Ballantine

MODEL 6127A PROGRAMMABLE OSCILLOSCOPE CALIBRATOR

VOL. 2

INSTRUCTION MANUAL

MODEL 6127A
PROGRAMMABLE
OSCILLOSCOPE
CALIBRATOR
VOL. 2

Serial Prefix No. 020-/021-

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WARRANTY

This Ballantine Laboratories, Inc. product is warranted against defects in materials and workmanship for a period of one year from the date of shipment, except for batteries, electron tubes, vacuum thermocouples, and certain other components, if any, listed in this manual. Ballantine Laboratories, Inc. will, at its option, repair or replace products which prove to be defective during the warranty period provided they are returned to Ballantine Laboratories, Inc. prepaid, and provided the proper preventive maintenance and calibration procedures as listed in this manual have been followed. Repairs necessitated by misuse of the product are not covered by this warranty. NO OTHER WARRANTIES ARE EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. BALLANTINE LABORATORIES, INC. IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

CERTIFICATION

Ballantine Laboratories, Inc. certifies that this equipment meets all applicable Ballantine specifications at time of shipment from the factory as determined by thorough testing and inspection. Ballantine further certifies that its measurements are traceable to the United States National Bureau of Standards. All instruments used in calibrating Ballantine products are standardized by systematic reference to NBS-traceable standards as described in the validation procedures shown below.

REFERENCE STANDARDS

DC	10mV-750V	0.01-0.04%
20Hz-50kHz	0.5V-500V	0.03%
20Hz-10MHz	0.5V-100V	0.1%
DC-30MHz	0.5V-100V	0.5%
DC-700MHz	10μV-0.5V	1%–NBS
10MHz-1000MHz	1V-300V	1%–NBS

WORKING STANDARDS

TRANSFER VM BALLANTINE, 1600A
MICROPOTENTIOMETERS BALLANTINE 440
RATIO TRANSFORMERS, GERTSCH

CALIBRATION CONSOLE 100Hz-100kHz FOR 0.25% ACCURACY INSTRUMENTS

LEVEL CHECK – DAILY
ATTENUATOR CHECK – 6 MONTH
DISTORTION CHECK – 1 MONTH
FREQUENCY RESPONSE CHECK – 3 MONTH
GROUND CURRENT CHECK – 3 MONTH

CALIBRATION CONSOLES 2Hz-20MHz FOR 1%-3% ACCURACY INSTRUMENTS

LEVEL CHECK – 1 WEEK
ATTENUATOR CHECK – 6 MONTH
DISTORTION CHECK – 3 MONTH
FREQUENCY RESPONSE CHECK – 3 MONTH
GROUND CURRENT CHECK – 3 MONTH

CROSSCHECK CONSOLE 2-20MHz FOR 1%-3% ACCURACY INSTRUMENTS

LEVEL CHECK – 1 WEEK
ATTENUATOR CHECK – 6 MONTH
DISTORTION CHECK – 3 MONTH
FREQUENCY RESPONSE CHECK – 3 MONTH
GROUND CURRENT CHECK – 3 MONTH

Ballantine's Quality Assurance program satisfied the requirements of MIL-I-45208

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SECTION 4

THEORY OF OPERATION

4-1. INTRODUCTION

4-2. This section discusses the Model 6127A theory of operation. First, is a general description of the overall operation referencing the Block Diagram, figure 4-1. This will provide maintenance personnel with an understanding of the relationship between the different circuit blocks that comprise the complete calibrator.

4-3. Next, is a more detailed explanation of the circuit theory describing the Amplitude calibrator and Time calibrator and how both are digitally controlled, either from the front panel or IEEE-488 Bus. Refer to the simplified diagrams, figures 4-2 through 4-5 as well as the detailed schematic diagrams in Section 6.

4-4. BLOCK DIAGRAM

4-5. For the following discussion, refer to the Model 6127A Block Diagram, figure 4-1. The calibrator provides both precise amplitude and time signals for the primary purpose of calibrating oscilloscopes. Two of its major sections are the Amplitude calibration circuits and the Time calibration circuits. A third major section includes the microprocessor and associated circuitry.

4-6. **Amplitude Calibrator.** The Programmable Dc Supply, Assembly A2, and Power Supply Control, Assembly A3, combine to provide a precise 2 mA reference current. This reference current is applied to a series network of selectable precision resistors in the Multiplier Selector, Assembly A4. Depending on the resistance selected, the precise voltage developed across these resistors is then buffered by the discrete amplifier on Assemblies A2, A3 and directed to the Output Mode Select, Assembly A7.

4-7. As a result of control signals from Assembly A31 that are applied to Assembly A7, the output signal from Assembly A7 may be a plus or minus dc voltage, zero volts, or a square wave of 10 Hz, 100 Hz, 1 kHz or 10 kHz. It may also be attenuated by 60 dB.

4-8. The signal from Assembly A7 is then applied to the Precision Voltage Dividers, Assemblies A5 and A6. The precision resistors on these assemblies provide selectable attenuation that, when combined with the multiplying function of Assembly A4, offer accurate amplitude selections from 200 volts down to 10 mV.

4-9. The selected Amplitude signal is applied to the Volts/Div Output Amplifier located on Assembly A26. This section outputs either a high impedance Amplitude signal that ranges from 200V down to 40 uV; or a low impedance (50 Ω) Amplitude signal ranging from 5V down to 40 uV. The output signal from the Volts/Div Output Amplifier, while having a plus and minus polarity, is a floating system. As can be seen from the block diagram, all signal paths in the Amplitude section (with the exception of the control signals) are independent of chassis ground. This floating Amplitude calibrator signal is connected by coaxial cable to the Output Selector located on Assembly A27.

4-10. When the CURRENT MODE is selected, the Amplitude output voltage is connected through a series resistor to the Current Loop. Currents from $\pm$ 1 mA to $\pm$ 50 mA may be selected by changing the voltage applied to the precision current resistance.

4-11. **Volts Deviation.** Either by Local or Remote control, digital instructions are sent to the microprocessor to increment or decrement the Amplitude deviation (or to turn off Amplitude deviation). The microprocessor; on CPU Control Logic Board, Assembly A30, sends information over the data bus to the D/A Converter on the Signal Control Decoder, Assembly A31. The analog output is directly proportional to the amount of % Deviation selected.

4-12. This voltage is then applied to Assembly A7 where it is transformed into a signal that may be varied both above and below V_S ("HI"), becoming D_V. This signal is then directed to A18, the Time/Volts Deviation Control Assembly. There, it is applied through resistors that change it into a deviation current; ranging from minus 0.2 mA to plus 0.2 mA ($\pm$ 10% Deviation). This current is algebraically summed at the 2 mA reference current node between A2, A3 and A4 Assemblies and causes the Amplitude signal to deviate proportionately. Also, the resulting Deviation current is applied to the A/D Converter on Assembly A117. The digital signal is then fed back as digital data to the microprocessor for comparison with the selected deviation and displayed digitally as % Volts Deviation.

4-13. **Time Calibrator.** Reference for the Time calibrator is provided by the 10 MHz crystal controlled oscillator located on Assembly A11. This signal is compared in the phase detector and AFC portion of Assembly A11 with a 10 MHz signal that is divided down from the 1 GHz Voltage Controlled Oscillator (VCO) on Assembly A27. Any frequency shift in the VCO causes an error signal from the phase detector to be instantly fed back to the VCO, restoring it to the original frequency.

4-14. The 1 GHz signal is multiplied by 2X to provide the 2 GHz signal; and it is also divided by two, five and ten to produce the 500 MHz, 200 MHz and 100 MHz Time signals, respectively. This is all accomplished on Assembly A27. The 100 MHz signal from A27 is applied to the Time Marker Amplifier, Assembly A12. On this circuit board, it is divided further to produce a 50 and 20 MHz signal. These signals, including the 100 MHz signal are directed to the Output Amplifier on A12 Assembly. In addition, the 100 MHz signal is divided by ten to produce a 10 MHz signal that is sent to the Time/Div Selector, Assembly A13.

4-15. This 10 MHz signal is applied to a series of chain dividers on Assembly A13. The divided signals are fed to a multiplexer that is logic controlled. The result is a frequency selection of 0.1 us (10 MHz) to 5 seconds. These signals are then directed to the Output Amplifier on Assembly A12 and the Low Distortion Pulse Generator, Assembly A127. The total range of shaped time markers available from the output amplifier is from 10 ns to 5 seconds; in a 1, 2, 5 sequence.

4-16. The selectable signals available from the Output Amplifier on Assembly A12; as well as the 5 ns (200 MHz), 2 ns (500 MHz), 1 ns (1 GHz) and 500 ps (2 GHz) signals; are applied to the main output selector on Assembly A27.

4-17. **Time Deviation.** When Time Deviation is selected, either through Local or Remote programming, a digital signal to increase or decrease Time Deviation is sent via the data bus to the Central Processing Unit (CPU) on Assembly A30. As in Volts Deviation, digital instructions are sent to the D/A Converter on Assembly A31. A proportional analog voltage that varies from minus 10 to plus 10 V dc (-9.9% to +9.9% deviation) is directed through Assembly A27 to the AFC circuits on Assembly A11.

4-18. In Time Deviation mode, control signal F_D energizes relay A11-K1; connecting the analog Time Deviation signal through to the 1 GHz VCO where it causes a shift in frequency proportional to the plus or minus Time Deviation selected. Through frequency division, a 2 MHz signal is applied to the Time/Volts Deviation Control, Assembly A18.

4-19. The 2 MHz signal is divided down to 1 MHz and compared with a 1 MHz signal that is referenced to the 10 MHz crystal oscillator. The result is a $\pm$ dc voltage proportional to the frequency difference of the two signals. This is applied to the A/D Converter on Assembly A117 and is returned to the uP on Assembly A31 as digital data. The result is then displayed digitally as % Time Deviation.

4-20. **Program Control.** All of the Calibrator's functions and ranges are digitally controlled, with the exception of the ac power switch. There are two separate methods of controlling the 6127A; Local and Remote. In the Local mode, control is accomplished by touching the front panel key pads; in Remote, control is by commands sent over the IEEE-488 Bus.

4-21. Central to this is the CPU, A30-U10. When controlled by the IEEE-488 Bus, it processes the flow of data entering and leaving the 6127A by addressing the General Purpose Interface Adapter (GPIA), A22-U15. When under Local control, it processes the commands and data inputted from the front panel touch keys by enabling the Peripheral Interface Adapter (PIA), A30-U18. Whether instructions come from the bus controller or front panel, the CPU issues instructions through PIA, A31-U7, that are translated into control logic. This logic determines the mode, range and function of the Model 6127A.

4-22. CIRCUIT DESCRIPTION

4-23. For the following discussion of the 6127A circuits, refer to the main schematic diagrams in Section 6 as well as the simplified diagrams, figures 4-2, 4-3, 4-4 and 4-5 in this section.

4-24. AMPLITUDE

4-25. **General Description.** The basic Amplitude generator consists of a resistance programmable, precisely regulated dc supply; a high voltage, low impedance transistor switch circuit that operates on the dc level to provide square wave output; a precision resistor, multirange attenuator; and a selectable low impedance (50 Ω) output stage which ranges from 5 volts down to 40 uV. The combination of resistance programming of the dc supply and attenuator selection provides calibrated amplitude from 200V down to 40 uV in 1, 2, 5 steps. Amplitude output may be positive or negative dc; or square waves having a frequency of 10, 100, 1kHz or 10 kHz as determined by the output mode select circuits on Assembly A7. Deviation circuitry permits calibrated, metered, $\pm$ deviation of the output amplitude displayed digitally as a percentage of the nominal Amplitude selected. (Refer to simplified schematic, figure 4-2.)

4-26. **Programmable Dc Supply.** The programmable precision dc power supply encompasses circuitry located on Assemblies A2, A3 and A4. It provides the precise initial dc voltage from which both $\pm$ dc and square wave output signals are derived. The full wave rectifier bridge, CR1, CR2, CR3 and CR4, in the Programmable Power Supply, Assembly A2, provides a nominal 260 volts, unregulated, across capacitor A2-C2. A voltage doubler (A2-CR5, CR6) provides an additional 240 volts dc in series across A2-C3, for a total unregulated dc voltage of 500 V.

4-27. A 17V ac secondary winding on the power transformer, A26-T2, drives rectifiers A3-CR1, CR2 to produce both a plus and minus regulated 12 volts (A3-U1 and A3-U2 respectively) referenced to VS ("HI"). This serves as the source voltage for plus and minus amplitude deviation.

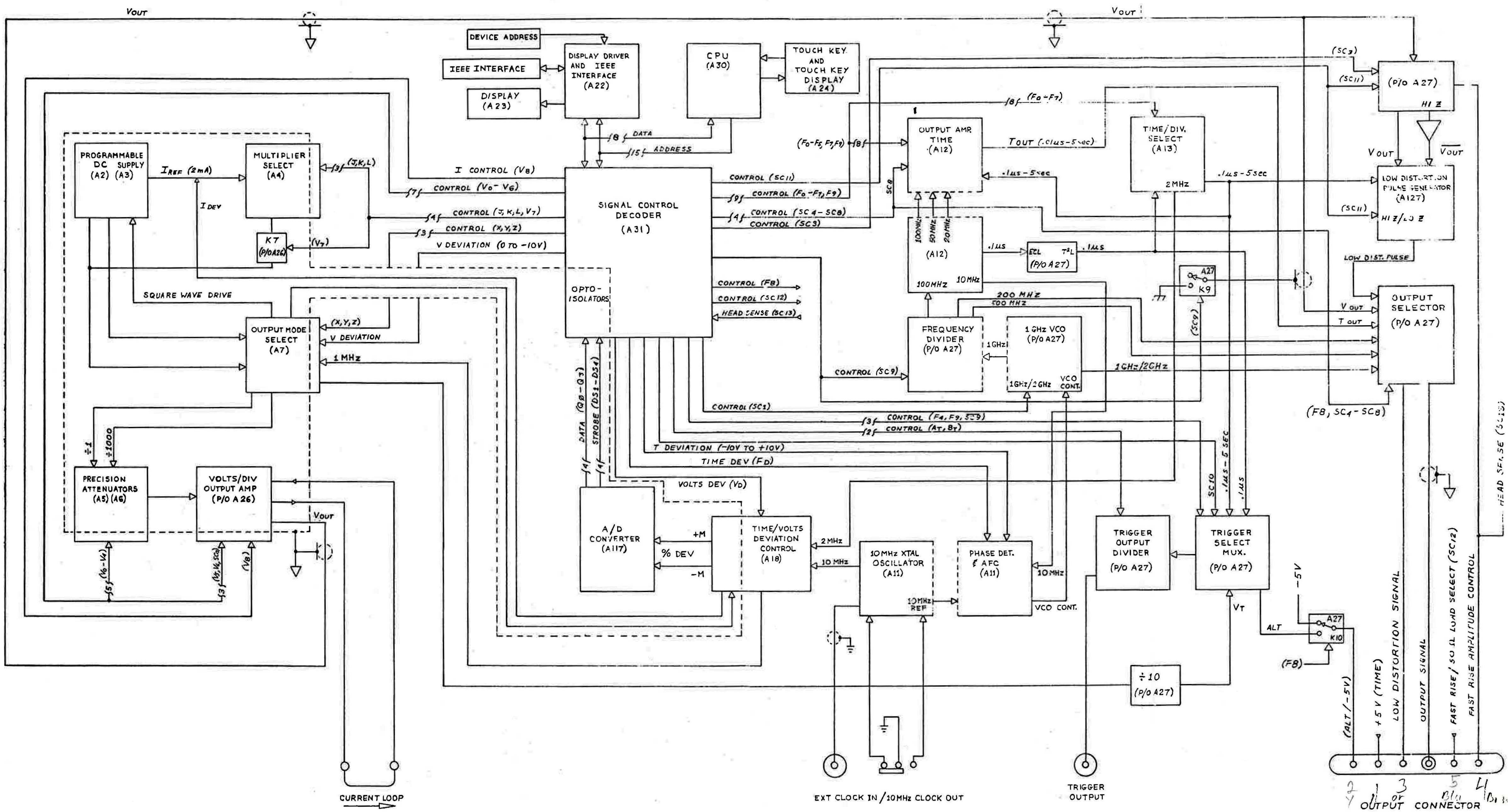


Figure 4-1. Model 6127A Block Diagram

4-28. Zener diode, A3-CR5, provides the voltage from which the 2 mA reference current is derived. This current is sent to the precision series resistors on the Multiplier Selector, Assembly A4. The resistance selected is a function of the control logic (J, K, L) applied to the 3-line to 8-line decoder, A4-U1. See table 4-1. Depending on the output line that is "low", one of the relays, A4-K1 through A4-K7 will be energized; or in the case where all three control lines are "high", none of the relays will be energized. This determines the multiplier resistance and, in turn, the initial precision amplitude. In addition to these multiples, a 15 k precision resistor, A26-R2, may also be inserted in series as a result of control line V7 acting upon relay A26-K4. This permits selection of an Amplitude value of 150 volts.

4-29. The selected voltage is applied as the positive input to an "operational amplifier" used as a voltage follower and comprised of transistors A3-Q1A, B and A2-Q2, Q3 and Q4. The operational amplifier is a voltage follower with 100% negative feedback. Any change in voltage at the output causes an opposing current change at the collector of A3-Q1A which, in turn, maintains the output at its original voltage.

4-30. **Output Selection.** Control lines X, Y, Z are applied as logic inputs to gate circuits A7-U5 and A7-U6 which, in turn, control relays A7-K2 and A7-K4. (Refer to table 4-2.) When relay A7-K2 is de-energized and relay A7-K4 is energized (GND Mode), the Amplitude voltage is disconnected from Assembly A6 and the precision attenuator input is "grounded" (STANDBY mode). When the relay "states" are reversed (NEG Mode), the negative side of the Amplitude voltage is connected to HI and the positive side is connected to LO. For the POS mode, both relays are de-energized and the HI terminal becomes the positive polarity; while the LO becomes negative. In both cases, the logic state of A7-U5 pin 13 is at "1". This causes A7-Q2 to turn "on" and control opto-isolator A7-U2, maintaining it in a steady "ON" condition. This results in either a positive or negative dc output.

4-31. The X, Y, Z control lines also are used as logic inputs to chain divider, A7-U1. This determines whether the 1 MHz clock signal is divided by 10^5, 10^4, 10^3 or 10^2 for an output signal of 10 Hz, 100 Hz, 1 kHz or 10 kHz respectively. This output signal will control the state of A7-U2, through the action of A7-Q1, provided the logic state of A7-U5 pin 13 is at "0". A7-Q3, which is controlled by the opto-isolator output, provides the square wave drive signal to Assembly A3. When A7-Q3 is turned "on" steady, both A3-Q4 and A3-Q5 are turned "off". This causes A3-Q3 to transfer the precision Amplitude output voltage (VS) from the Programmable Dc Supply on to the HI terminal. This is the condition for either POS or NEG (dc) output mode. When any of the ac output modes are selected, A7-Q3 is switched at the frequency determined by the output control signal from A7-U1. This causes A3-Q4 and A3-Q5 to also switch "off" and "on" at the selected square wave frequency. The result is that A3-Q3 alternates between transfer and disconnect at the "chopped" frequency, causing the HI terminal to alternate between HI and LO.

TABLE 4-1. VOLTS/DIV MULTIPLIER (A4 ASSEMBLY)

MULT.	CONTROL LINES J	CONTROL LINES K	CONTROL LINES L	A4-U1 OUTPUTS U1-9	U1-10	U1-11	U1-12	U1-7	U1-6	U1-5	ENERG. RELAY
X1	0	0	0	0	1	1	1	1	1	1	K1
X2	0	0	1	1	0	1	1	1	1	1	K2
X3	0	1	0	1	1	0	1	1	1	1	K3
X4	0	1	1	1	1	1	0	1	1	1	K4
X5	1	0	0	1	1	1	1	0	1	1	K5
X6	1	0	1	1	1	1	1	1	0	1	K6
X8	1	1	0	1	1	1	1	1	1	0	K7
X10	1	1	1	1	1	1	1	1	1	1	NONE

NOTE:		VALID ENTRIES
	50 V = 5 V x 10	50 V x 1
	100 V = 10 V x 10	50 V x 2
	150 V = 20 V x 6 + 30 V (V_7 at logic "0")	50 V x 3
	200 V = 20 V x 10	50 V x 4

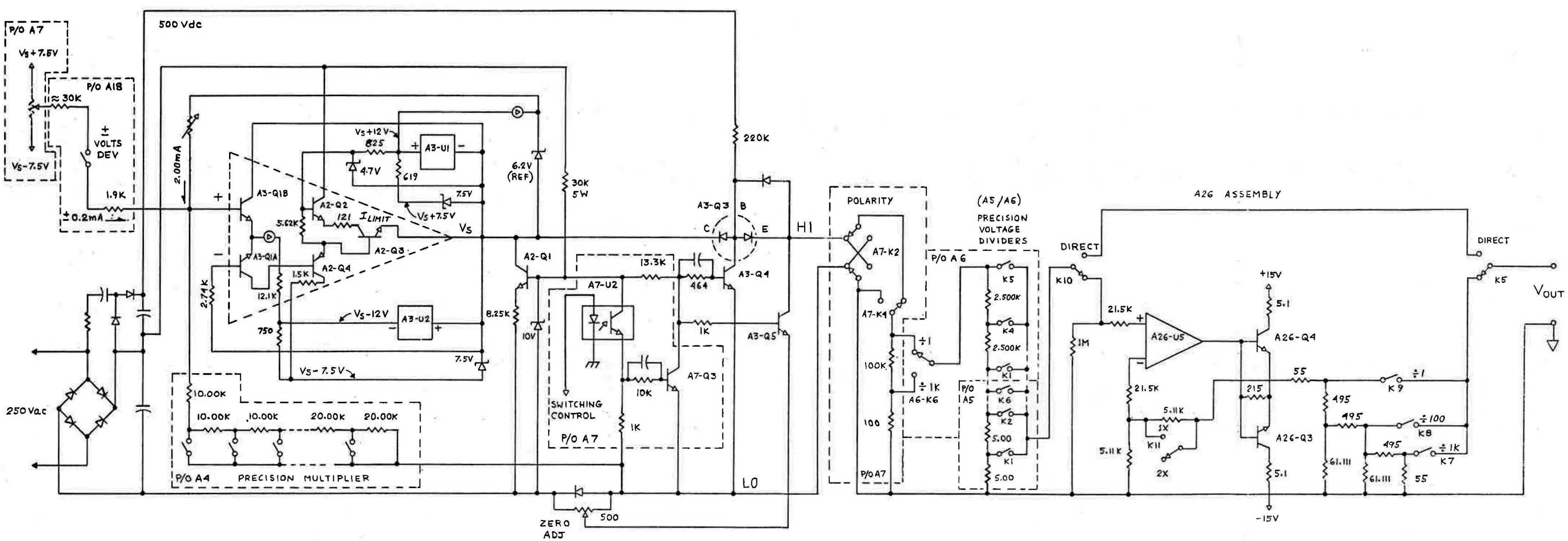


Figure 4-2. Model 6127A
Simplified Schematic, Volts/Div

TABLE 4-2 VOLTS/DIV OUTPUT MODE SELECT (A7 ASSEMBLY)

OUTPUT MODE	DIVIDE 1MHz CLOCK BY	CONTROL LINES			LOGIC ELEMENTS						RELAYS	
		X	Y	Z	U6-6	U5-13	U6-8	U5-4	U6-12	U5-10	K2	K4
GND		0	0	0	1	0	1	1	1	0	OFF	ON
NEG		1	1	0	0	1	0	0	1	1	ON	OFF
POS		1	1	1	0	1	1	0	0	1	OFF	OFF
10Hz	10^5	1	0	1	1	0	1	0	1	1	OFF	OFF
100Hz	10^4	1	0	0	1	0	1	0	1	1	OFF	OFF
1kHz	10^3	0	1	1	1	0	1	0	0	1	OFF	OFF
10kHz	10^2	0	1	0	1	0	1	0	1	1	OFF	OFF

4-32. **Precision Voltage Dividers.** Two Amplitude outputs are provided by Assembly A7; one having no attenuation and one attenuated by 1000:1. Both of these outputs are applied to the Precision Voltage Dividers, Assemblies A5 and A6. Depending on the state of relays A6-K6 and A6-K7, one of the Amplitudes is applied directly to the voltage dividers. When control V_0 is at logic "0", relay A6-K6 is energized and relay A6-K7 is de-energized. This selects the 60 dB attenuated input.

4-33. Control lines V_0 through V_4 are applied as inputs to Assembly A6. As previously mentioned, V_0 controls relays A6-K6 and K7. Control lines V_1 through V_4 are the inputs to decoder/demultiplexer, A6-U1. Refer to table 4-3. Depending on the input logic, one of the five outputs will be at logic "0"; energizing the associated relay. As can be seen from the table, when V_1 is at logic "1" and V_2, V_3, V_4 are all at logic "0", the 2Y0 (A6-U1 pin 9) output is at logic "0". This causes relay A6-K1 to become energized and divides the 20 V Amplitude signal down to 1 V.

4-34. Except for control line V_0, the same control lines are also applied as inputs to decoder/-demultiplexer, A5-U1. When V_1 changes its logic state to "0", A5-U1 is enabled instead of A6-U1. Again, refer to table 4-3. Depending on the relays energized on Assemblies A5 and A6, precise voltage division of the input signal may be selected down to 10 mV.

4-35. **Low Impedance Output.** The Amplitude output signal from the dividers is then directed to the Volts/Div Output Amplifier on Assembly A26. Control lines SC_0, V_5 and V_6 are the inputs to decoder, A26-U4. See table 4-3.

4-36. For Amplitude signals down to 2 V, only the "Direct" output is available. The signal by-passes the low impedance (50Ω) output circuits. For signals below 2 V, either a high impedance output may be selected or the 50Ω output. When SC_0 is at logic "1", the 50Ω output is selected and by de-energizing K11, the gain of A26-U5 is increased to 2X. This means that the selected Amplitude output voltage, applied from a 50Ω source impedance, will be correct, as measured across a 50Ω load. For the higher impedance output, SC_0 is at logic "0" and relay A26-K11 is energized; changing the gain of A26-U5 back to X1.

4-37. Control logic signals V_5 and V_6 determine the degree of further voltage division of the Amplitude signal. As can be seen from table 4-3, the signal is divided by 1, 100 or 1000; resulting in a selection of Amplitude output signals down to 10 uV. When both V_5 and V_6 are at logic "1", relays K10 and K5 are energized; resulting in a "direct" output.

NOTE

Circuit design considerations restrict the minimum Amplitude output voltage that may be selected to 40 uV.

4-38. **Current Mode.** Control line V_8 is also applied as an input to decoder, A26-U4. When CURRENT MODE is selected, V_8 is at a logic "1". Relay A26-K5 is energized and disconnects the output of the low impedance circuit from the Amplitude path. Simultaneously A26-Q2 is switched on, energizing relay A26-K6. This connects the output to the CURRENT LOOP.

4-39. When control line V_8 is at logic "0", the signal is directed to either the Output Selector on Assembly A27 if AMPLITUDE MODE is selected; or to the Low Distortion Pulse Generator, Assembly A127, if LOW DISTORTION PULSE MODE is selected.

TABLE 4-3. VOLTS/DIV RANGE SELECTION LOGIC

VOLTS/DIV RANGE	CONTROL LINES V_0	V_1	V_2	V_3	V_4	DIVIDE BY 1 (A6 RELAYS ENERGIZED) K7	1K K6	1 K5	2 K4	4 K3	10 K2	20 K1	40 (A5 RELAYS ENERGIZED) K6	100 K5	200 K4	400 K3	AMPLITUDE A5 OUT / A26 IN	CONTROL LINES V_6	V_5	SC_0	A26 RELAYS ENERGIZED K11	DIRECT OUT K10	K5	DIVIDE BY 1 K9	100 K8	1K K7	V_{OUT}
20V	1	1	1	0	1	X		X									20V	1	1	//////	X	X	X				20V
10V	1	1	1	0	0	X			X								10V	1	1	//////	X	X	X				10V
5V	1	1	0	1	0	X				X							5V	1	1	//////	X	X	X				5V
2V	1	1	0	0	1	X					X						2V	1	1	//////	X	X	X				2V
1V	1	1	0	0	0	X						X					1V	1	0					X			1V
500 mV	1	0	1	1	0	X							X				.5V	1	0					X			500 mV
200 mV	1	0	1	0	1	X								X			.2V	1	0					X			200 mV
100 mV	1	0	1	0	0	X									X		.1V	1	0					X			100 mV
50 mV	1	0	0	1	0	X										X	50 mV	1	0					X			50 mV
20 mV	0	1	1	0	1		X	X									20 mV	1	0					X			20 mV
10 mV	0	1	1	0	0		X		X								10 mV	1	0					X			10 mV
5 mV	1	0	1	1	0	X							X				.5 V	0	1	SEE NOTES 1 AND 2					X		5 mV
2 mV	1	0	1	0	1	X								X			.2 V	0	1						X		2 mV
1 mV	1	0	1	0	0	X									X		.1 V	0	1						X		1 mV
500 µV	1	0	1	1	0	X							X				.5V	0	0							X	500 µV
200 µV	1	0	1	0	1	X								X			.2V	0	0							X	200 µV
100 µV	1	0	1	0	0	X									X		.1V	0	0							X	100 µV
50 µV	1	0	0	1	0	X										X	50 mV	0	0							X	50 µV
20 µV	0	1	1	0	1		X	X									20 mV	0	0							X	20 µV
10 µV	0	1	1	0	0		X		X								10 mV	0	0							X	10 µV

NOTES: 1. When 50 Ω LOAD is selected, SC_0 is at a logic "1" changing the gain of A26-U1 to 2X by de-energizing K11.
2. When 50 Ω LOAD is not selected, SC_0 is at logic "0" changing the gain of A26-U1 to 1X by energizing K11.
3. An "X" signifies an energized relay.
4. All voltages are shown for X1 DIVISION selection

4-40. Low Distortion Pulse Generator. The selectable Time signal from Time/Div Select, Assembly A13, is also the timing source for the Low Distortion Pulse Generator, Assembly A127. This square wave Time signal is applied to both the terminated (50 Ω) and unterminated Low Distortion Pulse Generators simultaneously. However, the frequency range for the unterminated (high impedance) Low Distortion Pulse output is from 1 kHz to 100 kHz; while that for the terminated (50 Ω) output is 10 Hz to 1 MHz.

4-41. When the terminated output is selected, relay A27-K3 is energized and relay A27-K11 is de-energized. This connects the V_{OUT} signal to the input of the signal translator circuits (A127-U2, Q12, U3, Q18) which converts the positive going transition so that it now switches from a minus voltage up to "0". The transition frequency is controlled by the Time input signal at A127-Q2. The differential "pairs" (A127-Q2, Q3; A127-Q4, Q7 and A127-Q10, Q11) speed up the transition time and provide a "squared-up" timing signal at the base of A127-Q16. This produces a fast leading edge to the terminated (50 Ω) output signal.

4-42. The output signal is directed to the normally open contact of relay A127-K1. However, when the terminated output is selected, control signal signal SC_{11} is at a logic "1". This turns on transistor A127-Q107, de-activating the unterminated output circuits, and energizes relay A127-K1. The result is that the terminated (50 Ω) output is connected as the Low Distortion Pulse output. This output is a square wave whose frequency may be selected from 10 Hz to 1 MHz, in decade steps. The positive transition (switching from a minus voltage to a zero base) is used for the "edge". The minus voltage may be varied from -50 mV up to -1 V in a 1, 2, 5 sequence.

4-43. When the unterminated output is selected, relay A27-K3 is de-energized and relay A27-K11 is energized. This applies the V_{OUT} signal to a unity-gain, inverting amplifier circuit (A27-U8, U17, Q2, Q3) which produces $\overline{V_{OUT}}$. This becomes the variable voltage source for the unterminated output and is applied to A127-R113.

4-44. As in the terminated output, timing is provided by the square wave output from Assembly A13. For the unterminated output, the timing signal is applied to the base of A127-Q100. Again, the square wave is "squared-up". This time it is through the action of Q104 that the positive going transition is pulled quickly to "0".

4-45. When the unterminated output is chosen, control signal SC_{11} is at logic "0" and A127-Q107 is turned off; activating the unterminated output circuits. This also de-energizes relay A127-K1 and selects the unterminated output. This output is also a square wave, but the frequency range is restricted from 1 kHz to 100 kHz. As in the terminated output, the positive going transition is used for the "edge" and it switches from a minus voltage up to a zero base.

4-46. TIME

4-47. General Description. The Time calibrator basic reference is a 10 MHz crystal controlled oscillator located on Assembly A11. A 10 MHz signal obtained by frequency division from a 1 GHz voltage controlled oscillator (VCO) is applied to a Phase Detector, where it is compared to the 10 MHz reference signal. Any difference in frequency between the two signals result in an error voltage which is fed back to phase-lock the 1 GHz VCO; from which all Time signals are derived, either by frequency division or multiplication (200 MHz and 2 GHz). The Time signals are selected by logic control to provide Markers from 500 ps to 5 sec in a 1, 2, 5 sequence. In addition, the Time signals also provide the frequencies for Low Distortion Pulse, Fast Risetime Pulse, Trigger signals and as timing for Amplitude ac signals. A deviation circuit is also referenced to the Time signals and it provides direct reading of % Deviation for both Time/Div and Fast Rise Pulse.

4-48. Reference Oscillator. (Refer to simplified diagram, figure 4-3.) The internal timing source for the Model 6127A Calibrator is a crystal controlled 10 MHz master oscillator having long term stability to better than 1 part in 10^5 per month, after a 72 hour warm-up. This oscillator is located on the 10 MHz OSC and AFC board, Assembly A11. The 10 MHz output from A11-U1C pin 6 is applied as the reference Time signal to pin 6 of the phase detector, A11-U3. The 10 MHz signal frequency divided from the 1 GHz VCO is applied as the other input to the phase detector, at A11-U3 pin 9. The output signals from the phase detector, A11-U3 pins 3 and 12 are sent to comparator, A11-U4. If there is a difference, then a dc voltage will be present at the output, pin 6 of A11-U4. This voltage appears at contact 14 of A11-K1. When control signal F_D is at a logic "1", the relay is energized and the dc voltage is applied to the 1 GHz VCO on Assembly A27; instantly restoring it to precisely 1 GHz. When F_D is at a logic "0", a plus or minus dc voltage from the microprocessor digital-to-analog converter (DAC) is connected through relay A11-K1 to control the frequency of the VCO. The 10 MHz reference signal is also connected through a buffered output to the CLOCK OUT/IN switch on the rear panel. When this switch is in the 10 MHz CLOCK OUT position, the 10 MHz reference signal is available at a rear panel BNC connector. When the switch is in the EXT CLK position, an external reference signal may be applied to the Calibrator through the same BNC connector.

4-49. Voltage Controlled Oscillator. The 1 GHz VCO is located on Assembly A27. When control signal SC_2 is "HI", it energizes both relay A27-K1 and K2 through inverter A27-U18. This activates the 1 GHz VCO and connects its rf output terminal through A27-K1 contacts to the signal output line. When the VCO is active (oscillating) its frequency is determined by the dc level applied to the AFC terminal. In addition to the direct 1 GHz rf output, another 1 GHz signal is coupled from the ECL output to frequency divider, A27-U10. The Q output from pin 10 of A27-U10 becomes the 500 MHz Time signal. The Q output is applied to a divide-by-five frequency divider, A27-U9. The Q output from this divider is the 100 MHz signal that is sent to the Time Output Amplifier, Assembly A12. The $\overline{Q}$ output from A27-U9 is applied to EOR gate A27-U118 and then through a frequency selective network tuned to the second harmonic. This produces the 200 MHz output. Depending on the logic state of control signal SC_4, relay A27-K4 will select either the 500 MHz or 200 MHz Time signal. Control signal SC_1 applied to transistor A27-Q14 determines whether the rf output from the VCO is 1 GHz or 2 GHz.

4-50. The 100 MHz Time signal applied to Assembly A12 from A27 is the source for additional frequency division. The 100 MHz signal is applied directly to the X_0 input (pin 3) of multiplexer A12-U6 and it is also applied to A12-U4 ($\div$ 2) and A12-U5 ($\div$ 5, $\div$ 10). The 50 MHz output from A12-U4 pin 2 is applied to the X_1 input of A12-U6 and the 20 MHz Time signal from A12-U5 pin 2 is applied to the X_2 input of U6. Depending on the logic state of F_0 and F_1, one of the three Time frequencies 100, 50 or 20 MHz will be selected at the output of A12-U6 pin 2 when U6 is enabled by control signal F_9 going to logic "0". The Time signal is then directed to the common Time output terminal of Assembly A12 by A12-Q9.

4-51. Time Signals, selected by multiplexing, from Time/Div Selection Board, Assembly A13, are also applied to Assembly A12. When control signal F_7 is at logic "0", a NOR gate of U7 is enabled and the 10 MHz, 5 MHz or 2 MHz Time signal is passed through A12-Q10 to the common Time output terminal. Time signals from 1 MHz down to .2 Hz (5 sec) are clocked through J-K flip-flop A12-U2 to shaping circuits that are logic controlled by BCD inputs F_0, F_1 and F_2 to the digitally controlled analog switch, A12-U1; as well as control logic signals F_3, F_4 and F_5 to Q4, Q3 and Q2 respectively. The shaped signal is then applied to the time output bus via A12-Q6.

4-52. Time/Div Selector. A 10 MHz phase-locked signal is the Time reference input to the Time/Div Selector Board, Assembly A13. The decade counters A13-U5, through U11, U17 and flip-flops A13-U1 through U4 combine to form a frequency divider chain that provides Time frequencies down to 5 sec in a $\div$ 10, 5, 2 sequence. These individual frequencies are applied to multiplexers A13-U12 through U16. Depending upon the logic states of control signals F_0, F_1, F_2, $\overline{F_3}$, $\overline{F_4}$, $\overline{F_5}$, F_6 and F_7, any one of these frequencies may be selected and outputted at terminal A13P1-J and then to Assembly A12. Refer to table 4-4 for information showing Assembly A13 Time/Div logic selection.

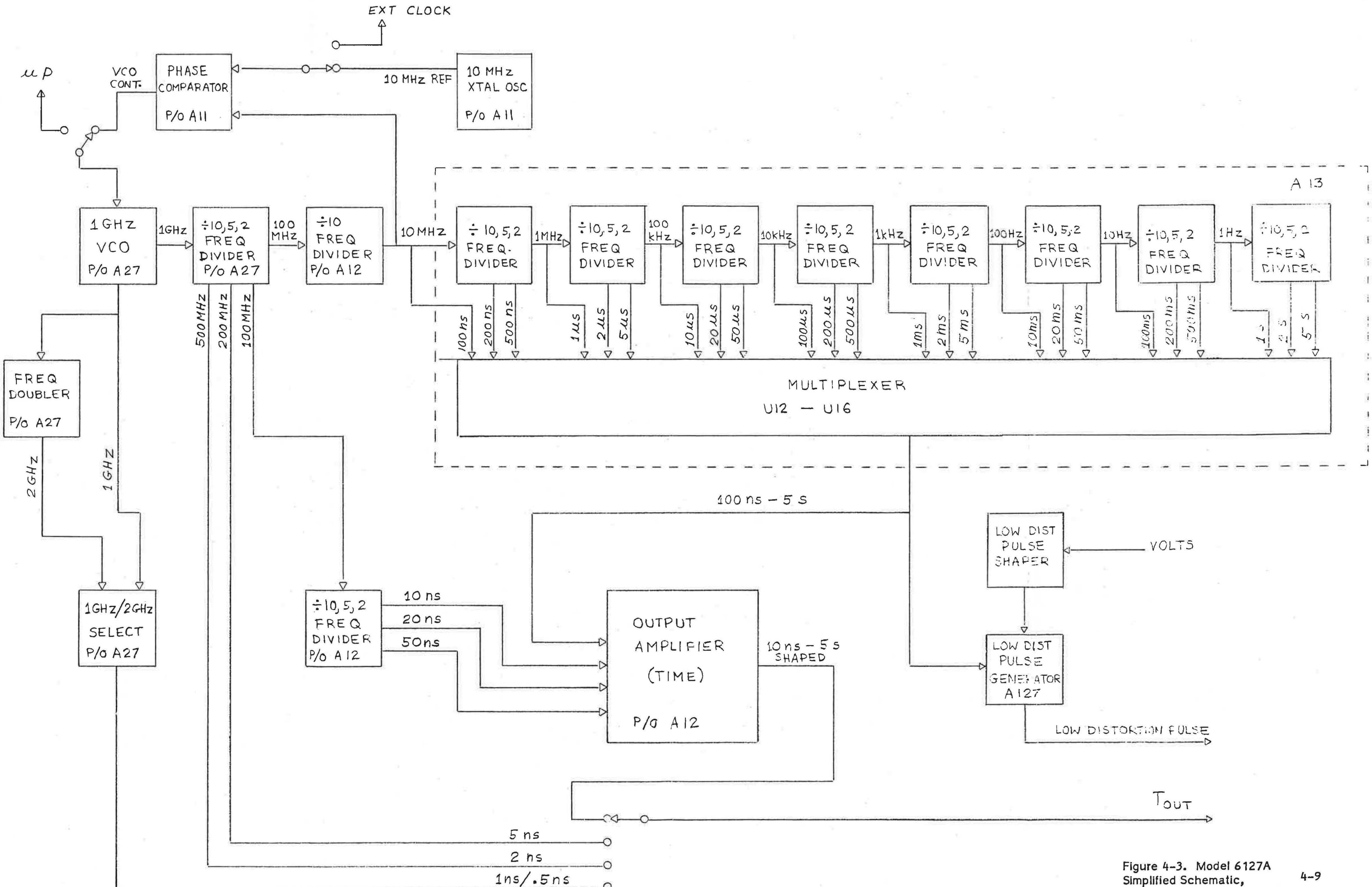


Figure 4-3. Model 6127A Simplified Schematic, Time/Div

TABLE 4-4. TIME/DIV RANGE SELECTION LOGIC (A13 ASSEMBLY)

TIME/DIV RANGE	CONTROL LINES F0	F1	F2	$\overline{F3}$	$\overline{F4}$	$\overline{F5}$	F6	F7	MULTIPLEXER OUTPUT
5 s	0	1	1	0	1	1	1	1	U16-D6
2 s	1	0	1	0	1	1	1	1	U16-D5
1 s	0	0	1	0	1	1	1	1	U16-D4
500ms	0	1	1	1	0	1	1	1	U15-D6
200ms	1	0	1	1	0	1	1	1	U15-D5
100ms	0	0	1	1	0	1	1	1	U15-D4
50ms	0	1	0	1	0	1	1	1	U15-D2
20ms	1	0	0	1	0	1	1	1	U15-D1
10ms	0	0	0	1	0	1	1	1	U15-D0
5ms	0	1	1	1	1	0	1	1	U14-D6
2ms	1	0	1	1	1	0	1	1	U14-D5
1ms	0	0	1	1	1	0	1	1	U14-D4
500us	0	1	0	1	1	0	1	1	U14-D2
200us	1	0	0	1	1	0	1	1	U14-D1
100us	0	0	0	1	1	0	1	1	U14-D0
50us	0	1	1	1	1	1	0	1	U13-D6
20us	1	0	1	1	1	1	0	1	U13-D5
10us	0	0	1	1	1	1	0	1	U13-D4
5us	0	1	0	1	1	1	0	1	U13-D2
2us	1	0	0	1	1	1	0	1	U13-D1
1us	0	0	0	1	1	1	0	1	U13-D0
500ns	0	1	0	1	1	1	1	0	U12-D2
200ns	1	0	0	1	1	1	1	0	U12-D1
100ns	0	0	0	1	1	1	1	0	U12-D0

4-53. Time Deviation. When Time deviation is selected, signal F_D goes to logic "0" and relay A11-K1 is de-energized. Voltage control of the VCO is switched from the phase comparator output of A11-U4 and connected to the analog output from DAC, U10 on Assembly A31. Digital Time deviation commands from the microprocessor result from either the IEEE-488 Bus controller (in the REM mode) or from touch key entries at the Calibrator front panel (in LOC mode). The digital % Deviaton command is compared by the microprocessor to the instantaneous deviation state and, based on the comparison, an up-dated digital instruction is issued to DAC, A31-U10. The maximum Time deviation range of -9.9% to +9.9% translates to a converted analog outpu' anging from -10 Vdc to +10 Vdc.

4-54. The analog deviation signal from op-amp A31-U11 varies the frequency of the 1 GHz VCO. Through subsequent frequency division, a 2 MHz signal is present at pin 14 of Assembly A13 connector. This 2 MHz signal shifts in frequency in direct proportion to the % Time Deviation and is applied to the Time/Volts Deviation Control, Assembly A18.

4-55. The 2 MHz deviation frequency is applied to chain dividers A18-U3, U4, U5 and compared to a 1 MHz signal divided down from the 10 MHz xtal oscillator on Assembly A11. The two signals are compared and NAND gated at A18-U2. The double-ended output is an analog signal proportional to plus or minus Time deviation. This voltage is connected through relays A18-K2 and A18-K3 to +M and -M respectively. (In Time/Div mode these relays are de-energized by default.)

4-56. The floating Time deviation signal is applied to the Display Driver Board, Assembly A117, where it becomes the input to A/D converter, A117-U3. The converted digital deviation signal is used to provide the microprocessor with digital deviation comparison information. The uP then generates the digital display data.

4-57. OUTPUT CONTROL

4-58. All of the Model 6127A Calibrator outputs share a common OUTPUT connector, J100. It is by logic control of various relays that a particular output is selected. Refer to the simplified diagram, figure 4-4.

