for voltage transient protection.

4-31. Operation of the —100 V supply is similar to the +100 V supply. A1A2Q15 and A1A2Q16 operate as a differential comparator, with A1A2Q16 sensing any change in output voltage. Transistor A1A2Q14 with A1A2R33 provides current limiting. Current foldback operation reduces the current output in the event of a short-circuited load. Voltage and current variations are coupled to driver A1A2Q13 which controls the conduction of series regulator A1Q4. Adjustment of the supply output voltage is accomplished with potentiometer A1A2R40. Turn-on/turn-off protection is furnished by A1A2CR6, while A1A2CR7 provides reverse voltage protection for C9.

4-32. GATE AMPLIFIER. The inputs to the gate amplifier are an unblanking gate, a chopped blanking signal, or an externally applied input Z-axis signal. These three signals may be present singly or simultaneously, depending on control settings and signals applied.

4-33. The unblanking gate is first applied as a current to A7Q1, a common base amplifier, then combined in the low impedance emitter circuit of A7Q5 with a current established by the INTENSITY, FIND BEAM, or EXT DISPLAY front-panel controls. Pressing FIND BEAM shunts the adjustable INTENSITY potentiometer to increase emitter current and produce an intensified beam. Setting the horizontal DISPLAY to EXT supplies additional current from the —100 V supply. This establishes an unblanking current level to compensate for removal of the internal unblanking signal from the plug-in, and establishes a nominal brightness level.

4-34. The output voltage of A7Q5 is coupled through emitter follower A7Q6 to complimentary amplifier A7Q7/Q8. Diodes A7CR1 through A7CR4 provide a clamping action to prevent overdriving the amplifier.

4-35. A large negative feedback from the collectors of A7Q7 and A7Q8 ensures that the amplifier gain is very stable. Capacitors A7C6 and A7C8 provide for adjustment of the high frequency feedback and gain. Decreasing the capacitance of A7C6 decreases the high frequency feedback and increases gain, while decreasing the capacitance of A7C8 increases high frequency feedback and decreases gain. Amplifier voltage gain is approximately 10 for Z-axis signals.

4-36. The gate amplifier output unblanking signal is added to the —3200 V output of the high voltage power supply and applied to the CRT control grid. Voltage level changes of the unblanking signal cause corresponding changes to the CRT control grid voltage. Diodes A7CR6 through A7CR9 provide isolation protection against high voltage transients from the CRT control grid.

4-37. An alternate trigger signal is used by multi-channel vertical amplifier plug-ins to initiate channel switching action. Transistors A7Q2 and A7Q3 function as a fast-acting switch. With A7Q2 normally conducting and A7Q3 non-conducting, the unblanking gate trailing edge causes A7Q3 to conduct and A7Q2 to cease conducting. The switching output is differentiated and applied to A7Q4, providing a negative-going voltage pulse for vertical amplifier channel switching.

4-38. The input impedance to the Z-axis input is approximately 5100 ohms. An input signal of approximately +2 volts amplitude is sufficient to blank a trace of normal viewing intensity, while an input signal of —2 volts will provide unblanking. Since the gate amplifier has a voltage gain of about 10, a 2-volt input will result in a 20-volt change at the CRT grid.

4-39. HIGH VOLTAGE POWER SUPPLY (HVPS). The HVPS generates three regulated voltages. These are applied to the cathode (—3150 V), control grid (—3200 V) and post-accelerator (+19 kV) of the CRT to provide the accelerating potential required to produce excitation of the CRT phosphor for a visible trace. The HVPS is shown in simplified from in figure 4-3. Refer to this figure, and to the schematic in Section VIII while reading the following explanation of HVPS operation.

4-40. Chassis-mounted transistor Q1 and transformer A6A1T1 form an oscillator that generates approximately 36 V p-p at 40 kHz. A feedback winding on the transformer provides the regenerative coupling to sustain oscillation. Operating power is provided by the unregulated +27 V supply. The supply source is fused and decoupled.

4-41. The 40-kHz oscillator output is stepped up by the secondary windings of A6T1. Two half-wave rectifiers and a voltage multiplier are used to develop the high voltages necessary for CRT operation.

4-42. The CRT grid voltage is developed by half-wave rectifier A6CR1 and filter A6C1, A6C2, and A6R1 through A6R5. The display intensity lower limit, determined by the CRT grid voltage level, is adjusted by A6R2. The CRT cathode voltage and the focusing voltage, approximately —2270 V, are developed by half-wave rectifier A6CR4 and filter A6C3, A6C4, and A6R7. A6R8 is part of a voltage divider that drops the —3150 V to —2270 V for focus control. Diodes A6CR5 and A6CR6 prevent the CRT grid from becoming positive with respect to the cathode. The CRT post-accelerator voltage is developed by high-voltage multiplier assembly A11.

4-43. Variations in high voltage output are fed back to the high-voltage regulator circuitry consisting of A10Q1, A10Q2, A10Q3, and associated components. The regulator controls the high voltage oscillator bias to maintain high voltage at a constant level. If, for example, the CRT cathode voltage tends to decrease (go more positive), a positive-going signal is applied through the regulator to the base of oscillator Q1. The oscillator then conducts for a greater period of time, causing a larger voltage change at the primary of A6T1. This increases the secondary voltage to restore cathode voltage to the desired level.

4-44. The high-voltage regulator monitors CRT cathode voltage through coupling network A6R9 and A6C5. Resistors A10R3 and A10R4 form a voltage divider between +100 V and the coupling network output. A10R3 adjusts the operating level of FET A10Q1. High voltage fluctuations are sensed by A10Q1 and amplified by A10Q2 and A10Q3. Diodes A10CR4 and A10CR5 provide clamping action to prevent overdriving the high-voltage oscillator. The regulator output is applied through the regenerative winding of A6T1 as bias to the base of Q1, thereby controlling high-voltage oscillator drive.

4-45. CALIBRATOR. The calibrator provides outputs of 10 volts and 250 millivolts at approximately 1-kHz. The calibrator output is a negative-going waveform.