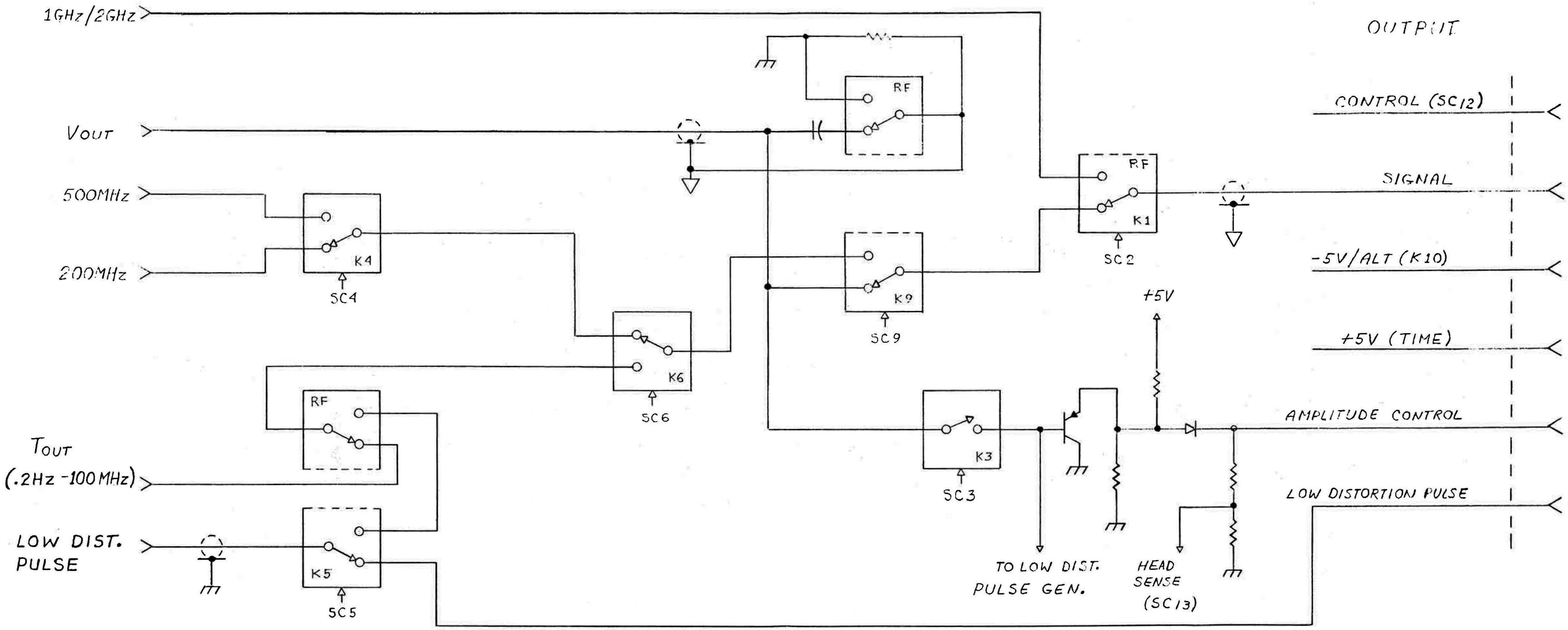


Figure 4-4. Model 6127A Output Selection

4-59. Standard Amplitude. When the STANDARD AMPLITUDE mode is selected, the V_{OUT} signal is connected through a set of de-energized contacts on rf relay A27-K9 to de-energized contacts on relay A27-K1. From the common terminal of rf relay A27-K1, the V_{OUT} signal is connected by cable to the coaxial output of the main OUTPUT connector, J100. Note that the A27-K9 does not connect the coax shield (LO) to frame ground.

4-60. Standard Time. In the STANDARD TIME mode, markers from 5 secs (0.2 Hz) to 10 ns (100 MHz) are directed through a set of normally closed contacts on rf relay A27-K5 to relay A27-K6 normally open contacts. For this frequency range, control signal SC_6 is at a logic "0" and relay A27-K6 is energized. In all Time/Div ranges control signal SC_9 is at logic "1" and this causes relay A27-K9 to be energized. The markers are then connected through the energized contacts of this relay to the de-energized contacts of relay A27-K1. Since control signal SC_2 is at logic "1" for this range of marker frequencies, relay A27-K1 remains de-energized and the marker signals are coupled to the coaxial output of the main OUTPUT connector.

4-61. When the 5 ns (200 MHz) Time markers are selected, control signal SC_4 goes to logic "1" energizing relay A27-K4. This connects the signal to the normally closed contacts of relay A27-K6. For the 5 ns (200 MHz) Time markers, control signal SC_6 is at logic "1" also and relay A27-K6 is de-energized. This connects the signal through to a set of normally open contacts on rf relay A27-K9. Since the STANDARD TIME mode is selected, control signal SC_9 remains at logic "1" maintaining relay A27-K9 in its energized state. For all markers except 1 ns (1 GHz) and 500 ps (2 GHz), control signal SC_2 is at logic "0" keeping relay A27-K1 de-energized and connecting the 5ns (200 MHz) markers through to the coaxial output of the main OUTPUT connector. For the 2 ns (500 MHz) Time markers, all control logic remains the same as for 5 ns (200 MHz) except for SC_4 which goes to logic"0", de-energizina relay A27-K4.

4-62. When either 1 ns (1 GHz) or 500 ps (2 GHz) Time markers are chosen, control signal SC_2 becomes a logic "1". This energizes relay A27-K1 and couples either of these markers to the coaxial output of main OUTPUT connector J100.

4-63. Low Distortion Pulse. The LOW DISTORTION PULSE from Assembly A127 is connected to a common terminal on rf relay A27-K5. When this mode is selected, control signal SC_5 becomes logic "1" and relay A27-K5 is energized. The Low Distortion Pulse signal is then connected through both sets of closed contacts on A27-K5 to A27-K6. Because control signal SC_6 is at logic "0" in this mode, relay A27-K6 is also energized. Control signal SC_9 is at a logic "1", causing relay A27-K9 to be energized. And as a result, the Low Distortion Pulse signal is passed through to the coaxial output on the main OUTPUT connector, J100.

4-64. Fast Risetime Pulse. When the FAST RISE PULSE mode is selected, the Low Distortion Pulse signal is coupled through de-energized relay A27-K5 to pin 3 of the main OUTPUT connector, J100. Control signal SC_3 is at logic "1", energizing relay A27-K3 and thus providing the Amplitude Control signal at J100-pin 4. Both of these signals are inputs to circuitry in the Model 61271A head (Assembly A41) that generates the Fast Risetime Pulse. The output of the Fast Risetime Pulse circuit is connected to the normally open contact of relay A41-K1. Because FAST RISE PULSE mode has been selected, control signal SC12 is at logic "1" and control signal SC12 is at logic "0". This energizes relay A41-K1, presenting the Fast Risetime Pulse signal to output BNC connector A41-P1.

4-65. PROGRAM CONTROL

4-66. Central Processor Control. The central processing unit (CPU) and its memory are located on the CPU Control Logic board, Assembly A30. Refer to the simplified diagram, figure 4-5, for the discussion of program control.

4-67. The microprocessor or CPU (A30-U10) controls the functions of the other components in the Model 6127A. Upon command, the microprocessor fetches instructions from memory, decodes the desired operation and executes these instructions. Commands may be given to it by either the front panel touch-key control (Local) or by a controller via the IEEE-488 bus (Remote). Both the CPU and its memory have a 16-bit address bus and an 8-bit bi-directional data bus.

4-68. Memory. Temporary memory storage for the various programming operations are provided by the random access memory (RAM) in A30-U1. The CPU can both store and retrieve data in this memory depending on the status of the read/write control line. The read only memory (ROM) contained in A30-U2, U3, U4 consists of pre-programmed firmware instructions necessary to operate the calibrator.

4-69. The Peripheral Interface Adapter (PIA), A30-U18 is used to communicate with the front panel touch key matrix. Information is sent to the front panel via a 5-bit data line and received by a 4-bit data line after processing by 10-to-4 line priority encorder, A30-U17.

4-70. SIGNAL CONTROL

4-71. Control of the Model 6127A internal logic is handled through PIA A31-U9 located on the Signal Control Decoder board, Assembly A31. Information is exchanged between it and the CPU by the 8-bit bi-directional data bus. Control of the 6127A internal logic is by a 4-bit data line, through hex buffer A31-U7, in combination with a second 4-bit data line through the 1-of-16 line decoder, A31-U8.

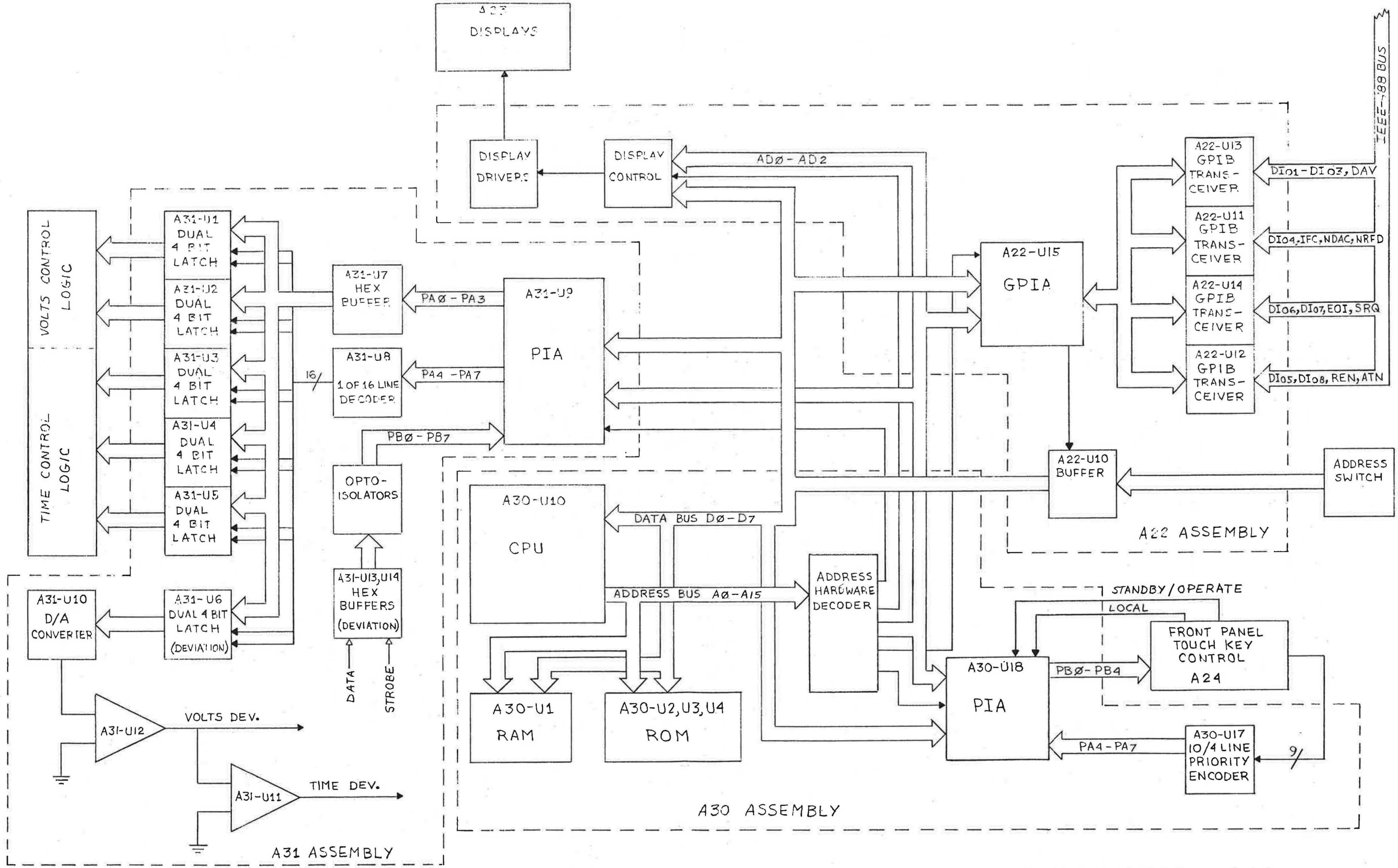


Figure 4-5. Model 6127A Program Control, Simplified Diagram

4-72. This data is then applied to the dual 4-bit latches, A31-U1 to U5. The data outputted from latches A31-U1 and A31-U2 controls Volts/Div logic while that from A31-U3, U4 and U5 controls the Time/Div logic.

4-73. Decoded data is also directed through latch A31-U6 to the D/A converter A31-U10. This data represents either Volts deviation or Time deviation analog current information. Operational amplifier A31-U12 converts the analog current signal to a voltage signal that may vary from 0 to -10 Vdc. This represents a voltage deviation range of -9.9 to +9.9%. For Time/Div, the signal is further processed by operational amplifier A31-U11. This output signal ranges from -10 to +10 Vdc and is equivalent to -9.9 to +9.9% time deviation.

4-74. For both Volts/Div and Time/Div, the analog deviation signal from Assembly A18 is applied to the A/D Converter, Assembly A117. It is converted to BCD data and optically coupled to P1A A31-U9 to be fed back as digital data to the microprocessor on Assembly A31. It is then compared with the selected deviation. Computations are performed by the CPU and the DAC word is corrected such that the % Deviation displayed represents the real percentage error of the UUT.

4-75. BUS CONTROL

4-76. The General Purpose Interface Adapter (GPIA), A22-U15 on Assembly A22 provides the interface between the IEEE-488 Bus and the Calibrator. This permits the Model 6127A to communicate with a controller on the General Purpose Interface Bus (GPIB). The 6127A CPU receives, processes and sends messages to the bus via this GPIA.

4-77. Bus tranceivers A22-U11, 12, 13, 14 buffer the bi-directional data between the GPIA and IEEE-488 Bus. They contain three-state elements (driver/receivers) and the direction of data flow is controlled by disabling the undesired elements (driver or receivers).

WARNING

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

CAUTION

Semi-conductor devices using metal oxide junctions are liable to suffer destructive damage from electrostatic discharges. Such devices appear with several names, such as MOS, MCMOS, CMOS, MOSFET, IGET, detector diode, etc. Whenver these devices or assemblies including such devices are handled, the operator must be grounded, and only grounded soldering irons can be used safely. To facilitate identification of assemblies containing metal oxide devices, Ballantine pw boards containing such devices are marked with this symbol:

CALIBRATION AND MAINTENANCE

5-1. INTRODUCTION

5-2. This section contains information for calibrating and maintaining the Model 6127A Oscilloscope Calibrator. Included are performance assurance checks, calibration procedures, preventive maintenance checks, and troubleshooting instructions. The test equipment and special tools required to check, maintain and calibrate the Model 6127A are listed in table 5-2.

5-3. PERFORMANCE ASSURANCE CHECKS.

The performance assurance checks described in the following paragraphs are "in-cabinet" tests that compare the Calibrator with the applicable specifications. They are intended to be used by incoming inspection to determine the acceptability of a newly received instrument and do not check every facet of calibration. These performance checks should be performed in the order listed before any attempt is made to calibrate the instrument. For optimum performance, allow the Model 6127A approximately 30 minutes warmup time. All performance checks and calibration should be performed at 22°C ± 2°C. A Test Record Form is provided at the end of this section for recording the results. This form may be duplicated for future checks.

5-4. Power Line Voltage Setting. The 6127A power transformer primary winding, as supplied, is set for operation from 120 Vac. The performance checks which follow reference 120 V as the nominal voltage setting for the 120 V primary power line voltage. For that setting as well as other available settings refer to table 5-1.

Table 5-1. Power Line Voltage Settings

Line Voltage	Nominal Midline	Low Line	High Line
100 Vac	100 Vac	90 Vac	108 Vac
120 Vac	120 Vac	108 Vac	128 Vac
220 Vac	220 Vac	198 Vac	238 Vac
240 Vac	240 Vac	216 Vac	259 Vac

5-5. Calibrator Self Test Check

a. Connect the Model 6127A Calibrator to the ac line by use of a Variac. Monitor the Variac settings using a Ballantine Model 3620A true rms voltmeter or equivalent.

b. Adjust the Variac for a nominal midline voltage reading (120 Vac rms) on the voltmeter.

c. Push the 6127A POWER switch in to the on position.

d. Observe that both the green POWER lamp and red SELF TEST lamp illuminate and that the Calibrator executes its self tests. In sequence, observe that no error indications appear. All of the annunciators illuminate simultaneously, all of the segments in all of the displays will illuminate for about 10 seconds and finally, prompt lines will be displayed in all of the windows and the SELF TEST lamp will extinguish.

e. Re-initiate the self-test by pressing the Time/Div key pad and then pressing the CLEAR touch key twice.

f. Again observe that the Calibrator executes its self tests.

g. Release the 6127A POWER switch out to the off position.

h. Adjust the Variac to the low line voltage listed in table 5-1 and repeat step d.

i. Adjust the Variac to the high line voltage listed in table 5-1 and repeat step d.

5-6. Oscillator Frequency Accuracy.

a. Interconnect the Calibrator and test equipment as shown in figure 5-1.

b. Select TIME/DIV Mode, 100 ns TIME/DIV-FREQUENCY.

c. Connect the 61271A OUTPUT BNC to the A input of the frequency counter (Ballantine Model 5500B, Option 35 - or equivalent). Use a 50 feed-thru termination at the counter end of the connecting cable.

d. Adjust the line voltage Variac to midline.

NOTE

If available, use a 1 MHz atomic frequency standard or a WWV receiver as a reference for the 5500B to ensure absolute accuracy of the measurement.

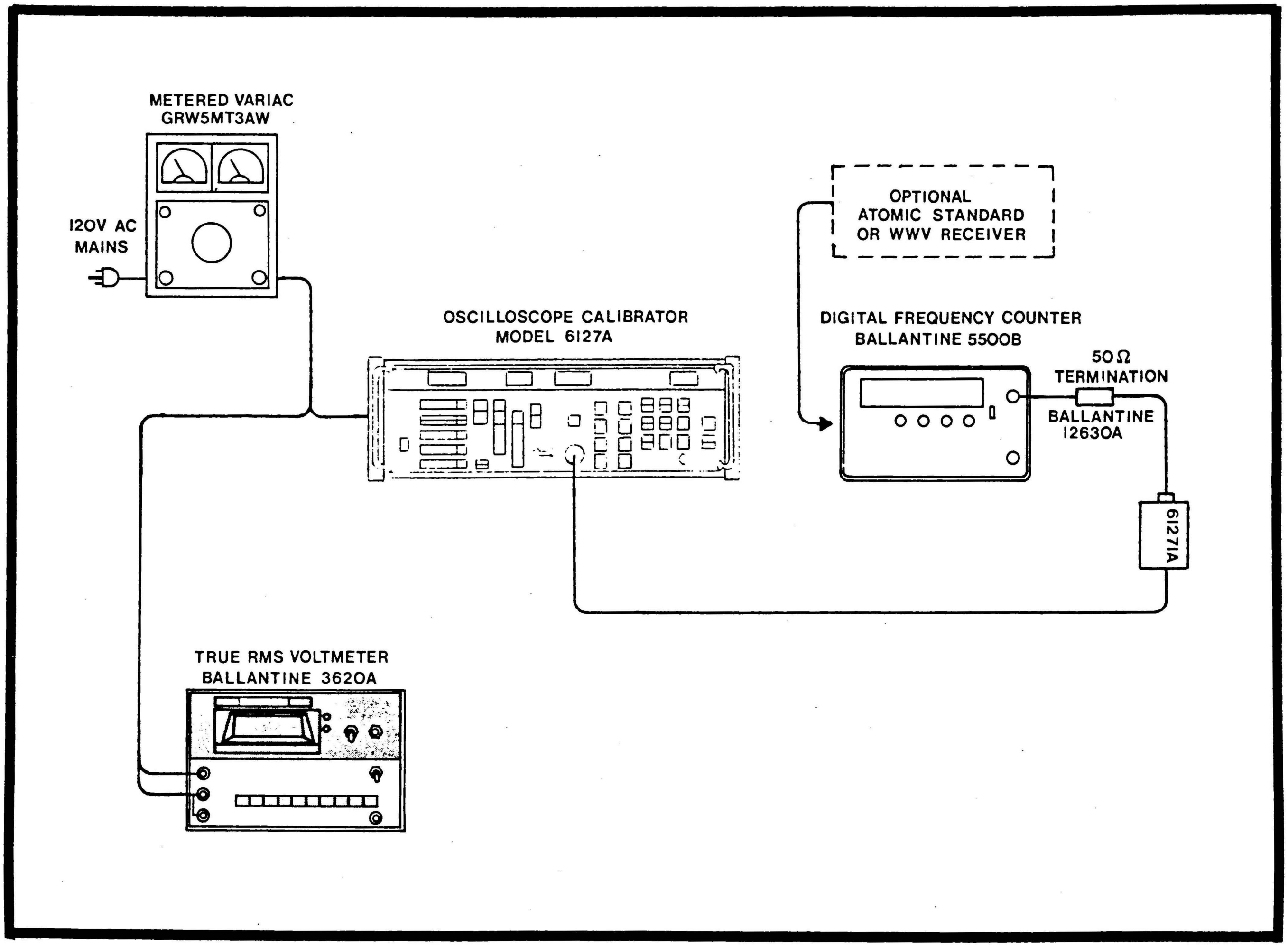


Figure 5-1. Clock Frequency Check, Bench Set-Up

e. Allow 20 minutes warm-up then measure the 100 ns (10 MHz) frequency. Adjust the frequency counter trigger level to obtain a stable count. The counter must read within the range of 9,999,900 to 10,000,100 Hz. Record this reading in the Test Record Form.

f. Set the line voltage to low line (108 Vac). The counter should display a reading between 9,999,825 and 10,000,175 Hz.

g. Vary the line voltage to 128 Vac (high line) and note the frequency counter reading. It should read between 9,999,825 and 10,000,175 Hz.

h. Reset the variac to nominal midline (120 Vac).

5-7. TIME/DIV Output Check

a. Interconnect the 6127A Calibrator and test equipment as shown in figure 5-2.

b. Select Time/DIV Mode, 10 ns TIME/DIV-FREQUENCY.

c. Connect the 61271A OUTPUT BNC to the CH1 input of the oscilloscope (Ballantine Model 1052A or equivalent). Connect a 50 Ω feed-thru termination at the oscilloscope end of the connecting cable.

d. Press the STANDBY/OPERATE touch key.

e. Adjust the oscilloscope controls as follows:

CH1 VOLTS/DIV	.5 V
CH1 Coupling	DC
CH1 POSITION	Centered
CH2 POSITION	OFF
A TIME/DIV	50 ns
X10 mag	on
A Trigger SOURCE	CH1 +
A Trigger COUPLING	AC

f. Adjust Time Base A trigger level and trace positioning controls to position a stable display on the oscilloscope.

TABLE 5-2. TEST EQUIPMENT

EQUIPMENT NO.	NOMENCLATURE	USE AND APPLICATION	MINIMUM SPECIFICATIONS
Ballantine Model 1032A	Oscilloscope	General Fault Finding	5 mV, dual trace, 8 x 10 cm graticule, Dc to 25 MHz; rise time < 17 ns. Signal delay. Sweep time < 50 ns/cm to 1 s/cm.
Ballantine Model 3028B	Multimeter	Fault finding; power supply voltage and resistance checks.	Dc, 1 mV to 1 kV. Ac, 1 mV to 500 V, 10 Hz to 100 kHz rms responding. Ohms, 0.1 Ω to 20 MΩ, 0.2 V to 2 V measuring voltage. Ac amperes, 100 mA to 1A. Dc amperes, 100 mA to 1A. 3-1/2 digit display, battery and line operation.
Ballantine Model 3620A	Ac/Dc True RMS Digital Voltmeter	Line voltage measurement	4-1/2 digit display. 10 mV to 1 kV full scale. 1 uV resolution. Dc and ac to 1 MHz, dc coupled true rms response. Nominal accuracy 0.2%. Guarded and floating input.
Ballantine Model 5500B (with Option 35)	Digital Frequency Counter	Frequency calibration and check of markers to 1 GHz (1 ns). Check of TIME DEVIATION range.	1 GHz eight digit counter with high-stability clock (5 parts in 10^7 per day) and NBS frequency traceability. External clock input capability. Sensitivity better than 25 mV rms at 500 MHz and 100 mV at 1 GHz. Period measurement.
Fluke Model 885AB or 887AB	Differential Voltmeter	Dc Voltage Calibration	Dc; 1 volt to 300 volts with 10 uV resoulution. Accuracy 0.02%.
Ballantine Model 9635M	Digital Voltmeter	Dc Voltage Calibration	0.1% accuracy, measure to 300 Vdc.
Ballantine Model 1052A	Oscilloscope	Performance Checks	100 MHz bandwidth, 5mV/div vertical sensitivity.
Ballantine Model 12620A	Adapter	Test Equipment connections.	BNC female to General Radio GR-874 connector.
Ballantine Model 12625A	Adapter	Test Equipment connections.	BNC male to General Radio GR-874 Connector.
Ballantine Model 12630A	Termination	Termination, 50 ohms, 2 watts.	BNC/BNC feed-thru, 50 ohms, 2 watts.
Ballantine Model 12249D.	Cable Assembly 8 in.	Test equipment connections.	RG-58C/U cable with male BNC terminations.

TABLE 5-2. TEST EQUIPMENT (Cont'd)

EQUIPMENT NO.	NOMENCLATURE	USE AND APPLICATION	MINIMUM SPECIFICATIONS
General Radio Type GR-874 (Ballantine Model 12626A)	Attenuator, 20 dB	Input attenuator for high sensitivity sampling oscilloscope.	50 ohm, 20 dB attenuator, dc to 1 GHz, flatness 0.1%, dc to 100 MHz.
General Radio Type W5MT3A	Metered Variac	Line Voltage control; metered current and voltage.	(As required.)
Hewlett-Packard Model 651B or 652A	Test Oscillator	Test external clock input signal source.	10 Hz to 10 MHz (sinewave). 50 ohm output to 2 V rms. Distortion < ± 0.25%.
JFD Part No. 5284	Adjustment Tool	Adjustment of variable capacitors, resistors, and inductors.	Low capacity alignment tool with 3/32 inch screwdriver blade and 5/64 hexagon drive.
Rhode & Schwarz Model XSAM or Model XSA/XKA*	Frequency Standard, Atomic or WWV Receiver	To calibrate clock frequency.	Rubidium frequency standard, 1 MHz, or WWV receiver/comparator, 1 MHz.
Tektronix 7000 Series with 7S11 Sampling Unit (S2 Head) and 7T11 Time Base Plug-ins.	Oscilloscope	Check fast rise time (< 3 ns) of output square wave, performance checks.	Frequency response to 4 GHz. Rise time < 75 ps. Internal and external triggering beyond 500 MHz. 50 ohm input. Sensitivity better than 50 mV/cm. Sweep time < 2 ns/cm to 0.1 us/cm.
UG-274A/U (Ballantine Model 12619A)	Adapter	Test equipment connections.	BNC tee adapter.
	Termination	Provide a precise 50 Ω termination.	50 Ω ± 0.01%
Ballantine Model 12617A	Adapter	Test equipment connections.	BNC female to dual banana adapter.

g. Observe that a marker pulse occurs on each vertical line of the CRT graticule.

h. Select continuously lower frequency TIME/DIV markers in a 5,2,1 sequence-down to 5 sec, as shown on the Test Record Form, and observe that the pulse amplitude displayed is at least 1 V (2 div). Continuously change the oscilloscope sweep range to maintain a display of one marker pulse on each vertical line of the CRT graticule.

NOTE

For time base speeds slower than 50 ns, do not use the X10 magnifier.

5-8. Trigger Output Check

a. Refer to the equipment set-up of the previous check, paragraph 5-7. Disconnect the 61271A Head from the 50 Ω termination.

b. Connect a BNC-to-BNC cable from the 6127A TRIGGER OUTPUT to the oscilloscope CH1 input BNC through the 50 Ω termination.

c. Press the X1/OFF touch key on the 6127A and observe that the X1 annunciator illuminates.

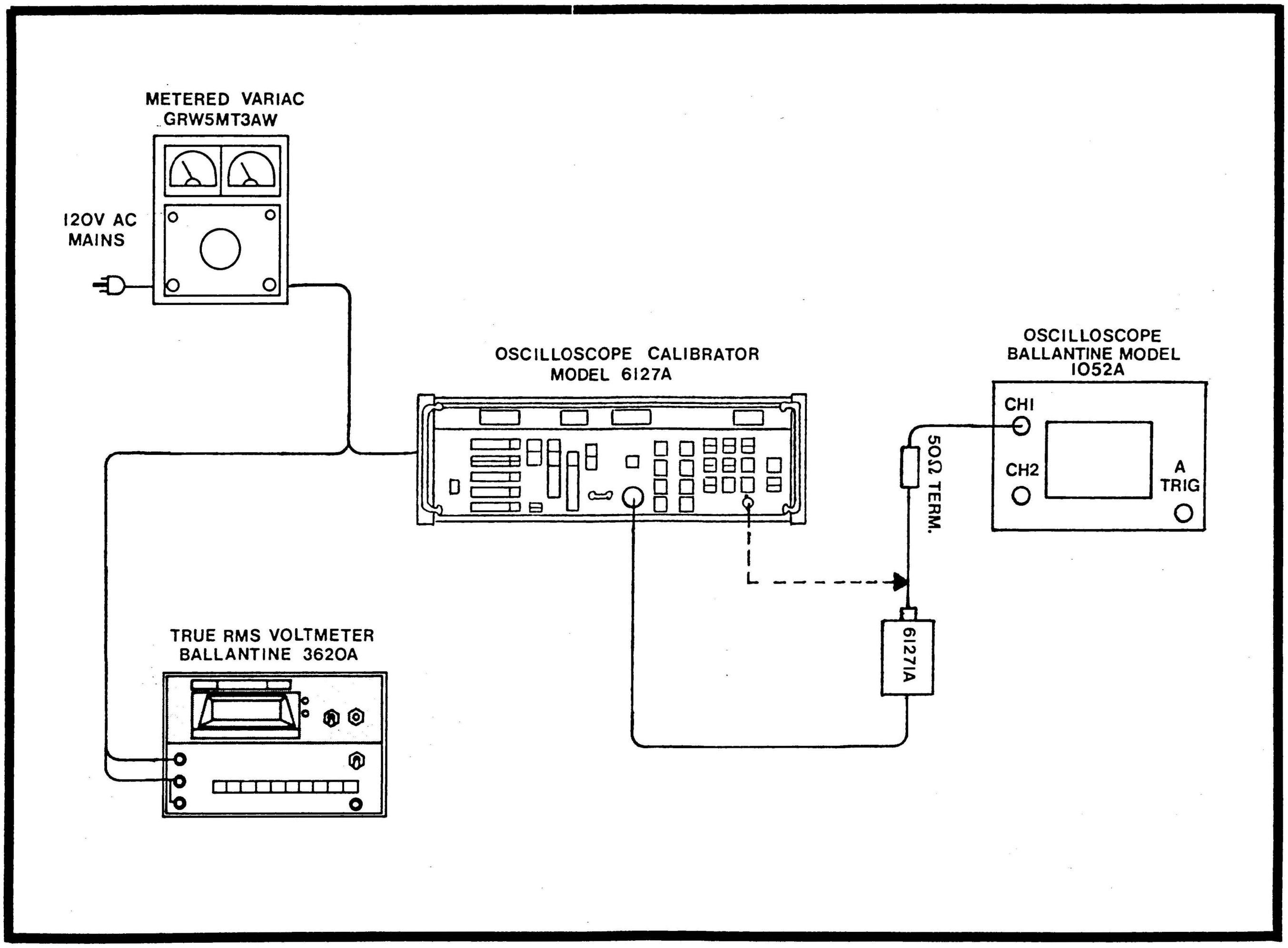


Figure 5-2. Time/Div and Trigger Amplitude Check, Bench Set-Up

d. Set the oscilloscope Time Base A to 0.1 us/div and switch the X10 magnifier off.

e. Observe a square wave display on the oscilloscope. The period of each complete square wave must occupy 1 division and the amplitude must be at least 1 V (2 div).

f. Press the ÷ 10 touch key on the 6127A and change the oscilloscope time base to 1 us/div.

g. Observe that the oscilloscope display is the same as step e.

h. Press the ÷ 100 touch key on the 6127A and change the oscilloscope time base to 10 us/div.

i. Observe that the oscilloscope display is the same as step e.

5-9. Time Deviation Check

a. Connect the equipment as shown in Figure 5-1.

b. Select the TIME/DIV mode, 10 us TIME/-DIV-FREQUENCY.

c. Press the STANDBY/OPERATE touch key.

d. Observe a reading of 100,000 Hz (± 50 Hz) on the frequency counter.

e. Press the DEV touch key.

f. Press the Δ (increment) touch key and observe that the LO annunciator is illuminated. Maintain pressure on the key while observing that the display in the DEVIATION window increments continuously in 0.5% steps up to a maximum of -9.9%.

g. Select the period average mode on the frequency counter and observe a reading of 11.10 (± 0.06) us.

h. Press the ∇ (decrement) touch key and observe that the HI annunciator is illuminated. Maintain pressure on the key while observing that the display in the DEVIATION window decrements continuously in 0.5% steps down to a maximum of +9.9%.

i. Observe a reading of 9.01 (± 0.06) us on the frequency counter.

5-10. VOLTS/DIV Output (High Z) Check

a. Connect the equipment as shown in figure 5-3. Select battery power mode for the voltmeter. This check is applicable for a 10 M Ω load on the 61271A Head.

b. Select VOLTS/DIV mode, 20 V AMPLITUDE/DIV, 10 DIVISIONS, POS DC.

c. Set the differential voltmeter to the 1000 V range and 100 mV null sensitivity. Set the dials to + 200.00.

d. Press the STANDBY/OPERATE touch key.

e. Observe the null meter reading on the differential voltmeter. It should be less than ± 500 uV.

f. Refer to the Test Record Form and continue with the checks, down to 10 mV, as shown on the form.

NOTE

Always measure the dc offset voltage by observing the null meter reading in the STANDBY mode. Algebraically add this thermal voltage to all readings under 100 mV to obtain the exact output calibration voltage.

g. For optional output verification from 5 mV/div to 10 uV/div, select 1 kHz FREQUENCY on the 6127A and observe squarewave on an oscilloscope.

h. Press the STANDBY/OPERATE touch key to return the 6127A Calibrator to the STANDBY mode.

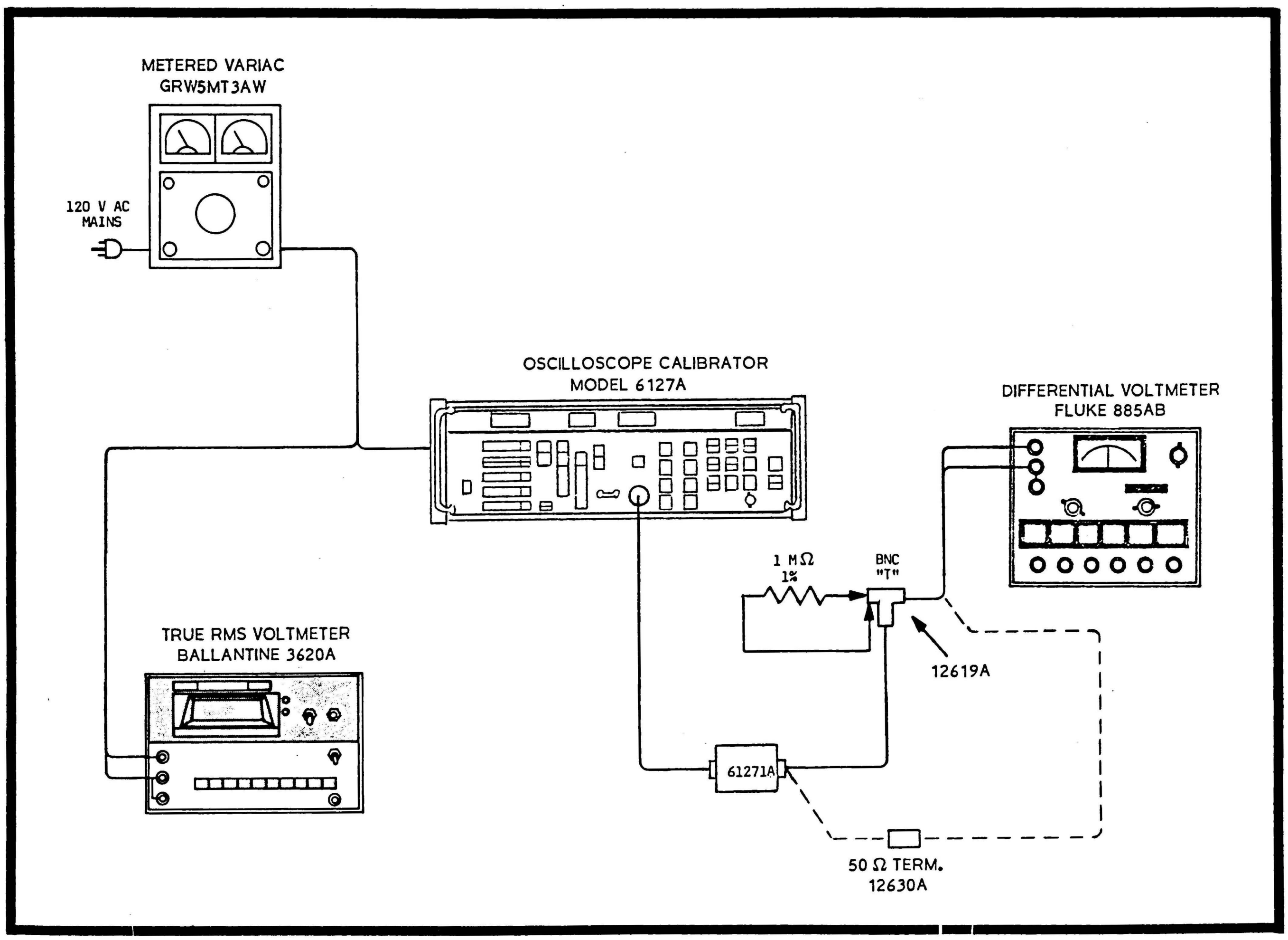


Figure 5-3. VOLTS/DIV Output Check, Test Set-Up

5-11. VOLTS/DIV Output (50Ω) Check

a. Connect the equipment as detailed in step 5-10.a.

b. Connect a precision 50Ω ± 0.1 % termination between the 61271A OUTPUT BNC and the differential voltmeter.

c. Select 1 V AMPLITUDE/DIV, 5 DIVISIONS, POS DC and precision 50 Ω LOAD.

d. Set the differential voltmeter to the 10V range and select a null sensitivity of 0.1V. Set the dials to + 5.000.

e. Press the STANDBY/OPERATE touch key.

f. Refer to the Test Record Form and continue with the checks, down to 10 mV, as shown on the form.

NOTE

Always measure the dc offset voltage by observing the null meter reading in the STANDBY mode. Algebraically add this thermal voltage to all readings under 100 mV to obtain the exact output calibration voltage.

g. For optional output verification from 5 mV to 10 uV/DIV select 1 kHz FREQUENCY on the 6127A and observe squarewave on an oscilloscope.

h. Press the STANDBY/OPERATE touch key to return the 6127A Calibrator to the STANDBY mode.

5-12. Volts Deviation Check

a. Connect the equipment as detailed in step 5-10.a. (10 MΩ load).

b. Select 10 V AMPLITUDE/DIV, 10 DIVISIONS and POS DC.

c. Set the differential voltmeter to the 1000 V range and 0.1 V null sensitivity. Set the dials to +110.988 volts.

d. Press the STANDBY/OPERATE touch key.

e. Press the DEV touch key.

f. Press the △ (increment) touch key and observe that the LO annunciator is illuminated. Maintain pressure on the key while observing that the display in the DEVIATION window increments in 0.5% steps down to a maximum of -9.9%.

g. Note that the differential voltmeter null meter indication is less than ± 500 mV.

NOTE

To return % DISTORTION to a reading of 0.0%, press the DEV touch key.

h. Press the ▽ (decrement) touch key and observe that the HI annunciator is illuminated. Maintain pressure on the key while observing that the display in the DEVIATION window decrements in 0.5% steps up to a maximum of +9.9%.

i. Set the dials on the differential voltmeter to +90.992 volts.

j. Note that the differential voltmeter null meter indication is less than ± 500 mV.

5-13. LOW DISTORTION PULSE Output Check (High Z)

a. Interconnect the Calibrator and test equipment as shown in figure 5-4. Connect the 61271A OUTPUT BNC directly to the oscilloscope CH1 input BNC.

b. Select LOW DISTORTION PULSE mode, 10 V AMPLITUDE/DIV, 4 DIVISIONS and 100 kHz TIME/DIV-FREQUENCY.

c. Set the oscilloscope to 5V/div vertical sensitivity, dc coupled, + external trigger and 0.01 us/div A sweep speed.

d. Press the STANDBY/OPERATE touch key.

e. Obtain a stable display of a positive going edge of the square wave on the oscilloscope.

f. Observe that the leading edge of the waveform is nominally 8 divisions in amplitude peak-to-peak and the overshoot at the top of the leading edge does not exceed 3%.

g. Observe that the 10% to 90% risetime of the positive-going edge is no more than 100 ns.

h. Press the STANDBY/OPERATE touch key to return the 6127A Calibrator to the STANDBY mode.

5-14. LOW DISTORTION PULSE Output Check (50Ω).

a. Connect the equipment as shown in figure 5-4. Connect the 61271A Head to the oscilloscope CH1 input through a precision 50 Ω termination.

b. Select LOW DISTORTION PULSE mode, 100 mV AMPLITUDE/DIV, 4 DIVISIONS, 50 Ω LOAD and 1 MHz TIME/DIV-FREQUENCY.

c. Set the oscilloscope to 50 mV/div vertical sensitivity, dc coupled, + external trigger and 0.01 us/div A sweep speed with X10 magnifier pulled out.

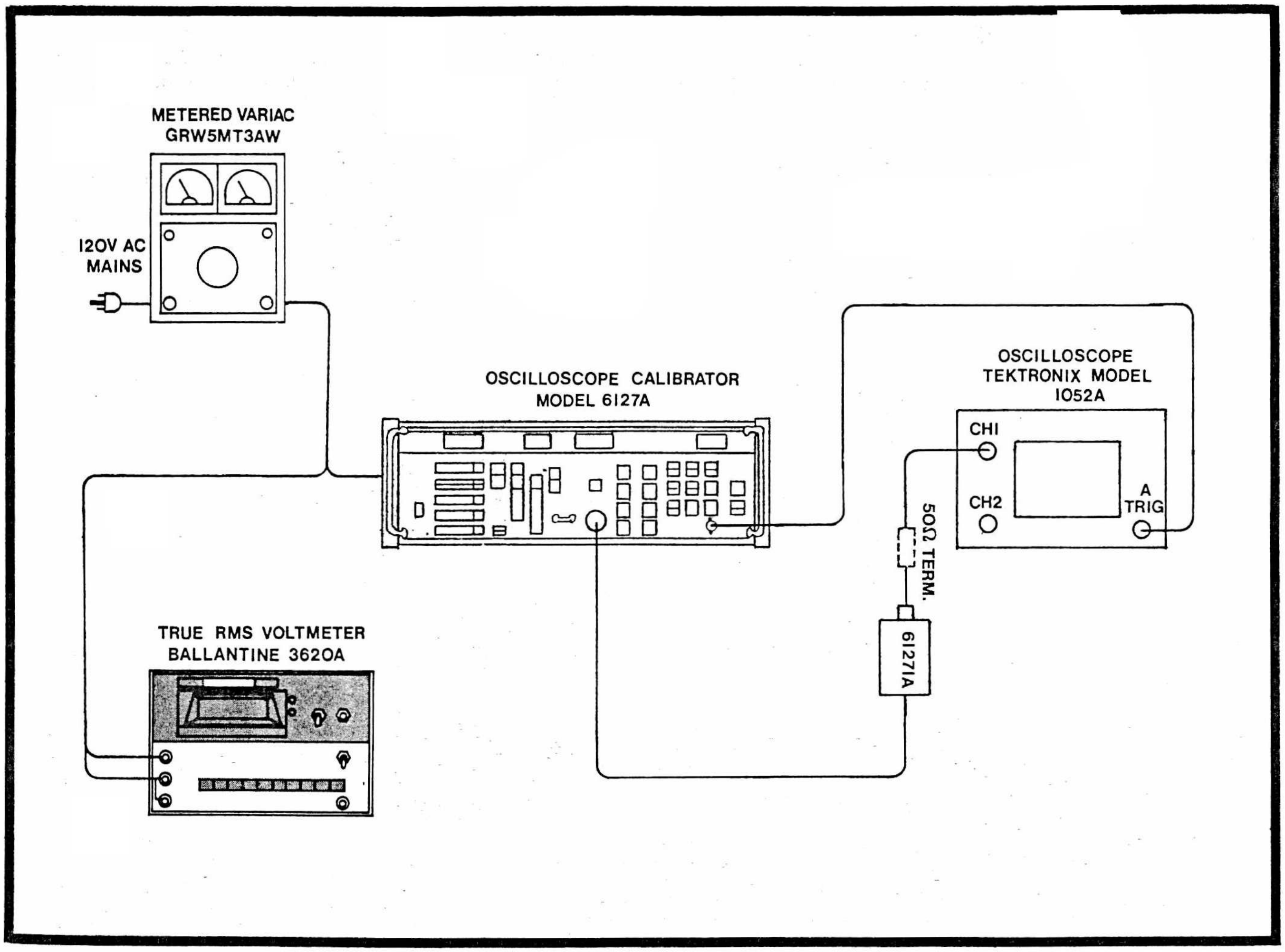


Figure 5-4. LOW DISTORTION PULSE Output Check, Test Set-Up

d. Press the STANDBY/OPERATE touch key.

e. Obtain a stable display of a positive going edge of the square wave on the oscilloscope.

f. Observe that the leading edge of the waveform is 8 divisions in amplitude peak-to-peak and the overshoot at the top of the leading edge does not exceed 3%.

g. Observe that the 10% to 90% risetime of the positive-going edge is no more than 2 ns.

h. Press the STANDBY/OPERATE touch key to return the 6127A Calibrator to the STANDBY mode.

5-15. FAST RISE PULSE Output Check

a. Connect the equipment as shown in figure 5-5. Connect the 61271A Head to the sampling oscilloscope through the BNC to GR-874 adapter.

b. Select FAST RISE PULSE mode, 100 kHz TIME/DIV-FREQUENCY.

c. Select 100 ps/div and internal triggering on the oscilloscope.

d. Obtain a stable display of a positive going edge of the square wave on the screen of the oscilloscope, as shown in figure 5-6.

e. Observe that the leading edge of the waveform displayed is at least five divisions peak-to-peak.

f. Observe that the overshoot of the leading edge is no greater than 3% of the peak-to-peak value.

g. Observe that the 10% to 90% rise time of the positive going edge is less than 200 ps.

h. Activate the % DEVIATION by pressing the DEV touch key pad.

i. Press the Δ increment key pad until a display of +9.9% (HI) deviation is indicated. Observe that the amplitude of the fast rise pulse has been increased to about 5.5 divisions.

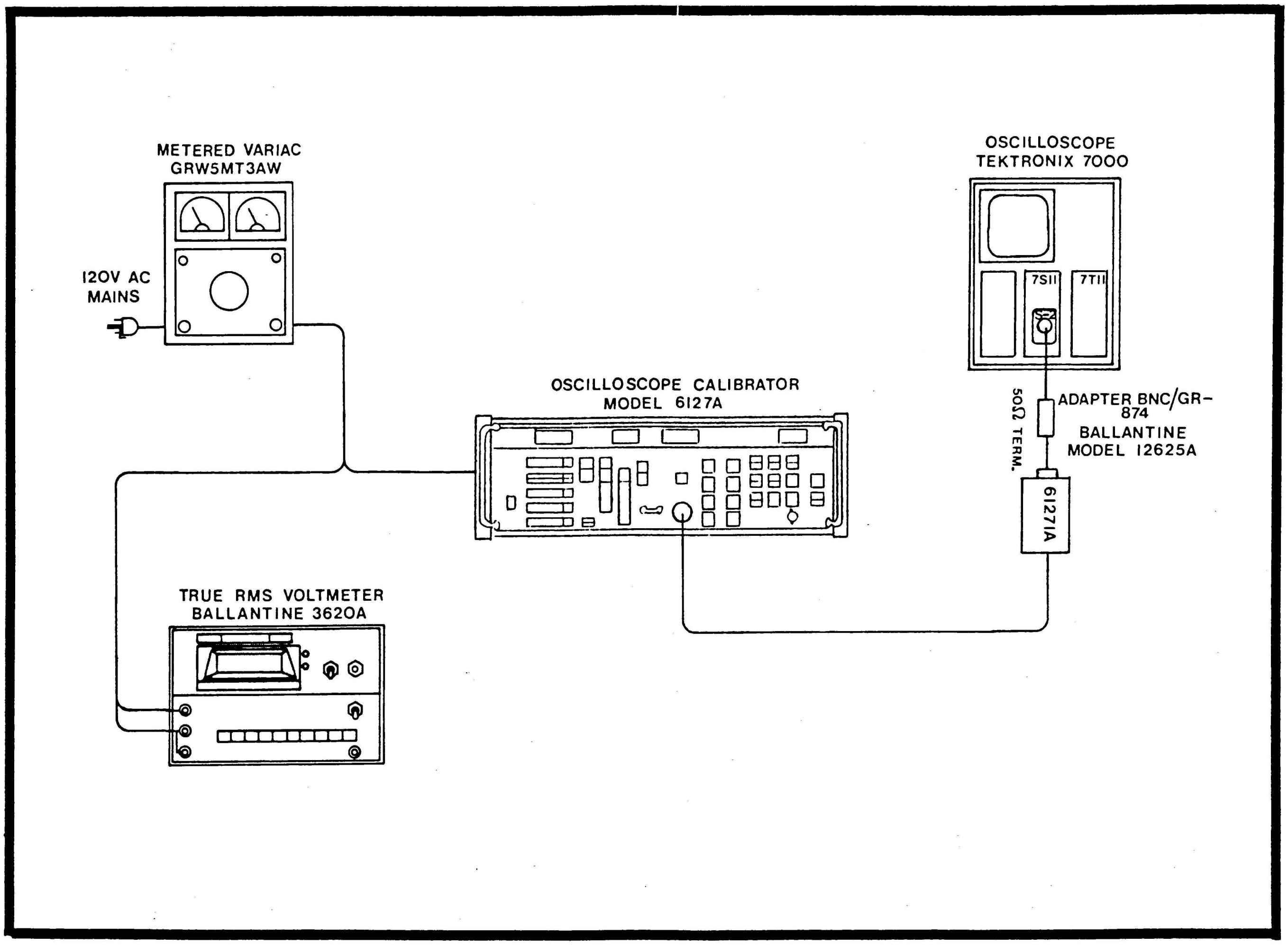


Figure 5-5. FAST RISE PULSE Output Check, Test Set-Up

j. Press the ∇ decrement key pad until a display of -9.9% (LO) deviation is indicated. Observe that the amplitude of the fast rise pulse has been decreased to about 4.5 divisions.

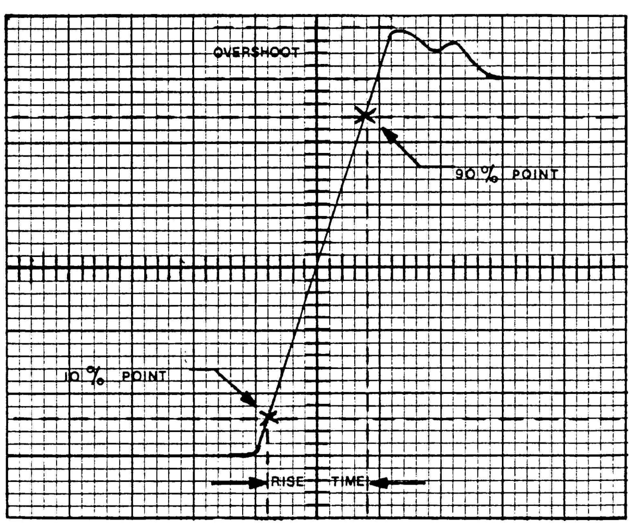


Figure 5-6. Determining Risetime

5-16. MILLIAMPERES/DIV Output Check

a. Connect the equipment as shown in figure 5-7.

b. Select MILLIAMPERES/DIV mode, 5 mA AMPLITUDE/DIV, 10 DIVISIONS and 1 kHz TIME/-DIV-FREQUENCY.

NOTE

Initially both mode annunciators will illuminate unless instrument was previously in VOLTS/DIV Mode.

c. Select 10 mV/div on the oscilloscope CH1 vertical input attenuator and set the oscilloscope time base A to .5 ms/div.

d. Press the STANDBY/OPERATE touch key.

e. Observe the oscilloscope display. It should be a squarewave having a peak-to-peak edge amplitude of five divisions and show five complete cycles of the signal (for a current probe having 1 milliamp/millivolt sensitivity.

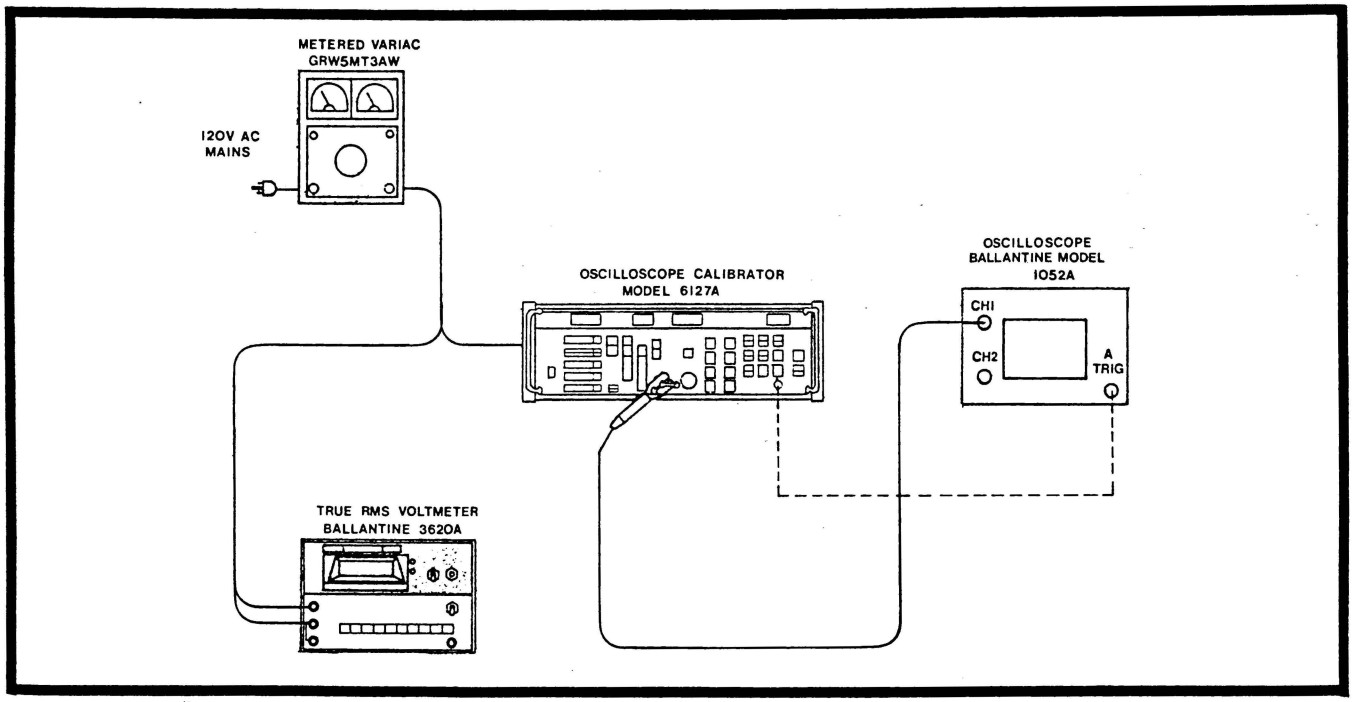


Figure 5-7. MILLIAMPERES/DIV Output Check, Test Set-Up

f. Press the STANDBY/OPERATE touch key to return the 6127A Calibrator to the STANDBY mode.

5-17. CALIBRATOR COMPARATOR CHECK

a. Connect the equipment shown in figure 3-8. Be sure to use the 61272A Amplitude Comparator Head with the 6127A.

b. Set the 6127A to CALIBRATOR mode. Note that the VOLTS/DIV and CALIBRATOR annunciator lamps are lit and 1 kHz FREQUENCY is displayed. The red UUT SELECTED indicator on the 61272A head should also be lit.

c. Note the output amplitude of the Scope Calibrator and set the 6127A VOLTS/DIV to the same amplitude. Select 1 DIV unless the Scope Calibrator signal is not in the normal 1,2,5 sequence. If necessary, use the 6127A DIV selection as a multiplier for the VOLTS/DIV selection to obtain 61272A output equal to that of the Scope Calibrator signal.

d. Set the Scope input to DC coupling and VOLT/DIV to one fifth (or sixth) the value of the Scope Calibrator. Set the time base to 10 us/DIV. Free run the Scope time base without triggering and observe two or three horizontal lines on the Scope. Two lines will appear if the Scope Calibrator signal and the 6127A output amplitude are matched.

e. Select DEVIATION and observe that the three lines can be merged into two lines or the upper of the two lines spread apart when using 6127A DEVIATION.

f. Select UUT/CALIB and push the key pad several times and note that the red lamp on the 61272A is lit in UUT mode and extinguished in CALIB mode.

g. Disconnect the cable from the UUT CALIBRATOR BNC input on the 61272A head. Set the 6127A to ALT MODE with the red indicator on the 6127A lit, showing that the UUT CALIBRATOR BNC is connected to the output BNC. Connect an ohm meter across the UUT CALIBRATOR INPUT BNC on the 6127A. Observe an open circuit, then press the 50 ohm LOAD touch key pad on the 6127A and read 50 ohm (± 0.2 ohm) on the ohm meter.

5-18. PREVENTIVE MAINTENANCE

General. Preventive maintenance performed on a regular schedule can prevent instrument breakdown and may improve instrument reliability. To insure that the calibrator is always ready for operation, it must be inspected systematically so that defects may be discovered and corrected before they result in serious damage or failure.

5-19. Cleaning

a. Clean exterior surfaces with a mild detergent mixed equally with water. Wipe dry with a soft clean cloth.

b. Clean interior surfaces by first removing dust with low pressure compressed air. Limit the nozzle pressure to no more than 29 pounds per square inch (PSIG). Clean contacts and component terminals with a small acid brush dipped in FREON TF.

5-20. Periodic Electrical Adjustment

5-21. DISASSEMBLY

5-22. Cover Removal and Replacement

5-23. The 6127A top and bottom covers are easily removed. First, make sure that the POWER switch is released out to the off position and disconnect the power cord from the ac line to avoid shock hazard. Each cover is secured by two machine screws at the rear of the instrument and two on the sides. After removing both of these screws, raise the cover up slightly at the rear and slide it forward to clear the front lip and then lift it off.

WARNING

A safety hazard exists when the 6127A top and bottom covers are removed. To avoid shock, exercise extreme care when making checks and adjustments.

5-24. **Location of Circuit Board Assemblies.** Refer to figure 5-8 for the location of the 6127A circuit board assemblies.

5-25. Removal of Circuit Board Assemblies

5-26. Make sure that the POWER switch is released out to the off position and the ac power cord is disconnected.

a. First remove the circuit board retainer by unscrewing the four flat head screws securing it.

b. Grasp the printed circuit card securely and pull it straight up from the connector socket.

c. If necessary, disconnect any cables.

CAUTION

When re-inserting a circuit board make sure that it is oriented correctly. In all cases, except the larger A22, A30, and A31 assemblies; the component side faces the front of the Calibrator. For the three larger assemblies, the component side is towards the right side of the instrument.

5-27. CALIBRATION PROCEDURES

5-28. **General.** The following adjustments are performed to insure that the calibrator meets its performance specifications. Failure to satisfy an adjustment requirement indicates a malfunction. Re-check to be sure that the procedure and set-up are being performed correctly. If unsatisfactory results are obtained, refer to the troubleshooting procedures beginning with paragraph 5-50. For the location of adjustments, see figure 5-9.

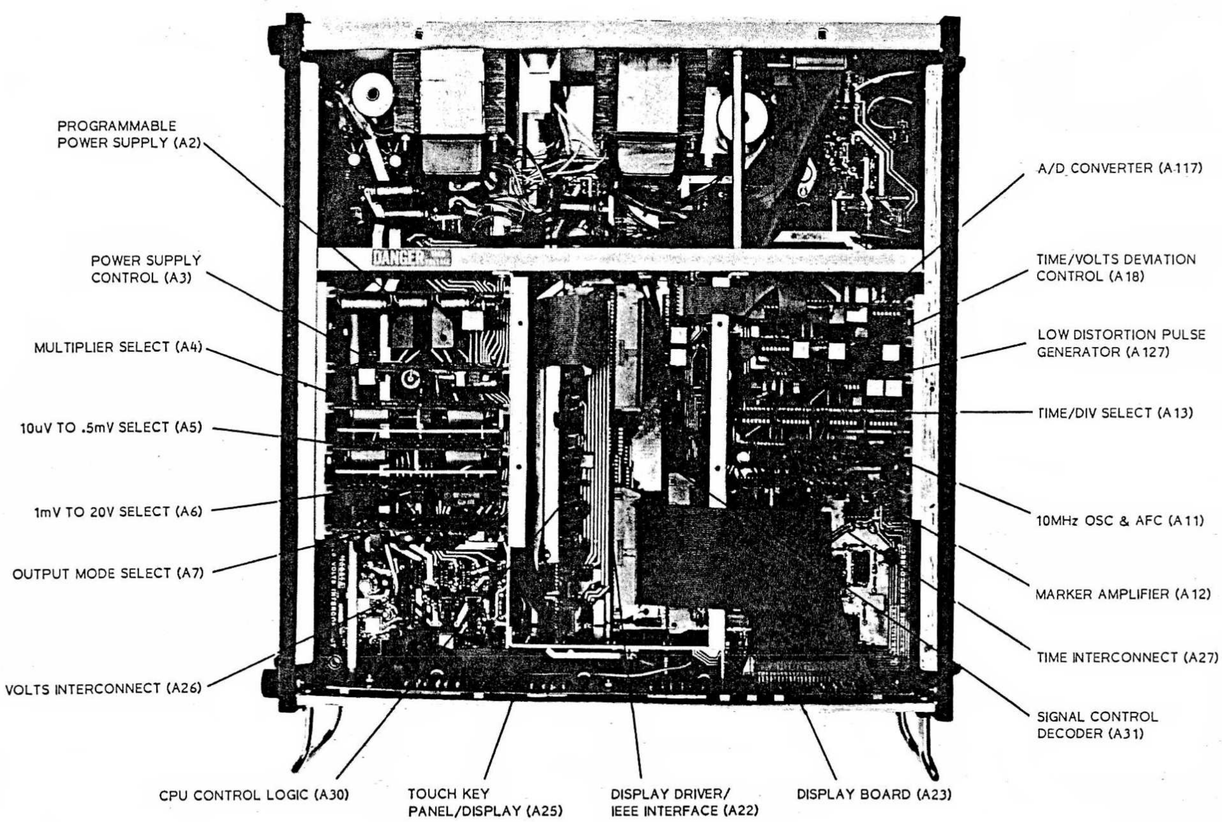


Figure 5-8. Location of 6127A Circuit Board Assemblies

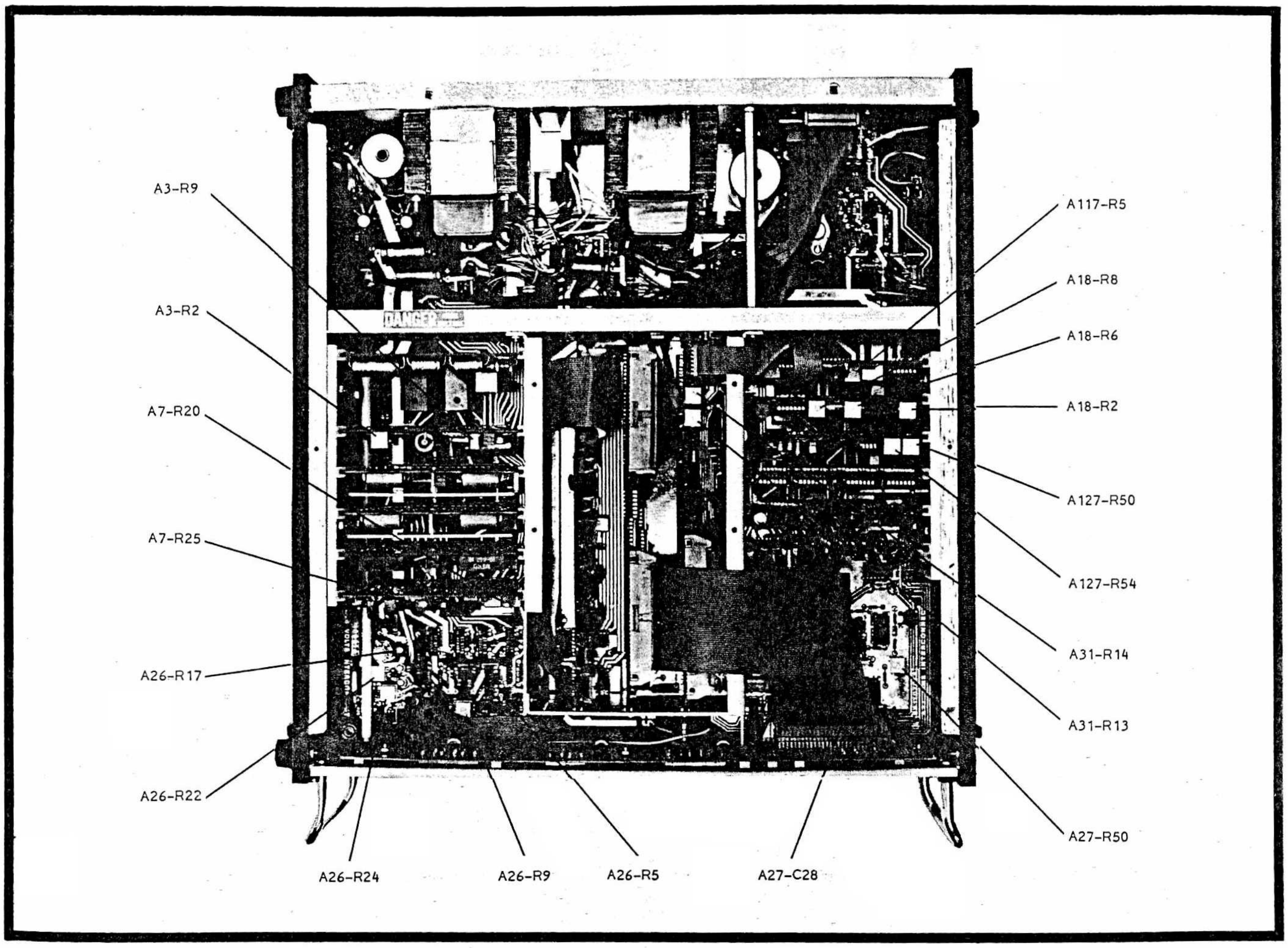


Figure 5-9. Location of Adjustments

5-29. VOLTS CALIBRATION

5-30. 200 Volt Calibration Adjust (A3-R9)

a. Push the 6127A POWER switch in to the on position.

b. Select VOLTS/DIV Mode, 20 V AMPLITUDE/-DIV, 10 DIVISIONS, and POS DC.

c. Connect the 61271A OUTPUT BNC to the differential voltmeter (Fluke 887AB or equivalent) as shown in figure 5-3. Set the ac line voltage to midline.

d. Set the differential voltmeter to 1000 V range and 100 mV null sensitivity. Set the dials to + 200.00.

e. Press the STANDBY/OPERATE touch key.

f. Adjust A3-R9, the 200 VOLT CALIBRATION ADJ potentiometer, until the differential voltmeter shows a null within ± 25 mV.

g. If the adjustment potentiometer is near either end of its range, solder or unsolder the butting pad on A3 Assembly board. (Either across A3-R10 or A3-R11.) Decrease by unsoldering; increase by soldering.

h. Measure each of the 6127A output voltages listed in table 5-3.

NOTE

Determine the measurement circuit offset voltage on each range by first selecting the GND (Standby) mode. Subtract this offset voltage from the range calibration being performed and the null limits indicated.

5-31. Square Wave Zero Level Adj. (A3-R2)

a. Select VOLTS/DIV Mode, 20 V AMPLITUDE/-DIV and 1 DIVISIONS.

b. Select 1 kHz TIME/DIV-FREQUENCY.

c. Connect the differential voltmeter to the Model 61271A OUTPUT BNC connector as shown in figure 5-3.

Table 5-3. VOLTS/DIV Accuracy Limits

AMPLITUDE/ DIVISION	DIVISIONS	TIME/DIV- FREQUENCY	LIMITS
20 V	10	POS DC	+ 199.5 to + 200.5 Vdc
20 V	8	POS DC	+ 159.6 to + 160.4 Vdc
50 V	3	POS DC	+ 149.6 to + 150.4 Vdc
20 V	6	POS DC	+ 119.7 to + 120.3 Vdc
20 V	5	POS DC	+ 99.75 to +100.25 Vdc
20 V	4	POS DC	+ 79.8 to + 80.2 Vdc
20 V	3	POS DC	+ 59.85 to + 60.15 Vdc
20 V	2	POS DC	+ 39.9 to + 40.1 Vdc
20 V	1	POS DC	+ 19.95 to + 20.05 Vdc

d. Set the differential voltmeter sensitivity to 100 mV.

e. Press the STANDBY/OPERATE touch key.

f. Switch the EXT CLOCK IN/OUT switch located on the rear panel to the in position.

g. Repeat step f. until the output goes low.

h. Adjust A3-R2, the SQUARE WAVE ZERO LEVEL ADJ. potentiometer, for an offset reading of less than 20 mV.

i. Set the EXT CLOCK IN/OUT switch to the out position.

5-32. 50 Ω Zero Volts Offset Adjust (A26-R17)

a. Push the 6127A POWER switch in to the on position.

b. Connect the differential voltmeter to the 61271A OUTPUT BNC connector as indicated in figure 5-3.

c. Select VOLTS/DIV Mode, 1 V AMPLITUDE/-DIV and 10 DIVISIONS.

d. Select POS DC.

e. Set the differential voltmeter to the 1 V range and select a null sensitivity of 100 uV. Set the dials to + .0000. Allow 5 minutes for temperature stabilization.

f. Select OPERATE, then return to STANDBY by pressing the STANDBY/OPERATE touch key.

g. Adjust A26-R17 for a reading of 0 ± 10 uV on the differential voltmeter.

5-33. 50 Ω Amplifier Hi Z Cal. (A26-R22)

a. Select VOLTS/DIV Mode, 1 V AMPLITUDE/-DIV and 10 DIVISIONS.

b. Select POS DC.

NOTE

Make sure that 50 Ω is not selected.

c. Connect the 61271A OUTPUT BNC to the differential voltmeter as shown in figure 5-3.

d. Set the differential voltmeter to the 10 V range and select a null sensitivity of 0.1 V. Set the dials to + 10.000.

e. Press the STANDBY/OPERATE touch key.

f. Adjust A26-R22, the HI Z CAL, for a null reading of 0 ± 25 mV.

5-34. 50 Ω Amplifier LO Z Cal. (A26-R24)

a. Select VOLTS/DIV Mode, 1 V AMPLITUDE/-DIV and 5 DIVISIONS.

b. Select POS DC and 50 Ω LOAD.

c. Connect a precision 50 Ω termination to the 61271A OUTPUT BNC connector. (See figure 5-3.)

d. Connect the differential voltmeter as shown in figure 5-3.

e. Set the differential voltmeter to the 10 V range and select a null sensitivity of 0.1 V. Set the dials to +5.000.

f. Press the STANDBY/OPERATE touch key.

g. Adjust A26-R24, the LO Z CAL, for a null reading of 0 ± 12.5 mV.

5-35. 60 dB Attenuator Cal. Adj. (A7-R20)

a. Refer to figure 5-3 for test equipment set-up. (Use 1 M Ω termination.)

b. Select VOLTS/DIV Mode, 20 mV AMPLITUDE/-DIV and 10 DIVISIONS.

c. Select POS DC.

d. Set the differential voltmeter to the 1 V range and select a null sensitivity of 1 mV. Set the dials to + .2000. Allow 5 minutes for temperature stabilization.

e. Press the STANDBY/OPERATE touch key.

f. Adjust A7-R20, 60 dB ATTENUATOR CAL. ADJ., for a null reading of 0 ± 500 uV.

5-36. Std. Current Cal. (A26-R9)

a. Release the 6127A POWER switch out to the off position.

b. Connect the differential voltmeter across A26-R5 as shown in figure 5-10.

c. Push the 6127A POWER switch in to the on position.

d. Select MILLIAMPERES/DIV Mode, 10 mA AMPLITUDE/DIV and 5 DIVISIONS.

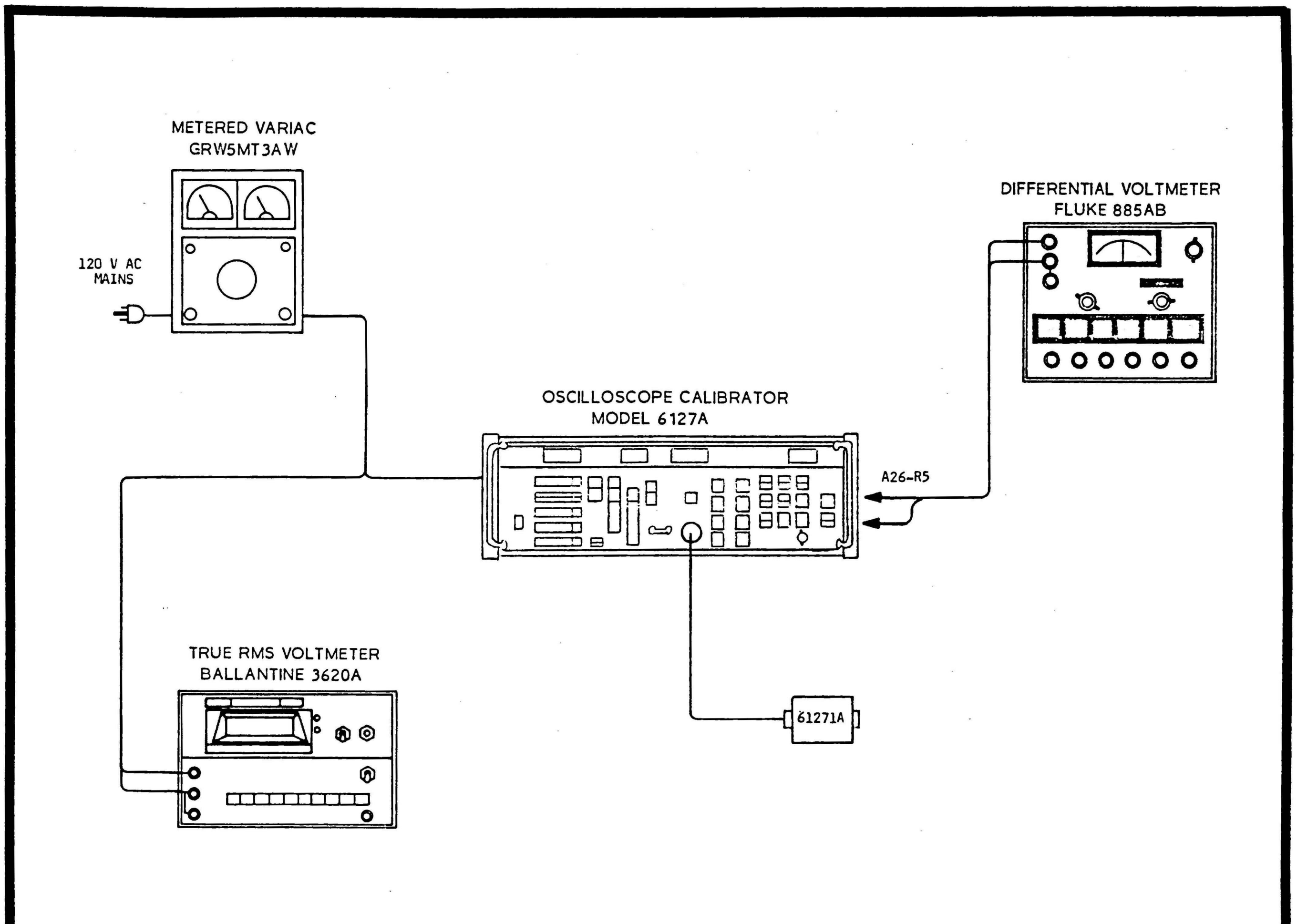


Figure 5-10. Current Calibration, Test Set-Up

e. Select POS DC.

f. Set the differential voltmeter to the 10 V range and select a null sensitivity of 0.1 V. Set the dials to +5.000.

g. Press the STANDBY/OPERATE touch key.

h. Adjust A26-R9, the STD. CURRENT CAL., for a null reading of 0 ± 12.5 mV.

i. Release the 6127A POWER switch out to the off position and disconnect the differential voltmeter from A26-R5.

5-37. Volts Deviation Calibration

5-38. Volts Deviation Range (A18-R2)

a. Push the 6127A POWER switch in to the on position.

b. Select special 6127A Deviation Calibration routine by first pressing the TIME/DIV mode key, then press the hidden touch key, located directly below DEV. Sequentially press the row of 5 keys.

c. Select VOLTS/DIV Mode on the 6127A.

NOTE

When "special routine" is used, the VOLTS/DIV mode will immediately be selected as indicated by only that annunciator illuminating.

d. Connect the digital voltmeter (Ballantine Model 9635M or equivalent) to the 61271A OUTPUT BNC as shown in figure 5-11.

e. Press the STANDBY/OPERATE touch key.

f. Press the ∇ (decrement) touch key. % DEVIATION will go immediately to 9.9% (LO) as indicated by the display.

g. Adjust A18-R2 for a reading of +224.4 V ± 0.1 V on the 9635M. (Note this reading.)

5-39. Deviation Meter Calibration (A117-R5)

a. Continuing from the previous paragraph, press the DEV touch key and note reading. Subtract this reading from step 5-38. g., then divide

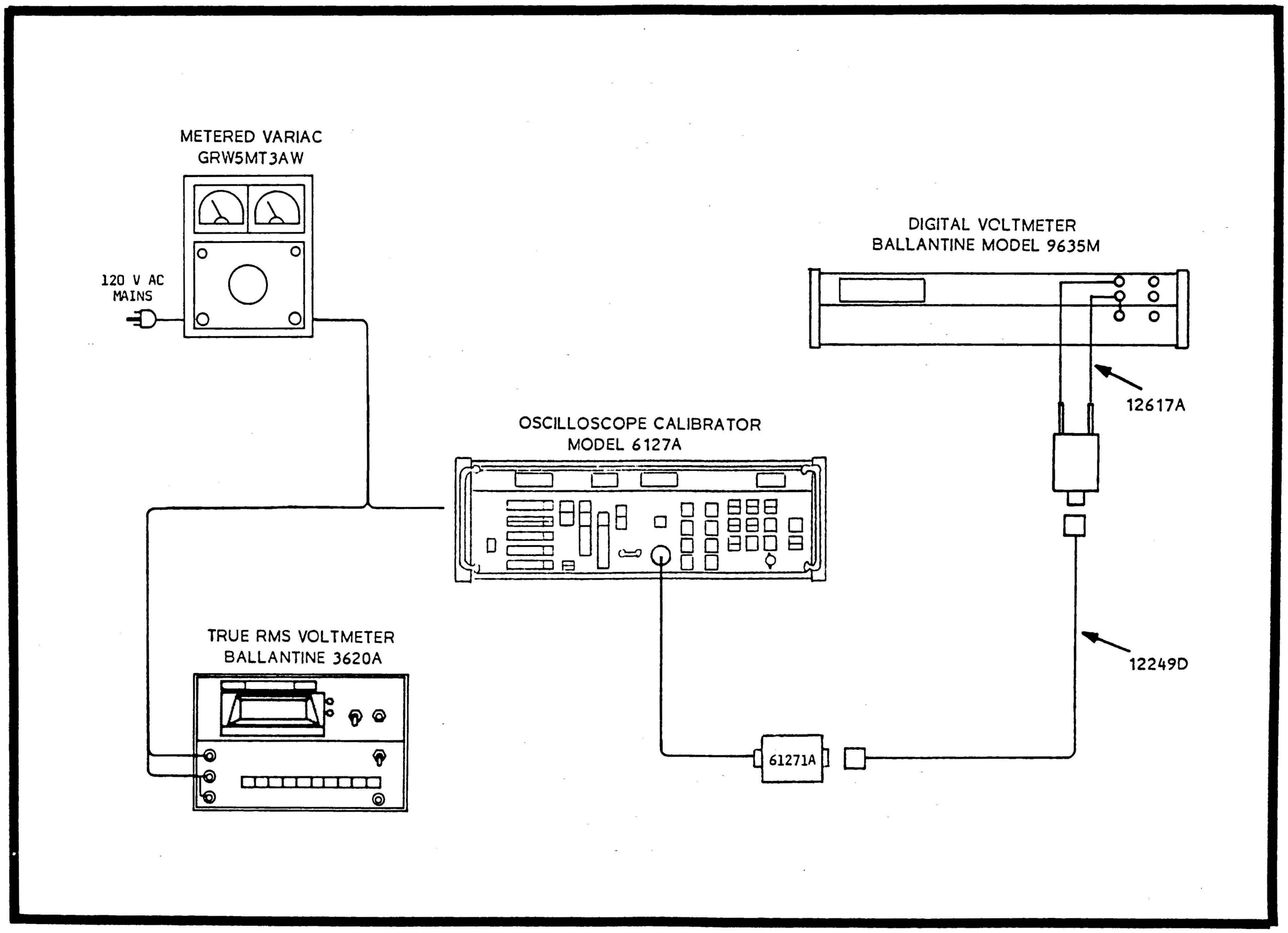


Figure 5-11. Volts Deviation Calibration, Test Set-Up

by 2 and adjust A117-R5 for a front panel reading of the calculated number. Example: 224.4 - 200.0 = 24.4 ÷ 2 = 12.20 ± .05.

5-40. Volts Deviation Centering Adj. (A7-R25)

a. Continuing from the previous paragraph, press the △ (increment) touch key. % DEVIATION will go immediately to +9.9% (HI) as indicated by the display.

b. Adjust A7-R25 for a reading of +178.3 V ± 0.1 V on the 9635M.

c. Observe the reading of the 6127A AMPLITUDE/DIV display. It must be -10.85 ± .05.

d. Depress the CLEAR touch key once to return the Calibrator to its normal position.

5-41. TIME CALIBRATION

5-42. 200 MHz Doubler Adj. (A27-R50, A27-C28)

a. Push the 6127A POWER switch in to the on position.

b. Select TIME/DIV Mode and 5 ns TIME/DIV-FREQUENCY.

c. Connect a sampling oscilloscope (Tektronix Model 7000 with 7S11 plug-in or equivalent) to the 61271A OUTPUT BNC. Refer to figure 5-5.

d. Press the STANDBY/OPERATE touch key.

e. Set the oscilloscope time base to 5ns/-cm and the vertical sensitivity to 20 mV/cm.

f. Select external triggering and connect the 6127A TRIGGER OUTPUT BNC to the sampling oscilloscope external trigger input. Adjust the sweep triggering for a stable triggered display.

g. Adjust A27-R50 until a signal having a frequency of 200 MHz is displayed on the oscilloscope.

h. Adjust A27-C28, 200 MHz TUNE, for maximum amplitude and fidelity of the 200 MHz (5 ns) signal.

i. If necessary, re-adjust A27-R50.

5-43. Low Distortion Pulse Generator Adj. (A127-R50)

a. Push the 6127A POWER switch in to the on position.

b. Select LOW DISTORTION PULSE Mode, 500 mV AMPLITUDE DIV, and 2 DIVISIONS.

c. Select 1 kHz TIME/DIV-FREQUENCY.

d. Connect the 61271A OUTPUT BNC to the oscillocope. Terminate in 50 Ω . Set the V/DIV to 200 mV/cm and TIME/DIV-FREQUENCY to 1 ms/cm. Refer to figure 5-4.

e. Press the STANDBY/OPERATE touch key.

f. Adjust A127-R50 for a reading of 1 V ± 30 mV.

5-44. Low Distortion Pulse Generator Adj.: (A127-R54)

a. Push the 6127A POWER switch in to the on position.

b. Select LOW DISTORTION PULSE Mode, 50 mV AMPLITUDE/DIV and 1 DIVISION.

c. Select 1 kHz TIME/DIV-FREQUENCY.

d. Connect the 61271A OUTPUT BNC to a precision 50 Ω termination, then to the V/DIV input of the oscilloscope. Set the V/DIV to 10 mV/cm and the TIME/DIV-FREQUENCY to 1 ms/cm. Refer to figure 5-4.

e. Press the STANDBY/OPERATE touch key.

f. Adjust A127-R54 for a reading of 50 mV ± 1.5 mV.

5-45. Time Deviation Calibration

5-46. A31-R13, A31-R14 Adjustments

a. Push the 6127A POWER switch in to the on position.

b. Select special 6127A Deviation Calibration routine by first pressing TIME/DIV mode key, then pressing the hidden touch key, located directly below DEV key and sequentially press the row of 5 keys.

c. Select TIME/DIV Mode.

d. Connect a frequency counter (Ballantine Model 5500B-Option 35 or equivalent) to the 61271A OUTPUT BNC. Terminate the connection in a 50 Ω load. Set the counter to display a period of 100 ms.

e. Press the STANDBY/OPERATE touch key.

f. Press the △ (increment) touch key.

g. Adjust A31-R13 for a display 1110.00 kHz ± .50 kHz on the frequency counter.

h. Press the ▽ (decrement) touch key.

i. Adjust A31-R14 for a display of 890.00 kHz ± .50 kHz on the frequency counter.

5-47. A18-R6, A18-R8 Adjustments

a. Continue from previous paragraph and press the ▽ (decrement) touch key.

b. Observe the reading displayed in the 6127A AMPLITUDE/DIV and DIVISIONS windows.

c. If necessary, adjust A18-R8 until +11 is displayed in the window. (See example.)

Example:

AMPLITUDE/DIV	DIVISIONS
11	00

d. Press the △ (increment) touch key and observe the reading displayed in the AMPLITUDE/DIV and DIVISIONS windows.

e. If necessary, adjust A18-R6 until -11 is indicated in the windows. (See example.)

Example:

AMPLITUDE/DIV	DIVISIONS
-11	00

f. Press the CLEAR touch key once to return the Calibrator to its normal operation.

5-48. Check of TIME/DIV Deviation

a. Select TIME/DIV Mode, <u>100 ms</u> TIME/DIV-FREQUENCY.

b. Press the STANDBY/OPERATE touch key.

c. Press the DEV touch key.

d. Press the △ touch key. Continue to maintain pressure on it while observing the display in the % DEVIATION window.

e. It should continue to increase and finally stop at 9.9%. The LO annunciator will illuminate.

f. Observe the reading displayed by the frequency counter. It should indicate 111 ms.

g. Press the ▽ touch key. Continue to maintain pressure on it while observing the display in the % DEVIATION window.

h. It should continue to decrease and finally stop at 9.9%. The HI annunciator will illuminate.

i. Observe the reading displayed by the frequency counter. It should indicate 91 ms.

5-49. 200 ps Fast Rise Adj. (A41-R4, A41-R18, A41-C5)

a. Remove the two upper screws at the front of the Model 61271A Head and the two upper screws at the rear. Lift off the top (labeled) half of the enclosure.

b. Connect the sampling oscilloscope to the 61271A OUTPUT BNC.

c. Push the 6127A POWER switch in to the on position.

d. Select FAST RISE PULSE, 100 kHz TIME/-DIV-FREQUENCY.

e. Press the STANDBY/OPERATE touch key.

f. Referring to figure 3-21, adjust A41-R4 for a flat top. Adjust A41-R18 for squaring of the corner. Adjust A41-C5 for minimum overshoot. See figure 5-12 for location of adjustments.

5-50. TROUBLESHOOTING

5-51. The troubleshooting procedures should be performed only when the Model 6127A cannot be calibrated using the procedures of paragraph 5-27 through 5-49. Proceed as follows:

a. Carefully examine the instrument and check for any visual evidence or trouble. Check for broken wires, burned resistors, loose components and shorted, open, or defective solder joints on the printed circuit board. Check for separation of printed circuit board lands and pads. Check for open, defective, or intermittent switches. Check that connectors are clean and mate properly. Check that the instrument circuit ground is connected to the chassis ground.

b. Refer to the circuit theory described in Section 4. Use the block diagram and simplified schematic diagrams contained in that section as well as the logic tables.

c. To locate faults see the troubleshooting flowcharts beginning with figure 5-13.

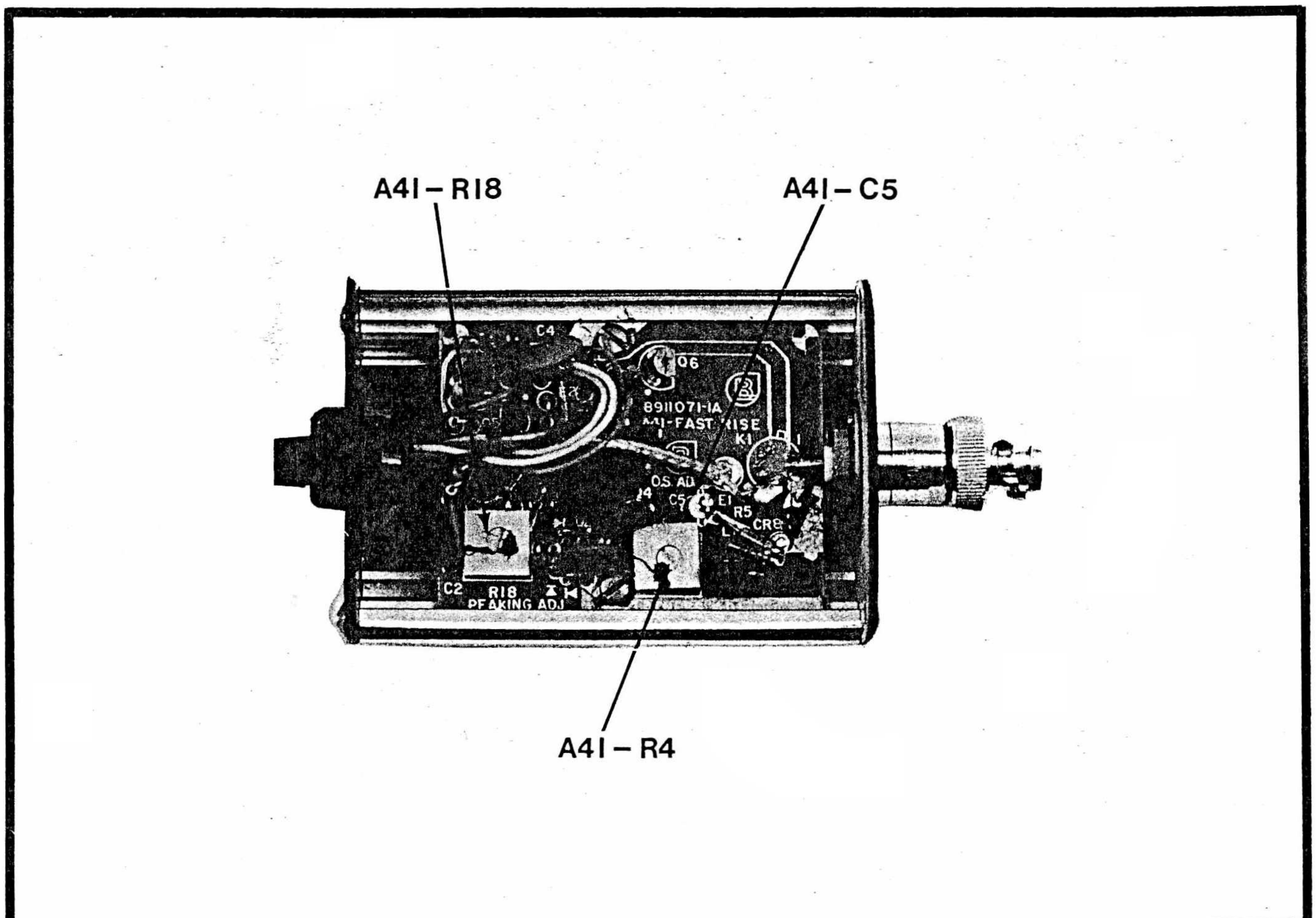


Figure 5-12. Location of Adjustments, 61271A

5-52. Printed Circuit Board Repair

5-53. The calibrator uses an etched-copper printed circuit board. Some of the printed circuit boards uses plated-through holes. To prevent damage to circuit boards and components, observe the following instructions when soldering:

a. Use a low-heat capacity soldering iron with a 700 F. tip, 1.5 mm (1/16 inch) to 2.5 mm (3/32 inch) wide, similar to Weller Model No. W-TCP, 60 watts.

b. Be sure that the solder iron tip is grounded to the power line "earth" ground to avoid possible over voltage damage to semiconductor and tantalytic capacitors. Also, "earth" ground the case of the instrument.

c. When removing a component, clip a heat sink, such as long nose tweezers or alligator clips, to the component leads; as close as possible to the body of the component to ensure minimum heating of the component when soldering.

d. Place the soldering iron directly on the component lead on the conductor side of the printed circuit board. Use a desoldering tool such as the SOLDAPULLIT, manufactured by Edsyn Products, to remove all solder and free the component lead.

e. Straighten the component lead with long-nose pliers and remove the component from the board.

f. If a component is obviously faulty or damaged, clip the leads close to the body of the component and remove the remaining leads from the conductor side of the board.

g. Use a short soldering cycle since excessive or prolonged heat may destroy the laminate and lift the copper conductors from the circuit board; or cause immediate degrading or latent damage to the components.

h. Clean the component lead holes by heating the solder on the circuit board conductor pad, quickly removing the soldering iron, and inserting a pointed nonmetallic object, such as a toothpick, to clean the hole. Do not allow solder to cover the hole since new component leads may then push the pad away from the board.

i. To install a new component, first straighten and shape the leads. Insert the component into the proper holes. Bend the leads on the conductor side of the circuit board so that they extend to the foil of the incoming conductor path. Cut the bent lead approximately 2.5 mm (3/32 inch) from the hole. Clip a heat sink to the component lead at the body of the component. Heat the lead and the pad with a soldering iron and form a meniscus over the hole to ensure a good electrical connection.

j. After removing or inserting a component, clean excess flux from the connection and surrounding area. Use TF Freon spray cleaner, such as Miller Stephenson Chemical Co., Type MS-180 (Ballantine P/N 80-10004-01), low air pressure (5 to 20 PSIG), and a humidity seal spray, such as Humiseal, Columbia Technical Corp., Type 1B15 (Ballantine P/N 80-10005-0A), to seal the board and protect it against humidity. To avoid leakage, which may affect performance if the instrument is exposed to high humidity, do not touch the cleaned board or handle the components excessively.

PERFORMANCE ASSURANCE CHECKS
TEST RECORD
BALLANTINE MODEL 6127A

Serial No. ______________________ Date ______________________

Options Installed ______________________ Performed By ______________________

NOTE: All tests performed at reference conditions of 22°C ± 2°C after warmup of one hour.