4-46. Transistors A2Q1 and A2Q2 oscillate at a rate determined by the time constant of associated RC components. A2CR1 disconnects the collector of A2Q2 from the negative discharge of A2C3 and A2Q2 cuts off, resulting in a faster rise time. Diodes A2CR2 and A2CR3 protect the transistors from voltage breakdown. A filter network, A2L1 and A2C4, isolates the multivibrator from the —100 V supply.

4-47. With A2Q2 conducting, voltage divider A2R17, A2R18, and A2R19 divides the —100 V supply voltage. The values selected for these resistors permit the output of 10 V and 250 mV. These two outputs are available at the front panel and may be used for probe compensation adjustment and horizontal or vertical sensitivity calibration checks.

4-48. HORIZONTAL AMPLIFIER. The inputs to the horizontal amplifier are an internal sweep signal from

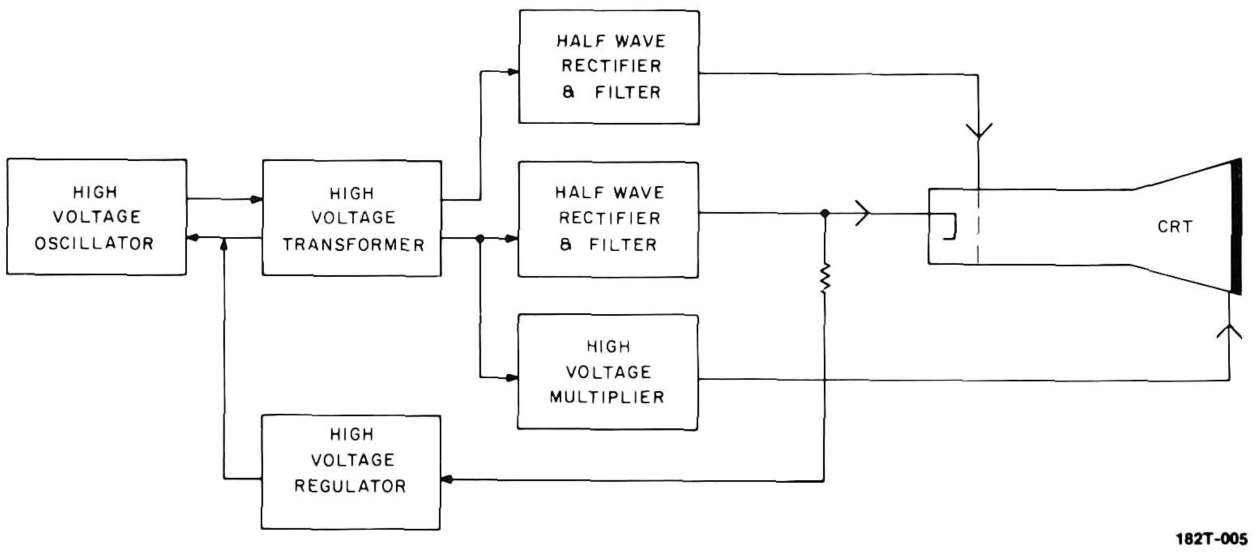


Figure 4-3. High-voltage Power Supply Block Diagram

the plug-in or an external signal applied to the horizontal EXT INPUT jack. Positioning the horizontal DISPLAY to INT grounds the input of the preamplifier and disconnects the external signal preamplifier from the output amplifier. The internal sweep signal is connected through the horizontal DISPLAY switch to the output amplifier.

4-49. Positioning horizontal DISPLAY to EXT disconnects the internal sweep signal and connects the external signal through the preamplifier to the output amplifier. With EXT selected, the amplitude of the signal from the preamplifier is adjustable by rotating the EXT VERNIER control. When the control is in the CAL detent position the output amplitude of the preamplifier is determined by the input amplitude.

4-50. The selected signal is applied to the output amplifier and summed with a current established by the horizontal POSITION control. A horizontal MAGNIFIER allows the gain to be increased by a factor of 10 (X10) or to be directly related to the amplitude of the input signal (X1). The resulting current is converted to a differential signal, amplified, and applied to the horizontal deflection plates of the CRT.

4-51. An external signal applied to the preamplifier is coupled through a divider composed of A5R5 and A5R6 to A5Q1. The output of A5Q2 is coupled through the horizontal EXT VERNER and the horizontal DISPLAY switch. The high input impedance of A5Q1, in conjunction with the voltage divider and A5R4, provides a 1 megohm load to the external circuit. Transistor A5Q2 is an emitter follower that supplies a current, determined by A5R15 and the EXT VERNIER control, to A5Q3.

4-52. A vernier balance adjustment A5R11 is used to establish a zero input voltage reference level. This eliminates horizontal dc shift as the EXT VERNIER control is rotated. The EXT VERNIER provides a range of control of the deflection factor when an EXT INPUT signal is used for horizontal deflection. It has sufficient range to change the deflection factor by at least 10.

4-53. The input signal to A5Q3 is summed in the low impedance emitter circuit with a current established by the horizontal POSITION controls. Fine and coarse positioning operate from a single control, and are mechanically interconnected. Rotating the control first provides fine positioning. When the limit of available rotation of the fine position potentiometer has been reached, the coarse positioning potentiometer becomes effective.

4-54. The output of A5Q3 is coupled through emitter-follower A5Q4 to differential amplifier A5Q5 and A5Q7. The low impedance necessary to drive A5Q5 is provided by A5Q4, and A5Q6 maintains a similar low impedance voltage source for A5Q7.

4-55. The position of the MAGNIFIER switch A5S4 selects either of two values of emitter degeneration between A5Q5 and A5Q7 and controls the gain. As degeneration decreases, gain increases. Two gain levels are provided, X1, and X10. Each has an adjustable element to provide for calibration of the gain. With X1 magnification selected, A5R46 is used to set the gain. With X10 magnification selected A5R44 sets the gain. The emitter potentials of A5Q5 and A5Q7 are balanced by A5R49. This prevents horizontal dc shift as the MAGNIFIER control is switched between ranges.