1. CALIBRATOR SELF TEST CHECK (Paragraph 5-5)

At nominal voltage (Table 5-1)

a. Power on and self test indicators light ______________ Volts

b. No error indications ______________ (✓)

c. All panel numerics and indicators light ______________ (✓)

d. Prompt lines appear ______________ (✓)

At low mains voltage (Table 5-1)

e. Initiate self test by double CLEAR ______________ (✓)

f. No error indications ______________ (✓)

g. All panel numerics and indicators light ______________ (✓)

h. Prompt lines appear ______________ (✓)

At high mains voltage (Table 5-1)

i. No error indications ______________ (✓)

j. All panel numerics and indicators light ______________ (✓)

k. Prompt lines appear ______________ (✓)

2. OSCILLATOR FREQUENCY ACCURACY CHECK (Paragraph 5-6)

At nominal mains voltage (Table 5-1)

a. 10 MHz (limit: 9,999,900 to 10,000,100 Hz) ______________ Hz

At low mains voltage (Table 5-1)

b. 10 MHz (limit: 9,999,825 to 10,000,175 Hz) ______________ (✓)

At high mains voltage (Table 5-1)

c. 10 MHz (limit: 9,999,825 to 10,000,175 Hz) ______________ (✓)

3. TIME/DIV OUTPUT CHECK (Paragraph 5-7)

Check for 1 marker per graticlue lir.e

500 ps _____ *(✓)			
1 ns _____ *(✓)	1 us _____ (✓)	1 ms _____ (✓)	1 sec _____ (✓)
2 ns _____ *(✓)	2 us _____ (✓)	2 ms _____ (✓)	2 Sec _____ (✓)
5 ns _____ (✓)	5 us _____ (✓)	5 ms _____ (✓)	5 Sec _____ (✓)
10 ns _____ (✓)	10 us _____ (✓)	10 ms _____ (✓)	
20 ns _____ (✓)	20 us _____ (✓)	20 ms _____ (✓)	
50 ns _____ (✓)	50 us _____ (✓)	50 ms _____ (✓)	
100 ns _____ (✓)	100 us _____ (✓)	100 ms _____ (✓)	
200 ns _____ (✓)	200 us _____ (✓)	200 ms _____ (✓)	
500 ns _____ (✓)	500 us _____ (✓)	500 ms _____ (✓)	

* Optional - Test with Sampling Oscilloscope

4. TRIGGER OUTPUT CHECK (Paragraph 5-8)

X 1 _______________ (✓)   1 V _______________ (✓)

÷ 10 _______________ (✓)

÷ 100 _______________ (✓)

5. TIME DEVIATION CHECK (Paragraph 5-9)

a. 100,000 Hz (± 50 Hz) _______________ (Hz)

b. △ 11.11 us (limit: 10.05 to 11.17 us) _______________ (✓)

c. LO annunciator is lit _______________ (✓)

d. ▽ 9.11 us (limit: 9.05 to 9.17 us) _______________ (✓)

e. HI annunciator is lit _______________ (✓)

6. VOLTS/DIV OUTPUT (HIGH Z) CHECK (Paragraph 5-10)

STANDBY mode DC offset voltage ______________ uV

6127A (High Z)			DIFFERENTIAL VOLTMETER	
VOLT/DIV	DIVS	ERROR LIMITS	VOLTAGE	READING
20 V	10	± 500 mV	200 V	
50 V	3	± 375 mV	150 V	
10 V	10	± 250 mV	100 V	
5 V	10	± 125 mV	50 V	
2 V	10	± 50 mV	20 V	
1 V	10	± 25 mV	10 V	
1 V	8	± 20 mV	8 V	
1 V	6	± 15 mV	6 V	
1 V	5	± 12.5 mV	5 V	
1 V	4	± 10 mV	4 V	
1 V	3	± 7.5 mV	3 V	
1 V	2	± 5 mV	2 V	
1 V	1	± 2.5 mV	1 V*	
500 mV	10	± 12.5 mV	5 V	
200 mV	10	± 5 mV	2 V	
100 mV	10	± 2.5 mV	1 V*	
50 mV	10	± 1.25mV	.5 V*	
20 mV	10	± 500 uV	.2 V*	
10 mV	10	± 250 uV	.1 V*	

7. VOLT/DIV OUTPUT (50Ω) CHECK (Paragraph 5-11)

Terminate the 61271A with 50 ohms (± 0.1%)

STANDBY mode DC offset voltage ______________ uV

6127A (50 Ω)			DIFFERENTIAL VOLTMETER	
VOLT/DIV	DIVS	ERROR LIMITS	VOLTAGE	ERROR READING
1 V	5	± 17.5 mV	5 V	
500 mV	10	± 17.5 mV	5 V	
200 mV	10	± 70 mV	2 V	
100 mV	10	± 3.5 mV	1 V*	
50 mV	10	± 1.75 mV	.5 V*	
20 mV	10	±700 uV	.2 V*	
10 mV	10	±350 uV	.1 V*	

* Requires DC offset voltage correction

8. VOLTS DEVIATION CHECK (Paragraph 5-12)

a. △ LO annunciator lights	________	(✓)
b. + 109.9 Volts ± 500 mV	________	(✓)
c. ▽ HI annuciator lights	________	(✓)
d. + 90 ± 500 mV	________	(✓)

9. LOW DISTORTION PULSE OUTPUT (HIGH Z) CHECK (Paragraph 5-13)

a. 8 divisions amplitude	________	(✓)
b. Rise time ($\leq$ 100 ns)	________	ns

10. LOW DISTORTION PULSE OUTPUT (50Ω) CHECK (Paragraph 5-14)

a. 8 divisions amplitude	________	(✓)
b. Rise time ($\leq$ 2 ns)	________	ns

11. FAST RISE PULSE OUTPUT CHECK (Paragraph 5-15)

a. 5 divisions amplitude	________	(✓)
b. Overshoot (< 3%)	________	%
c. Rise time ($\leq$ 200 ps)	________	ps
d. △ HI increase to 5.5 divs	________	(✓)
e. ▽ LO decrease to 4.5 divs	________	(✓)

12. MILLIAMPERES/DIV OUTPUT CHECK (Paragraph 5-16)

Use 1 mA/mV current probe

a. Amplitude 5 divisions	________	(✓)

13. AMPLITUDE COMPARATOR CHECK (Paragraph 5-17)

a. CALIBRATOR, VOLT/DIV and 1 kHz are lit	________	(✓)
b. Three lines across scope face	________	(✓)
c. Merge to two lines with DEVIATION	________	(✓)
d. Alternate switch mode select with lamp indication	________	(✓)
e. 50 ohm termination check (limit: 49.8 to 50.2 Ω)	________	ohms

14. IEEE-488 BUS CHECK	________	(✓)
Controller Model ________	________	(✓)

15. OPTION CHECK (if installed)

a. Option ____________________ ____________ (√)

b. Option ____________________ ____________ (√)

16. MECHANICAL CHECKS

a. 6127A ____________ (√)

b. 61271A Fast Rise Pulse Head ____________ (√)

c. 61272A Amplitude Comparator Head ____________ (√)

____

Test Engineer

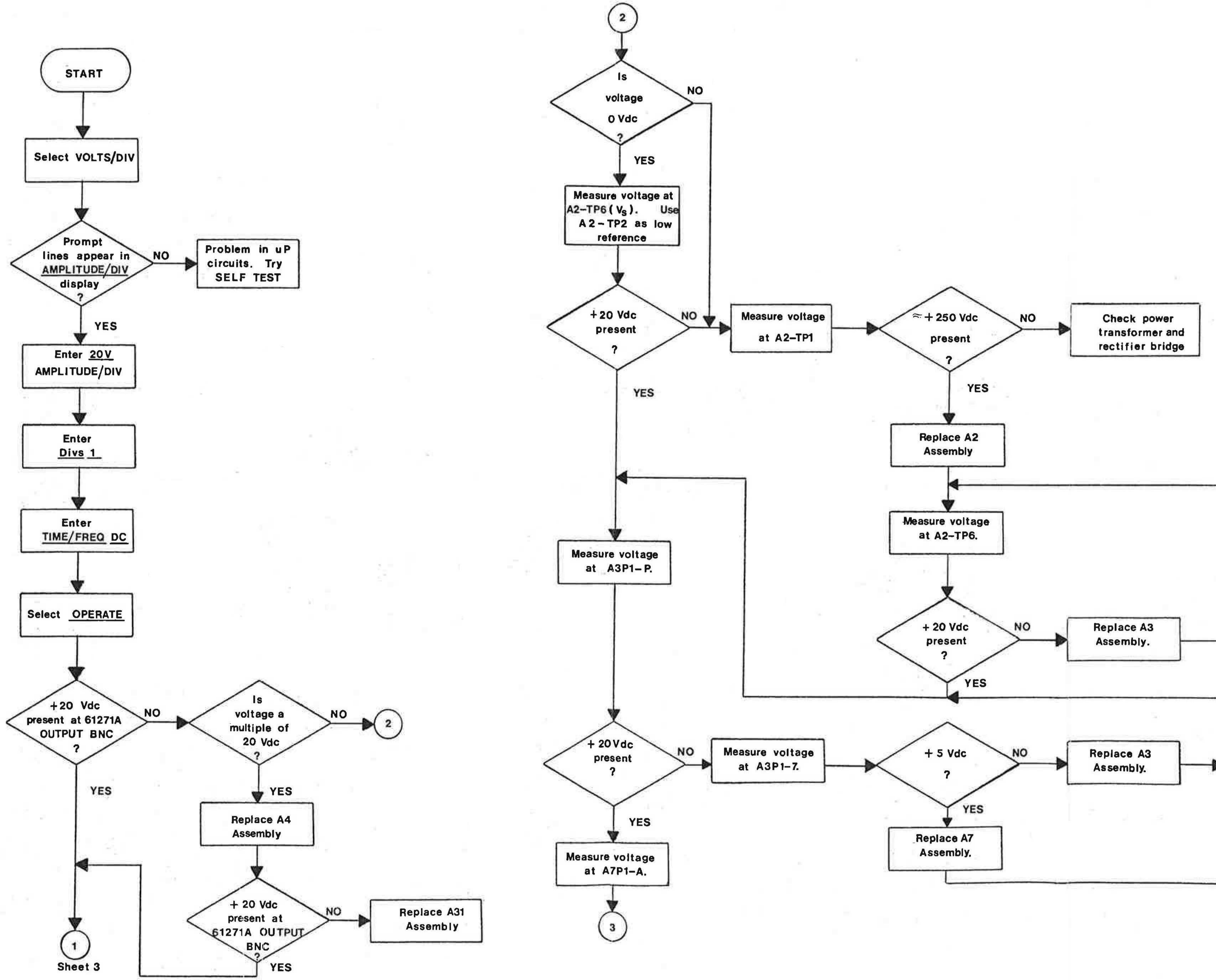


Figure 5-13. (Sheet 1)
Model 6127A VOLTS/DIV
TROUBLESHOOTING FLOW-
CHART

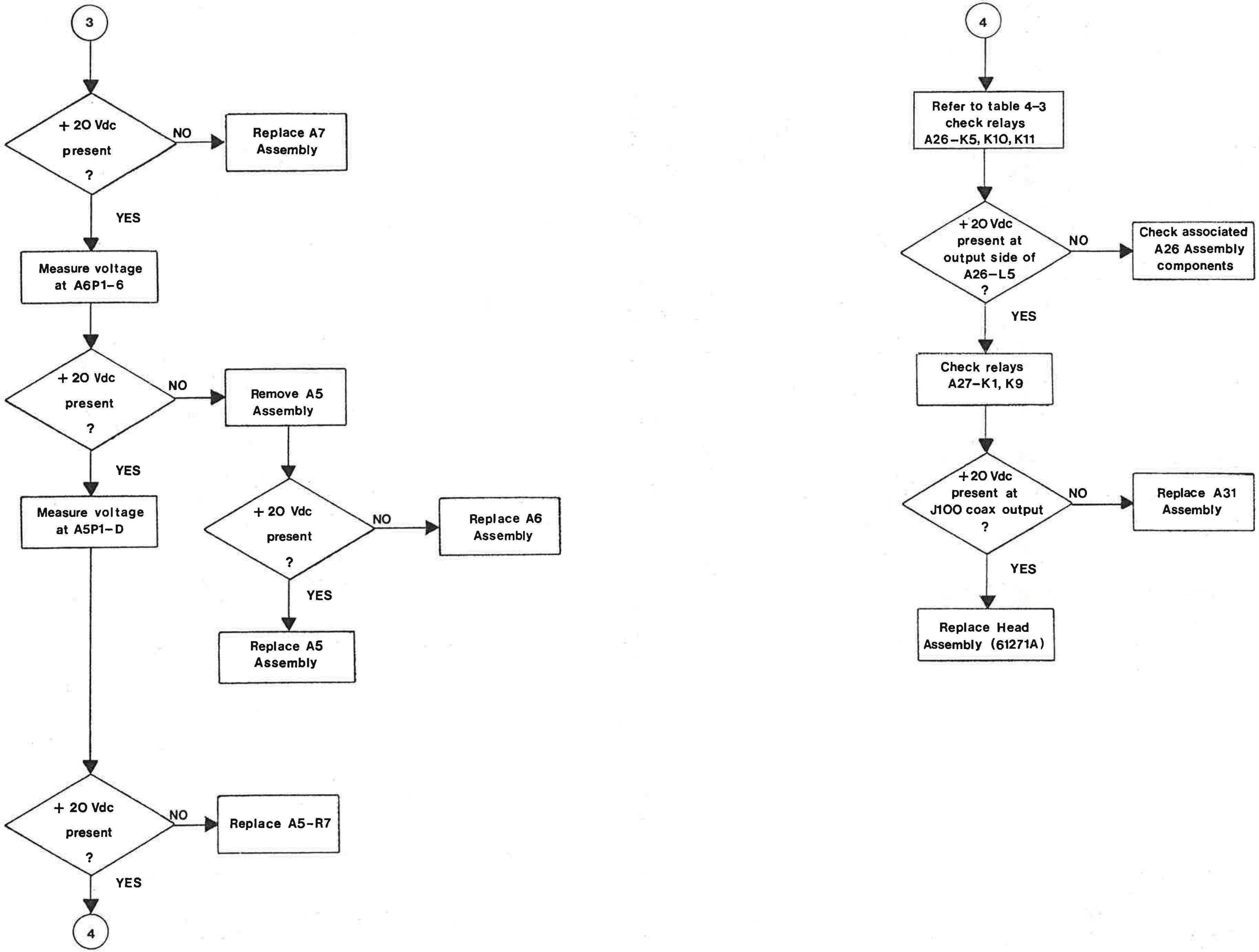


Figure 5-13. (Sheet 2)
Model 6127A VOLTS/DIV
TROUBLESHOOTING FLOW-
CHART

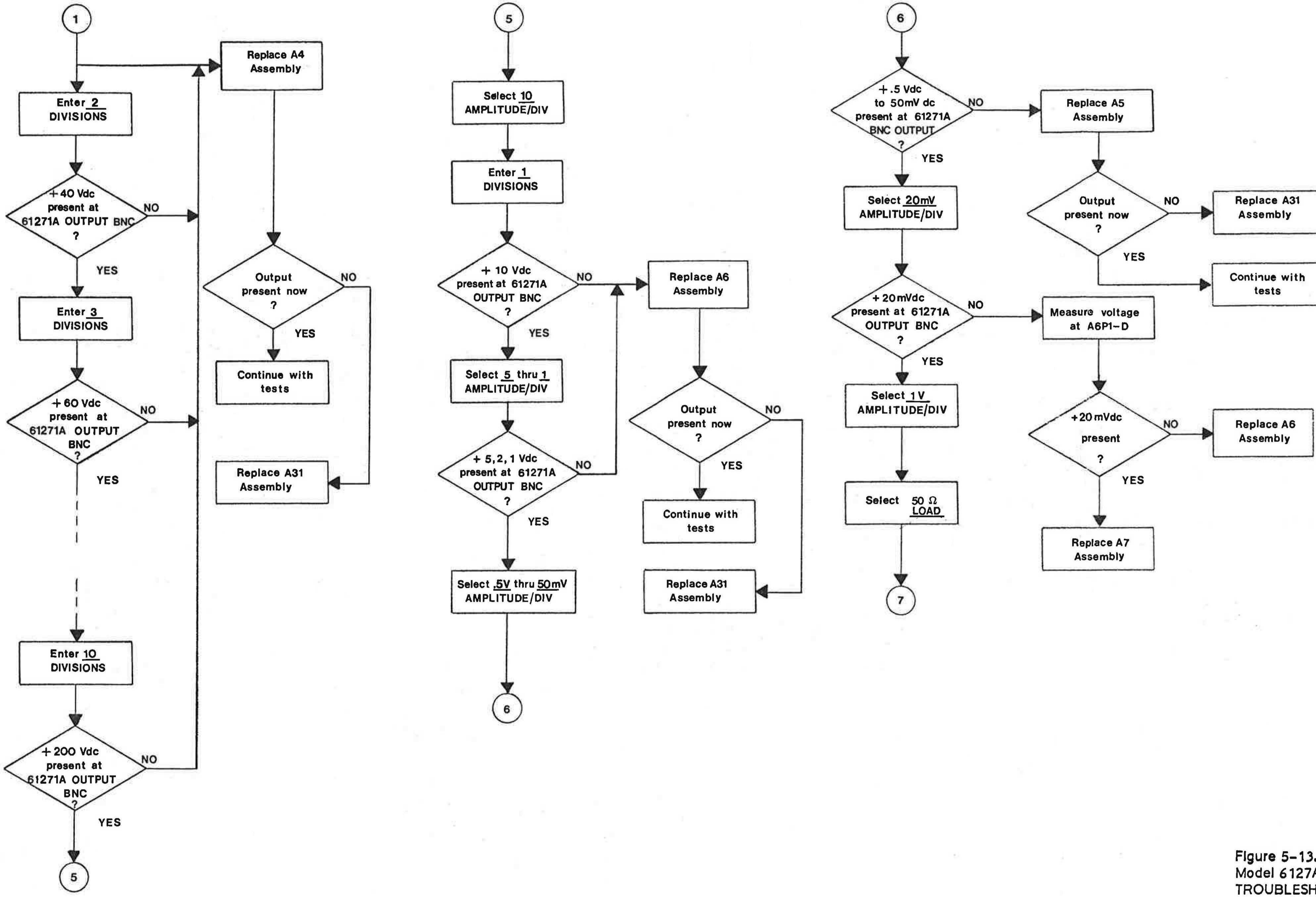


Figure 5-13. (Sheet 3)
Model 6127A VOLTS/DIV
TROUBLESHOOTING FLOW-
CHART

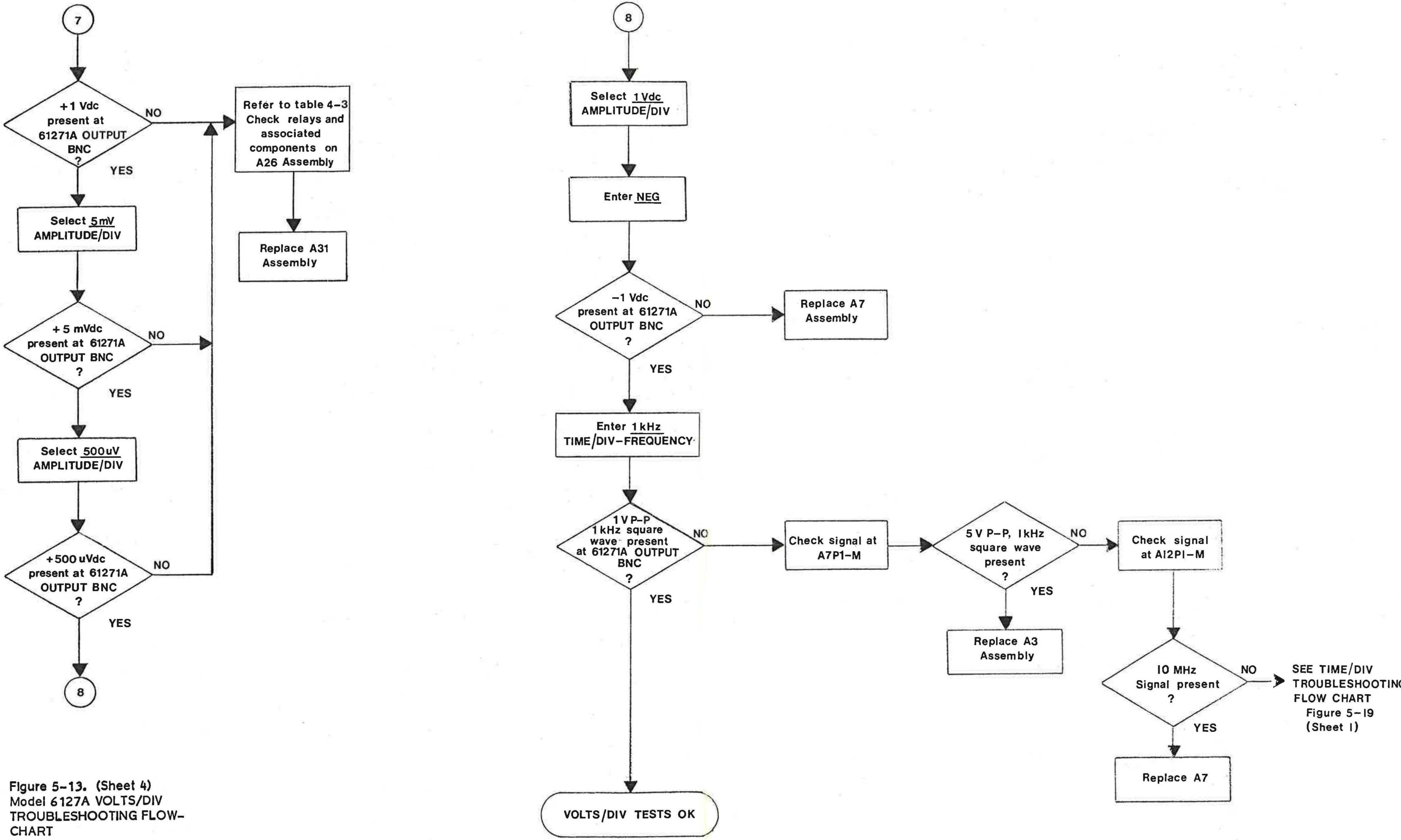


Figure 5-13. (Sheet 4)
Model 6127A VOLTS/DIV
TROUBLESHOOTING FLOW-
CHART

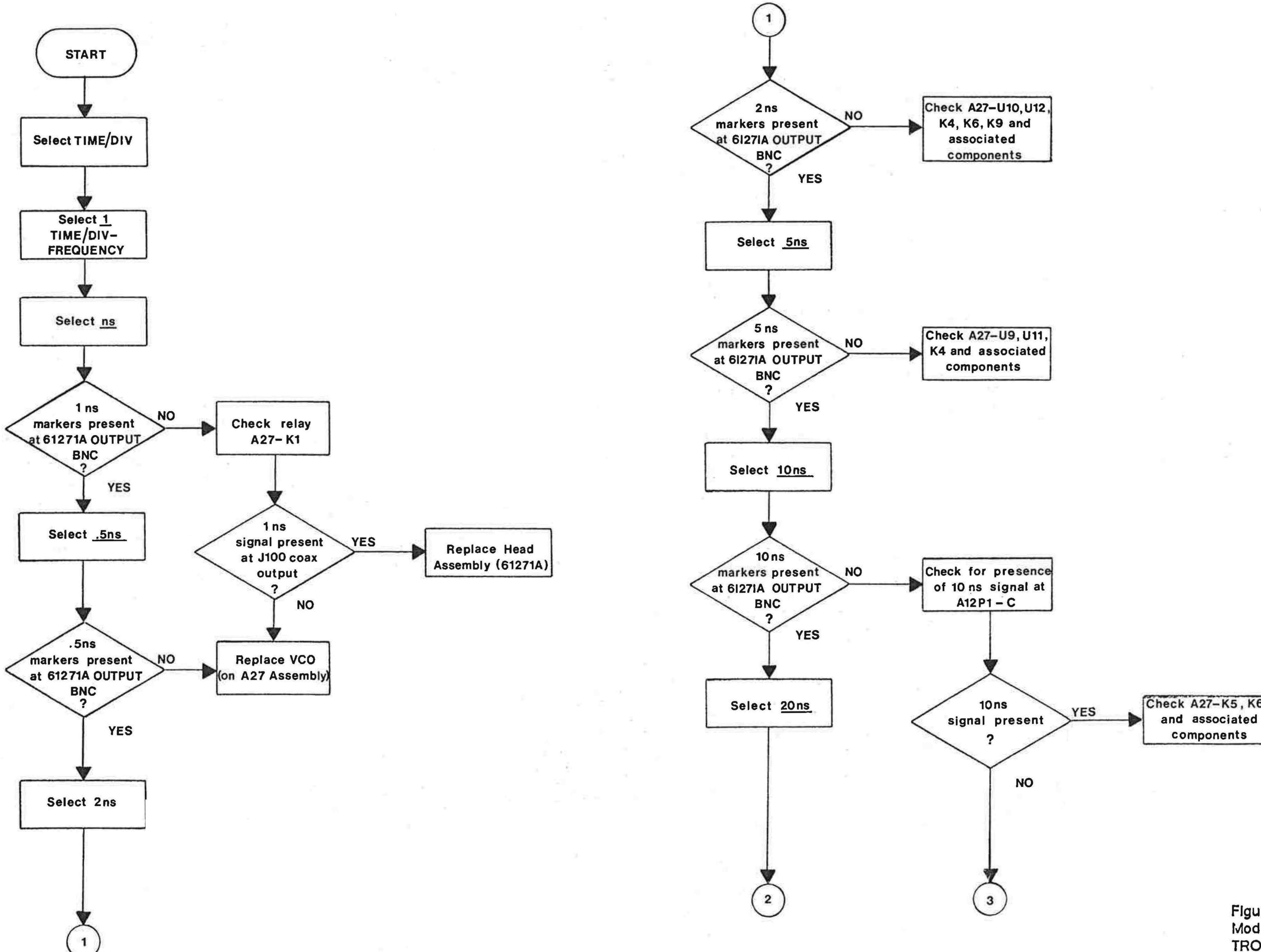


Figure 5-14. (Sheet 1)
Model 6127A TIME/DIV
TROUBLESHOOTING FLOW-
CHART

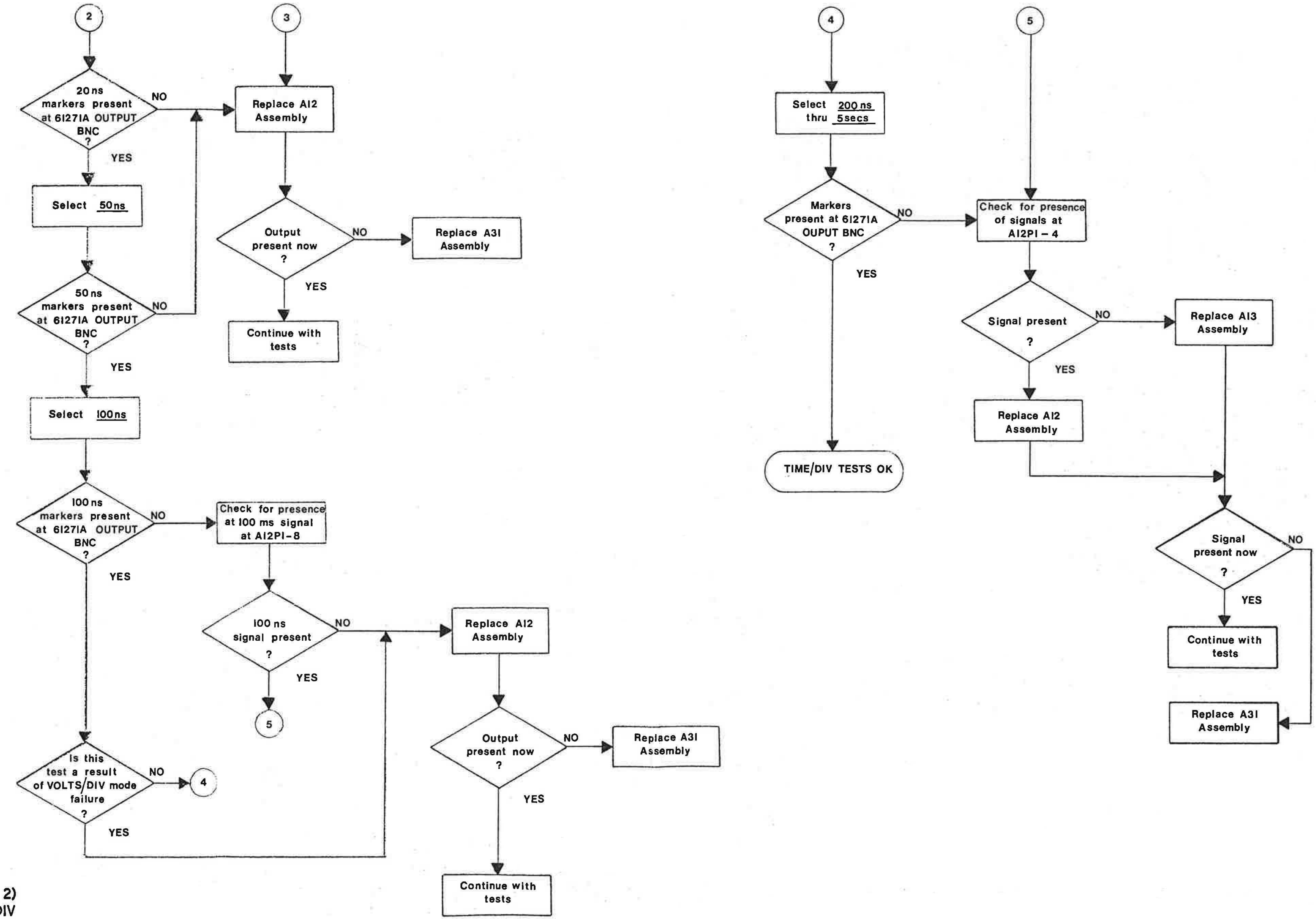


Figure 5-14. (Sheet 2)
Model 6127A TIME/DIV
TROUBLESHOOTING FLOW-
CHART

SECTION 6

PARTS LIST & CIRCUIT DIAGRAMS

The replacement parts listed are available from the vendors listed or from Ballantine Laboratories. Your local Ballantine Field Engineering Representative may also carry a stock of parts and can assist you. If pricing quotations are required for parts and or repairs, your local representative will give the most rapid service or you may contact the Ballantine Factory directly.

When ordering replacement parts always give the following information:

a) Instrument Model number

b) Serial number

c) Ballantine Part number

d) Schematic Symbol number

e) Identification and description of part

Ballantine will do its best to improve the instrument and make changes in style of components and replacement parts. Replacement parts may differ in appearance from those found in your instrument but are always equal or superior in performance. Where necessary minor mechanical modifications may be required in the replacement of the components.

Parts are generally available locally for most replacements. The parts list calls out the recommended vendors where applicable.

Alternate components may be substituted but the use of parts specified in this parts list is recommended. A part similar to the part initially installed at the factory may be used, i.e., a 5% composition resistor may be replaced with a similar part or a 5% film resistor or the preferred 1% metal film resistor. Use of the preferred component will always simplify calibration and speed repairs.

Selected components are identified in this manual and may be replaced with a similar valued part unless re-selection is required due to replacement or change of a related part. The schematics and calibration procedures identify selected components and replacement procedures.

The Manufacturer Code is taken from Federal Supply Code Cataloging Handbooks H4-1, H4-2, and H4-3. Ballantine Code is 50423.

The following parts coding are used:

CVC	Capacitor, Variable, Ceramic
CCT	Capacitor, Ceramic, Tubular
CFP	Capacitor, Fixed, Plastic
CCD	Capacitor, Ceramic, Disc
CYF	Capacitor, Mylar, Foil
CMD	CapaciTor, Mica, Dipped
CMM	Capacitor, Mica, Molded
CEA	Capacitor, Electrolytic, Aluminum
CET	Capacitor, Electrolytic, Tantalum
DGP	Diode, General Purpose
DZG	Diode, Zener, General Purpose
DRP	Diode, Bridge, Power
FLT	Filter
ICP	Integrated Circuit
TRQ	Transistor
RFF	Resistor, Fixed, Film
RFC	Resistor, Fixed, Composition
RVC	Resistor, Variable, Composition
RFW	Resistor, Fixed, Wirewound
SWC	Switch
LMP	Lamp
TRX	Transformer

Resistors may generally be replaced by Corning Electronics (CCW) type N-55, N-60 and C-32. Allen Bradley carbon composition resistors type EB may also be used but should generally be avoided (except for emergency replacements) in favor of the preferred part listed in this parts list.

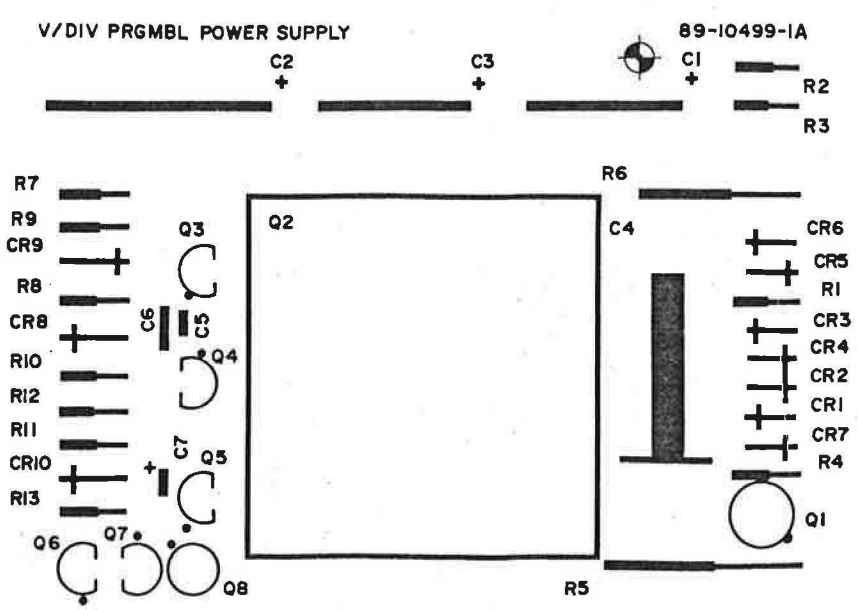
Table 6-1 lists the replaceable assemblies used in the 6127A. The parts lists and circuit diagrams of these assemblies are also included in this section.

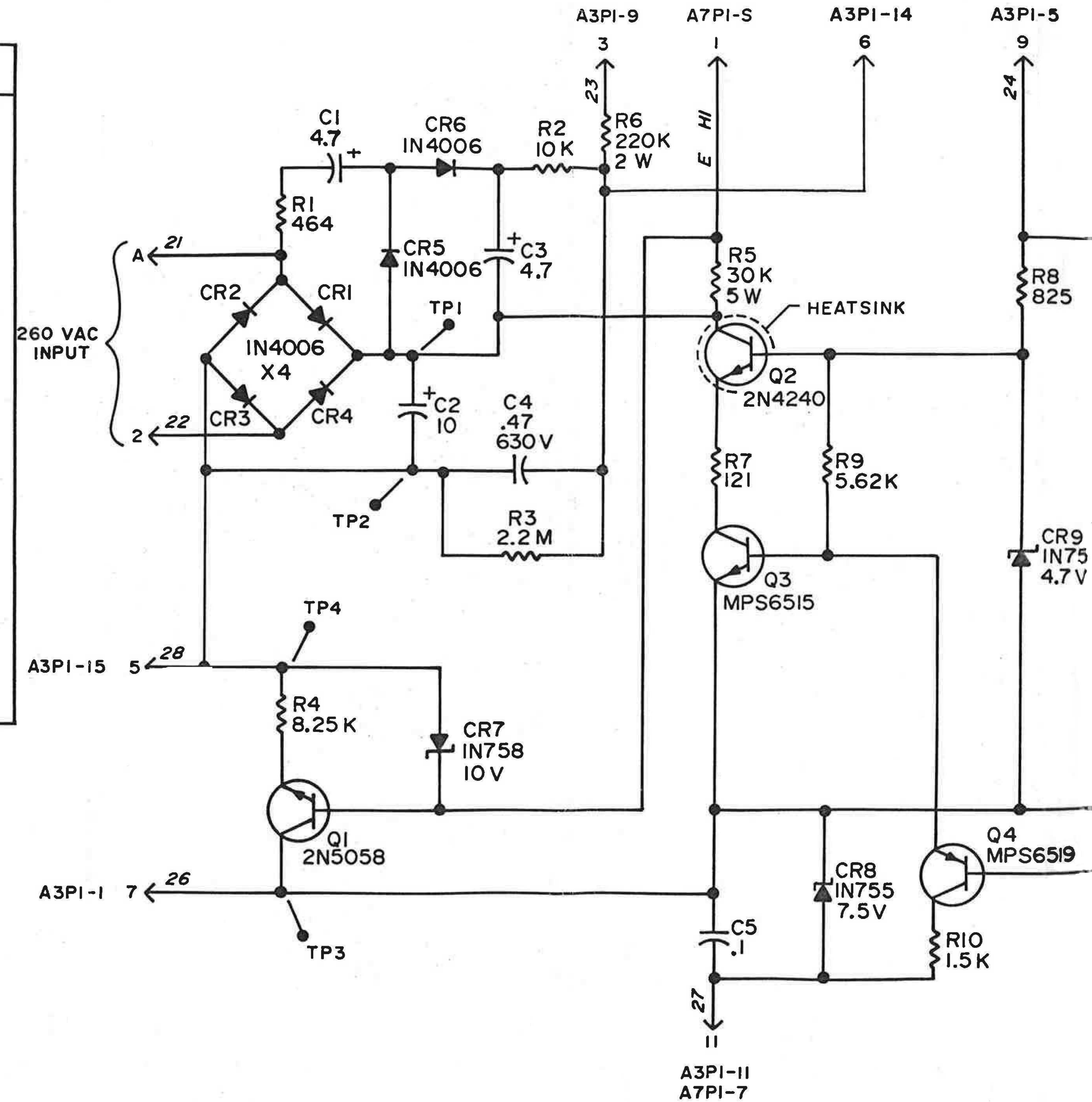
TABLE 6-1. REPLACEABLE ASSEMBLIES

ASSEMBLY	BALLANTINE P/N	DESCRIPTION
A2	89104991A	Programmable Power Supply - Volts
A3	89105001A	Power Supply Control - Volts
A4	89105011A	Multiplier Select - Volts
A5	89105021A	10 uV to .5 mV Select - Volts
A6	89105031A	1 mV to 20 V Select - Volts
A7	89105241A	Output Mode Select - Volts
A11	89110511A	10 MHz Osc & AFC - Time
A12	89110521A	Marker Amplifier - Time
A13	89111781A	Time/DIV Select
A18	89105261A	Time/Div Deviation Control
A22	89110841A	Display Driver/IEEE Interface
A23	89110871A	Numeric, Front Panel Display
A25	8911210-1A	Front Panel Keyboard
A26	89110691A	Interconnect Board - Volts
A27	89110701A	Interconnect Board - Time
A30	89110851A	CPU Control Logic
A31	89110831A	Signal Control Decoder
A41	89110711A	Fast Rise Assembly
A43	89111631A	Amplitude Comparator Assembly
A117	89111741A	A/D Converter
A127	89110681A	Low Distortion Pulse Generator

PARTS LIST, A2 V/DIV PROGRAMMABLE POWER SUPPLY (89-10499-1A)

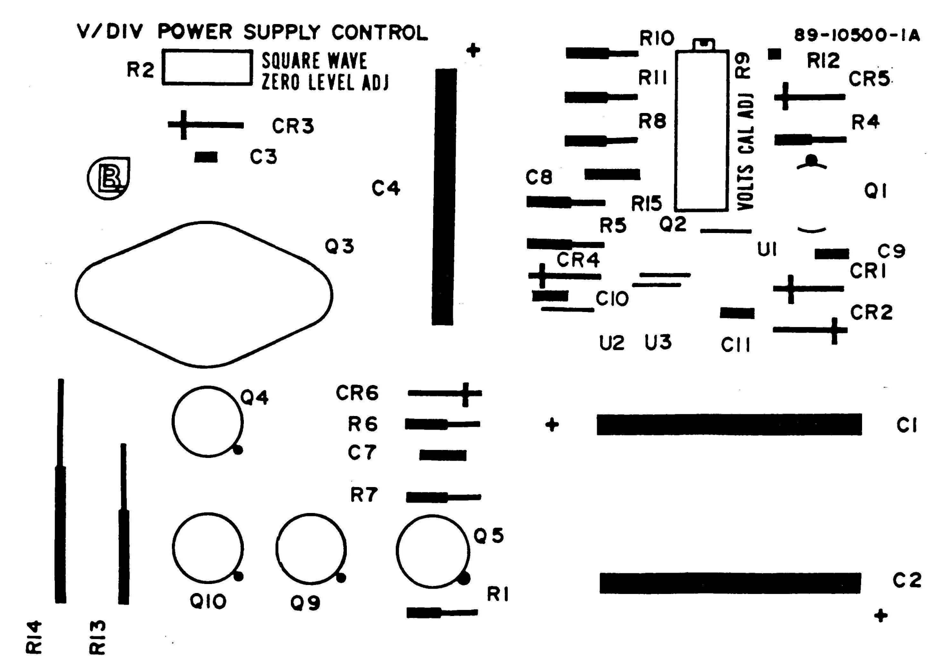
SCHEM REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
C...1	07-10421-0A	CER 4.7UF 350.0 V-10+50%	80031	3072FE479T350SF
C...2	07-10420-0A	CEA 10UF 350.0 V-10+50%	80031	3072LF100T350SF
C...3	07-10421-0A	CER 4.7UF 350.0 V-10+50%	80031	3072FE479T350SF
C...4	07-10423-0A	CRM 470.0NF 630.0 VK	80031	MEPCO C280MCG/A470K
C...5	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	0	AVX CERAMICS MD015E104ZAA
C...6	07-02592-0A	CCD 1.0UF 1.0KVK+-10%	84171	ARCO TYPE CCD-102
C...7	07-10053-0A	CET 10.0UF 35.0V M	56289	199D106X0035DA2
CR..1	05-08058-0A	DGP 1N4006 400 1A	15238	ITT SI D046
CR..2	05-08058-0A	DGP 1N4006 400 1A	15238	ITT SI D046
CR..3	05-08058-0A	DGP 1N4006 400 1A	15238	ITT SI D046
CR..4	05-08058-0A	DGP 1N4006 400 1A	15238	ITT SI D046
CR..5	05-08058-0A	DGP 1N4006 400 1A	15238	ITT SI D046
CR..6	05-08058-0A	DGP 1N4006 400 1A	15238	ITT SI D046
CR..7	05-10035-0A	DZG 1N 758A 10 20M .4	4713	MOT SI
CR..8	05-10007-0A	DZG 1N 755A 7.5 20M .4	4713	MOT SI
CR..9	05-10010-0A	DZG 1N 750A 4.7 20M .4	4713	MOT SI
CR.10	05-10007-0A	DZG 1N 755A 7.5 20M .4	4713	MOT SI
Q...1	10-10016-0A	TRQ 2N5058 NPN 1 300	7263	FCH 5 10
Q...2	10-10123-0A	TRQ 2N4240 HI VOLTAGE NPN	3607	RCA 2N4240
Q...3	10-10005-0A	TRQ MPS6515 NPN 1 25 PTO-92	4713	MOT .350 390M 150
Q...4	10-10009-0A	TRQ MPS6519 PNP 1 25 PTO-92	4713	MOT 1 340M 250
Q...5	10-10009-0A	TRQ MPS6519 PNP 1 25 PTO-92	4713	MOT 1 340M 250
Q...6	10-10043-0A	TRQ 2N3904 NPN 1 40 PTO-92	4713	MOT 1 300M 40
Q...7	10-09473-0A	TRQ 2N3906 PNP 1 40 PTO-92	4713	MOT 1 200M 60
Q...8	10-10099-0A	TRW E507	17856	SILICONIX
R...1	12-12264-0A	RFF 464.0 250 MW F+-1%	16299	CGW RN55D 4640 F
R...2	12-12400-0A	RFF 10.0 K 250.0MW F+- 1%	16299	CGW RN55D 1002 F
R...3	12-09823-0A	RFC 2.2 M 250.0MW J+- 5%	1121	A-B TYP CB
R...4	12-12388-0A	RFF 8.25K 250.0MW F+- 1%	16299	CGW RN55D 8251 F
R...5	12-12734-0A	PFW 30.0 K 5.0 W F 20PPM	75042	IRC AS-5
R...6	12-13112-0A	RFC 220.0 K 2.0 W J	1121	A-B 220K HB TYPE 5%
R...7	12-12208-0A	RFF 121.0 250.0MW F+- 1%	16299	CGW RN55D 1210 F
R...8	12-12288-0A	RFF 825.0 250 MW F+-1%	16299	CGW RN55D 8250 F
R...9	12-12372-0A	RFF 5.62K 250.0MW F+- 1%	16299	CGW RN55D 5621 F
R..10	12-12317-0A	RFF 1.50K 250 MW F+-1%	16299	CGW RN55D 1501 F
R..11	12-12457-0A	RFF 39.2 K 250.0MW F+- 1%	16299	CGW RN55D 3922 F
R..12	12-12276-0A	RFF 619.0 250 MW F+-1%	61299	CGW RN55D 6190 F
R..13	12-12288-0A	RFF 825.0 250 MW F+-1%	16299	CGW RN55D 8250 F

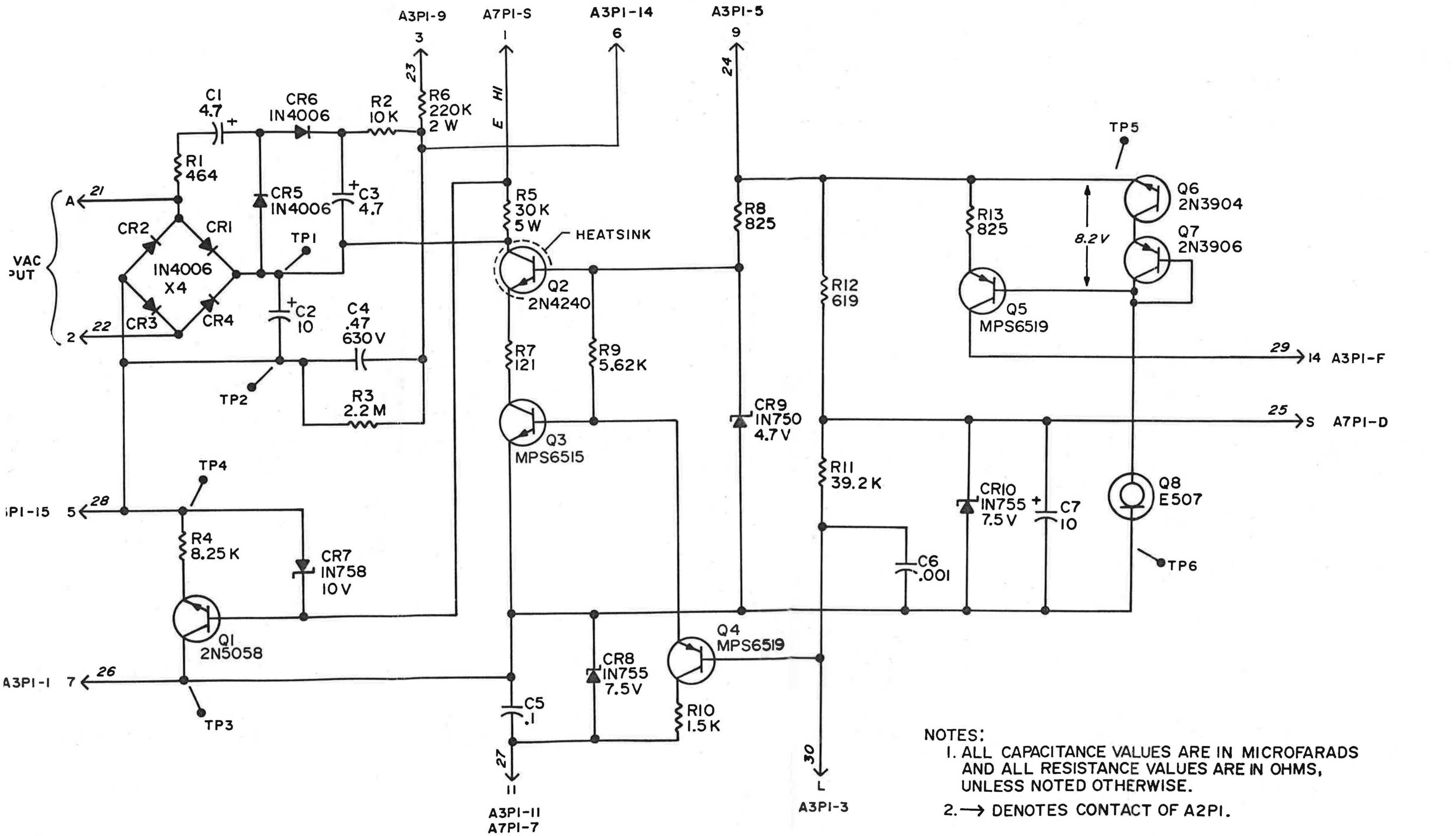




PARTS LIST, A3 POWER SUPPLY CONTROL - VOLTS (89-10500-1A)

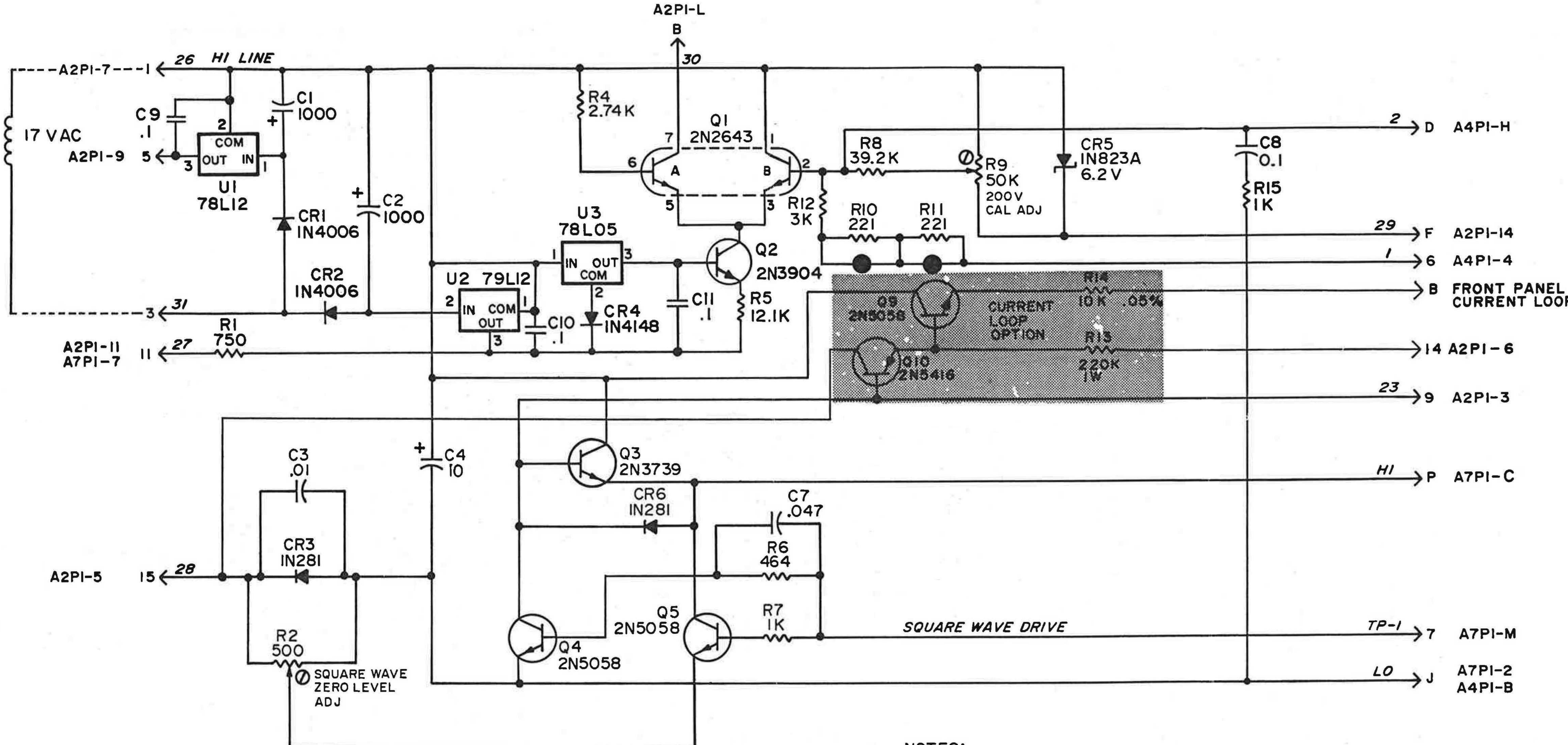
SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
C...1	07-10422-0A	CEA1000.0UF 25.0 V -10+50%	80031	MEPCO ET102X025A03
C...2	07-10422-0A	CEA1000.0UF 25.0 V -10+50%	80031	MEPCO ET102X025A03
C...3	07-10373-0A	CCD 10.0NF 25.0 VK -20+80%	56289	SPRAGUE HY-520
C...4	07-10420-0A	CEA 10UF 350.0 V-10+50%	80031	3072LF100T350SF
C...7	07-10214-0A	CCD 47. NF 25. VM	56289	SPR C069B250J473M OR EQUV
C...8	07-10223-0A	CYF 100. NF 250. VK	73445	AMPRFX C280AE/A100K
C9	07-20094-0A	CCD .1UF 25.0 V +-20%	91418	M25-1
C10	07-20094-0A	CCD .1UF 25.0 V +-20%	91418	M25-1
C11	07-20094-0A	CCD .1UF 25.0 V +-20%	91418	M25-1
CR..1	05-08058-0A	DGP 1N4006 400 1A	15238	ITT
CR..2	05-08058-0A	DGP 1N4006 400 1A	15238	ITT
CR..3	05-10025-0A	DGP 1N 281	15238	ITT
CR..4	05-10049-0A	DGP 1N4148	1295	TI
CR..5	05-10040-0A	DZG 1N 823A	4713	MOT
CR..6	05-10025-0A	DGP 1N 281	15238	ITT
Q...1	10-10013-0A	TRQ 2N2643 NPN 2 40 M65407	4713	MOT
Q...2	10-10043-0A	TRQ 2N3904 NPN 1 40 PTO-92	4713	MOT
Q...3	10-10015-0A	TRQ 2N3739 NPN 1 300 MTO-66	4713	MOT
Q...4	10-10016-0A	TRQ 2N5058 NPN 1 300	7263	FCH
Q...5	10-10016-0A	TRQ 2N5058 NPN 1 300	7263	FCH
R...1	12-12284-0A	RFF 750.0 250 MW F+-1%	16299	CGW RN550D 7500 F
R...2	09-10094-0A	RVF 500.0 500.0MW KVERT MT	73138	HELIPOT 72XW 500
R...4	12-12342-0A	RFF 2.74K 250.0MW F+- 1%	16299	CGW RN55D 2741 F
R...5	12-12408-0A	RFF 12.1 K 250.0MW F+- 1%	16299	CGW RN55D 1212 F
R...6	12-12264-0A	RFF 464.0 250 MW F+-1%	16299	CGW RN55D 4640 F
R...7	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
R...8	12-12457-0A	RFF 39.2 K 250.0MW F+- 1%	16299	CGW RN55D 3922 F
R...9	09-09956-0A	RVF 50.0 K 750.0MW	32997	BOU TYP 3069P
R..10	12-12233-0A	RFF 221.0 250 MW F+-1%	16299	CGW RN55D 2210 F
R..11	12-12233-0A	RFF 221.0 250 MW F+-1%	16299	CGW RN55D 2210 F
R..12	12-12630-0A	RFP 3.0 K 200.0MW +-.02%	50423	BLI
R..15	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
U...1	24-10286-0A	ICP 12V 100MA REG. TO-92	7263	FAIRCHILD UA78L12 TO-92
U...2	24-10302-0A	ICP -12V 100MA REG 5% TO-92	4713	MOT MC79L12ACP O/E
U...3	24-10301-0A	ICP 5V 100MA REG TO-92	4713	MOT MC78L05ACP O/E





NOTES:
1. ALL CAPACITANCE VALUES ARE IN MICROFARADS AND ALL RESISTANCE VALUES ARE IN OHMS, UNLESS NOTED OTHERWISE.
2. → DENOTES CONTACT OF A2PI.

Figure 6-1. V/DIV PROGRAMMABLE POWER SUPPLY (A2)



NOTES:

1. ALL CAPACITANCE VALUES ARE IN MICROFARADS AND ALL RESISTANCE VALUES ARE IN OHMS, UNLESS NOTED OTHERWISE.
2. -●- INDICATES A SOLDER CONNECTION WHICH MAY BE REMOVED TO ADJUST R9 CALIBRATION RANGE DURING TEST.
3. → DENOTES CONTACT OF A3PI.
4. ALL RESISTOR VALUES SHOWN ARE FOR 1% RESISTORS.

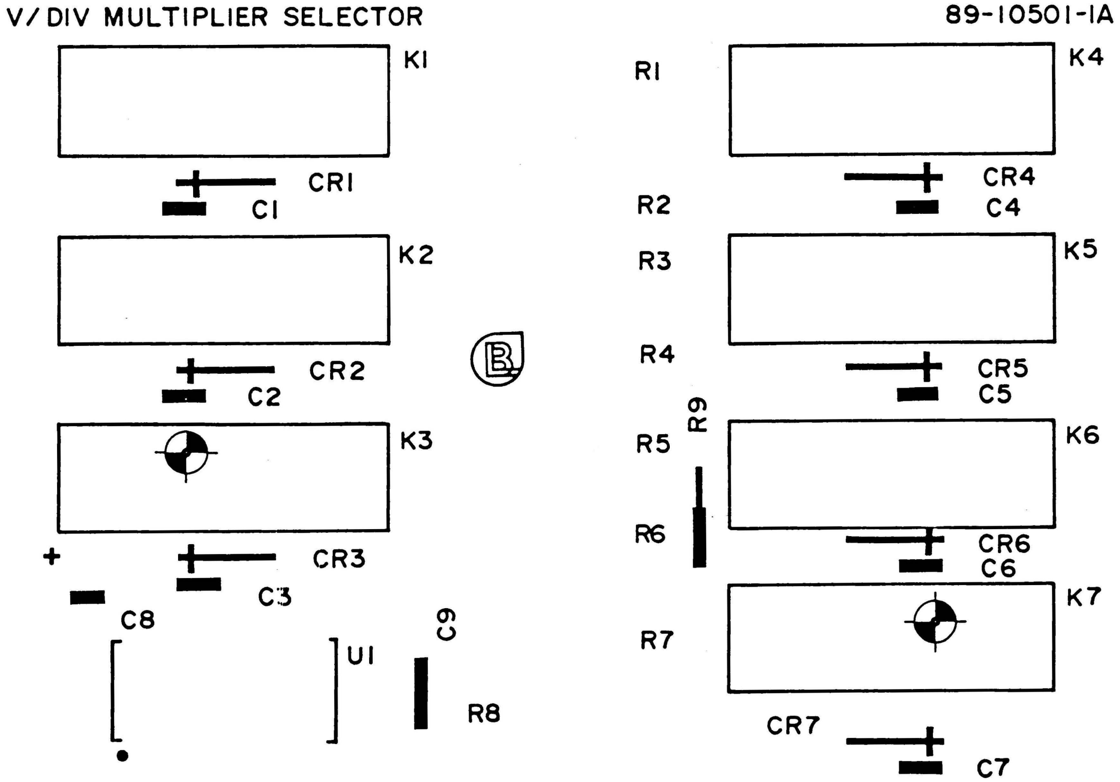
Figure 6-2. POWER SUPPLY CONTROL – VOLTS (A3)

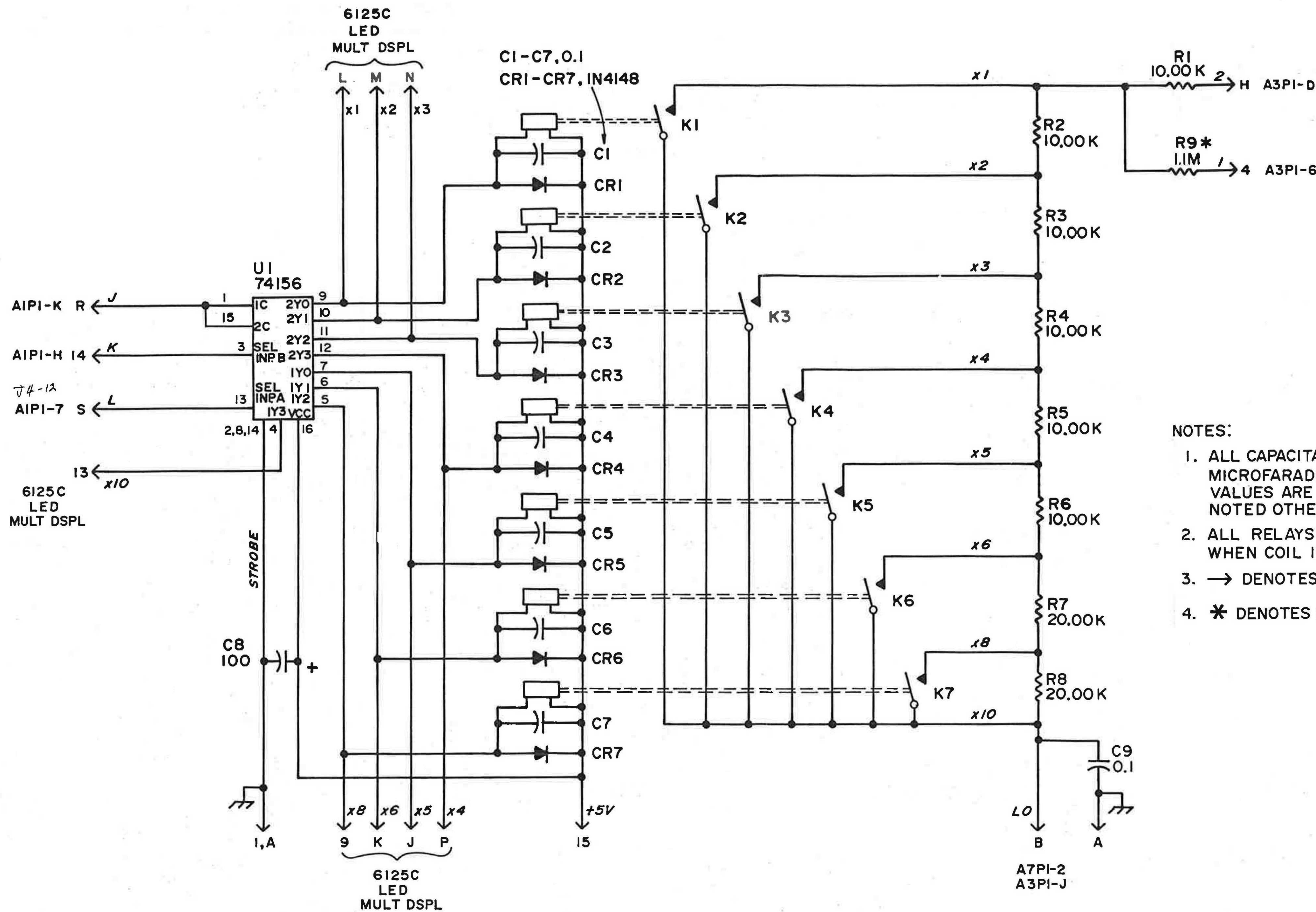
PARTS LIST, A4 VOLTS/DIV MULTIPLIER SELECTOR (89-10501-1A)

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
C...1	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...2	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...3	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...4	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...5	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...6	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...7	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...8	07-10184-0A	CET 100.0UF 10.0 VM DIP TAN	56289	SPRAGUE 196D107X0010-LA3
C...9	07-10223-0A	CYF 100. MF 250. VK	73445	AMPREX C280AE/A100K
CR..1	05-07920-0A	DGP 1N4148	7263	FCH
CR..2	05-07920-0A	DGP 1N4148	7263	FCH
CR..3	05-07920-0A	DGP 1N4148	7263	FCH
CR..4	05-07920-0A	DGP 1N4148	7263	FCH
CR..5	05-07920-0A	DGP 1N4148	7263	FCH
CR..6	05-07920-0A	DGP 1N4148	7263	FCH
CR..7	05-07920-0A	DGP 1N4148	7263	FCH
K...1	14-10015-1A	RLY REED FORM A 6V 300 OHM	50423	BLI
K...2	14-10015-1A	RLY REED FORM A 6V 300 OHM	50423	BLI
K...3	14-10015-1A	RLY REED FORM A 6V 300 OHM	50423	BLI
K...4	14-10015-1A	RLY REED FORM A 6V 300 OHM	50423	BLI
K...5	14-10015-1A	RLY REED FORM A 6V 300 OHM	50423	BLI
K...6	14-10015-1A	RLY REED FORM A 6V 300 OHM	50423	BLI
K...7	14-10015-1A	RLY REED FORM A 6V 300 OHM	50423	BLI
R...1	12-12632-0A	RFP 10.0 K 200.0MW +- .02%	50423	BLI
R...2	12-12632-0A	RFP 10.0 K 200.0MW +- .02%	50423	BLI
R...3	12-12632-0A	RFP 10.0 K 200.0MW +- .02%	50423	BLI
R...4	12-12632-0A	RFP 10.0 K 200.0MW +- .02%	50423	BLI
R...5	12-12632-0A	RFP 10.0 K 200.0MW +- .02%	50423	BLI
R...6	12-12632-0A	RFP 10.0 K 200.0MW +- .02%	50423	BLI
R...7	12-12633-0A	RFP 20.0K 200.0MW +-.02%	50423	BLI
R...8	12-12633-0A	RFP 20.0K 200.0MW +-.02%	50423	BLI
R...9	12-12604-0A	RFF 1.10M 500 MW F+-1%	16299	CGW RN60D 1104 F
U...1	24-10306-0A	ICP 74156 DEMULTIPLEXER	1295	T.I SN74156N OR EQUAL

V/DIV MULTIPLIER SELECTOR

89-10501-IA





NOTES:

1. ALL CAPACITANCE VALUES ARE IN MICROFARADS AND ALL RESISTANCE VALUES ARE IN OHMS, UNLESS NOTED OTHERWISE.
2. ALL RELAYS SHOWN IN POSITION WHEN COIL IS NOT ENERGIZED.
3. → DENOTES CONTACT OF A4P1.
4. * DENOTES FACTORY SELECTED VALUE.

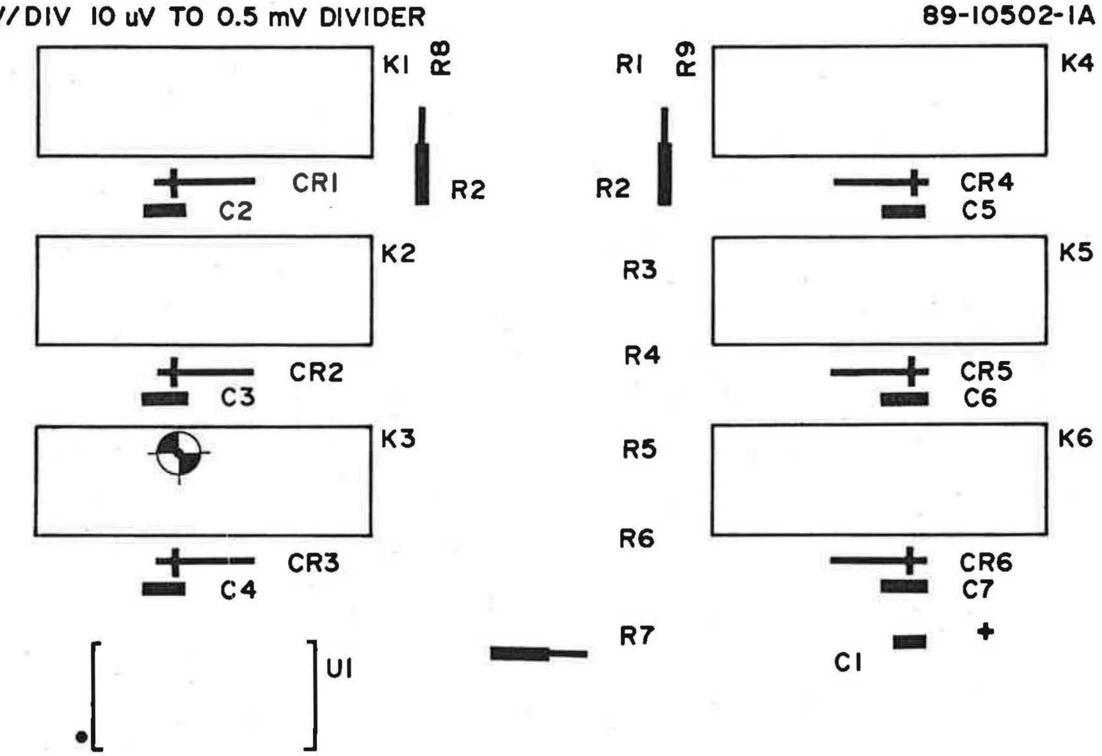
Figure 6-3. VOLTS/DIV MULTIPLIER SELECTOR (A4)

PARTS LIST, A5 V/DIV 10uV - 0.5mV DIVIDER (89-10502-1A)

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
C...1	07-10184-0A	CET 100.0UF 10.0 VM DIP TAN	56289	SPRAGUE 196D107X0010-LA3
C...2	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	0	AVX CERAMICS MD015E104ZAA
C...3	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	0	AVX CERAMICS MD015E104ZAA
C...4	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	0	AVX CERAMICS MD015E104ZAA
C...5	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	0	AVX CERAMICS MD015E104ZAA
C...6	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	0	AVX CERAMICS MD015E104ZAA
C...7	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	0	AVX CERAMICS MD015E104ZAA
CR..1	05-07920-0A	DGP 1N4148	7263	FCH
CR..2	05-07920-0A	DGP 1N4148	7263	FCH
CR..3	05-07920-0A	DGP 1N4148	7263	FCH
CR..4	05-07920-0A	DGP 1N4148	7263	FCH
CR..5	05-07920-0A	DGP 1N4148	7263	FCH
CR..6	05-07920-0A	DGP 1N4148	7263	FCH
K...1	14-10015-1A	RLY REED FORM A 6V 300 OHM	50423	BLI
K...2	14-10015-1A	RLY REED FORM A 6V 300 OHM	50423	BLI
K...3	14-10015-1A	RLY REED FORM A 6V 300 OHM	50423	BLI
K...4	14-10015-1A	RLY REED FORM A 6V 300 OHM	50423	BLI
K...5	14-10015-1A	RLY REED FORM A 6V 300 OHM	50423	BLI
K...6	14-10015-1A	RLY REED FORM A 6V 300 OHM	50423	BLI
R...1	12-12646-0A	RF 5.05 200.0MW +- .1%	50423	BLI
R...2	12-12646-0A	RF 5.05 200.0MW +- .1%	50423	BLI
R...3	12-12645-0A	RFP 15.0 200.0MW +_ .1%	50423	BLI
R...4	12-12644-0A	RFP 25.0 200.0MW +- .02%	50423	BLI
R...5	12-12643-0A	RFP 50.0 200.0MW +- .02%	50423	BLI
R...6	12-12642-0A	RFP 150.0 200.0MW +-.02%	50423	BLI
R...7	12-12233-0A	RFF 221.0 250 MW F+-1%	16299	CGW RN55D 2210 F
R...8	12-12268-0A	RFF 511.0 250 MW F+-1%	16299	CGW RN550 5110 F
R...9	12-12268-0A	RFF 511.0 250 MW F+-1%	16299	CGW RN550 5110 F
U...1	24-10306-0A	ICP 74156 DEMULTIPLEXER	1295	T.I SN74156N OR EQUAL

V/DIV 10 uV TO 0.5 mV DIVIDER

89-10502-1A



NOTES:

1. ✳ DENOTES FACTORY SELECTED VALUE.
2. ⟶ DENOTES CONTACT OF A5P1.
3. ALL CAPACITANCE VALUES ARE IN MICROFARADS AND ALL RESISTANCE VALUES ARE IN OHMS, UNLESS NOTED OTHERWISE.
4. ALL RELAYS SHOWN IN POSITION WHEN COIL IS NOT ENERGIZED.

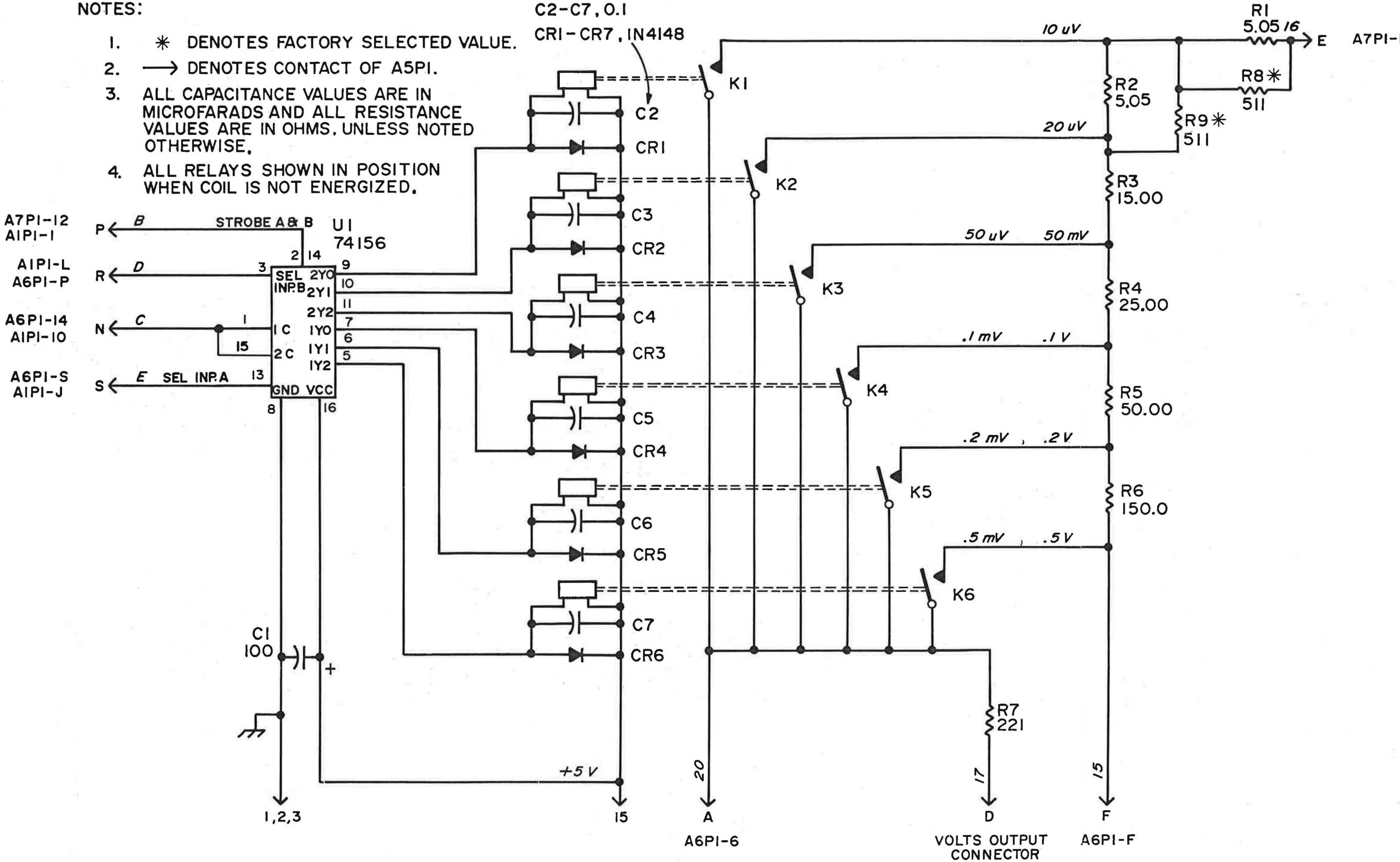
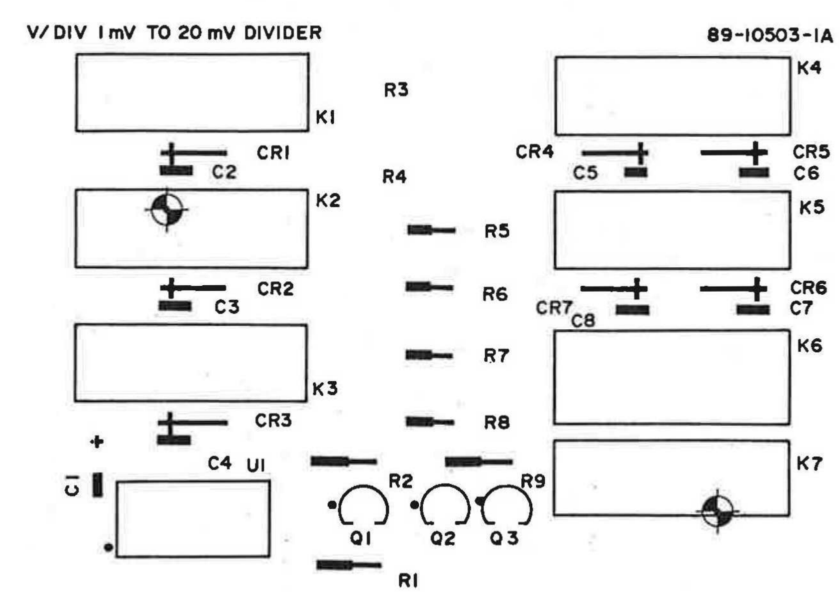


Figure 6-4. V/DIV 10uV - 0.5mV DIVIDER (A5)

PARTS LIST, A6 V/DIV 1mV - 20mV DIVIDER (89-10503-1A)

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
A...6	53-10097-1G	SHD 6125B ATTEN SHIELD	50423	BLI
C...1	07-10184-0A	CET 100.0UF 10.0 VM DIP TAN	56289	SPRAGUE 196D107X0010-LA3
C...2	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...3	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...4	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...5	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...6	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...7	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...8	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
CR..1	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR..2	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR..3	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR..4	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR..5	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR..6	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR..7	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
K...1	14-10015-1A	RLY REED FORM A 6V 300 OHM	50423	BLI
K...2	14-10015-1A	RLY REED FORM A 6V 300 OHM	50423	BLI
K...3	14-10015-1A	RLY REED FORM A 6V 300 OHM	50423	BLI
K...4	14-10015-1A	RLY REED FORM A 6V 300 OHM	50423	BLI
K...5	14-10015-1A	RLY REED FORM A 6V 300 OHM	50423	BLI
K...6	14-10016-1A	RLY REED FORM C 6V 175 OHM	50423	BLI
K...7	14-10015-1A	RLY REED FORM A 6V 300 OHM	50423	BLI
Q...1	10-10043-0A	TRQ 2N3904 NPN 1 40 PTO-92	4713	MOT 1 300M 40
Q...2	10-10080-0A	TRQ 2N4403 PNP	4713	MOTOROLA
Q...3	10-10043-0A	TRQ 2N3904 NPN 1 40 PTO-92	4713	MOT 1 300M 40
R...1	12-12364-0A	RFF 4.64K 250.0MW F+- 1%	16299	CGW RN55D 4641 F
R...2	12-12350-0A	RFF 3.32K 250.0MW F+- 1%	16299	CGW RN55D 3321 F
R...3	12-12641-0A	RFP 250.0 200.0MW +-.02%	50423	BLI
R...4	12-12640-0A	RFP 500.0 200.0MW +-.02%	50423	BLI
R...5	12-12639-0A	RFP 1.5 K 1.0 W +-.02%	50423	BLI
R...6	12-12638-0A	RFP 2.5 K 1.0 W +-.02%	50423	BLI
R...7	12-12638-0A	RFP 2.5 K 1.0 W +-.02%	50423	BLI
R...8	12-12638-0A	RFP 2.5 K 1.0 W +-.02%	50423	BLI
R...9	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
U...1	24-10306-0A	ICP 74156 DEMULTIPLEXER	1295	T.I SN74156N OR EQUAL



NOTES:

1. ALL CAPACITANCE VALUES ARE IN MICROFARADS AND ALL RESISTANCE VALUES ARE IN OHMS UNLESS NOTED OTHERWISE.
2. ALL RELAYS SHOWN IN POSITION WHEN COIL IS NOT ENERIZED.
3. → DENOTES CONTACT OF A6PI.

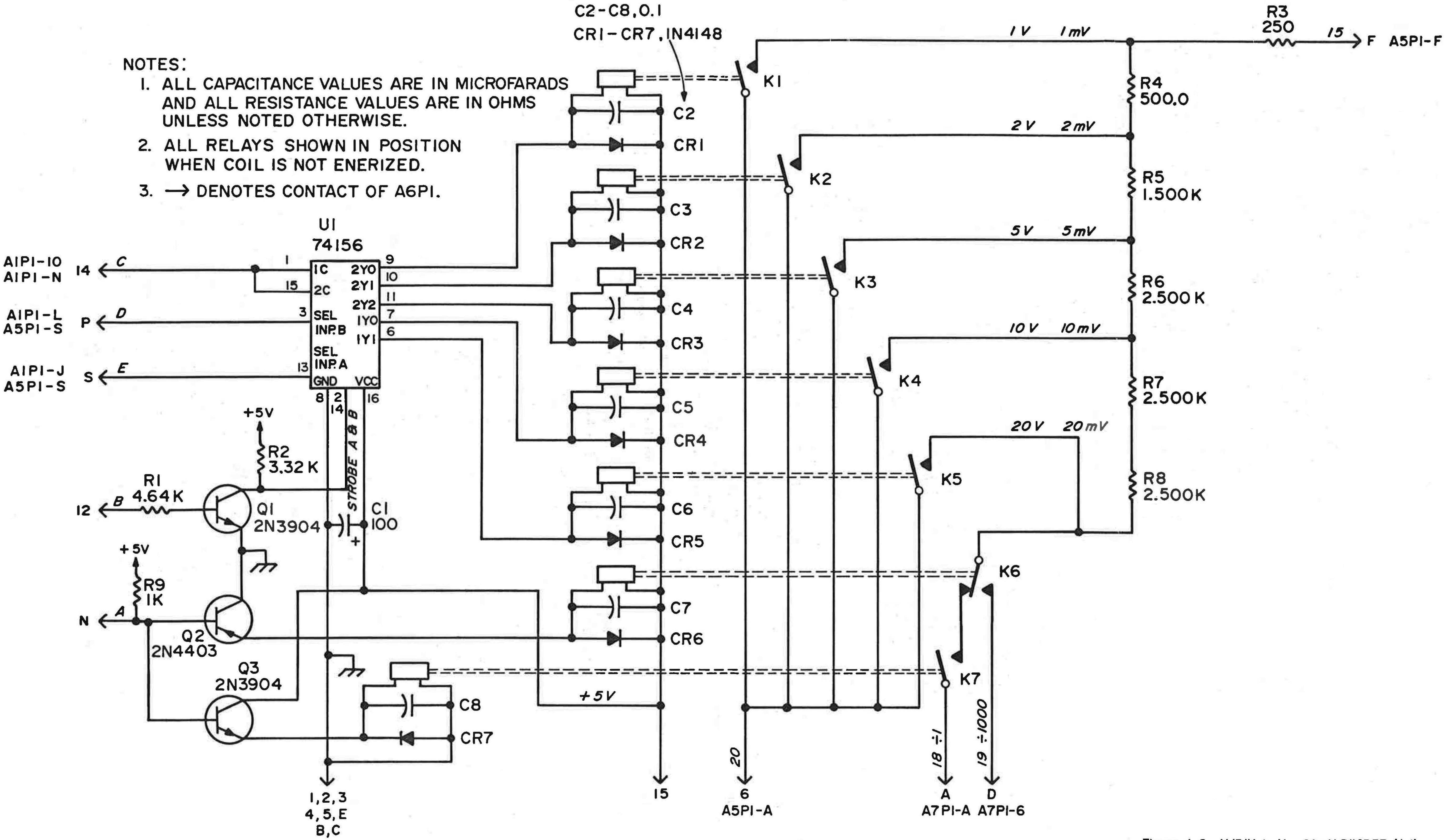
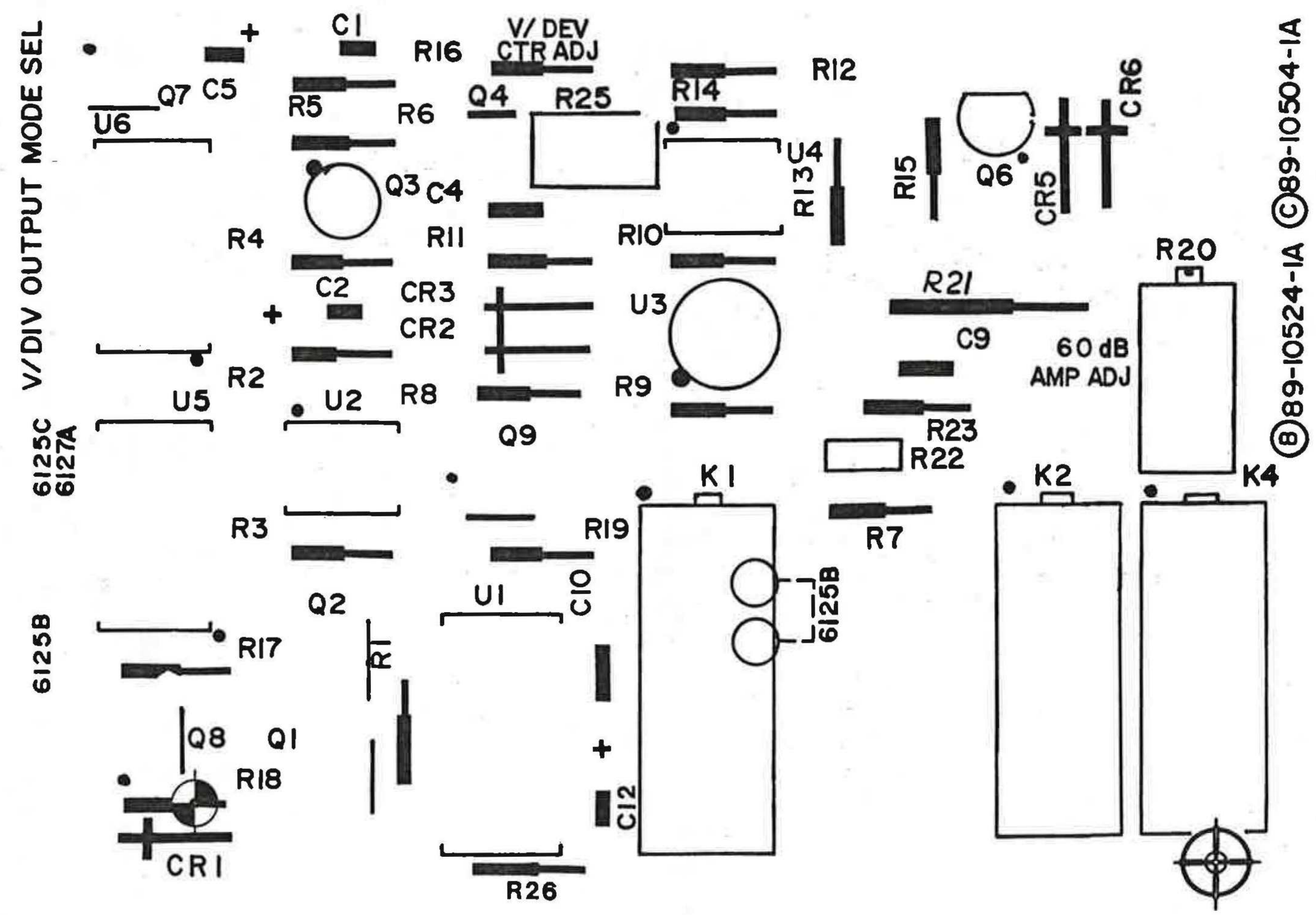


Figure 6-5. V/DIV 1mV - 20mV DIVIDER (A6)

PARTS LIST, A7 V/DIV OUTPUT MODE SELECTOR (89-10524-1A)

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
C...1	07-10025-0A	CCD 2.2NF 1.0KV DC	84171	ELMENCO LORCAP TYPECCD222
C...2	07-10184-0A	CET 100.0UF 10.0 VM DIP TAN	56289	SPRAGUE 196D107X0010-LA3
C...4	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	0	AVX CERAMICS MD015E104ZAA
C...5	07-10184-0A	CET 100.0UF 10.0 VM DIP TAN	56289	SPRAGUE 196D107X0010-LA3
C...9	07-10037-0A	CCD 4.7NF 1.0 KV DC	84171	ELMENCO TYPE CCD472
C..10	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	0	AVX CERAMICS MD015E104ZAA
C..12	07-10184-0A	CET 100.0UF 10.0 VM DIP TAN	56289	SPRAGUE 196D107X0010-LA3
CR..2	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR...3	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR..5	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR..6	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
K...2	14-10034-0A	RLY 2A2B 5V COIL	50423	BLI
K...4	14-10034-0A	RLY 2A2B 5V COIL	50423	BLI
Q...1	10-10043-0A	TRQ 2N3904 NPN 1 40 PTO-92	4713	MOT 1 300M 40
Q...2	10-10043-0A	TRQ 2N3904 NPN 1 40 PTO-92	4713	MOT 1 300M 40
Q...3	10-10001-0A	TRQ 2N2369 NPN 1 15 MTO-18	4713	MOT 1.2 500M 20
Q...4	10-09485-0A	TRQ MPS6521 NPN 1 25 PTU-92	4713	MOT 1 390M 100
Q...6	10-10080-0A	TRQ 2N4403 PNP	4713	MOTOROLA
Q...7	10-09473-0A	TRQ 2N3906 PNP 1 40 PTO-92	4713	MOT 1 200M 60
Q...8	10-10043-0A	TRQ 2N3904 NPN 1 40 PTO-92	4713	MOT 1 300M 40
Q...9	10-10154-0A	TRQ 2N4401 NPN 1 40V S TO92	4713	MOT
R...1	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
R...2	12-12280-0A	RFF 681.0 250 MW F+-1%	16299	CGW RN55D 6810 F
R...3	12-12236-0A	RFF 237.0 250 MW F+-1%	16299	CGW RN55D 2370 F
R...4	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
R...5	12-12300-1A	RFF 1.0K 250 MW F+-1%	50423	BLI
R...6	12-12412-0A	RFF 13.3 K 250.0MW F+- 1%	16299	CGW RN55D 1332 F
R...7	12-12444-0A	RFF 28.7 K 250.0MW F+- 1%	16299	CGW RN55D 2872 F
R...8	12-12476-0A	RFF 61.9 K 250.0MW F+- 1%	16299	CGW RN55D 6192 F
R...9	12-12376-0A	RFF 6.19K 250.0MW F+- 1%	16299	CGW RN55D 6191 F
R..10	12-12248-0A	RFF 316.0 250 MW F+-1%	16299	CGW RN55D 3160 F
R..11	12-12428-0A	RFF 19.6 K 250.0MW F+- 1%	16299	CGW RN55D 1962 F
R..12	12-08044-0A	RFC 22.0 M 250.0MW J+- 5%	1121	A-B TYP CB
R..13	12-12350-0A	RFF 3.32K 250.0MW F+- 1%	16299	CGW RN55D 3321 F
R..14	12-08029-0A	RFC 1.0 M 250.0MW J+- 5%	1121	A-B TYP CB
R..15	12-12228-0A	RFF 196.0 250 MW F+-1%	16299	CGW RN55D 1960 F
R..16	12-12342-0A	RFF 2.74K 250.0MW F+- 1%	16299	CGW RN55D 2741 F
R..17	12-12350-0A	RFF 3.32K 250.0MW F+- 1%	16299	CGW RN55D 3321 F
R..18	12-12350-0A	RFF 3.32K 250.0MW F+- 1%	16299	CGW RN55D 3321 F
R..19	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
R..20	09-10181-0A	RVF 500.0 K 500.0MW K 20TURN	80294	BOURNS 3069P
R..21	12-12939-0A	RFF 4.0 M 500.0MW F1%50PPM	80031	MEPCO MF6C-C-4.0M-F
R..22	12-12635-0A	RFP 100.0 K 200.0MW +_.25%	50423	BLI
R..23	12-12200-0A	RFF 100.0 250.0MW F+- 1%	16299	CGW RN55D 1000 F
R..25	09-10094-0A	RVF 500.0 500.0MW KVERT MT	73138	HELIPOT 72XW 500
R..26	12-12228-0A	RFF 196.0 250 MW F+-1%	16299	CGW RN55D 1960 F
R..27	27-01154-0A	THR 100 k+-10%	83186	VTE TYPE 21E26
U...1	24-10060-0A	ICP TIMEBASE DIVIDER	50088	MOSTEK MK 5009P
U...2	24-10183-0A	ICP L111 OPT. INSULATOR	1295	T.I TIL111
U...3	24-09420-0A	ICP UA741C FAIRCHILD	7263	#U5B7741393
U...4	24-10183-0A	ICP L111 OPT. INSULATOR	1295	T.I TIL111
U...5	24-10181-0A	ICP 74LS02 QUAD 2 IN NOR	1295	T.I.SN74LS02
U...6	24-10179-0A	ICP 74LS10 TRI.3 IN NAND	1295	T.I.SN74S10



NOTES:

1. —●— DENOTES A SOLDER CONNECTION.
2. ✳ DENOTES FACTORY SELECTED VALUE.
3. ALL CAPACITANCE VALUES ARE IN MICROFARADS AND ALL RESISTANCE VALUES ARE IN OHMS UNLESS NOTED OTHERWISE.
4. —> DENOTES CONTACT OF A7P1.
5. ALL RELAYS SHOWN IN POSITION WHEN COIL IS NOT ENERGIZED.