4-56. The differential signal at the collectors of A5Q5 and A5Q7 is applied to current-fed operational amplifiers A5Q11/A5Q12/A5Q13 and A5Q8/A5Q9/A5Q10. The amplifier low frequency gain is very stable because of the large negative feedback employed, and the high frequency feedback for each side of the amplifier is separately adjustable. High frequency feedback from the collectors of A5Q12/A5Q13 to the base of A5Q11 is controlled by A5C28; high frequency feedback from the collectors of A5Q9/A5Q10 to the base of A5Q8 is controlled by A5C21. Capacitor A5C24 adjusts the ratio of feedback for each side of the amplifier. The output of the amplifiers is a voltage that is connected to the horizontal deflection plates of the CRT.

4-57. Diodes A5CR9/A5CR10 and A5CR4/A5CR5 limit the output to the deflection plates to prevent overdriving. Diodes A5CR8 and A5CR3 prevent A5Q5 and A5Q7 from saturating.

4-58. Pressing the FIND BEAM control disables diode limiter A5CR4/A5CR5 and blocks the signal to A5Q8. The differential gain is effectively cut in half, and the horizontal deflection of the beam is confined to the limits of the CRT.

4-59. POWER SUPPLY DECOUPLING. Decoupling networks are used on each etched circuit assembly for the supply voltages. The use of decoupling is important to prevent extraneous signals or noise from being introduced into circuitry from the power supplies or supply leads. Decoupling also prevents transients originating in other circuits from being introduced.

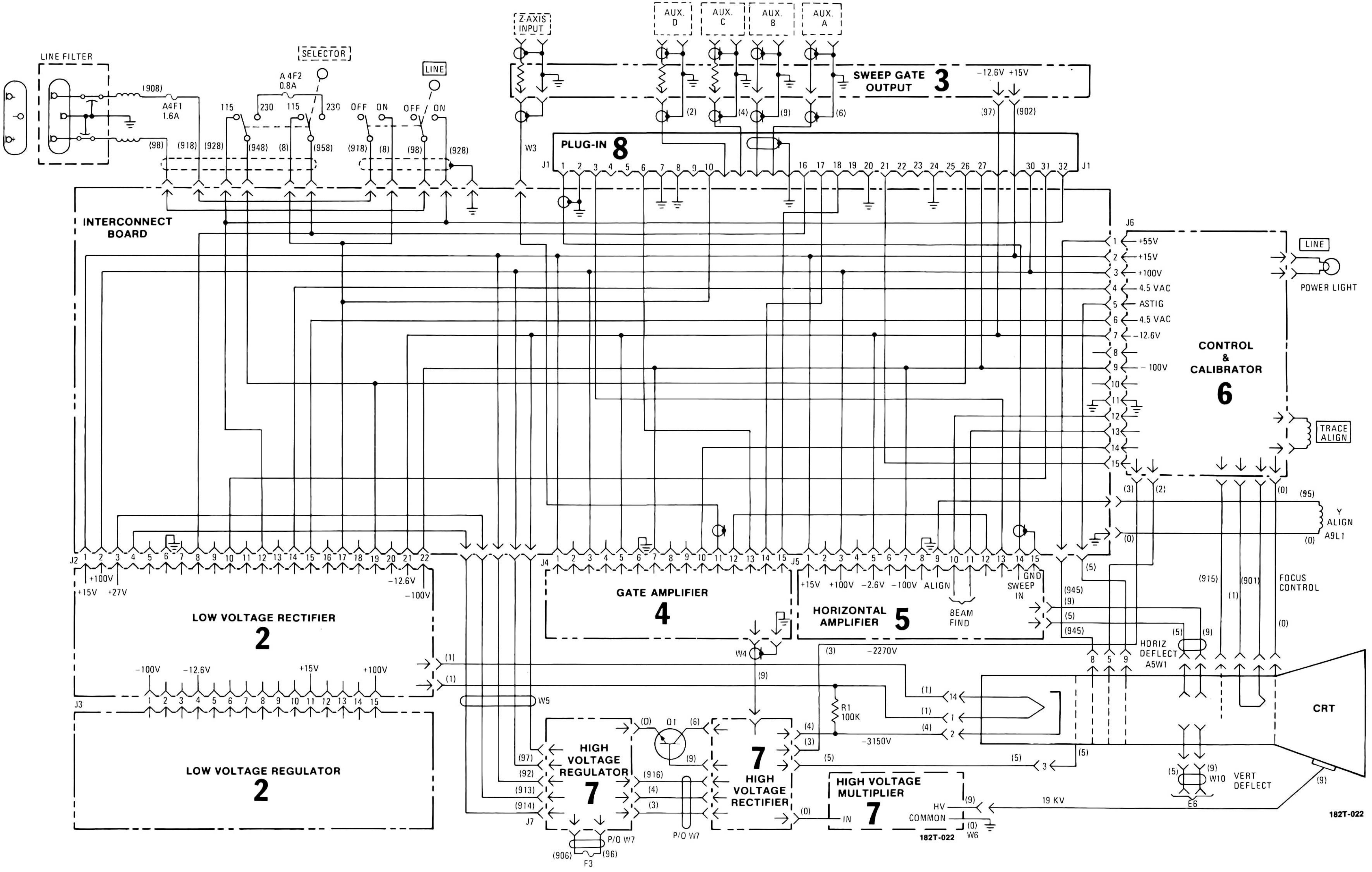
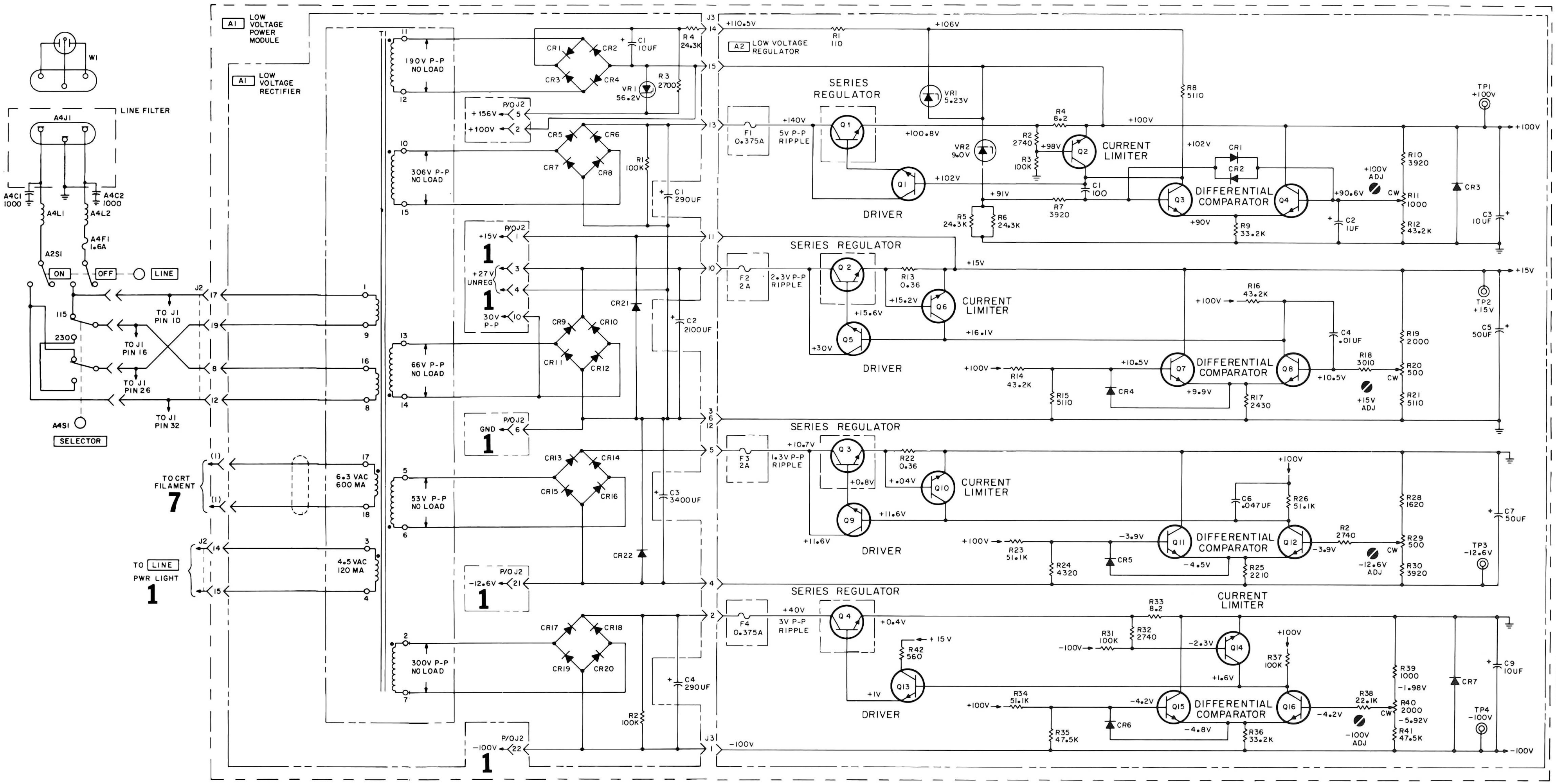


Figure
Mainframe Wiring Diag



REFERENCE DESIGNATIONS

A1	CHASSIS
C1-4 F1-4 Q1-4 T1	W1
A1A1	**A1A2**
C1 CR1-22 J2 R1-4 VR1	C1-9 CR1-7 J3 Q1-16 R1-42 TP1-4 VR1,2
A2	**A4**
S1	C1,2 F1,2 L1,2 S1

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Figure 8-8. Low Voltage Power Supply

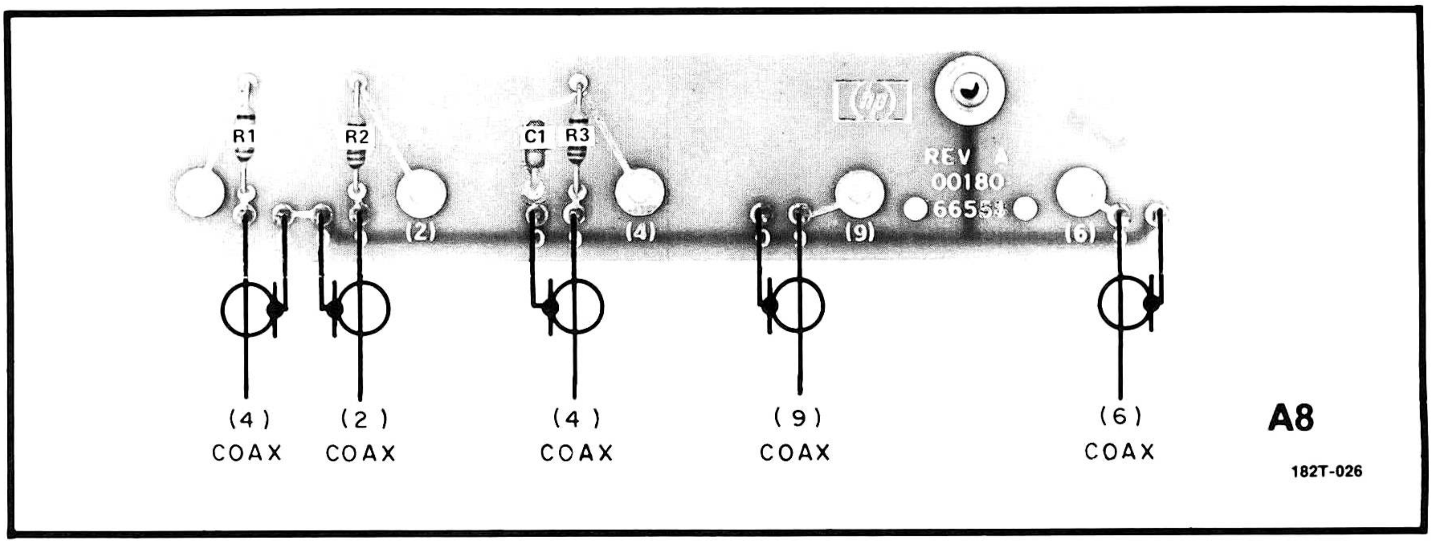


Figure 8-9. Auxiliary Output Board, A8 Component Identification