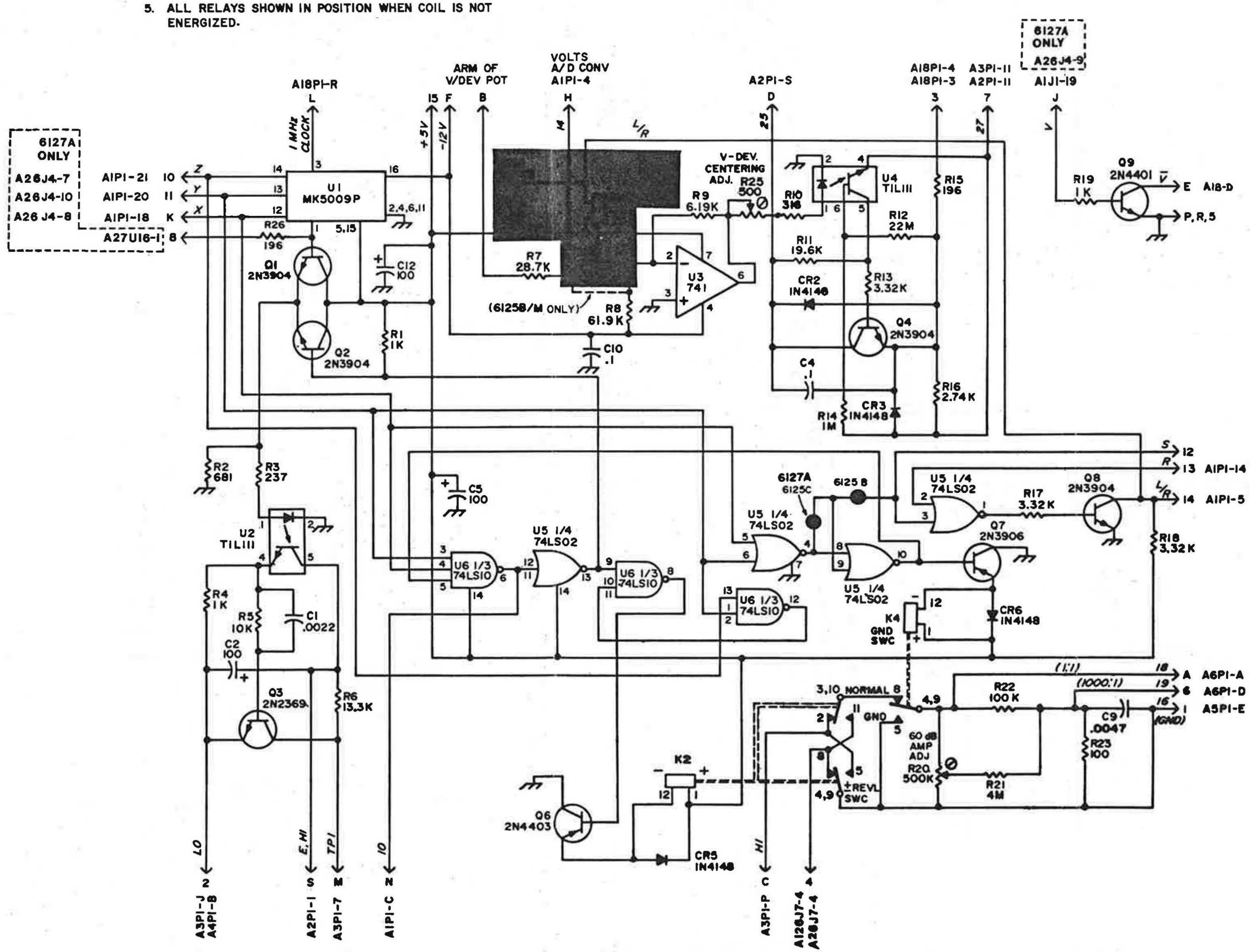


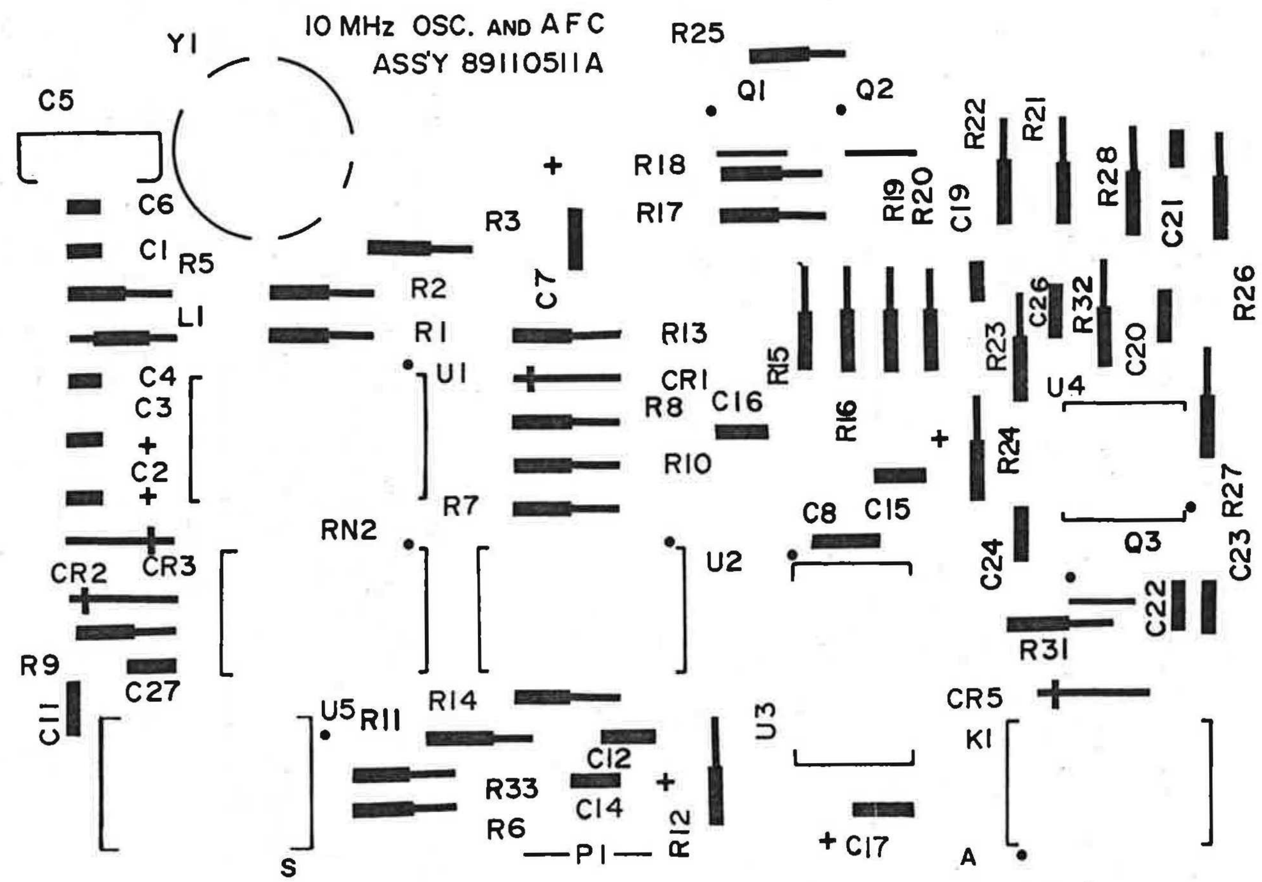
Figure 6-6. V/DIV OUTPUT MODE SELECTOR (A7)

PARTS LIST, A11 10MHz OSC & AFC (89-11051-1A)

SCHEM REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
C...1	07-10120-0A	CCD 22.0NF 25.0 VM	71590	CENTRLB UK25223 OR EQUIV
C...2	07-10053-0A	CET 10.0UF 35.0V M	56289	199D106X0035DA2
C...3	07-10053-0A	CET 10.0UF 35.0V M	56289	199D106X0035DA2
C...4	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...5	07-10208-0A	CVC 2.0-10PF TRIMMER	50423	BLI
C...6	07-10488-0A	CMD 10.0PF 300.0 VJ	84171	ARCO TYPE DM-15-BC10JN1
C...7	07-10184-0A	CET 100.0UF 10.0 VM DIP TAN	56289	SPRAGUE 196D107X0010-LA3
C...8	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C..11	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C..12	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C..14	07-10053-0A	CET 10.0UF 35.0V M	56289	199D106X0035DA2
C..15	07-10053-0A	CET 10.0UF 35.0V M	56289	199D106X0035DA2
C..16	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C..17	07-10053-0A	CET 10.0UF 35.0V M	56289	199D106X0035DA2
C..19	07-10543-0A	CMD 56.0PF 500.0 VJ+- 5%	84171	ARCO CM04FD560J03 O/E
C..20	07-02292-0A	CMD 470.0PF 500.0 FJ+- 5%	84171	ARCO DM-15-471-J
C..21	07-10543-0A	CMD 56.0PF 500.0 VJ+- 5%	84171	ARCO CM04FD560J03 O/E
C..22	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C..23	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C..24	07-02292-0A	CMD 470.0PF 500.0 FJ+- 5%	84171	ARCO DM-15-471-J
C..26	07-02292-0A	CMD 470.0PF 500.0 FJ+- 5%	84171	ARCO DM-15-471-J
C..27	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
CR..1	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR..2	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR..3	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR..5	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
K...1	14-10020-0A	RLY REED FORM C 5V 200OHM DI	50423	BLI
L...1	03-10051-0A	CRF 39 UH INDUCTOR	83125	NYTRONICS WEE39
Q...1	10-09473-0A	TRQ 2N3906 PNP 1 40 PTO-92	4713	MOT 1 200M 60
Q...2	10-09473-0A	TRQ 2N3906 PNP 1 40 PTO-92	4713	MOT 1 200M 60
Q...3	10-10043-0A	TRQ 2N3904 NPN 1 40 PTO-92	4713	MOT 1 300M 40
R...1	12-12264-0A	RFF 464.0 250 MW F+-1%	16299	CGW RN55D 4640 F
R...2	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
R...3	12-12280-0A	RFF 681.0 250 MW F+-1%	16299	CGW RN55D 6810 F
R...5	12-12264-0A	RFF 464.0 250 MW F+-1%	16299	CGW RN55D 4640 F
R...6	12-12364-0A	RFF 4.64K 250.0MW F+- 1%	16299	CGW RN55D 4641 F
R...7	12-12232-0A	RFF 215.0 250 MW F+-1%	16299	CGW RN55D 2150 F
R...8	12-12272-0A	RFF 562.0 250 MW F+-1%	16299	CGW RN55D 5620 F
R...9	12-12200-0A	RFF 100.0 250.0MW F+- 1%	16299	CGW RN55D 1000 F
R..10	12-12200-0A	RFF 100.0 250.0MW F+- 1%	16299	CGW RN55D 1000 F
R..11	12-12200-0A	RFF 100.0 250.0MW F+- 1%	16299	CGW RN55D 1000 F
R..12	12-12164-0A	RFF 46.4 250.0MW F+- 1%	16299	CGW RN55D 46R4 F
R..13	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
R..14	12-12333-0A	RFF 2.21K 250.0MW F+- 1%	16299	CGW RN55D 2211 F
R..15	12-12280-0A	RFF 681.0 250 MW F+-1%	16299	CGW RN55D 6810 F
R..16	12-12256-0A	RFF 383.0 250 MW F+-1%	16299	CGW RN55D 3830 F
R..17	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
R..18	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
R..19	12-12256-0A	RFF 383.0 250 MW F+-1%	16299	CGW RN55D 3830 F
R..20	12-12280-0A	RFF 681.0 250 MW F+-1%	16299	CGW RN55D 6810 F
R..21	12-12328-0A	RFF 1.96K 250.0MW F+- 1%	16299	CGW RN55D 1961 F
R..22	12-12400-0A	RFF 10.0 K 250.0MW F+- 1%	16299	CGW RN55D 1002 F
R..23	12-12400-0A	RFF 10.0 K 250.0MW F+- 1%	16299	CGW RN55D 1002 F
R..24	12-12400-0A	RFF 10.0 K 250.0MW F+- 1%	16299	CGW RN55D 1002 F
R..25	12-12328-0A	RFF 1.96K 250.0MW F+- 1%	16299	CGW RN55D 1961 F
R..26	12-12400-0A	RFF 10.0 K 250.0MW F+- 1%	16299	CGW RN55D 1002 F
R..27	12-12400-0A	RFF 10.0 K 250.0MW F+- 1%	16299	CGW RN55D 1002 F
R..28	12-12400-0A	RFF 10.0 K 250.0MW F+- 1%	16299	CGW RN55D 1002 F
R..31	12-12364-0A	RFF 4.64K 250.0MW F+- 1%	16299	CGW RN55D 4641 F
R..32	12-12400-0A	RFF 10.0 K 250.0MW F+- 1%	16299	CGW RN55D 1002 F
R..33	12-12364-0A	RFF 4.64K 250.0MW F+- 1%	16299	CGW RN55D 4641 F
RN..2	13-10023-0A	RNF 680.0 0.2 W F	80053	BECKMAN 899-3R680 -F

PARTS LIST, A11 10MHz OSC & AFC (89-11051-1A) - Cont'd

SCHEM REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
U...1	24-10041-0A	ICP LIN DUAL OD AMP 10116	4713	MOTOROLA
U...2	10-10084-0A	TRQ MPQ6700 4 P14 DIP	4713	MOT
U...3	24-10365-0A	ICP MC12040CP PHASE FREQ DET	4713	MOTOROLA MC12040
U...4	24-10307-0A	ICP LF351NJ FET OP AMP D.I.L	4713	MOTOROLA LF351N OR EQUIV
U...5	24-10257-0A	ICP CD4066AE QUAD BILAT SWC.	86684	RCA CD4066AE OR EQUAL
X...1	42-10000-0A	OVN OVEN SEMI CON TO-5 20V	1295	ULIXON TEXAS INST. MST1-2
Y...1	04-40003-0A	CRS 10.0MHZ TO-5	50423	BLI



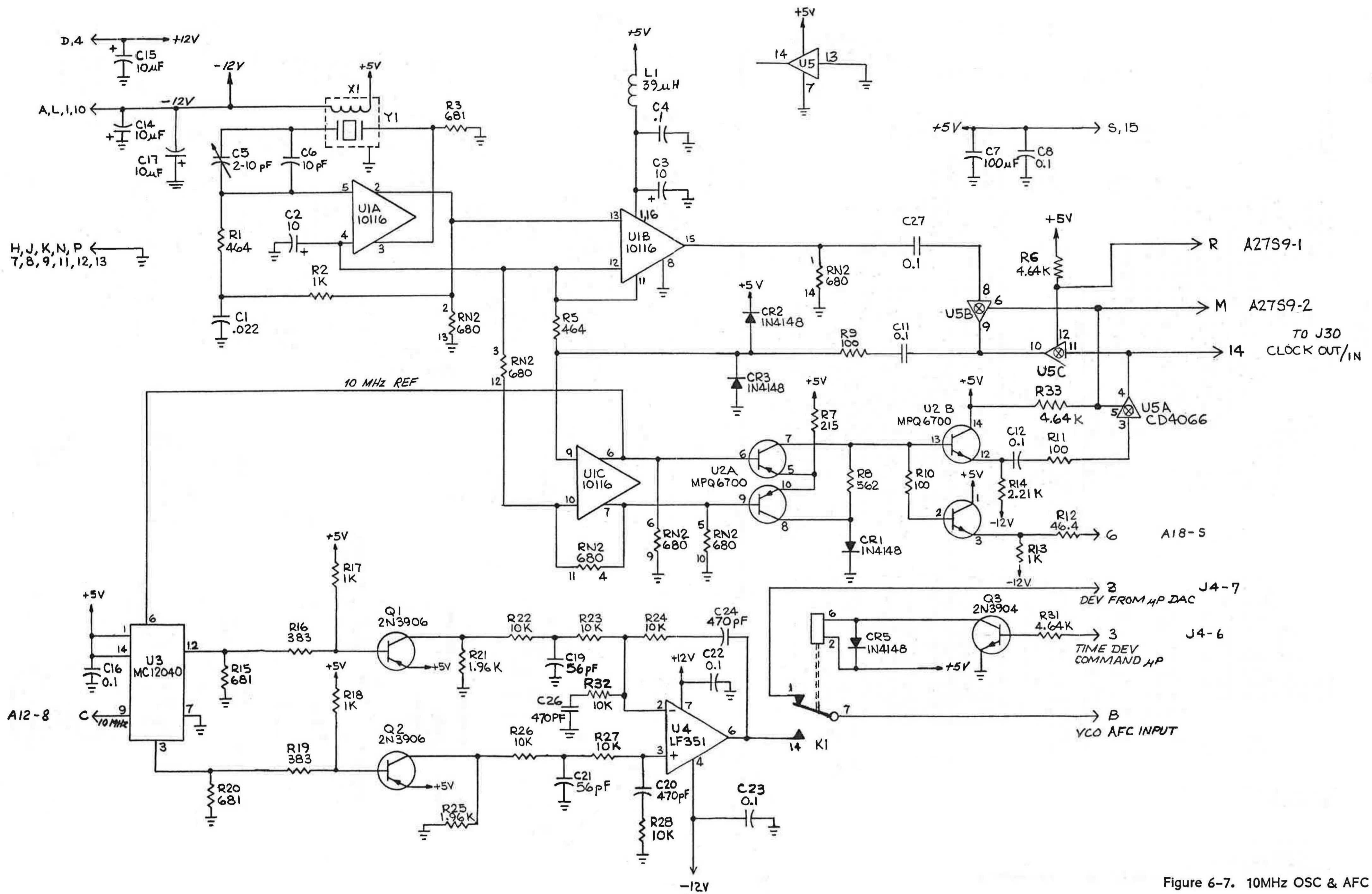


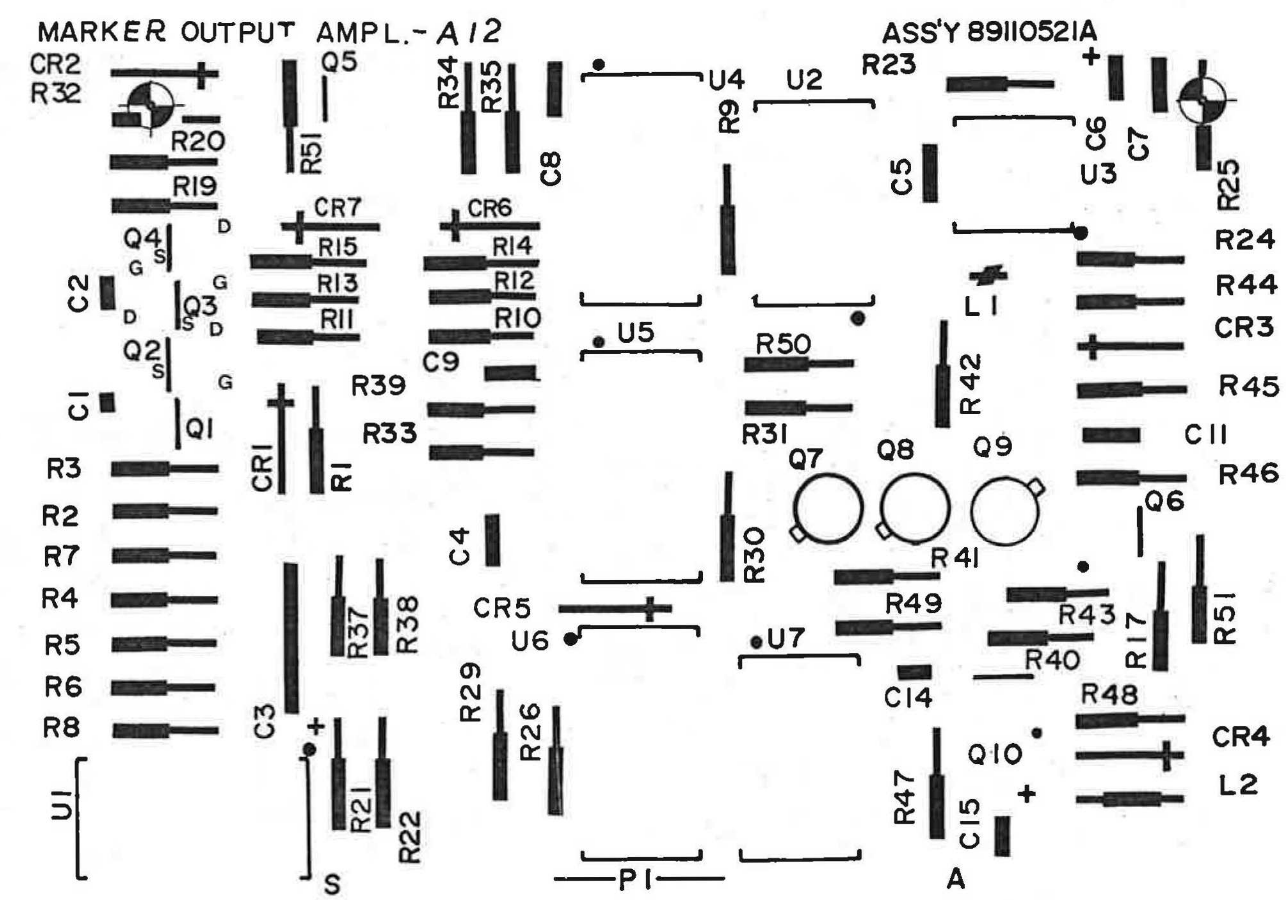
Figure 6-7. 10MHz OSC & AFC (A11)

PARTS LIST, A12 MARKER OUTPUT AMPLIFIER (89-11052-1A)

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
C...1	07-10472-0A	CBM 6.8NF 100.0 VJ	50587	ECI PLUCON I 6.8NF/5%/100V
C...2	07-10591-0A	CCR 680 NF 50V X 7R	50423	BLI
C...3	07-02785-0A	CET 6.8UF 35 V K 10%	56289	SPRAGUE 150D685X903582
C...4	07-20094-0A	CCD .1UF 25.0 V +-20%	91418	M25-1
C...5	07-20094-0A	CCD .1UF 25.0 V +-20%	91418	M25-1
C...6	07-10053-0A	CET 10.0UF 35.0V M	56289	199D106X0035DA2
C...7	07-20094-0A	CCD .1UF 25.0 V +-20%	91418	M25-1
C...8	07-20094-0A	CCD .1UF 25.0 V +-20%	91418	M25-1
C...9	07-20094-0A	CCD .1UF 25.0 V +-20%	91418	M25-1
C..11	07-20094-0A	CCD .1UF 25.0 V +-20%	91418	M25-1
C..14	07-10530-0A	CMD 33.0PF 500.0 V+- 5%	84171	DM15 330J
C..15	07-10184-0A	CET 100.0UF 10.0 VM DIP TAN	56289	SPRAGUE 196D107X0010-LA3
CR..1	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR..2	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR..3	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR..4	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR..5	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR..6	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR..7	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
L...1	46-10000-0A	FRB FERRITE BEAD	78488	STACKPOLE 57-0180-70 MAT
L...2	03-10008-0A	CRF 22MH MOLDED +-10%	76493	MILLER #9230-52
Q...1	10-09485-0A	TRQ MPS6521 NPN 1 25 PTO-92	4713	MOT 1 390M 100
Q...2	10-10193-0A	TRQ J210 N-CHAN. FET.	17856	SILICONIX J210
Q...3	10-10193-0A	TRQ J210 N-CHAN. FET.	17856	SILICONIX J210
Q...4	10-10193-0A	TRQ J210 N-CHAN. FET.	17856	SILICONIX J210
Q...5	10-09485-0A	TRQ MPS6521 NPN 1 25 PTO-92	4713	MOT 1 390M 100
Q...6	10-10168-0A	TRQ 2N5771	7263	FAIRCHILD OR EQUIV 2N5771
Q...7	10-08055-0A	TRQ 2N918 PNP 1 15 PTO-18	7263	FCH .300 900M 20
Q...8	10-08055-0A	TRQ 2N918 PNP 1 15 PTO-18	7263	FCH .300 900M 20
Q...9	10-10156-0A	TRQ MM4049 PNP 1 10V S T072	4713	MOT
Q..10	10-10168-0A	TRQ 2N5771	7263	FAIRCHILD OR EQUIV 2N5771
R...1	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
R...2	12-12564-0A	RFF 464.0 K 500.0MW F+-1%	16299	CGW RN60D 4643 F
R...3	12-12256-0A	RFF 383.0 250 MW F+-1%	16299	CGW RN55D 3830 F
R...4	12-12392-0A	RFF 9.09K 250.0MW F+-.1%	16299	CGW RN55D 9091 F
R...5	12-12426-0A	RFF 18.7 K 250.0MW F+-1%	16299	CGW RN55D 1872 F
R...6	12-12468-0A	RFF 51.1 K 250.0MW F+-1%	16299	CGW RN55D 5112 F
R...7	12-12504-0A	RFF 110.0 K 250.0MW F+-1%	16299	CGW RN55D 1103 F
R...8	12-12546-0A	RFF 301.0 K 250.0MW F+-1%	16299	CGW RN55D 3013 F
R...9	12-12364-0A	RFF 4.64K 250.0MW F+- 1%	16299	CGW RN55D 4641 F
R..10	12-12364-0A	RFF 4.64K 250.0MW F+- 1%	16299	CGW RN55D 4641 F
R..11	12-12364-0A	RFF 4.64K 250.0MW F+- 1%	16299	CGW RN55D 4641 F
R..12	12-12364-0A	RFF 4.64K 250.0MW F+- 1%	16299	CGW RN55D 4641 F
R..13	12-12364-0A	RFF 4.64K 250.0MW F+- 1%	16299	CGW RN55D 4641 F
R..14	12-12364-0A	RFF 4.64K 250.0MW F+- 1%	16299	CGW RN55D 4641 F
R..15	12-12364-0A	RFF 4.64K 250.0MW F+- 1%	16299	CGW RN55D 4641 F
R..17	12-12116-0A	RFF 14.7 250.0MW F+- 1%	16299	CGW RN55D 14R7 F
R..19	12-12500-0A	RFF 100.0 K 250.0MW F+- 1%	16299	CGW RN55D 1003 F
R..20	12-12350-0A	RFF 3.32K 250.0MW F+- 1%	16299	CGW RN55D 3321 F
R..21	12-12316-0A	RFF 1.47K 250 MW F+-1%	16299	CGW RN55D 1471 F
R..22	12-12316-0A	RFF 1.47K 250 MW F+-1%	16299	CGW RN55D 1471 F
R..23	12-12200-0A	RFF 100.0 250.0MW F+- 1%	16299	CGW RN55D 1000 F
R..24	12-12316-0A	RFF 1.47K 250 MW F+-1%	16299	CGW RN55D 1471 F
R..25	12-12280-0A	RFF 681.0 250 MW F+-1%	16299	CGW RN55D 6810 F
R..26	12-12280-0A	RFF 681.0 250 MW F+-1%	16299	CGW RN55D 6810 F
R..29	12-12168-0A	RFF 51.1 250.0MW F+- 1%	16299	CGW RN55D 51R1 F
R..30	12-12168-0A	RFF 51.1 250.0MW F+- 1%	16299	CGW RN55D 51R1 F
R..31	12-12280-0A	RFF 681.0 250 MW F+-1%	16299	CGW RN55D 6810 F
R..32	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
R..33	12-12280-0A	RFF 681.0 250 MW F+-1%	16299	CGW RN55D 6810 F
R..34	12-12280-0A	RFF 681.0 250 MW F+-1%	16299	CGW RN55D 6810 F
R..35	12-12280-0A	RFF 681.0 250 MW F+-1%	16299	CGW RN55D 6810 F

PARTS LIST, A12 MARKER OUTPUT AMPLIFIER (89-11052-1A) - Cont'd

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
R..37	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
R..38	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
R..39	12-12280-0A	RFF 681.0 250 MW F+-1%	16299	CGW RN55D 6810 F
R..40	12-12288-0A	RFF 825.0 250 MW F+-1%	16299	CGW RN55D 8250 F
R..41	12-12280-0A	RFF 681.0 250 MW F+-1%	16299	CGW RN55D 6810 F
R..42	12-12200-0A	RFF 100.0 250.0MW F+- 1%	16299	CGW RN55D 1000 F
R..43	12-12228-0A	RFF 196.0 250 MW F+-1%	16299	CGW RN55D 1960 F
R..44	12-12280-0A	RFF 681.0 250 MW F+-1%	16299	CGW RN55D 6810 F
R..45	12-12320-0A	RFF 1.62K 250 MW F+-1%	16299	CGW RN55D 1621 F
R..46	12-09839-0A	RFC 5.1 250.0MW J+- 5%	1121	AB TYP CB
R..47	12-12168-0A	RFF 51.1 250.0MW F+- 1%	16299	CGW RN55D 51R1 F
R..48	12-12128-0A	RFF 19.6 250.0MW F+-1%	16299	CGW RN55D 19R6 F
R..49	12-12308-0A	RFF 1.21K 250 MW F+-1%	16299	CGW RN55D 1211 F
R..50	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
R..51	12-12248-0A	RFF 316.0 250 MW F+-1%	16299	CGW RN55D 3160 F
R..51	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
U...1	24-10194-0A	ICP 4051 CMOS MULTIPLEXER	86684	RCA CD4051BE
U...2	24-09409-0A	ICP SN7473N T.I. OR	56289	SPRAGUE USN7473A
U...3	24-10261-0A	ICP LM306JG DUF COMP STR	1295	TI SN52106P OR EQUAL
U...4	24-10180-0A	ICP 10131 DUAL D FL. FL.	86684	MOTOROLA MC10131
U...5	24-10176-0A	ICP 10138 BI QUINARY CONTR	4713	MOTOROLA MC10138
U...6	24-10177-0A	ICP 10174 DUAL 4 TO 1 MCTPR	4713	MOTOROLA MC10174
U...7	24-10173-0A	ICP 7402 QUAD 2 IN NOR	1295	T.I.SN7402



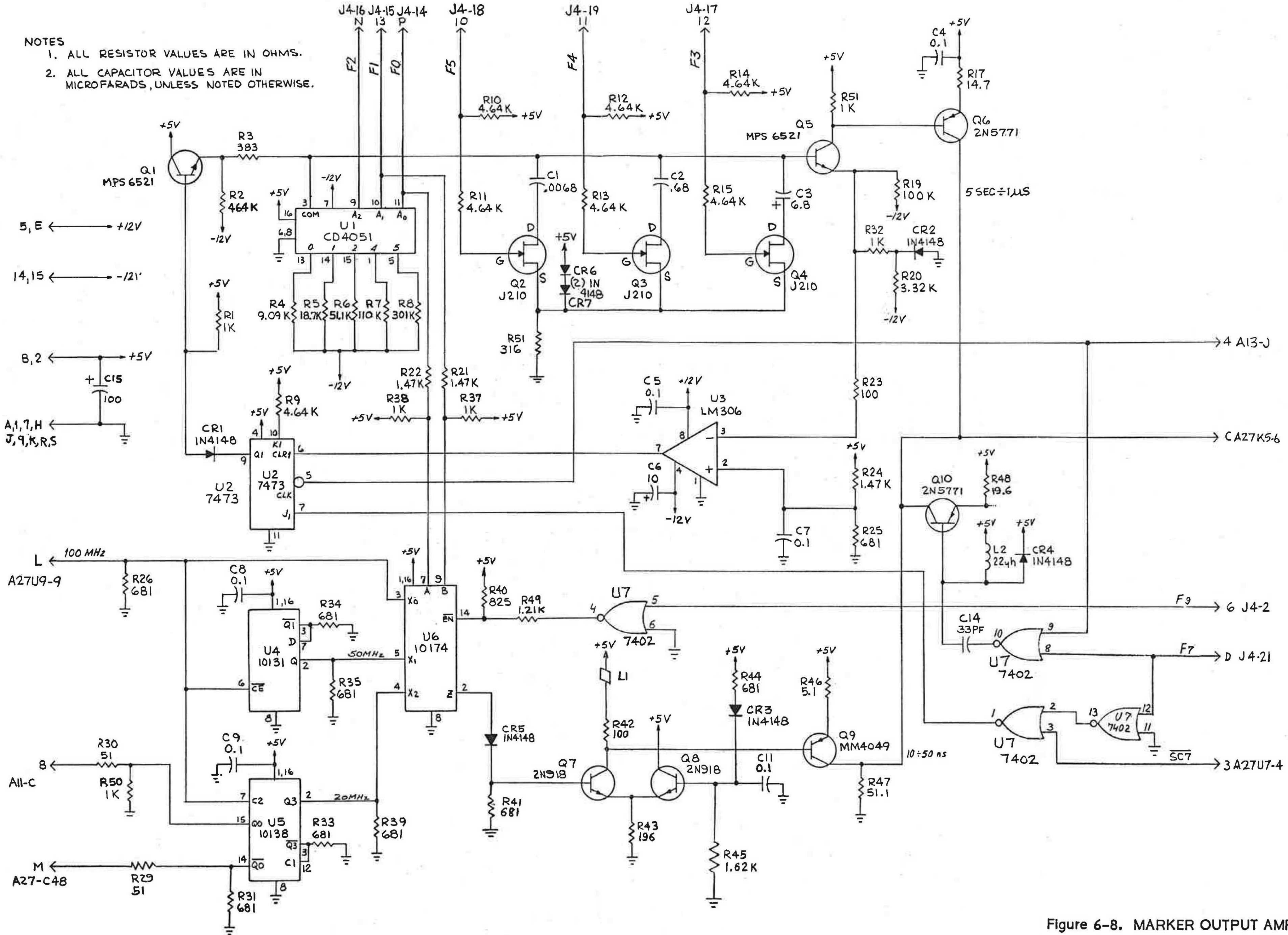
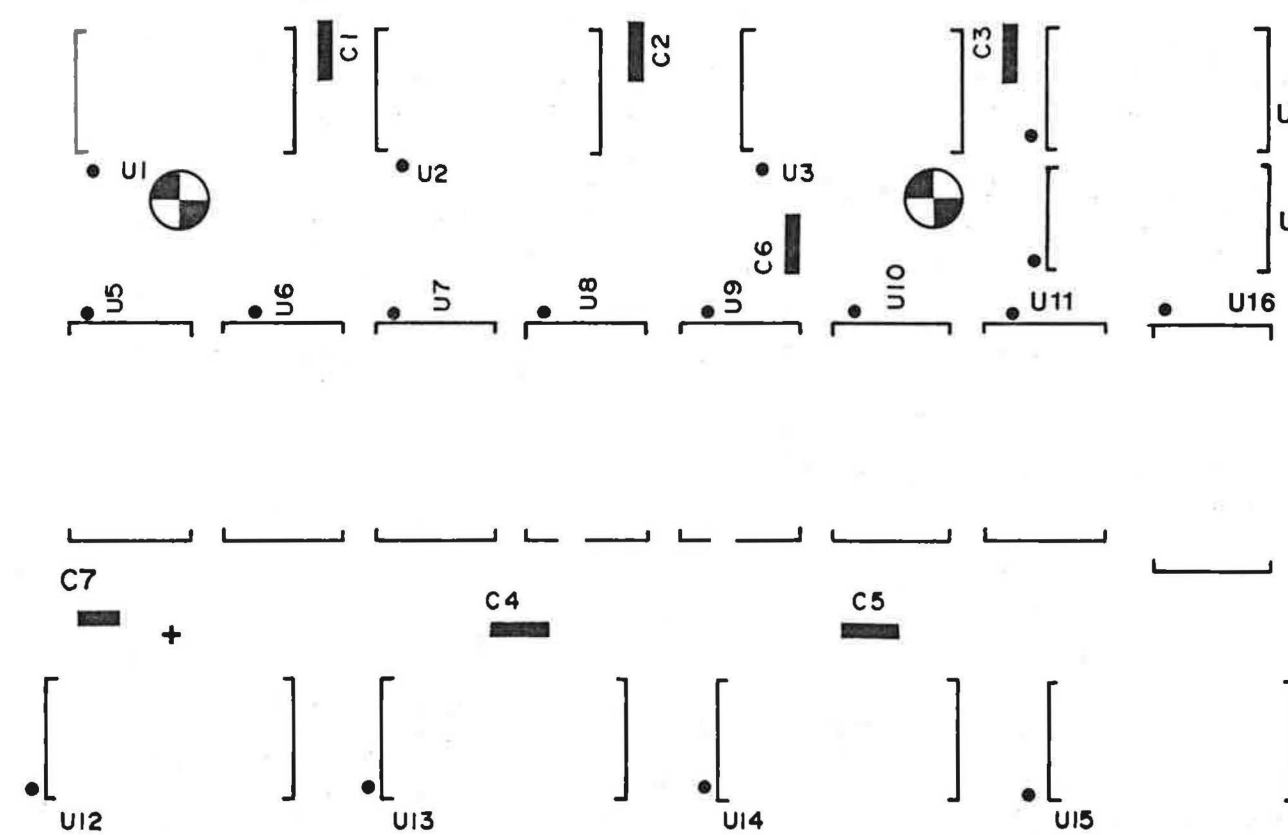


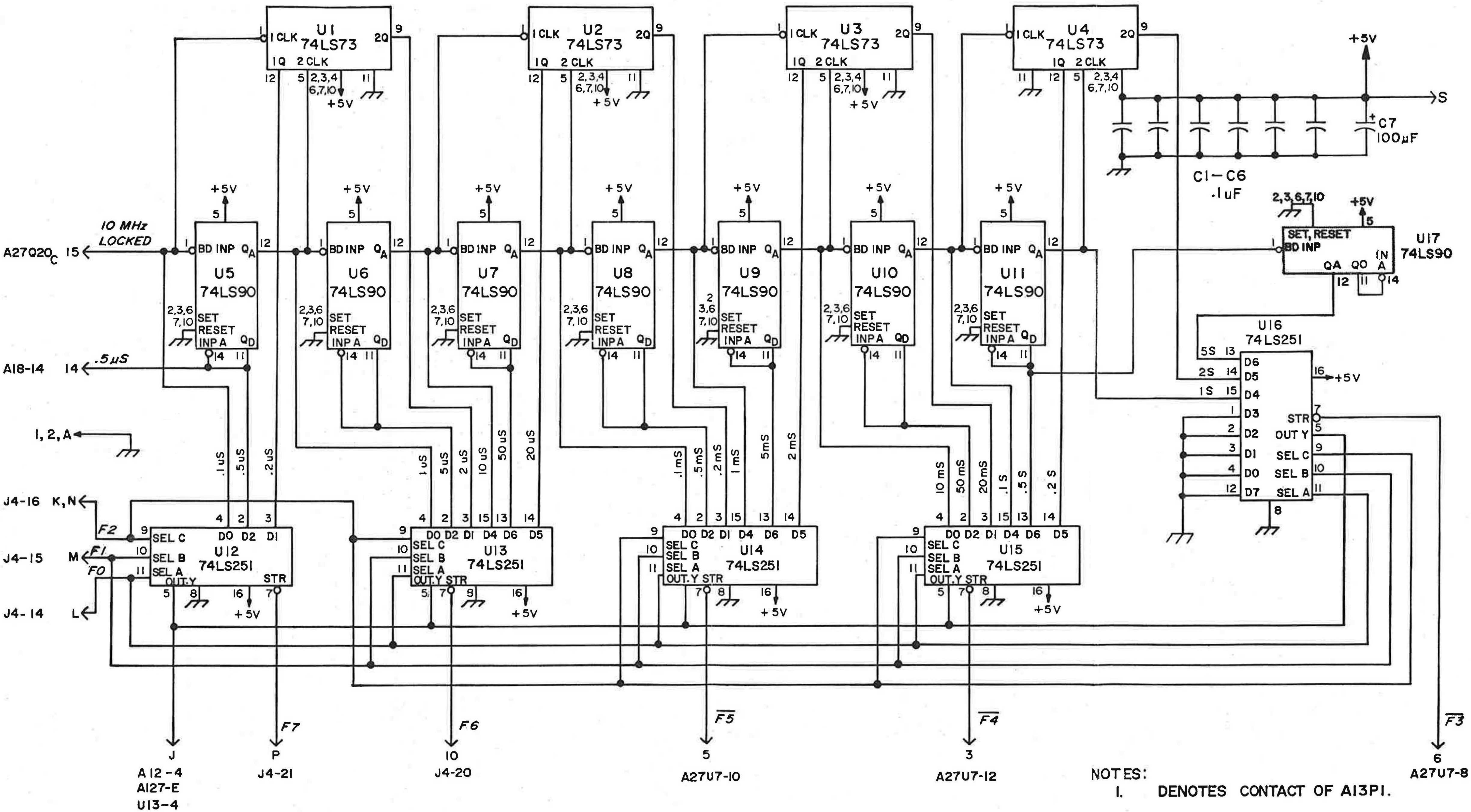
Figure 6-8. MARKER OUTPUT AMPLIFIER (A12)

PARTS LIST, A13 TIME/DIV SELECTOR LOGIC (89-11130-1A)

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
C...1	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	0	AVX CERAMICS MD015E104ZAA
C...2	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	0	AVX CERAMICS MD015E104ZAA
C...3	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	0	AVX CERAMICS MD015E104ZAA
C...4	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	0	AVX CERAMICS MD015E104ZAA
C...5	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	0	AVX CERAMICS MD015E104ZAA
C...6	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	0	AVX CERAMICS MD015E104ZAA
C...7	07-10184-0A	CET 100.0UF 10.0 VM DIP TAN	56289	SPRAGUE 196D107X0010-LA3
U...1	24-10169-0A	ICP 74LS73 DUAL JK FL.FL.	1295	T.I.SN74LS73
U...2	24-10169-0A	ICP 74LS73 DUAL JK FL.FL.	1295	T.I.SN74LS73
U...3	24-10169-0A	ICP 74LS73 DUAL JK FL.FL.	1295	T.I.SN74LS73
U...4	24-10169-0A	ICP 74LS73 DUAL JK FL.FL.	1295	T.I.SN74LS73
U...5	24-10171-0A	ICP 74LS90 DIVIDE BY 12	1295	T.I.SN74LS90
U...6	24-10171-0A	ICP 74LS90 DIVIDE BY 12	1295	T.I.SN74LS90
U...7	24-10171-0A	ICP 74LS90 DIVIDE BY 12	1295	T.I.SN74LS90
U...8	24-10171-0A	ICP 74LS90 DIVIDE BY 12	1295	T.I.SN74LS90
U...9	24-10171-0A	ICP 74LS90 DIVIDE BY 12	1295	T.I.SN74LS90
U..10	24-10171-0A	ICP 74LS90 DIVIDE BY 12	1295	T.I.SN74LS90
U..11	24-10171-0A	ICP 74LS90 DIVIDE BY 12	1295	T.I.SN74LS90
U..12	24-10170-0A	ICP 74LS251 DATA SELECTOR	1295	T.I.SN74LS251
U..13	24-10170-0A	ICP 74LS251 DATA SELECTOR	1295	T.I.SN74LS251
U..14	24-10170-0A	ICP 74LS251 DATA SELECTOR	1295	T.I.SN74LS251
U..15	24-10170-0A	ICP 74LS251 DATA SELECTOR	1295	T.I.SN74LS251
U..16	24-10170-0A	ICP 74LS251 DATA SELECTOR	1295	T.I.SN74LS251
U..17	24-10171-0A	ICP 74LS90 DIVIDE BY 12	1295	T.I.SN74LS90

T/DIV SELECTOR LOGIC 6127A — 89111301A



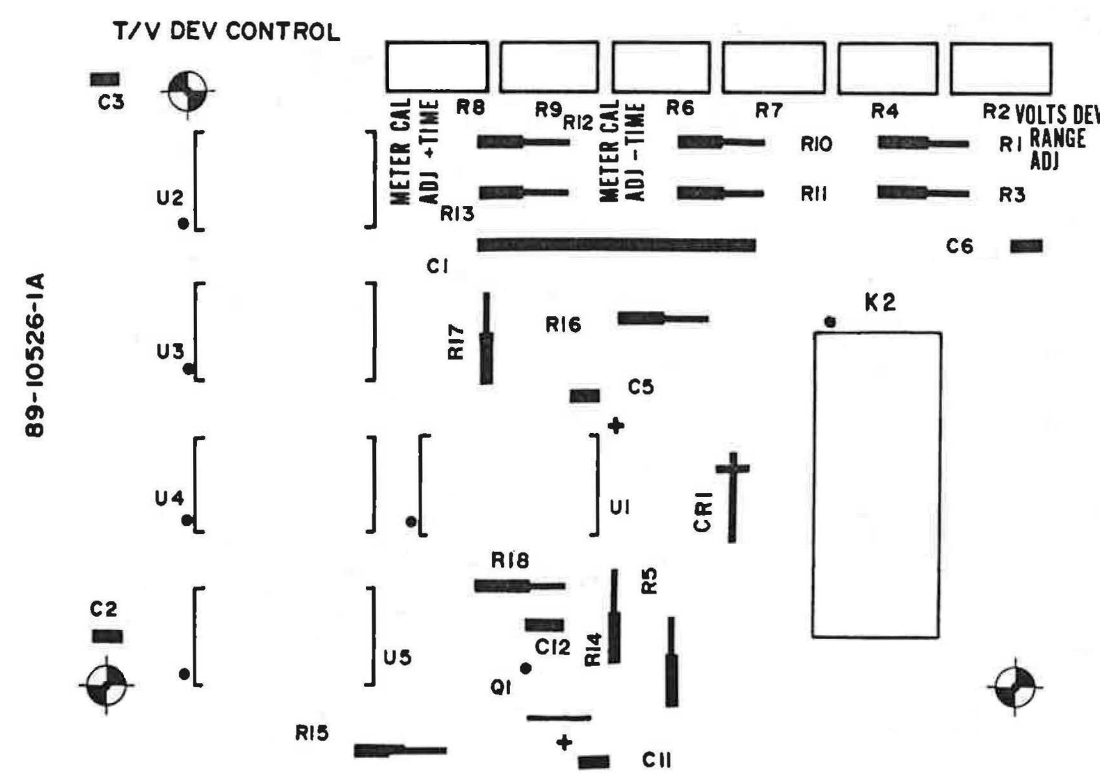


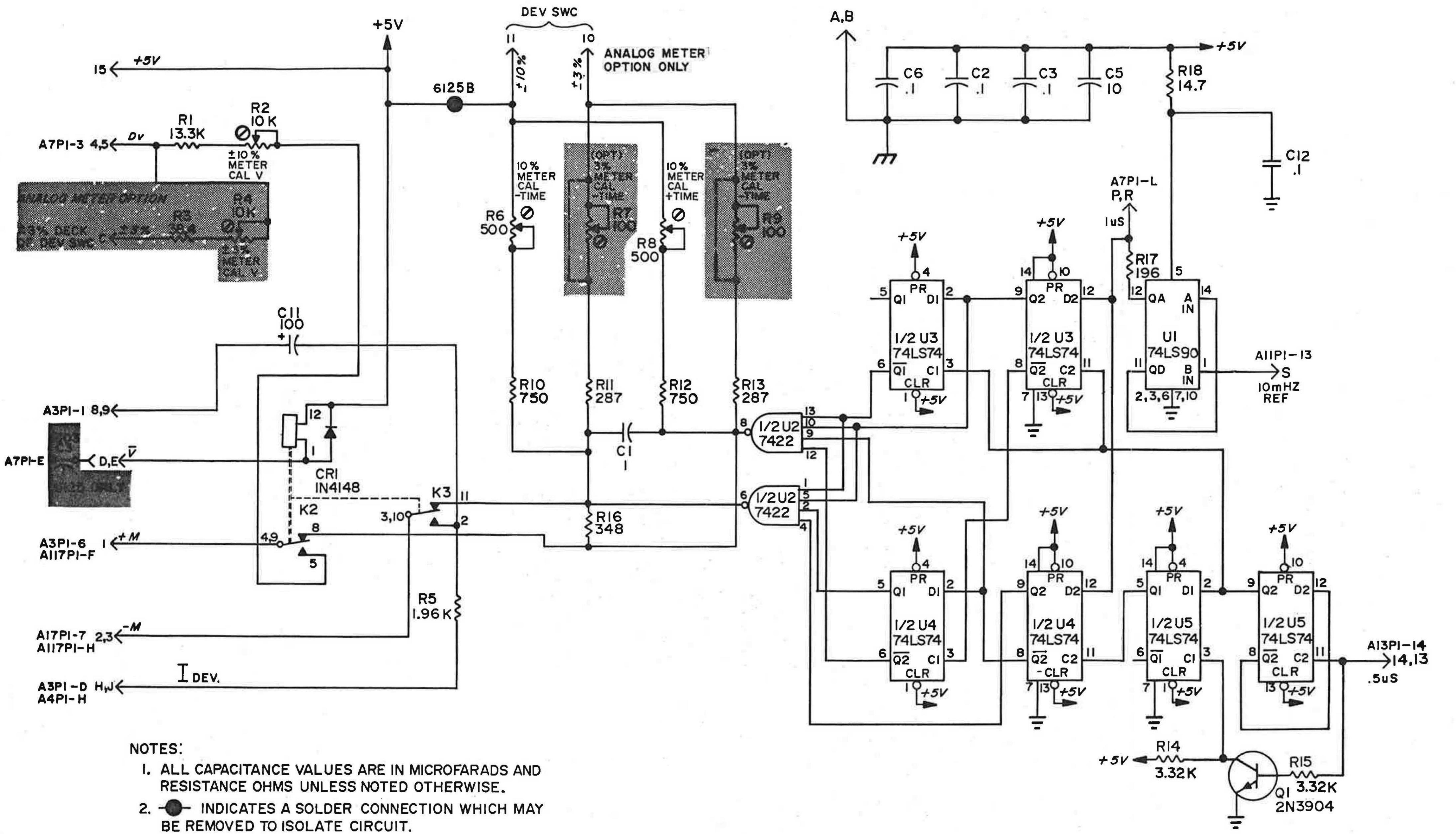
NOTES:
1. DENOTES CONTACT OF A13P1.