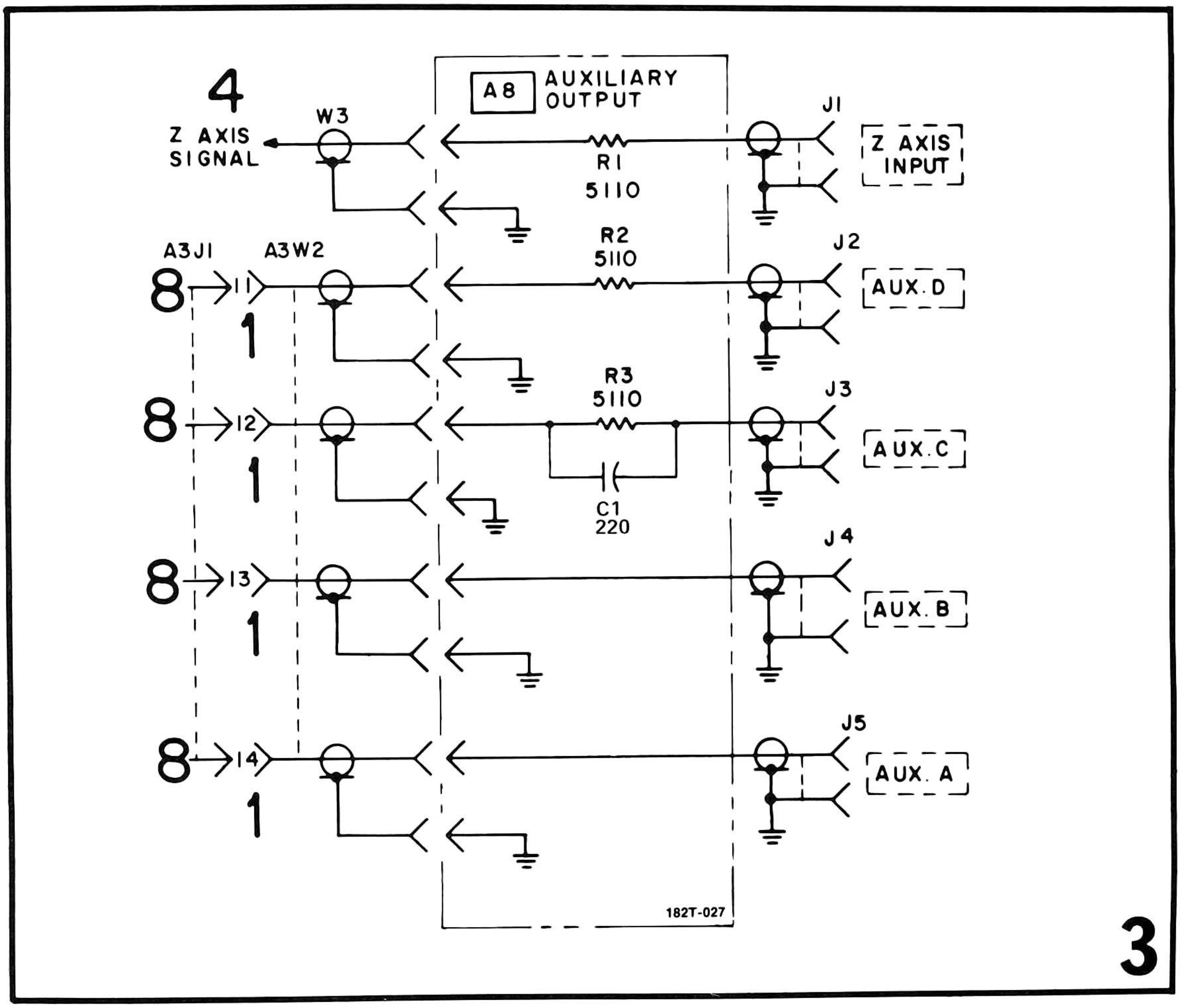


Figure 8-10.
Auxiliary Output Board

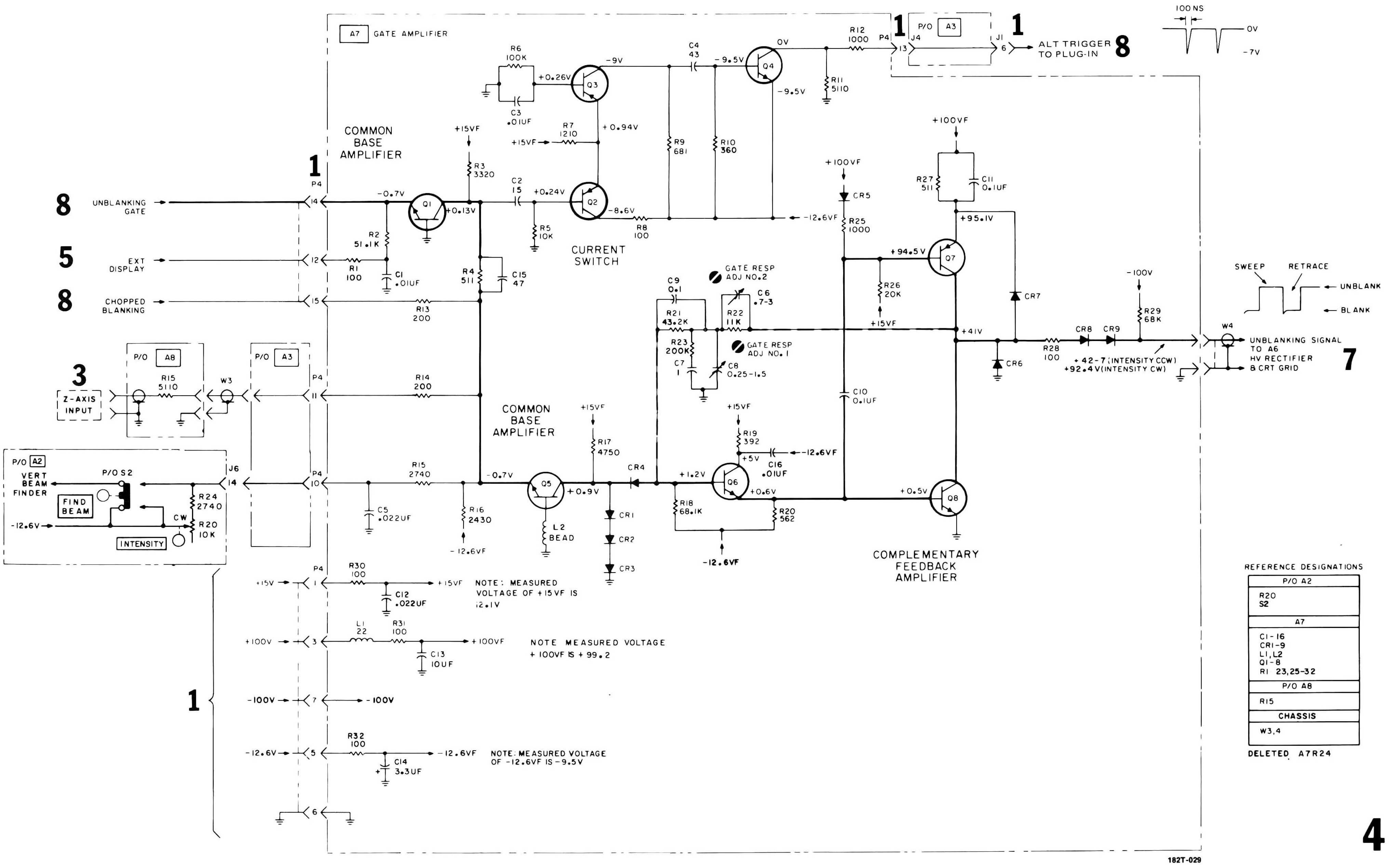
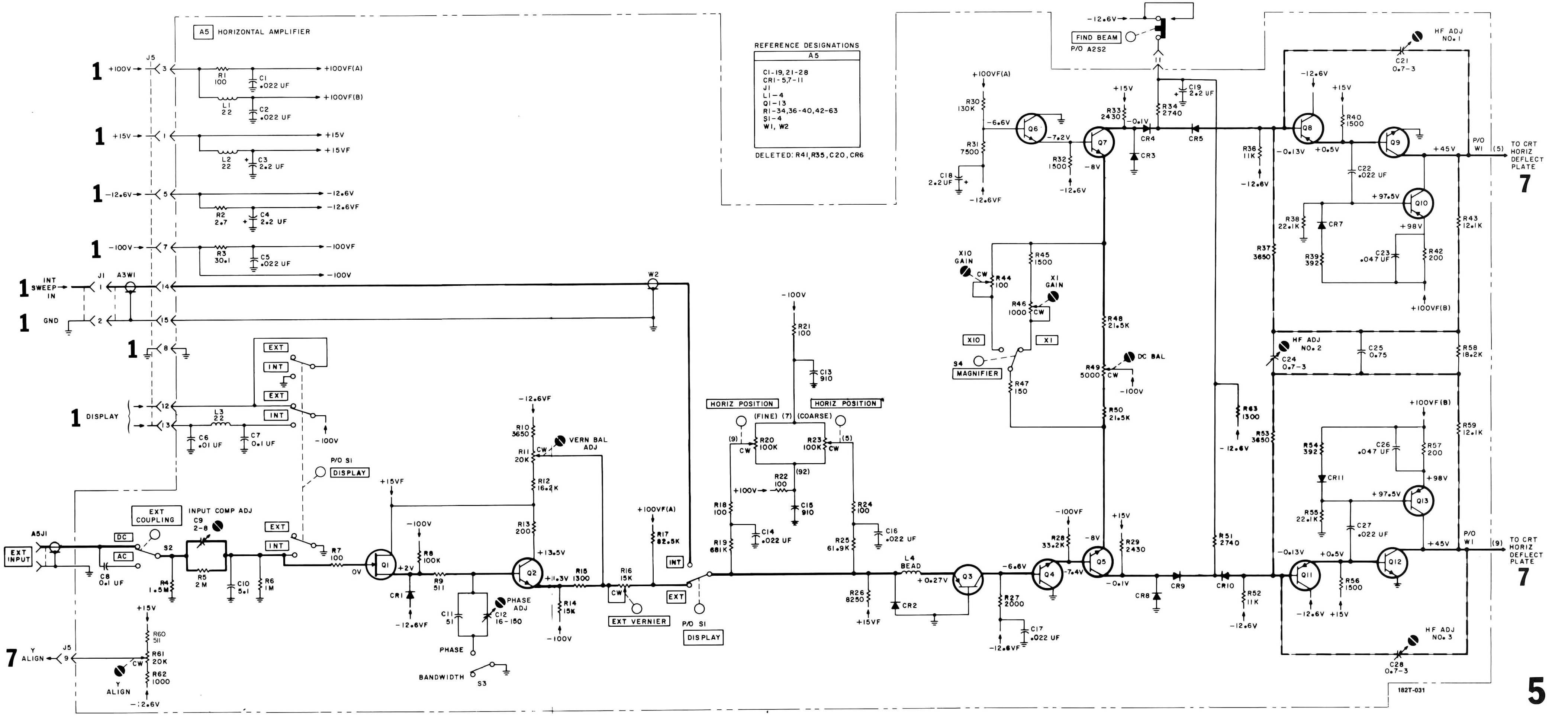
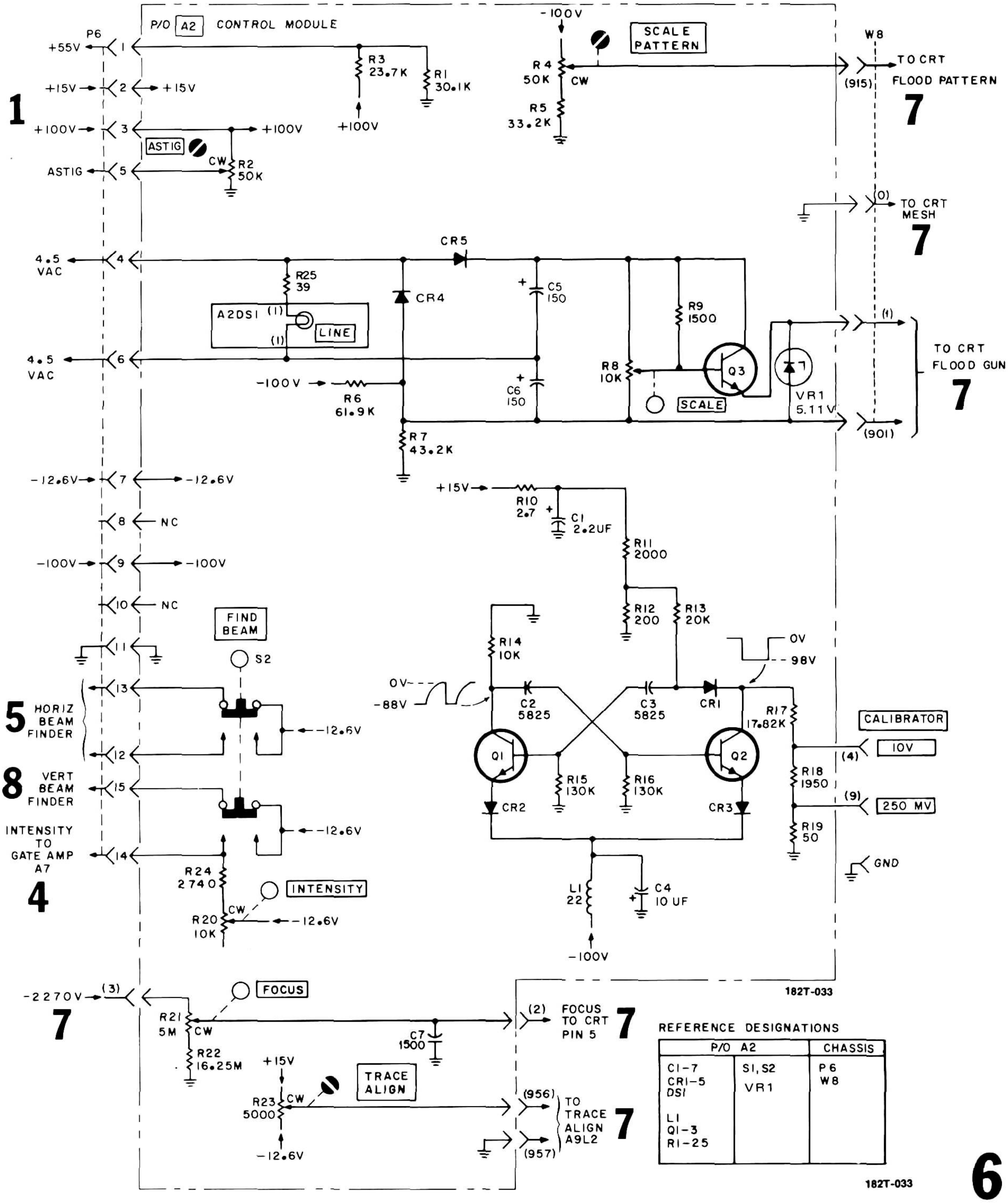