Figure 6-9. TIME/DIV SELECTOR LOGIC (A13)

PARTS LIST, A18 TIME/VOLTS DEVIATION CONTROL (89-10526-1A)

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
C...1	07-08134-0A	CYM 1.0UF 50 V M 20%	84411	TRW TYPE X663F
C...2	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	0	AVX CERAMICS MD015E104ZAA
C...3	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	0	AVX CERAMICS MD015E104ZAA
C...5	07-10053-0A	CET 10.0UF 35.0V M	56289	199D106X0035DA2
C...6	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	0	AVX CERAMICS MD015E104ZAA
C..11	07-10184-0A	CET 100.0UF 10.0 VM DIP TAN	56289	SPRAGUE 196D107X0010-LA3
C12	07-20094-0A	CCD .1UF 25.0 V +-20%	91418	M25-1
CR..1	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
K...2	14-10034-0A	RLY 2A2B 5V COIL	50423	BLI
Q...1	10-10043-0A	TRQ 2N3904 NPN 1 40 PTO-92	4713	MOT 1 300M 40
R...1	12-12412-0A	RFF 13.3 K 250.0MW F+- 1%	16299	CGW RN55D 1332 F
R...2	09-10093-0A	RVF 10.0 K 500.0MW KVERT MT	73138	HELIPOT 72XW 10K
R...5	12-12328-0A	RFF 1.96K 250.0MW F+- 1%	16299	CGW RN55D 1961 F
R...6	09-10094-0A	RVF 500.0 500.0MW KVERT MT	73138	HELIPOT 72XW 500
R..8	09-10094-0A	RVF 500.0 500.0MW KVERT MT	73138	HELIPOT 72XW 500
R..10	12-12284-0A	RFF 750.0 250 MW F+-1%	16299	CGW RN550D 7500 F
R..11	12-12244-0A	RFF 287.0 250 MW F+-1%	16299	CGW RN55D 2870 F
R..12	12-12284-0A	RFF 750.0 250 MW F+-1%	16299	CGW RN550D 7500 F
R..13	12-12244-0A	RFF 287.0 250 MW F+-1%	16299	CGW RN55D 2870 F
R..14	12-12350-0A	RFF 3.32K 250.0MW F+- 1%	16299	CGW RN550 3321 F
R..15	12-12350-0A	RFF 3.32K 250.0MW F+- 1%	16299	CGW RN55D 3321 F
R..16	12-12252-0A	RFF 348.0 250 MW F+-1%	16299	CGW RN55D 3480 F
R17	12-12228-0A	RFF 196.0 250 MW F+-1%	16299	CGW RN55D 1960 F
R18	12-12116-0A	RFF 14.7 250.0MW F+- 1%	16299	CGW RN55D 14R7 F
U...1	24-10171-0A	ICP 74LS90 DIVIDE BY 12	1295	T.I.SN74LS90
U...3	24-10143-0A	ICP 74LS74 D FIFL 14 DIP	1295	TI
U...4	24-10143-0A	ICP 74LS74 D FIFL 14 DIP	1295	TI
U...5	24-10143-0A	ICP 74LS74 D FIFL 14 DIP	1295	TI
U2	24-10353-0A	ICP 7422 DUAL 4 INPUT NAND	1295	TI SN7422 OR EQUIV.





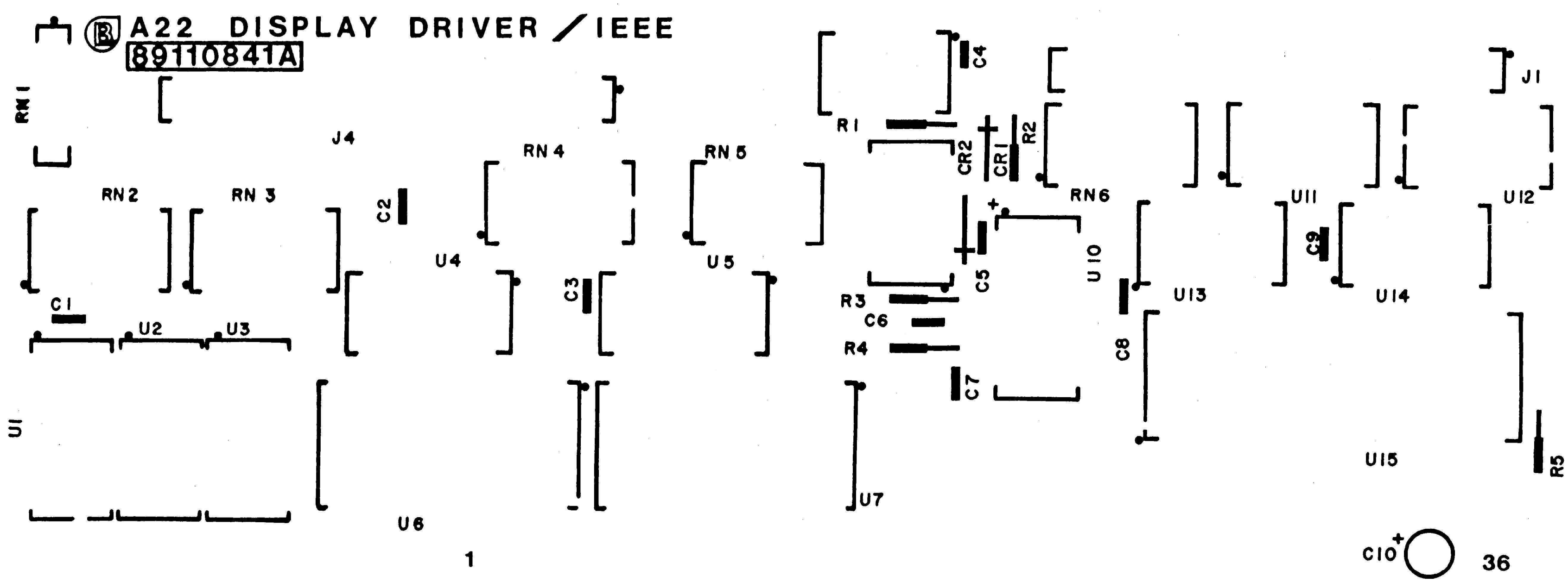
NOTES:

1. ALL CAPACITANCE VALUES ARE IN MICROFARADS AND RESISTANCE OHMS UNLESS NOTED OTHERWISE.
2. —●— INDICATES A SOLDER CONNECTION WHICH MAY BE REMOVED TO ISOLATE CIRCUIT.
3. ALL RELAYS SHOWN IN POSITION WHEN COIL IS NOT ENERGIZED.
4. —> DENOTES CONTACT OF A18P1.

Figure 6-10. TIME/VOLTS DEVIATION CONTROL (A18)

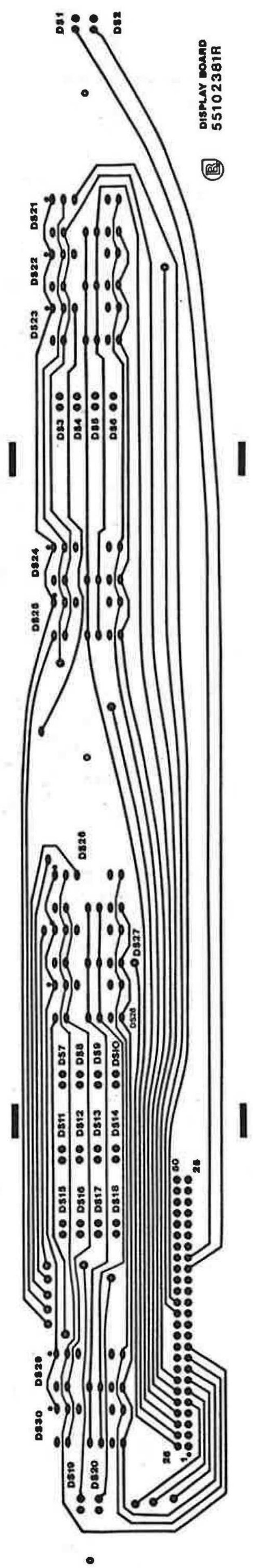
PARTS LIST, A22 DISPLAY DRIVER & IEEE INTERFACE (89-11084-1A)

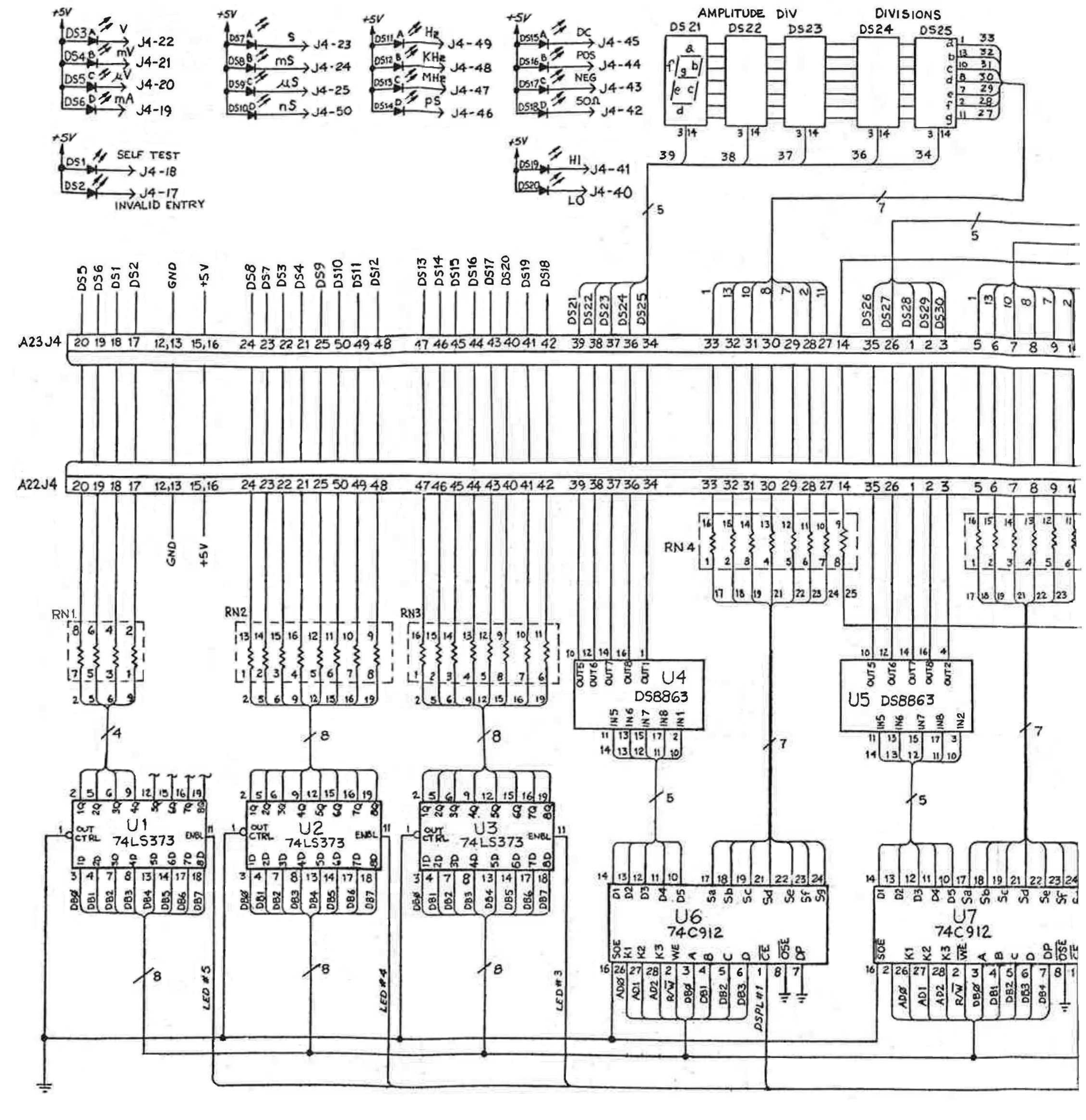
SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
C...1	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...2	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...3	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...4	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...5	07-10083-0A	CET 1.5 UF 35.0 V	56289	SPRAGUE 1960155Y0035A3
C...6	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...7	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...8	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...9	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C..10	07-10184-0A	CET 100.0UF 10.0 VM DIP TAN	56289	SPRAGUE 196D107X0010-LA3
CR..1	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR..2	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
J...1	31-10236-0A	CON 50 PIN MALE CONNECTOR	50423	BLI
J...4	31-10236-0A	CON 50 PIN MALE CONNECTOR	50423	BLI
R...1	12-12400-0A	RFF 10.0 K 250.0MW F+- 1%	16299	CGW RN55D 1002 F
R...2	12-12452-0A	RFF 34.8 K 250.0MW F+- 1%	16299	CGW RN55D 3482 F
R...3	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
R...4	12-12452-0A	RFF 34.8 K 250.0MW F+- 1%	16299	CGW RN55D 3482 F
R...5	12-12352-0A	RFF 3.48K 250.0MW F+- 1%	16299	CGW RN55D 3481 F
RN..1	13-10105-0A	RNF 390 8 PIN SIP 4 RES	80053	BECKMAN 784-3-R390/BOURNS
RN..2	13-10005-0A	RNF 390.0 250.0MW 8 8RESDP	80053	BECKMAN 898-3-R390
RN..3	13-10005-0A	RNF 390.0 250.0MW 8 8RESDP	80053	BECKMAN 898-3-R390
RN..4	13-10115-0A	RNF 68.0 16P DIP 8 RES.	80053	BECKMAN 898-3-R68
RN..5	13-10094-0A	RNF 68OHM 14PIN DIP 7 RES	80053	BECKMAN 899-3-R68
RN..6	13-10055-0A	RNF 4.7 K 16 PIN DP 8RES	80053	BECKMAN 898-3-R4.7K
U...1	24-10315-0A	ICP DM74LS373 OCT D-TYPE F/F	12040	NATIONAL DM74LS373 OR EQUIV.
U...2	24-10315-0A	ICP DM74LS373 OCT D-TYPE F/F	12040	NATIONAL DM74LS373 OR EQUIV.
U...3	24-10315-0A	ICP DM74LS373 OCT D-TYPE F/F	12040	NATIONAL DM74LS373 OR EQUIV.
U...4	24-10244-0A	ICP 8863 DIGIT DRIVER	12040	NATIONAL DS8863N
U...5	24-10244-0A	ICP 8863 DIGIT DRIVER	12040	NATIONAL DS8863N
U...6	24-10319-0A	ICP MM74C912 6 DGT DSP CONTR	12040	NATIONAL MM74C912
U...7	24-10319-0A	ICP MM74C912 6 DGT DSP CONTR	12040	NATIONAL MM74C912
U...8	24-10142-0A	ICP 74LS04 HEX INV 14 DIP	1295	TI
U...9	24-10314-0A	ICP MC9602 RE-TRIG ONE SHOT	4713	MOTOROLA MC9602 OR EQUIV.
U..10	24-10234-0A	ICP 81LS97 OCTAL DRIVER	12040	NAT'L SEMI.
U..11	24-10267-0A	ICP MC3448P QUAD BUS TRASIV	4713	MOT MC3448P OR EQUAL
U..12	24-10267-0A	ICP MC3448P QUAD BUS TRASIV	4713	MOT MC3448P OR EQUAL
U..13	24-10267-0A	ICP MC3448P QUAD BUS TRASIV	4713	MOT MC3448P OR EQUAL
U..14	24-10267-0A	ICP MC3448P QUAD BUS TRASIV	4713	MOT MC3448P OR EQUAL
U..15	24-10264-0A	ICP MC68488P GPI ADAPTER	4713	MOT MC68488P


A22 DISPLAY DRIVER / IEEE
89110841A
RN1
RN2
RN3
RN4
RN5
RN6
J1
J4
C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
CR1
CR2
R1
R2
R3
R4
R5
U1
U2
U3
U4
U5
U6
U7
U10
U11
U12
U13
U14
U15
1
36

PARTS LIST, A23 NUMERIC, FRONT PANEL DISPLAY (89-11087-1A)

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
DS..1	05-10159-0A	DGL MV57124 LED RED RECT PKG	50423	BLI
DS..2	05-10159-0A	DGL MV57124 LED RED RECT PKG	50423	BLI
DS..3	05-10159-0A	DGL MV57124 LED RED RECT PKG	50423	BLI
DS..4	05-10159-0A	DGL MV57124 LED RED RECT PKG	50423	BLI
DS..5	05-10159-0A	DGL MV57124 LED RED RECT PKG	50423	BLI
DS..6	05-10159-0A	DGL MV57124 LED RED RECT PKG	50423	BLI
DS..7	05-10159-0A	DGL MV57124 LED RED RECT PKG	50423	BLI
DS..8	05-10159-0A	DGL MV57124 LED RED RECT PKG	50423	BLI
DS..9	05-10159-0A	DGL MV57124 LED RED RECT PKG	50423	BLI
DS.10	05-10159-0A	DGL MV57124 LED RED RECT PKG	50423	BLI
DS.11	05-10159-0A	DGL MV57124 LED RED RECT PKG	50423	BLI
DS.12	05-10159-0A	DGL MV57124 LED RED RECT PKG	50423	BLI
DS.13	05-10159-0A	DGL MV57124 LED RED RECT PKG	50423	BLI
DS.14	05-10159-0A	DGL MV57124 LED RED RECT PKG	50423	BLI
DS.15	05-10159-0A	DGL MV57124 LED RED RECT PKG	50423	BLI
DS.16	05-10159-0A	DGL MV57124 LED RED RECT PKG	50423	BLI
DS.17	05-10159-0A	DGL MV57124 LED RED RECT PKG	50423	BLI
DS.18	05-10159-0A	DGL MV57124 LED RED RECT PKG	50423	BLI
DS.19	05-10159-0A	DGL MV57124 LED RED RECT PKG	50423	BLI
DS.20	05-10159-0A	DGL MV57124 LED RED RECT PKG	50423	BLI
DS.21	21-10040-0A	IND 0.43 IN HI EFF RED C.C.	28480	HP 5082-7653 COMMON CAT.
DS.22	21-10040-0A	IND 0.43 IN HI EFF RED C.C.	28480	HP 5082-7653 COMMON CAT.
DS.23	21-10040-0A	IND 0.43 IN HI EFF RED C.C.	28480	HP 5082-7653 COMMON CAT.
DS.24	21-10040-0A	IND 0.43 IN HI EFF RED C.C.	28480	HP 5082-7653 COMMON CAT.
DS.25	21-10040-0A	IND 0.43 IN HI EFF RED C.C.	28480	HP 5082-7653 COMMON CAT.
DS.26	21-10040-0A	IND 0.43 IN HI EFF RED C.C.	28480	HP 5082-7653 COMMON CAT.
DS.27	21-10040-0A	IND 0.43 IN HI EFF RED C.C.	28480	HP 5082-7653 COMMON CAT.
DS.28	21-10040-0A	IND 0.43 IN HI EFF RED C.C.	28480	HP 5082-7653 COMMON CAT.
DS.29	21-10040-0A	IND 0.43 IN HI EFF RED C.C.	28480	HP 5082-7653 COMMON CAT.
DS.30	21-10040-0A	IND 0.43 IN HI EFF RED C.C.	28480	HP 5082-7653 COMMON CAT.
J...4	31-10236-0A	CON 50 PIN MALE CONNECTOR	50423	BLI


DISPLAY BOARD
55102381R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INVALID ENTRY
AMPLITUDE DIV
DIVISIONS
A23J4
A22J4
RN1
RN2
RN3
RN4
U1
74LS373
U2
74LS373
U3
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U5 DS8863
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LED #4
LED #3
DSPL #1

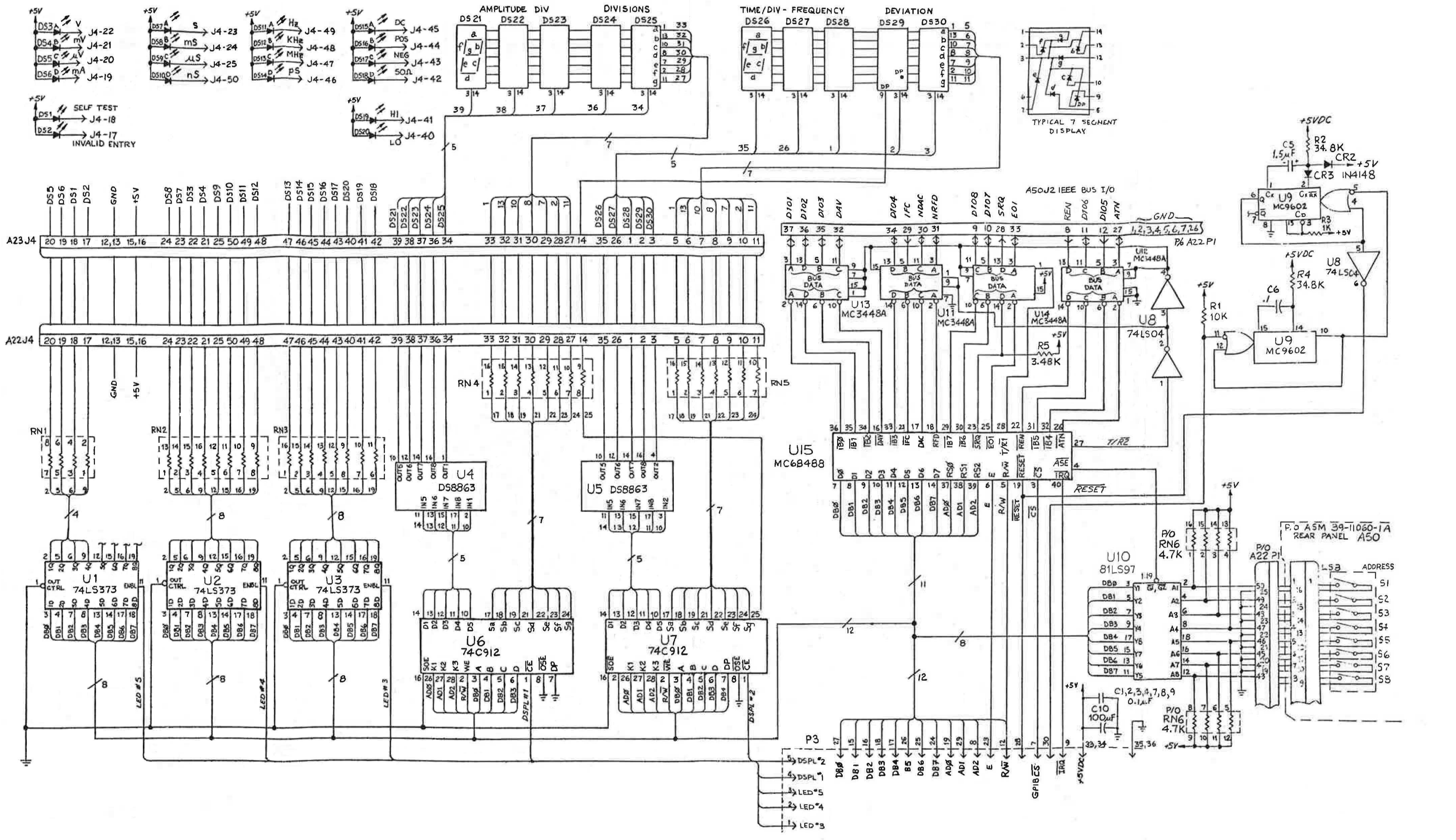


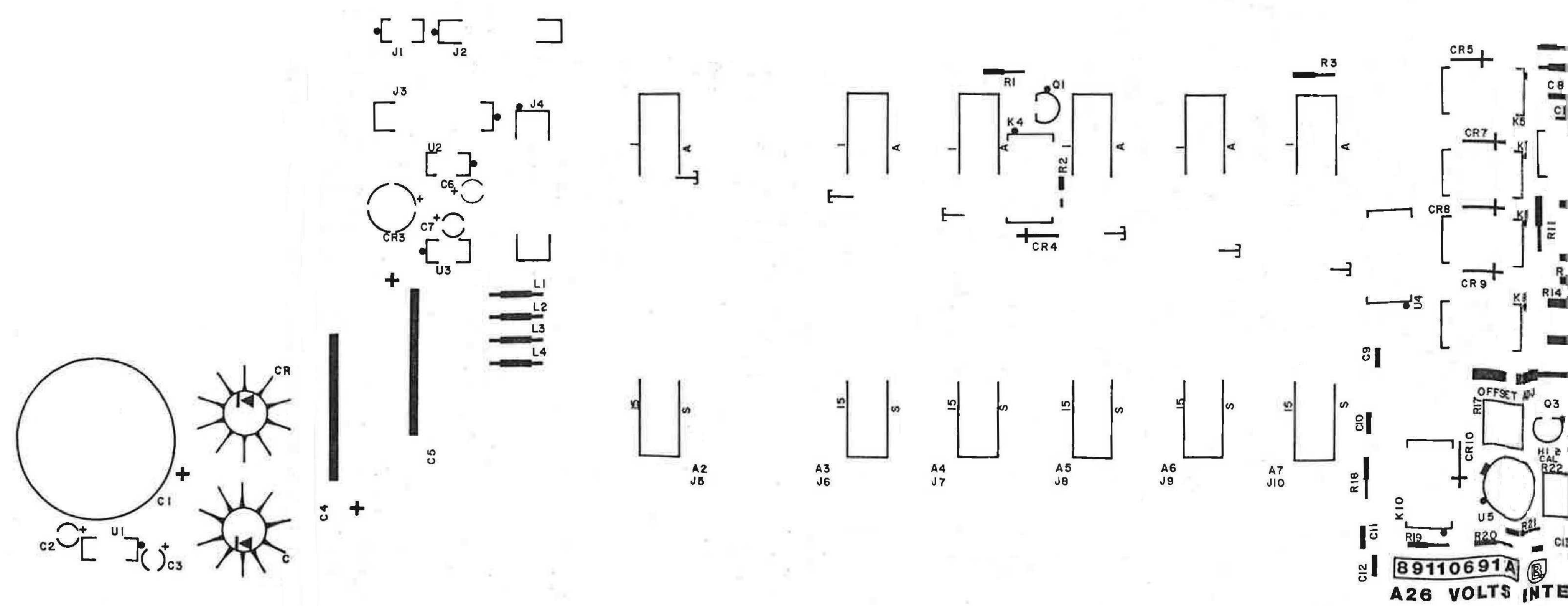
Figure 6-11. DISPLAY DRIVER/IEEE INTERFACE (A22) & DISPLAY BOARD (A23)

PARTS LIST, A26 VOLT INTERCONNECT BOARD (89-11069-1A)

SCHEM REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
C...1	07-10471-0A	CEA 10KUF 16V-10/+50 PC CAN	50423	BLI
C...1	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	50423	AVX CERAMICS MD015E104ZAA
C...2	07-10083-0A	CET 1.5UF 35.0 V	56289	SPRAGUE 1960155X0035A3
C...3	07-10083-0A	CET 1.5UF 35.0 V	56289	SPRAGUE 1960155X0035A3
C...4	07-10422-0A	CEA1000.0UF 25.0 V -10+50%	80031	MEPCO ET102X025A03
C...5	07-10422-0A	CEA1000.0UF 25.0 V -10+50%	80031	MEPCO ET102X025A03
C...6	07-10083-0A	CET 1.5UF 35.0 V	56289	SPRAGUE 1960155X0035A3
C...7	07-10083-0A	CET 1.5UF 35.0 V	56289	SPRAGUE 1960155X0035A3
C...8	07-10224-0A	CYF 47. NF 250. VK	73445	AMPREX C280AE/A47K
C...9	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	50423	AVX CERAMICS MD015E104ZAA
C..10	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	50423	AVX CERAMICS MD015E104ZAA
C..12	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	50423	AVX CERAMICS MD015F104ZAA
C..13	07-20135-0A	CMD 22.0PF 5%	84171	DM15-220J OR EQUIV.
C..14	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	0	AVX CERAMICS MD015E104ZAA
CR..1	05-10027-0A	DRP 1N4999 200 3A	4713	MOT SI
CR..2	05-10027-0A	DRP 1N4999 200 3A	4713	MOT SI
CR..3	05-10006-0A	DGP W04M 4000 1.5A	4713	GIC
CR..4	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR..5	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR..6	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR..7	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR..8	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR..9	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR.10	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR.11	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
J...1	31-10259-0A	CON MTA-100 POST 3 PIN	50423	BLI
J...2	79-10052-0A	CBL FLEX STRIP 10 LINES 2IN	15912	ANSLEY FST -22A-10
J...3	31-10258-0A	CON MTA-100 POST 10 PIN	50423	BLI
J...4	31-10237-0A	CON 20 PIN PCB MALE HEADER	15912	T&B/ANSLEY 609-2022M
J...5	31-10163-0A	CON 15 PIN CARD EDGE PC TYPE	2260	AMPHENOL 225-21521-110
J...6	31-10163-0A	CON 15 PIN CARD EDGE PC TYPE	2260	AMPHENOL 225-21521-110
J...7	31-10163-0A	CON 15 PIN CARD EDGE PC TYPE	2260	AMPHENOL 225-21521-110

PARTS LIST, A26 VOLT INTERCONNECT BOARD (89-11069-1A) - Cont'd

SCHEM REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
L...4	03-10006-0A	CRF 12UH MOLDED +- 10%	76493	MILLER #9230-46
L...5	03-10033-0A	CIL 2.7 UH RF MOLDED	83125	NYTRONICS 75008-33
Q...1	10-10043-0A	TRQ 2N3904 NPN 1 40 PTO-92	4713	MOT 1 300M 40
Q...2	10-10043-0A	TRQ 2N3904 NPN 1 40 PTO-92	4713	MOT 1 300M 40
Q...3	10-10090-0A	TRQ 2N2907A PNP 1 60 MTO-18	4713	MOT .400 200M 75
Q...4	10-10127-0A	TRQ 2N2222A NPN 1 40 MTO-180	40713	MOT .500 300M 100
R...1	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
R...2	12-13284-0A	RFP 15K000 0.02%	50423	BLI
R...3	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
R...4	12-12248-0A	RFF 316.0 250 MW F+-1%	16299	CGW RN55D 3160 F
R...5	12-13290-0A	RFW 100 OHM .1% 20PPM	50423	BLI
R...6	12-12144-0A	RFF 28.7 250.0MW F+- 1%	16299	CGW RN55D 28R7 F
R...7	12-12144-0A	RFF 28.7 250.0MW F+- 1%	16299	CGW RN55D 28R7 F
R...8	12-12248-0A	RFF 316.0 250 MW F+-1%	16299	CGW RN55D 3160 F
R...9	09-10008-0A	RVF 10.0 K 0.5 W K+-10%	73138	HEL TYP 72PM
R..10	13-10098-1B	RNF 6126M 50OHM MATCH SET	50423	BLI
J...8	31-10163-0A	CON 15 PIN CARD EDGE PC TYPE	2260	AMPHENOL 225-21521-110
J...9	31-10163-0A	CON 15 PIN CARD EDGE PC TYPE	2260	AMPHENOL 225-21521-110
J..10	31-10163-0A	CON 15 PIN CARD EDGE PC TYPE	2260	AMPHENOL 225-21521-110
K...4	14-10021-0A	RLY REED FORM A 5V 500OHMDIP	50423	BLI
K...5	14-10020-0A	RLY REED FORM C 5V 200OHM DI	50423	BLI
K...6	14-10021-0A	RLY REED FORM A 5V 500OHMDIP	50423	BLI
K...7	14-10021-0A	RLY REED FORM A 5V 500OHMDIP	50423	BLI
K...8	14-10021-0A	RLY REED FORM A 5V 500OHMDIP	50423	BLI
K...9	14-10021-0A	RLY REED FORM A 5V 500OHMDIP	50423	BLI
K..10	14-10020-0A	RLY REED FORM C 5V 200OHM DI	50423	BLI
K..11	14-10021-0A	RLY REED FORM A 5V 500OHMDIP	50423	BLI
L...1	03-10006-0A	CRF 12UH MOLDED +- 10%	76493	MILLER #9230-46
L...2	03-10006-0A	CRF 12UH MOLDED +- 10%	76493	MILLER #9230-46
L...3	03-10006-0A	CRF 12UH MOLDED +- 10%	76493	MILLER #9230-46

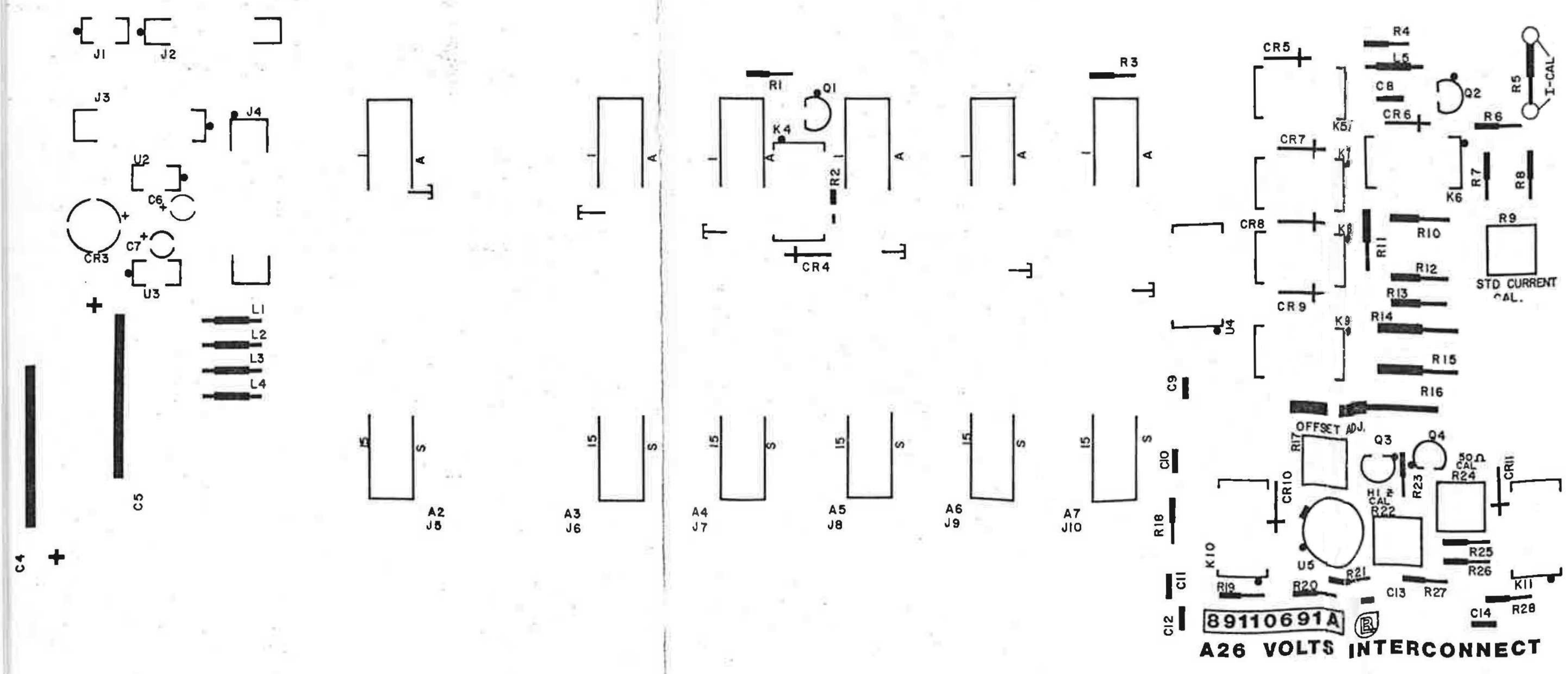


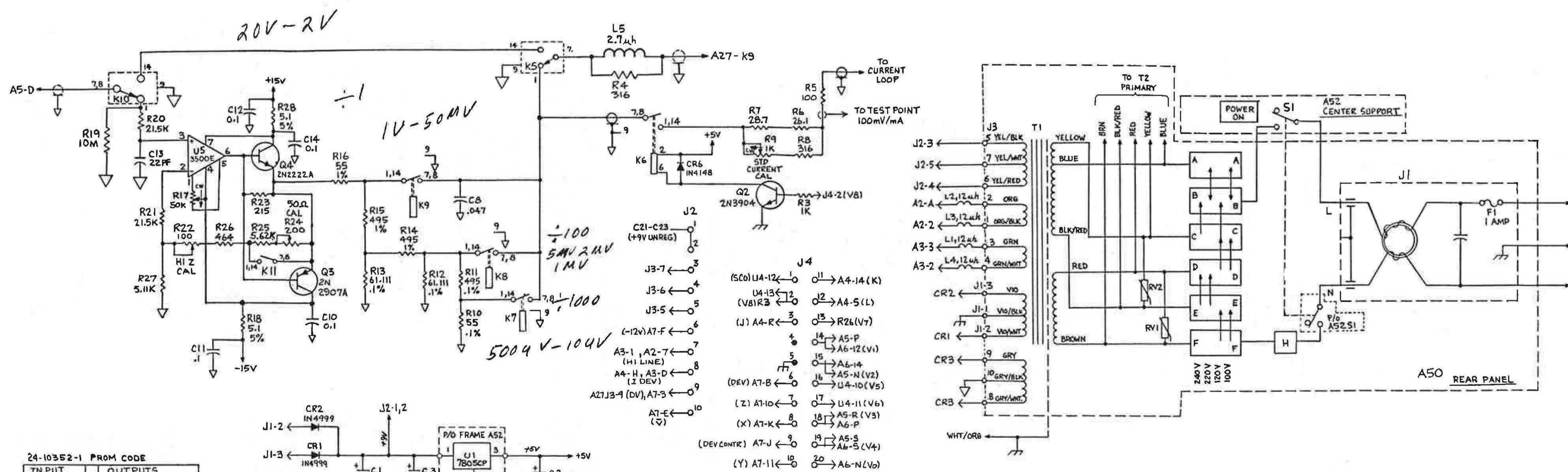
PARTS LIST, A26 VOLT INTERCONNECT BOARD (89-11069-1A) - Cont'd

SCHEM REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
L...4	03-10006-0A	CRF 12UH MOLDED +- 10%	76493	MILLER #9230-46
L...5	03-10033-0A	CIL 2.7 UH RF MOLDED	83125	NYTRONICS 75008-33
Q...1	10-10043-0A	TRQ 2N3904 NPN 1 40 PTO-92	4713	MOT 1 300M 40
Q...2	10-10043-0A	TRQ 2N3904 NPN 1 40 PTO-92	4713	MOT 1 300M 40
Q...3	10-10090-0A	TRQ 2N2907A PNP 1 60 MTO-18	4713	MOT .400 200M 75
Q...4	10-10127-0A	TRQ 2N2222A NPN 1 40 MTO-180	40713	MOT .500 300M 100
R...1	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
R...2	12-13284-0A	RFP 15K000 0.02%	50423	BLI
R...3	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
R...4	12-12248-0A	RFF 316.0 250 MW F+-1%	16299	CGW RN55D 3160 F
R...5	12-13290-0A	RFW 100 OHM .1% 20PPM	50423	BLI
R...6	12-12144-0A	RFF 28.7 250.0MW F+- 1%	16299	CGW RN55D 28R7 F
R...7	12-12144-0A	RFF 28.7 250.0MW F+- 1%	16299	CGW RN55D 28R7 F
R...8	12-12248-0A	RFF 316.0 250 MW F+-1%	16299	CGW RN55D 3160 F
R...9	09-10008-0A	RVF 10.0 K 0.5 W K+-10%	73138	HEL TYP 72PM
R..10	13-10098-1B	RNF 6126M 50OHM MATCH SET	50423	BLI
J...8	31-10163-0A	CON 15 PIN CARD EDGE PC TYPE	2260	AMPHENOL 225-21521-110
J...9	31-10163-0A	CON 15 PIN CARD EDGE PC TYPE	2260	AMPHENOL 225-21521-110
J..10	31-10163-0A	CON 15 PIN CARD EDGE PC TYPE	2260	AMPHENOL 225-21521-110
K...4	14-10021-0A	RLY REED FORM A 5V 500OHMDIP	50423	BLI
K...5	14-10020-0A	RLY REED FORM C 5V 200OHM DI	50423	BLI
K...6	14-10021-0A	RLY REED FORM A 5V 500OHMDIP	50423	BLI
K...7	14-10021-0A	RLY REED FORM A 5V 500OHMDIP	50423	BLI
K...8	14-10021-0A	RLY REED FORM A 5V 500OHMDIP	50423	BLI
K...9	14-10021-0A	RLY REED FORM A 5V 500OHMDIP	50423	BLI
K..10	14-10020-0A	RLY REED FORM C 5V 200OHM DI	50423	BLI
K..11	14-10021-0A	RLY REED FORM A 5V 500OHMDIP	50423	BLI
L...1	03-10006-0A	CRF 12UH MOLDED +- 10%	76493	MILLER #9230-46
L...2	03-10006-0A	CRF 12UH MOLDED +- 10%	76493	MILLER #9230-46
L...3	03-10006-0A	CRF 12UH MOLDED +- 10%	76493	MILLER #9230-46

PARTS LIST, A26 VOLT INTERCONNECT BOARD (89-11069-1A) - Cont'd

SCHEM REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
R..11	13-10098-1B	RNF 6126M 50OHM MATCH SET	50423	BLI
R..12	13-10098-1B	RNF 6126M 50OHM MATCH SET	50423	BLI
R..13	13-10098-1B	RNF 6126M 50OHM MATCH SET	50423	BLI
R..14	13-10098-1B	RNF 6126M 50OHM MATCH SET	50423	BLI
R..15	13-10098-1B	RNF 6126M 50OHM MATCH SET	50423	BLI
R..16	13-10098-1B	RNF 6126M 50OHM MATCH SET	50423	BLI
R..17	09-10134-0A	RVF 50.0 K 0.5 W +-30%	73138	HELIPOT 72PM
R..18	12-09839-0A	RFC 5.1 250.0MW J+- 5%	1121	AB CB
R..19	12-08020-0A	RFC 10.0M 250.0MW J+-5%	1121	A-B TYP CB
R..20	12-12432-0A	RFF 21.5 K 250.0MW F+- 1%	16299	CGW RN55D 2152 F
R..21	12-12432-0A	RFF 21.5 K 250.0MW F+- 1%	16299	CGW RN550 2152 F
R..22	09-10004-0A	RVF 100.0 0.5 W M	73138	HEL TYP 72PM
R..23	12-12232-0A	RFF 215.0 250 MW F+-1%	16299	CGW RN55D 2150 F
R..24	09-10107-0A	RVF 200.0 250.0MW K CER	73138	HEL TYPE 72PM-200
R..25	12-12372-0A	RFF 5.62K 250.0MW F+- 1%	16299	CGW RN550 5621 F
R..26	12-12264-0A	RFF 464.0 250 MW F+-1%	16299	CGW RN550 4640 F
R..27	12-12368-0A	RFF 5.11K 250.0MW F+- 1%	16299	CGW RN55D 5111 F
R..28	12-09839-0A	RFC 5.1 250.0MW J+- 5%	1121	AB CB
U...2	24-10228-0A	ICP 7915 15V NEG REG TO-220	4713	MOT MC7915CP O/E
U...3	24-10152-0A	CIP UA7815 15V REG.	7263	FCH UGH7815393
U...4	24-10352-1A	ICP 6127A PROM PROG.	50423	BLI
U...5	24-10308-0A	ICP 3500E OP AMP LOW DRIFT	50423	BLI





24-10352-1 PROM CODE

INPUT						OUTPUTS										
M	V8	SCO	V6	V5		Q8	Q7	Q6	Q5	Q4	Q3	Q2	Q1			
0	0	0	0	0		X	X	1	0	0	1	1	1	÷1000	GAIN X1	VOLTS
0	0	0	0	1		X	X	1	0	1	0	1	1	÷100		
0	0	0	1	0		X	X	1	0	1	1	0	1	÷1		
0	0	0	1	1		X	X	0	0	1	1	1	0	OFF		
0	0	1	0	0		X	X	1	1	0	1	1	1	÷1000	GAIN X2	
0	0	1	0	1		X	X	1	1	1	0	1	1	÷100		
0	0	1	1	0		X	X	1	1	1	1	0	1	÷1		
0	0	1	1	1		X	X	0	0	1	1	1	0	OFF		
0	1	0	0	0		X	X	0	0	0	1	1	1	÷1000	GAIN X.1	CURRENT
0	1	0	0	1		X	X	0	0	1	0	1	1	÷100		
0	1	0	1	0		X	X	0	0	1	1	0	1	÷1		
0	1	0	1	1		X	X	0	0	1	1	1	0	OFF		
0	1	1	0	0		X	X	0	1	0	1	1	1	÷1000	GAIN X2	
0	1	1	0	1		X	X	0	1	1	0	1	1	÷100		
0	1	1	1	0		X	X	0	1	1	1	0	1	÷1		
0	1	1	1	1		X	X	0	0	1	1	1	0	OFF		