Figure 8-12.
Gate Amplifier A7



5

Figure 8-14. Horizontal Amplifier A5

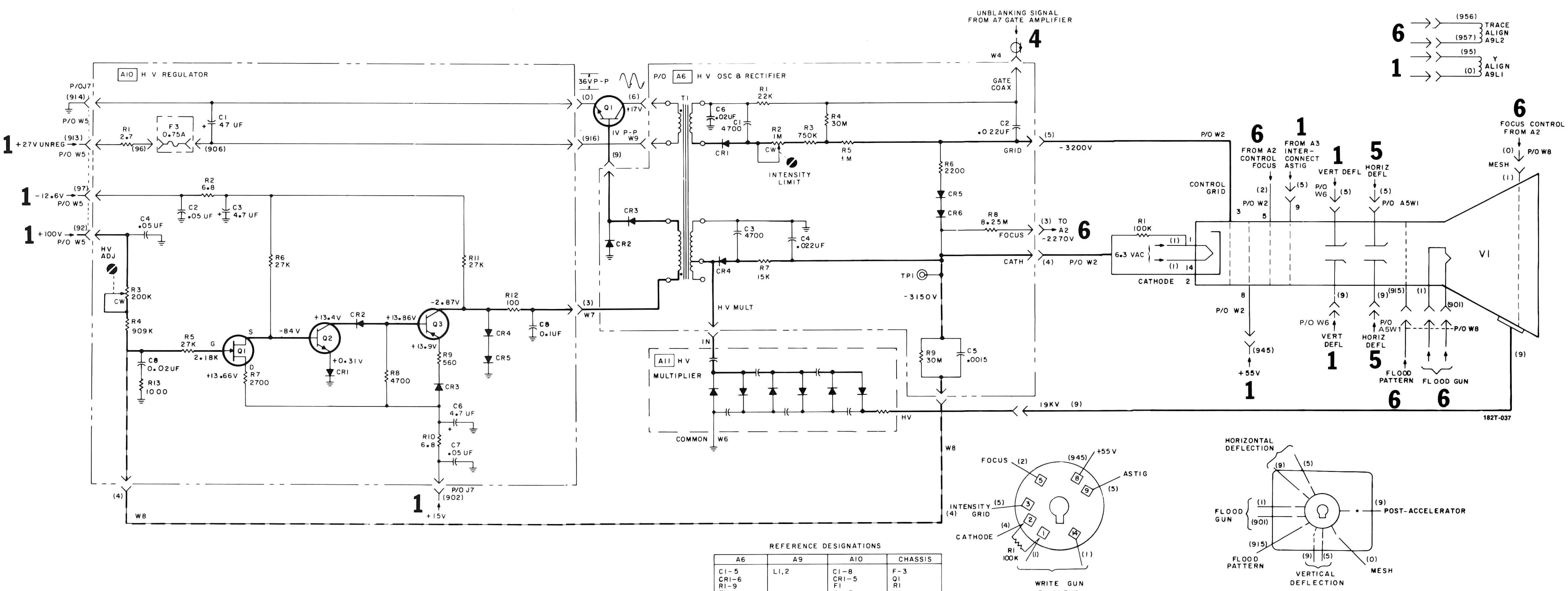


REFERENCE DESIGNATIONS

P/O A2		CHASSIS
C1-7 CR1-5 DS1 L1 Q1-3 R1-25	S1, S2 VR1	P6 W8

182T-033

Figure 8-16. Control Module A2



REAR VIEW
CRT SOCKET
CONNECTIONS

REAR VIEW
CRT NECK PIN
CONNECTION

REFERENCE DESIGNATIONS

A6	A9	A10	CHASSIS
C1-5 CR1-6 R1-9 T1 TP1	L1,2	C1-8 CR1-5 F1 Q1-3 R1-13	F-3 Q1 R1 V1 W2, 6,8

DELETED.

182T-037

7

Figure 8-20.
High Voltage Power Supply

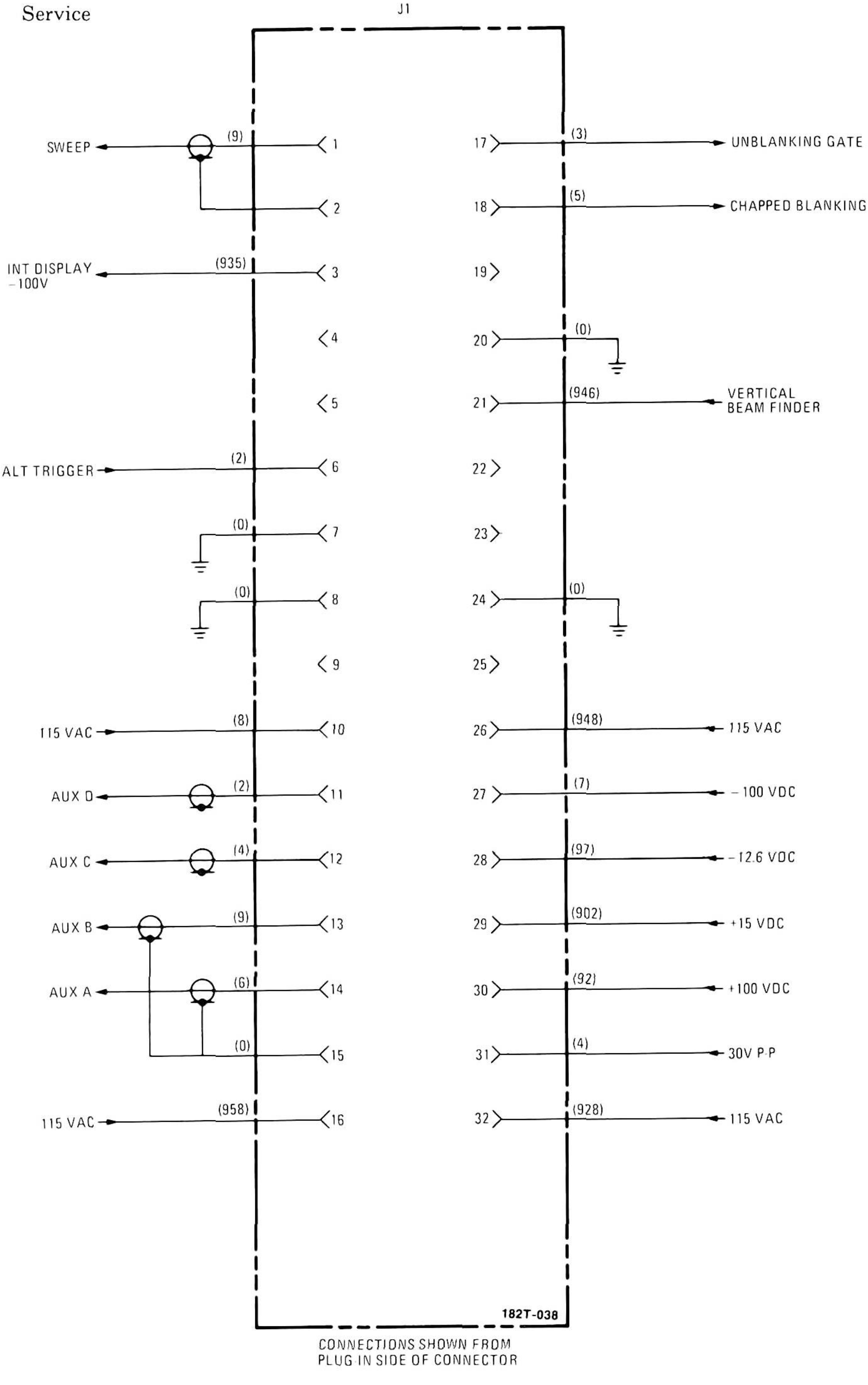


Figure 8-21. Spectrum Analyzer Plug-in Connections