CURRENT ENABLE
50Ω GAIN X2
50Ω DIVIDE SELECT

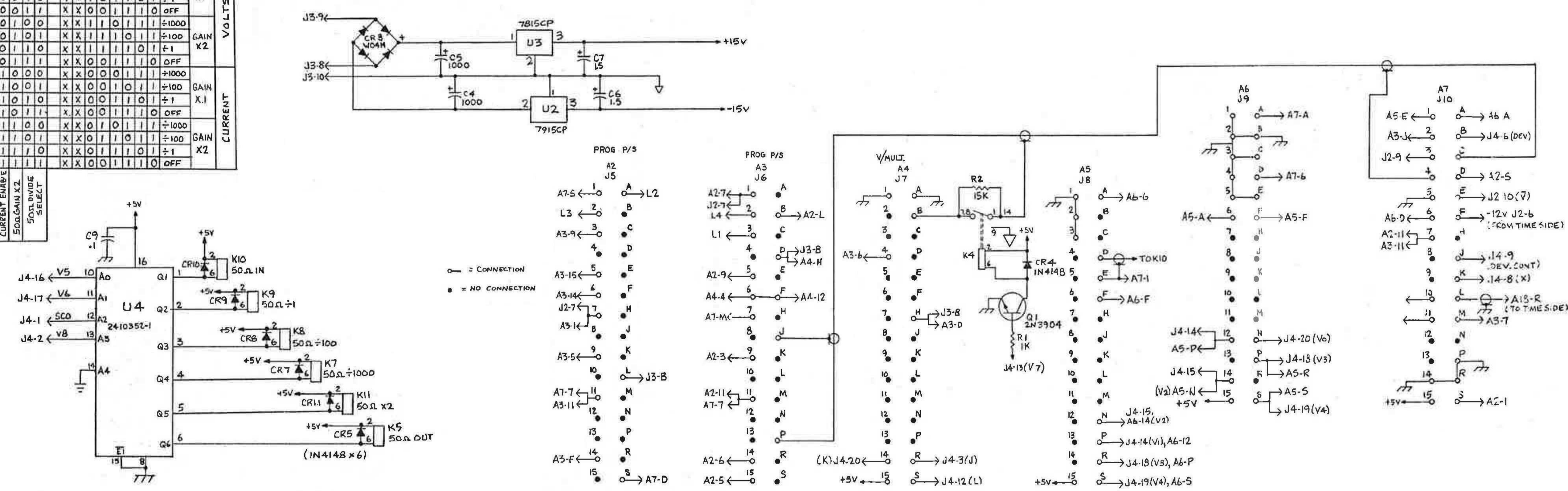


Figure 6-12. VOLT INTERCONNECT BOARD (A26)

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
C...1	07-10422-0A	CEA1000.0UF 25.0 V -10+50%	80031	MEPCO ET102X025A03
C...2	07-10422-0A	CEA1000.0UF 25.0 V -10+50%	80031	MEPCO ET102X025A03
C...3	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...4	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...5	07-10485-0A	CEA1000.0UF 35.0 V	50423	BLI
C...6	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...7	07-10422-0A	CEA1000.0UF 25.0 V -10+50%	80031	MEPCO ET102X025A03
C...8	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...9	07-10471-0A	CEA 10KUF 16V-10/+50 PC CAN	50423	STET.TRUSH ERO EYV00B8510D
C..10	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C..11	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C..12	07-10420-0A	CEA 10UF 350.0 V-10+50%	80031	3072LF100T350SF
C..13	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C..14	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C..15	07-10422-0A	CEA1000.0UF 25.0 V -10+50%	80031	MEPCO ET102X025A03
C..16	07-10223-0A	CYF 100. NF 250. VK	73445	AMPREX C280AE/A100K
C..17	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C..19	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C..23	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C..24	07-10112-0A	CCC 100.0NF 50.0 V CHIP	71590	CENTRLB W005FH104M
C..25	07-10112-0A	CCC 100.0NF 50.0 V CHIP	71590	CENTRLB W005FH104M
C..26	07-10112-0A	CCC 100.0NF 50.0 V CHIP	71590	CENTRLB W005FH104M
C..28	07-02449-0A	CVC 2.0-8PF 350.0 V	72982	ERIE NPO STYLE 538-011
C..29	07-10112-0A	CCC 100.0NF 50.0 V CHIP	71590	CENTRLB W005FH104M
C..30	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C..36	07-10112-0A	CCC 100.0NF 50.0 V CHIP	71590	CENTRLB W005FH104M
C..37	07-10184-0A	CET 100.0UF 10.0 VM DIP TAN	56289	SPRAGUE 196D107X0010-LA3
C..38	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C..39	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C..41	07-10112-0A	CCC 100.0NF 50.0 V CHIP	71590	CENTRLB W005FH104M
C..44	07-10117-0A	CMD 12.0PF 500.0 VJ	84171	ELMENCO DM15C120JN
C..48	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C..50	07-10350-0A	CMD 470.0PF 500.0 V TCE 2%	84171	ARCO DM15ED470G03 ARCO
C..51	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C..52	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C..55	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
CR..1	05-10006-0A	DGP W04M 4000 1.5A	4713	MOT OR GEN INST
CR..2	05-10006-0A	DGP W04M 4000 1.5A	4713	MOT OR GEN INST
CR..3	05-08058-0A	DGP 1N4006 400 1A	15238	ITT SI D046
CR..4	05-08058-0A	DGP 1N4006 400 1A	15238	ITT SI D046
CR..5	05-10027-0A	DRP 1N4999 200 3A	4713	MOT SI
CR..6	05-10027-0A	DRP 1N4999 200 3A	4713	MOT SI
CR..7	05-08058-0A	DGP 1N4006 400 1A	15238	ITT SI D046
CR..8	05-08058-0A	DGP 1N4006 400 1A	15238	ITT SI D046
CR..9	05-08058-0A	DGP 1N4006 400 1A	15238	ITT SI D046
CR.10	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR.11	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR.12	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR.13	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR.15	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR.16	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR.17	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR.18	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR.20	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR.21	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR.26	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR.31	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR.32	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR.33	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR.34	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR.36	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
J...2	31-10258-0A	CON MTA-100 POST 10 PIN	50423	BLI

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
J...4	31-10198-0A	CON 26 PCB TAIL HEADER STCON	15912	ANSLEY 609-2622M
J...8	31-10309-0A	CON 36PIN CARD EDGE PC TYPE	50423	BLI
J...9	31-10309-0A	CON 36PIN CARD EDGE PC TYPE	50423	BLI
J..10	31-10309-0A	CON 36PIN CARD EDGE PC TYPE	50423	BLI
J..11	31-10163-0A	CON 15 PIN CARD EDGE PC TYPE	2260	AMPHENOL 225-21521-110
J..12	31-10163-0A	CON 15 PIN CARD EDGE PC TYPE	2260	AMPHENOL 225-21521-110
J..13	31-10163-0A	CON 15 PIN CARD EDGE PC TYPE	2260	AMPHENOL 225-21521-110
J..18	31-10163-0A	CON 15 PIN CARD EDGE PC TYPE	2260	AMPHENOL 225-21521-110
J..22	31-10259-0A	CON MTA-100 POST 3 PIN	50423	BLI
J.117	31-10163-0A	CON 15 PIN CARD EDGE PC TYPE	2260	AMPHENOL 225-21521-110
J.127	31-10163-0A	CON 15 PIN CARD EDGE PC TYPE	2260	AMPHENOL 225-21521-110
K...1	14-10031-0A	RLY RF DPDT TO5 CASE 12V	50423	BLI
K...3	14-10021-0A	RLY REED FORM A 5V 500OHMDIP	50423	BLI
K...4	14-10024-0A	RLY SPDT 5V	50423	BLI
K...5	14-10031-0A	RLY RF DPDT TO5 CASE 12V	50423	BLI
K...6	14-10024-0A	RLY SPDT 5V	50423	BLI
K...9	14-10031-0A	RLY RF DPDT TO5 CASE 12V	50423	BLI
K..10	14-10020-0A	RLY REED FORM C 5V 200OHM DI	50423	BLI
K..11	14-10021-0A	RLY REED FORM A 5V 500OHMDIP	50423	BLI
L...1	03-10052-0A	CRF 33 UH INDUCTOR	71895	DELAVAN 1537-52
L...2	03-10085-0A	CRF .15 UH INDUCTOR	71895	DELAVAN 1025-00
L...3	03-10084-0A	CRF 2.2 UH INDUCTOR	71895	DELAVAN 1025-28
P...7	88-10085-1A	CAA 6127 IC REG CONN CA ASSY	50423	BLI
P...8	88-10085-1A	CAA 6127 IC REG CONN CA ASSY	50423	BLI
P..14	88-10085-1A	CAA 6127 IC REG CONN CA ASSY	50423	BLI
Q...1	10-10043-0A	TRQ 2N3904 NPN 1 40 PTO-92	4713	MOT 1 300M 40
Q...2	10-10123-0A	TRQ 2N4240 HI VOLTAGE NPN	3607	RCA 2N4240
Q...3	10-10012-0A	TRQ 2N3439 NPN 1 350 MTO-5	4713	MOT 5 15M 40
Q...7	10-10043-0A	TRQ 2N3904 NPN 1 40 PTO-92	4713	MOT 1 300M 40
Q...8	10-10080-0A	TRQ 2N4403 PNP	4713	MOTOROLA
Q..14	10-10080-0A	TRQ 2N4403 PNP	4713	MOTOROLA
Q..15	10-10080-0A	TRQ 2N4403 PNP	4713	MOTOROLA
Q..18	10-10080-0A	TRQ 2N4403 PNP	4713	MOTOROLA
Q..20	10-10033-0A	TRQ 2N3646 NPN 1 15 PTO-92	4713	FCH .5 350M 25
Q..21	10-10009-0A	TRQ MPS6519 PNP 1 25 PTO-92	4713	MOT 1 340M 250
R...2	12-12737-0A	RFC 68.0 K 2.0 W J+- 5%	1121	A-B TYP HB
R...3	12-12164-0A	RFF 46.4 250.0MW F+- 1%	16299	CGW RN55D 46R4 F
R...4	12-12232-0A	RFF 215.0 250 MW F+-1%	16299	CGW RN55D 2150 F
R...5	12-12400-0A	RFF 10.0 K 250.0MW F+- 1%	16299	CGW RN55D 1002 F
R...6	12-12264-0A	RFF 464.0 250 MW F+-1%	16299	CGW RN55D 4640 F
R...7	12-12136-0A	RFF 23.7 250.0MW F+- 1%	16299	CGW RN55D 23R7 F
R...8	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
R...9	12-12280-0A	RFF 681.0 250 MW F+-1%	16299	CGW RN55D 6810 F
R..10	12-12400-0A	RFF 10.0 K 250.0MW F+- 1%	16299	CGW RN55D 1002 F
R..11	12-12400-0A	RFF 10.0 K 250.0MW F+- 1%	16299	CGW RN55D 1002 F
R..12	12-12791-0A	RFF 1.0 M 500.0MW +-0.5%	16299	CGW NA65 OR ADV26346
R..13	12-12791-0A	RFF 1.0 M 500.0MW +-0.5%	16299	CGW NA65 OR ADV26346
R..21	12-12364-0A	RFF 4.64K 250.0MW F+- 1%	16299	CGW RN55D 4641 F
R..23	12-12280-0A	RFF 681.0 250 MW F+-1%	16299	CGW RN55D 6810 F
R..24	12-12168-0A	RFF 51.1 250.0MW F+- 1%	16299	CGW RN55D 51R1 F
R..25	12-12188-0A	RFF 82.5 250.0MW F+- 1%	16299	CGW RN55D 82R5 F
R..26	12-12212-0A	RFF 133.0 250.0MW F+- 1%	16299	CGW RN55D 1330 F
R..28	12-12348-0A	RFF 3.16K 250.0MW F+- 1%	16299	CGW RN55D 3161 F
R..29	12-13296-0A	RFC 680.0 1.0W J +/-5%	1121	ALLEN BRADLEY TYPE GB
R..30	12-13301-0A	RFC 56 500.0MW +/- 5%	1121	ALLEN BRADLEY TYPE EB
R..36	12-12329-0A	RFF 2.0 K 250.0MW F+- 1%	16299	CGW RN55D 2001 F
R..37	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
R..39	12-12212-0A	RFF 133.0 250.0MW F+- 1%	16299	CGW RN55D 1330 F
R..41	12-12212-0A	RFF 133.0 250.0MW F+- 1%	16299	CGW RN55D 1330 F
R..42	12-12400-0A	RFF 10.0 K 250.0MW F+- 1%	16299	CGW RN55D 1002 F
R..44	12-12364-0A	RFF 4.64K 250.0MW F+- 1%	16299	CGW RN55D 4641 F
R..45	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
R..46	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F

PARTS LIST, A27 TIME PCB INTERCONNECT BOARD (89-11070-1A) - Cont'd

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
R..49	12-12200-0A	RFF 100.0 250.0MW F+- 1%	16299	CGW RN55D 1000 F
R..50	09-10151-0A	RVF 2.0 K 500.0MW	73138	HELIPOT 72PM
R..51	12-12212-0A	RFF 133.0 250.0MW F+- 1%	16299	CGW RN55D 1330 F
R..52	12-12364-0A	RFF 4.64K 250.0MW F+- 1%	16299	CGW RN55D 4641 F
R..53	12-12316-0A	RFF 1.47K 250 MW F+-1%	16299	CGW RN55D 1471 F
R..55	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
R..56	12-09839-0A	RFC 5.1 250.0MW J+- 5%	1121	AB CB
R..60	12-12316-0A	RFF 1.47K 250 MW F+-1%	16299	CGW RN55D 1471 F
R..61	12-12400-0A	RFF 10.0 K 250.0MW F+- 1%	16299	CGW RN55D 1002 F
R..62	12-12500-0A	RFF 100.0 K 250.0MW F+- 1%	16299	CGW RN55D 1003 F
R..63	12-12500-0A	RFF 100.0 K 250.0MW F+- 1%	16299	CGW RN55D 1003 F
R..64	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
R..65	12-12348-0A	RFF 3.16K 250.0MW F+- 1%	16299	CGW RN55D 3161 F
R..68	12-13301-0A	RFC 56 500.0MW +/- 5%	1121	ALLEN BRADLEY TYPE EB
R..69	12-13296-0A	RFC 680.0 1.0W J +/-5%	1121	ALLEN BRADLEY TYPE GB
R..70	12-12188-0A	RFF 82.5 250.0MW F+- 1%	16299	CGW RN55D 82R5 F
R..71	12-12188-0A	RFF 82.5 250.0MW F+- 1%	16299	CGW RN55D 82R5 F
R..72	12-12280-0A	RFF 681.0 250 MW F+-1%	16299	CGW RN55D 6810 F
R..74	12-12188-0A	RFF 82.5 250.0MW F+- 1%	16299	CGW RN55D 82R5 F
R..75	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
R..76	12-12328-0A	RFF 1.96K 250.0MW F+- 1%	16299	CGW RN55D 1961 F
R..80	12-13305-0A	RFC 62.0 MEG 250 MW +/-5%	01121	AB TYPE CB
S...9	25-10062-1A	SWC SLIDE PC RT ANGLE DPDT	50423	BLI
U...3	24-10228-0A	ICP 7915 15V NEG REG TO-220	4713	MOT MC7915CP O/E
U...4	24-10167-0A	ICP CP7905 -5V REG.1.5 AMP	4713	MOTOROLA OR EQUIV.
U...7	24-10142-0A	ICP 74LS04 HEX INV 14 DIP	1295	TI
U...8	24-10307-0A	ICP LF351NJ FET OP AMP D.I.L	4713	MOTOROLA LF351N OR EQUIV
U...9	24-10367-0A	ICP 11C91 650 MHZ DIV BY 5	50423	BLI
U..10	24-10368-0A	ICP SP8606B DIVIDER/2 02-1MZ	50423	BLI
U..11	24-10369-0A	ICP MC1672 TRI 2 IN EXCL OR	4713	MOTOROLA MC1672
U..12	24-10370-0A	ICP MWA120 WIDEBAND AMP.	4713	MOTOROLA MWZ120
U..13	24-10170-0A	ICP 74LS251 DATA SELECTOR	1295	T.I.SN74LS251
U..14	24-10372-0A	ICP 74LS390 DUAL DEC COUNTER	4713	MOT OR EQUIV SN74LS390
U..15	24-10170-0A	ICP 74LS251 DATA SELECTOR	1295	T.I.SN74LS251
U..16	24-10113-0B	ICP 74LS90 TTL DECADE LS-PWR	27014	NAT.SEMI DM74LS90
U..17	24-10307-0A	ICP LF351NJ FET OP AMP D.I.L	4713	MOTOROLA LF351N OR EQUIV
U..18	24-10084-0A	ICP SN7416N HEX INV OPEN COL	1295	TI OR EQUIV

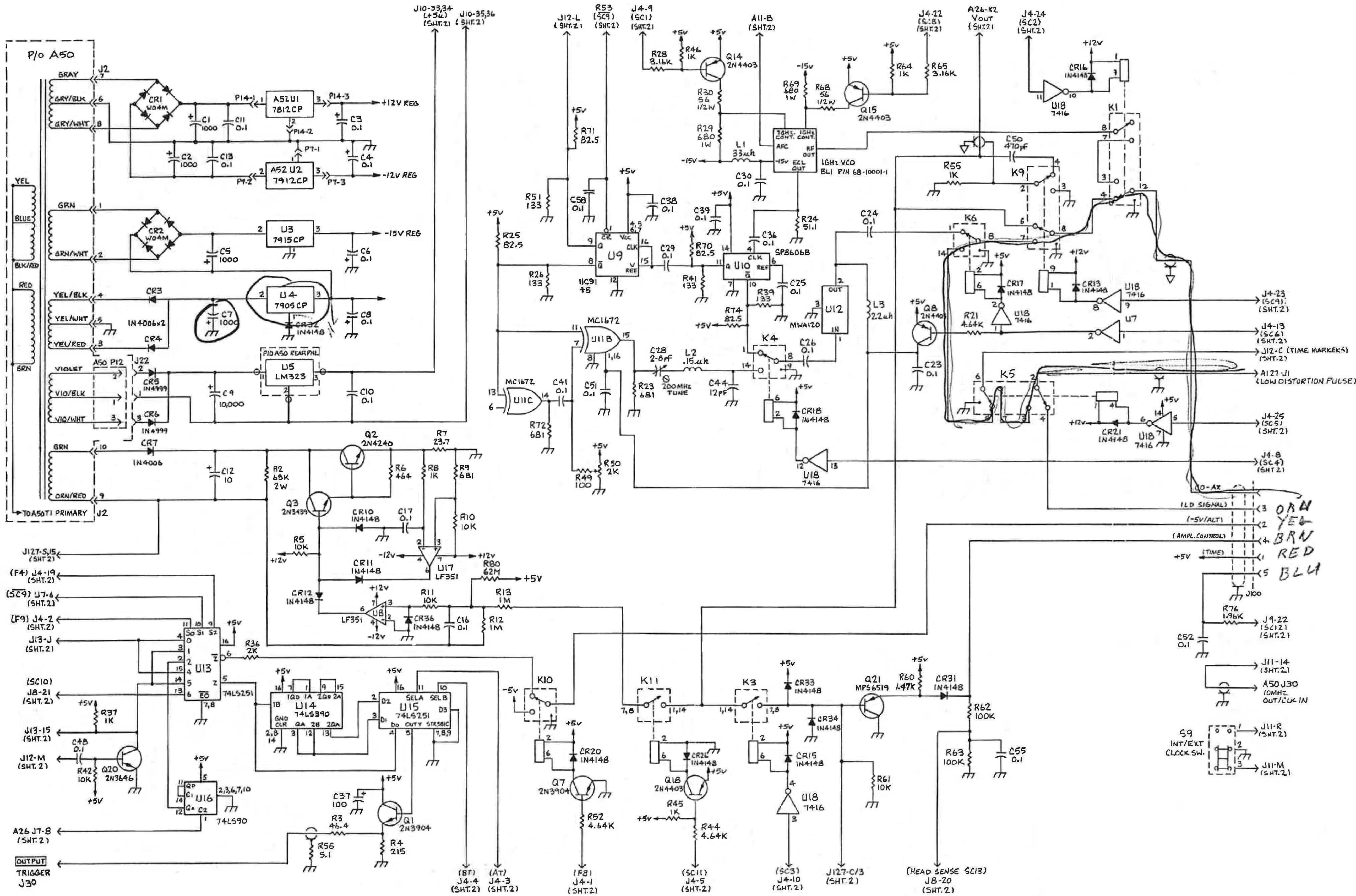
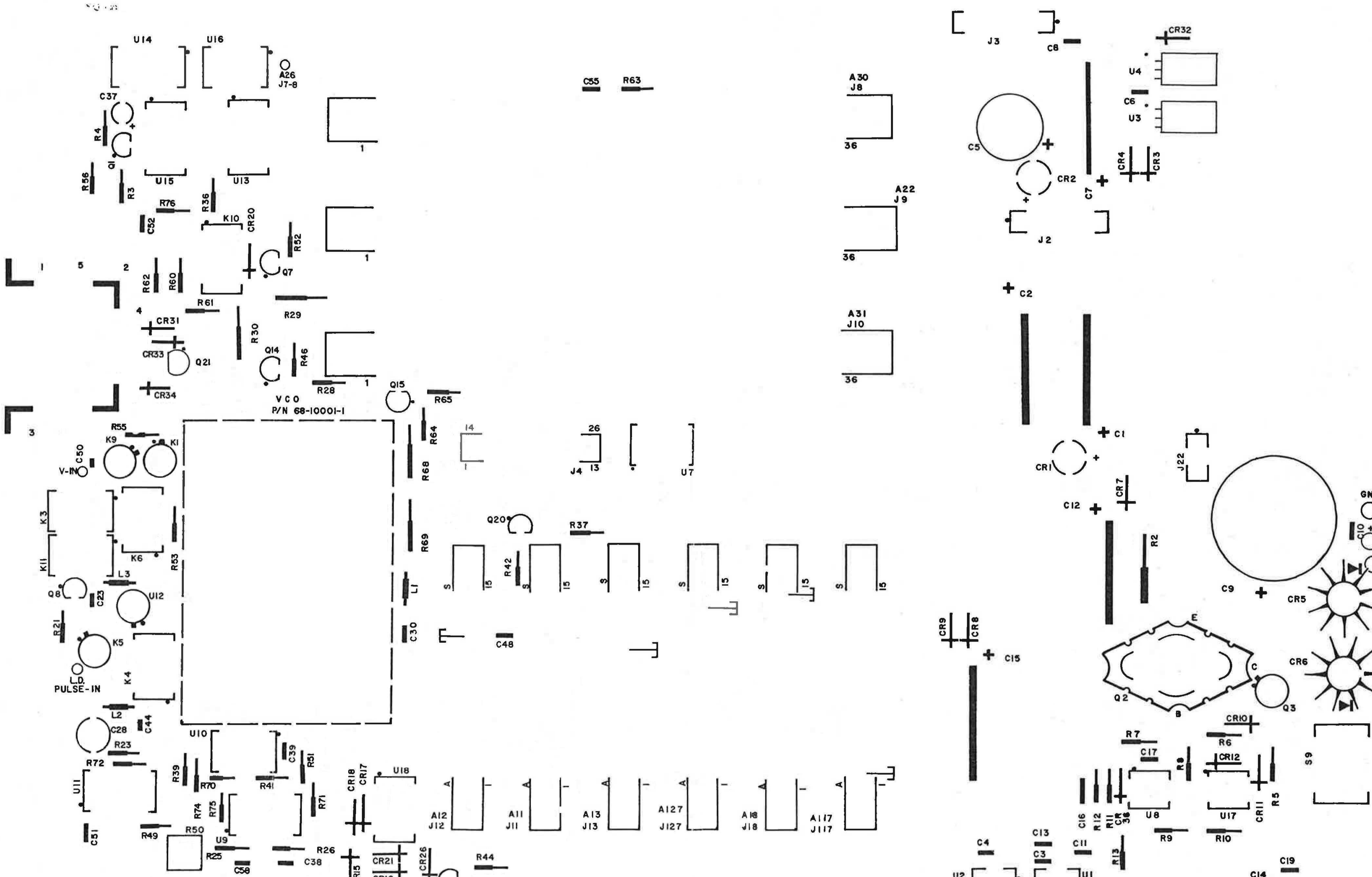


Figure 6-13. TIME PCB INTERCONNECT BOARD (A27-1)



89110701A
A27 TIME INTERCONNECT

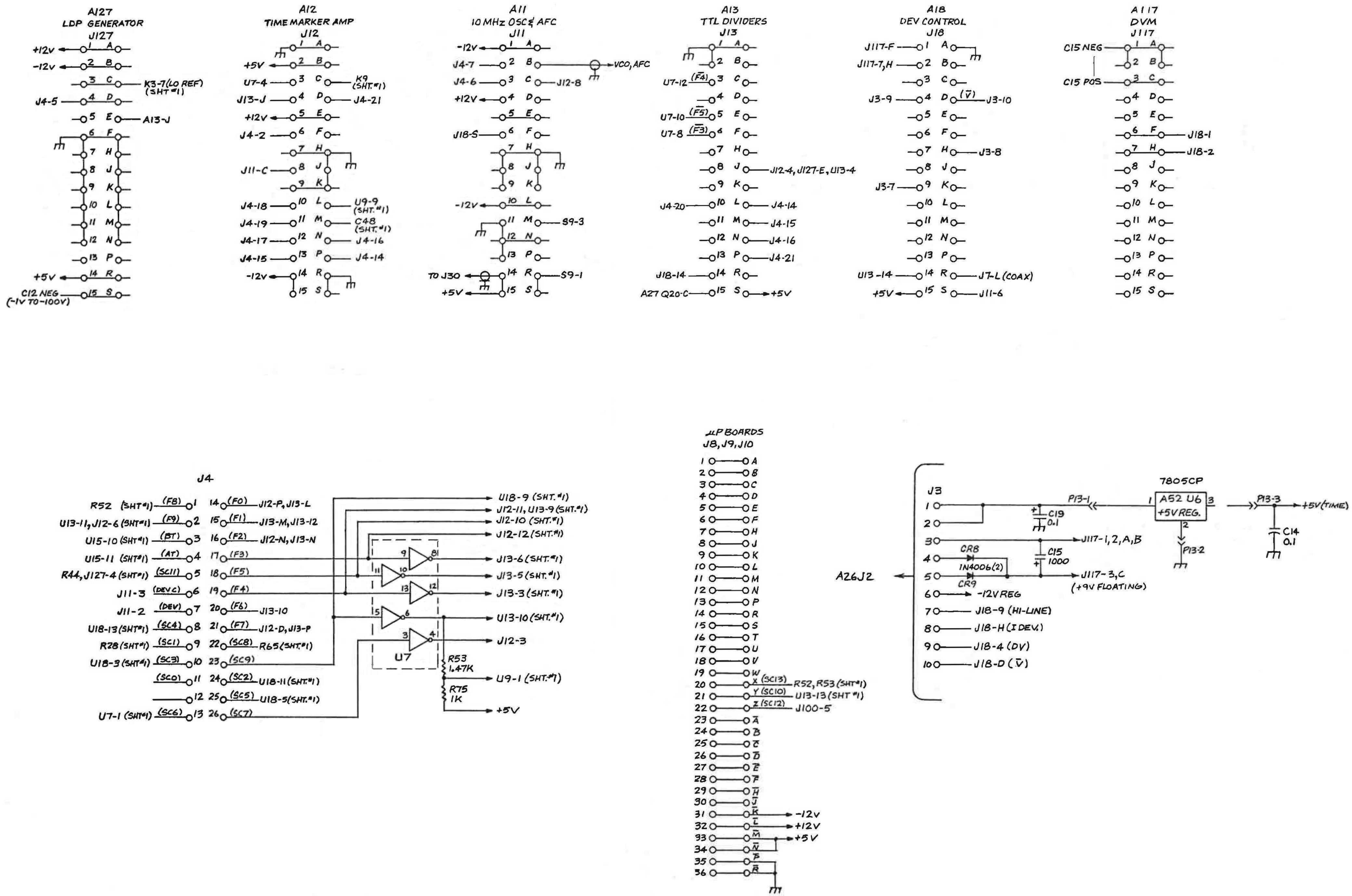
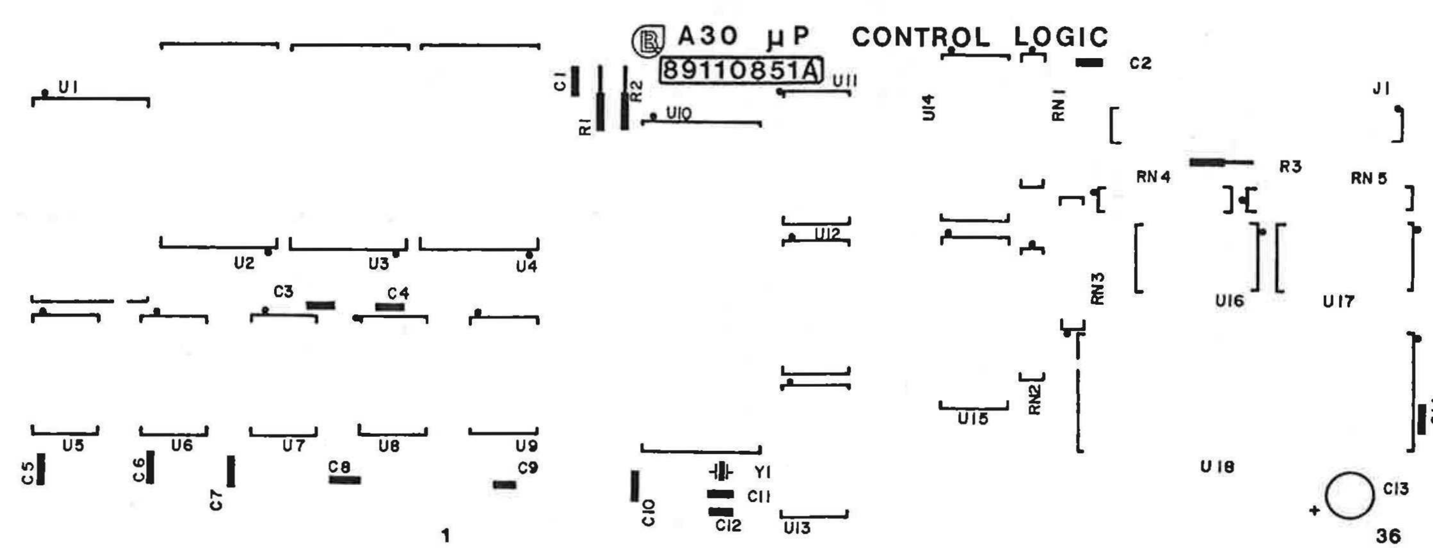
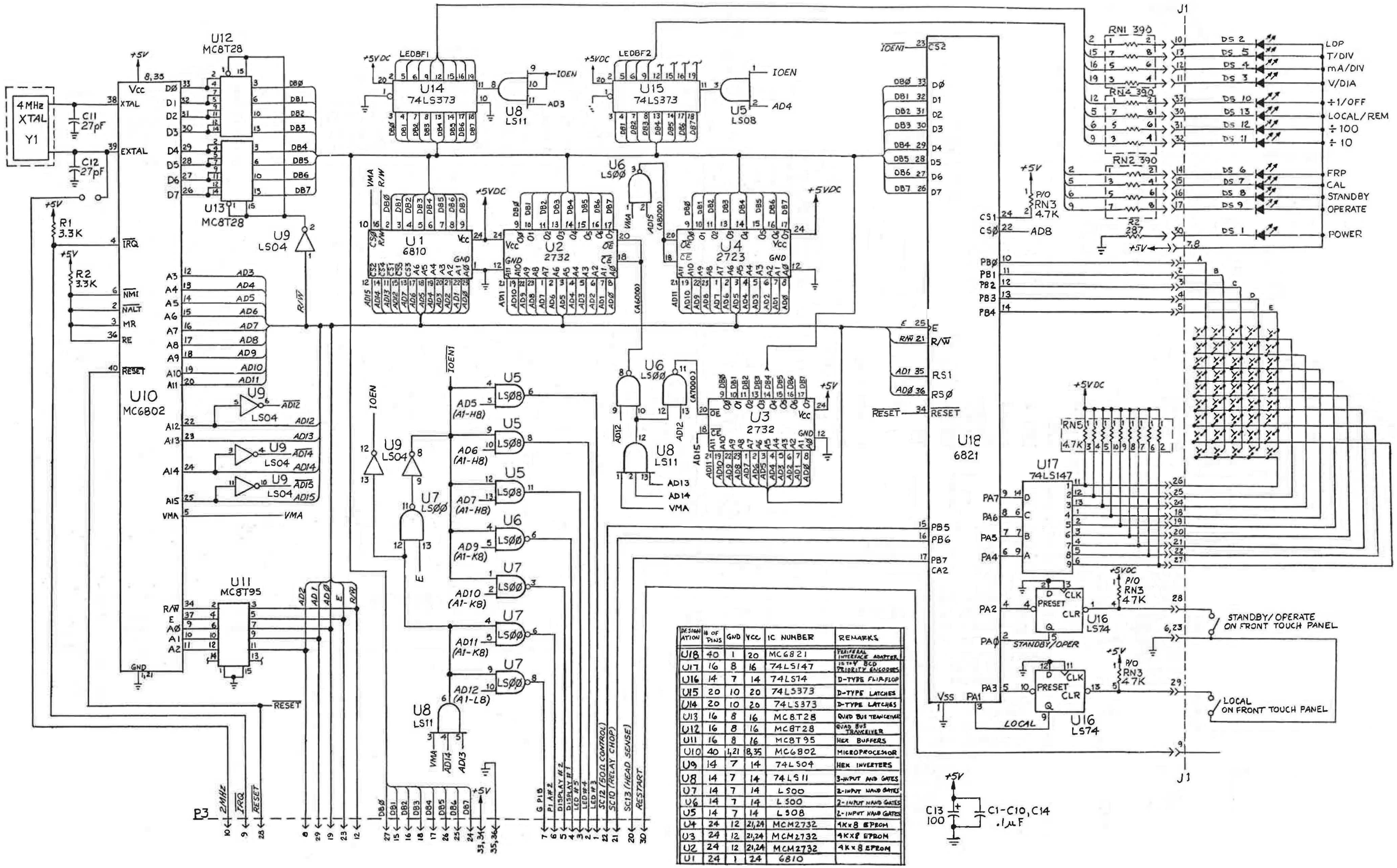


Figure 6-13. TIME PCB INTERCONNECT BOARD (A27-2)

PARTS LIST, A30 uP CONTROL LOGIC (89-11085-1A)

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
C...1	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...2	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...3	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...4	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...5	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...6	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...7	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...8	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...9	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C..10	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C..11	07-20004-0A	CCD 27.0PF 500.0 VK+-10%	71590	CTL DD-270
C..12	07-20004-0A	CCD 27.0PF 500.0 VK +-10%	71590	CTL DD-270
C..13	07-10184-0A	CET 100.0UF 10.0 VM DIP TAN	56289	SPRAGUE 196D107X0010-LA3
C..14	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
J...1	31-10270-0A	CON 34 PIN PCB MALE HEADER	50423	BLI
R...1	12-08024-0A	RFC 3.3 K 250.0MW J+- 5%	1121	A-B TYP CB
R...2	12-08024-0A	RFC 3.3 K 250.0MW J+- 5%	1121	A-B TYP CB
R...3	12-12244-0A	RFF 287.0 250 MW F+-1%	16299	CGW RN55D 2870 F
RN..1	13-10105-0A	RNF 390 8 PIN SIP 4 RES	80053	BECKMAN 784-3-R390/BOURNS
RN..2	13-10105-0A	RNF 390 8 PIN SIP 4 RES	80053	BECKMAN 784-3-R390/BOURNS
RN..3	13-10051-0A	RNF 4.7K 8 PIN SIP 5%	80053	BECKMAN 764-1-R4.7K
RN..4	13-10105-0A	RNF 390 8 PIN SIP 4 RES	80053	BECKMAN 784-3-R390/BOURNS
RN..5	13-10102-0A	RNF 4.7K 10 PIN SIP, 9 RES	80053	BECKMAN 785-1-R4.7K
U...1	24-10356-0A	ICP 6810 128 X 8 STATIC RAM	4713	MOTOROLA 6810P OR EQUIV.
U...2	24-10388-1A	ICP 6127A prog 6000/6FFF U2	50423	BLI
U...3	24-10389-1A	ICP 6127A PROG 7000/7FFF U3	50423	BLI
U...4	24-10390-1A	ICP 6127A PROG 8000/8FFF U4	50423	BLI
U...5	24-10144-0A	ICP 74LS08 QUAD AND 14 DIP	1295	TI
U...6	24-10145-0A	ICP 74LS00 QUAD NAND 14 DIP	1295	TI
U...7	24-10145-0A	ICP 74LS00 QUAD NAND 14 DIP	1295	TI
U...8	24-10290-0A	ICP 74LS11 (3)3 INPUT AND	4713	MOTOROLA 74LS11
U...9	24-10142-0A	ICP 74LS04 HEX INV 14 DIP	1295	TI
U..10	24-10262-0A	ICP MC6802P 8 BIT MICRO	4713	MOT MC6802P
U..11	24-10320-0A	ICP MC8T95 HEX TRI STATE BUF	4713	MOTOROLA MC8T95 OR EQUIV
U..12	24-10321-0A	ICP MC8T28 NON INV BVS TRANS	4713	MOTOROLA MC8T28 OR EQUIV
U..13	24-10321-0A	ICP MC8T28 NON INV BVS TRANS	4713	MOTOROLA MC8T28 OR EQUIV
U..14	24-10315-0A	ICP DM74LS373 OCT D-TYPE F/F	12040	NATIONAL DM74LS373 OR EQUIV.
U..15	24-10315-0A	ICP DM74LS373 OCT D-TYPE F/F	12040	NATIONAL DM74LS373 OR EQUIV.
U..16	24-10143-0A	ICP 74LS74 D FIFL 14 DIP	1295	TI
U..17	24-10323-0A	ICP DM74147 10 TO 4 PRI ENCO	12040	NATIONAL DMM74147 OR EQUIV
U..18	24-10316-0A	ICP MC 6821 PERIPH INT ADAPT	4713	MOTOROLA MC6821
Y...1	04-10021-0A	CRS 4 MHZ .01% H3W	50423	BLI





DESIGNATION	# OF PINS	GND	VCC	IC NUMBER	REMARKS
U18	40	1	20	MC6821	PERIPHERAL INTERFACE ADAPTER
U17	16	8	16	74LS147	10 TO 4 BCD PRIORITY ENCODERS
U16	14	7	14	74LS74	D-TYPE FLIP-FLOP
U15	20	10	20	74LS373	D-TYPE LATCHES
U14	20	10	20	74LS373	D-TYPE LATCHES
U13	16	8	16	MC8T28	QUAD BUS TRANCEIVER
U12	16	8	16	MC8T28	QUAD BUS TRANCEIVER
U11	16	8	16	MC8T95	HEX BUFFERS
U10	40	1,21	8,35	MC6802	MICROPROCESSOR
U9	14	7	14	74LS04	HEX INVERTERS
U8	14	7	14	74LS11	3-INPUT AND GATES
U7	14	7	14	LS00	2-INPUT NAND GATES
U6	14	7	14	LS00	2-INPUT NAND GATES
U5	14	7	14	LS08	2-INPUT NAND GATES
U4	24	12	21,24	MCM2732	4Kx8 EPROM
U3	24	12	21,24	MCM2732	4Kx8 EPROM
U2	24	12	21,24	MCM2732	4Kx8 EPROM
U1	24	1	24	6810	

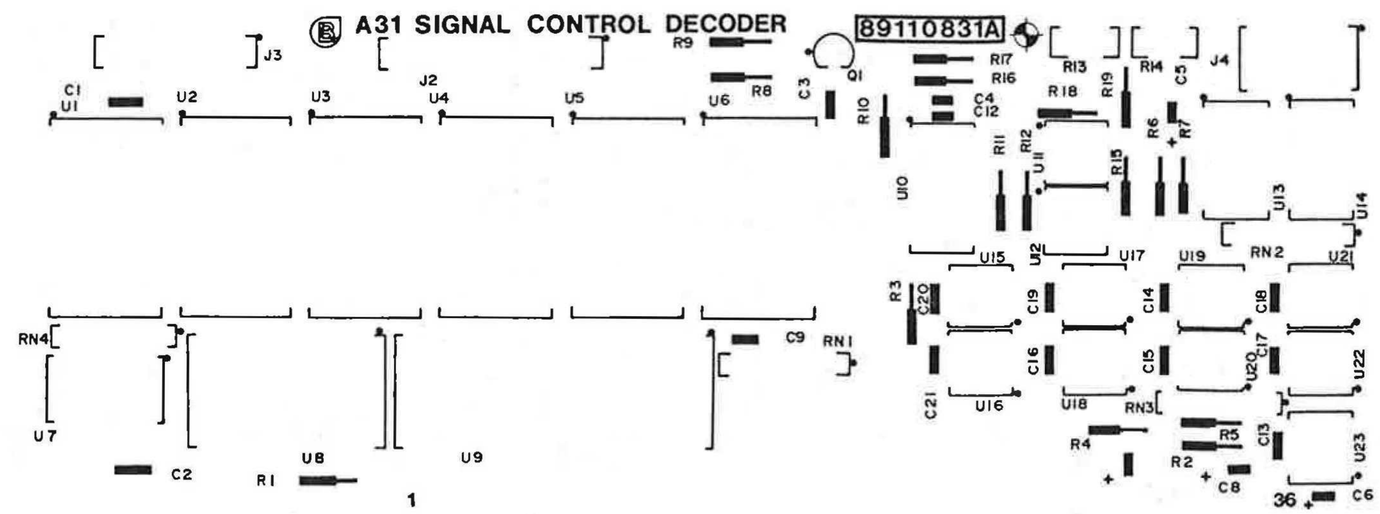
Figure 6-14. uP CONTROL LOGIC (A30)

PARTS LIST, A31 SIGNAL CONTROL DECODER (89-11083-1A)

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
C...1	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...2	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...3	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...4	07-02257-0A	CMD 200 PF 500 V K 10%	84171	ARCO TYPE DM-15-201-K
C...5	07-10184-0A	CET 100.0UF 10.0 VM DIP TAN	56289	SPRAGUE 196D107X0010-LA3
C...6	07-20108-0A	CET 10.0UF 20.0 V 10%	81349	CS13BE106K
C...7	07-10184-0A	CET 100.0UF 10.0 VM DIP TAN	56289	SPRAGUE 196D107X0010-LA3
C...8	07-20108-0A	CET 10.0UF 20.0 V 10%	81349	CS13BE106K
C...9	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C..12	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C..13	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C..14	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C..15	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C..16	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C..17	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C..18	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C..19	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C..20	07-10562-0A	CCR 0.1 UF 50 V .3	04222	AVX CERAMICS MD015E104ZAA
C..21	07-10562-0A	CCR 0.1 UF 50 V .3	04222	AVX CERAMICS MD015E104ZAA
C..22	07-10120-0A	CCD 22.0 NF 25.0 MV	71590	CENTRLB UK25223 or EQUIV
C..23	07-10120-0A	CCD 22.0 NF 25.0 MV	71590	CENTRLB UK25223 or EQUIV
C..24	07-10120-0A	CCD 22.0 NF 25.0 MW	71590	CENTRLB UK25223 or EQUIV
C..25	07-10120-0A	CCD 22.0 NF 25.0 MW	71590	CENTRLB UK25223 or EQUIV
J...2	31-10198-0A	CON 26 PCB TAIL HEADER STCON	15912	ANSLEY 609-2622M
J...3	31-10237-0A	CON 20 PIN PCB MALE HEADER	15912	T&B/ANSLEY 609-2022M
Q...1	10-09473-0A	TRQ 2N3906 PNP 1 40 PTO-92	4713	MOT 1 200M 60
R...1	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
R...2	12-12364-0A	RFF 4.64K 250.0MW F+- 1%	16299	CGW RN55D 4641 F
R...3	12-12364-0A	RFF 4.64K 250.0MW F+- 1%	16299	CGW RN55D 4641 F
R...4	12-12264-0A	RFF 464.0 250 MW F+-1%	16299	CGW RN55D 4640 F
R...5	12-12264-0A	RFF 464.0 250 MW F+-1%	16299	CGW RN55D 4640 F
R...6	12-12364-0A	RFF 4.64K 250.0MW F+- 1%	16299	CGW RN55D 4641 F
R...7	12-12364-0A	RFF 4.64K 250.0MW F+- 1%	16299	CGW RN55D 4641 F
R...8	12-12336-0A	RFF 2.37K 250.0MW F+- 1%	16299	CGW RN55D 2371 F
R...9	12-12336-0A	RFF 2.37K 250.0MW F+- 1%	16299	CGW RN55D 2371 F
R..10	12-12608-0A	RFF 1.21M 500 MW F+-1%	16299	CGW RN60D 1214 F
R..11	12-12336-0A	RFF 2.37K 250.0MW F+- 1%	16299	CGW RN55D 2371 F
R..12	12-12368-0A	RFF 5.11K 250.0MW F+- 1%	16299	CGW RN55D 5111 F
R..13	09-10093-0A	RVF 10.0 K 500.0MW KVERT MT	73138	HELIPOT 72XW 10K
R..14	09-10261-0A	RVF 20.0 K 500.0MW K VERT MT	73138	HELIPOT 72XW R20K
R..15	12-12380-0A	RFF 6.81K 250.0MW F+- 1%	16299	CGW RN55D 6811 F
R..16	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
R..17	12-12336-0A	RFF 2.37K 250.0MW F+- 1%	16299	CGW RN55D 2371 F
R..18	12-12412-0A	RFF 13.3 K 250.0MW F+- 1%	16299	CGW RN55D 1332 F
R..19	12-12380-0A	RFF 6.81K 250.0MW F+- 1%	16299	CGW RN55D 6811 F
RN..1	13-10051-0A	RNF 4.7 K 8PIN SIP 5%	80053	BECKMAN 764-1-R4.7K
RN..2	13-10051-0A	RNF 4.7 K 8PIN SIP 5%	80053	BECKMAN 764-1-R4.7K
RN..3	13-10013-0A	RNF 470.0 500.0MW 5%7RESUP	50423	BECKMAN 764-1R470
RN..4	13-10051-0A	RNF 4.7 K 8PIN SIP 5%	80053	BECKMAN 764-1-R4.7K
U...1	24-10247-0A	ICP 93L08 8 BIT LATCHED	7263	FCH 93L08-9N
U...2	24-10247-0A	ICP 93L08 8 BIT LATCHED	7263	FCH 93L08-9N
U...3	24-10247-0A	ICP 93L08 8 BIT LATCHED	7263	FCH 93L08-9N
U...4	24-10247-0A	ICP 93L08 8 BIT LATCHED	7263	FCH 93L08-9N
U...5	24-10247-0A	ICP 93L08 8 BIT LATCHED	7263	FCH 93L08-9N
U...6	24-10247-0A	ICP 93L08 8 BIT LATCHED	7263	FCH 93L08-9N
U...7	24-10085-0A	ICP SN7417N HEX BUF 15V COLL	33890	TI OR EQUIV
U...8	24-10287-0A	ICP 74L154 DECODER/DEMULTPLX	33890	TEXAS INSTRUMENT 74L154
U...9	24-10316-0A	ICP MC 6821 PERIPH INT ADAPT	4713	MOTOROLA MC6821
U..10	24-10175-0A	ICP 1408 D TO A CONVERTER	4713	MOTOROLA MC1408
U..11	24-10156-0A	ICP LM741CN OP.AMP	12040	NATL.SEMI LM741CN
U..12	24-10156-0A	ICP LM741CN OP.AMP	12040	NATL.SEMI LM741CN
U..13	24-10085-0A	ICP SN7417N HEX BUF 15V COLL	33890	TI OR EQUIV
U..14	24-10085-0A	ICP SN7417N HEX BUF 15V COLL	33890	TI OR EQUIV

PARTS LIST, A31 SIGNAL CONTROL DECODER (89-11083-1A) - Cont'd

SCHEM REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
U..15	24-10318-0A	ICP 6N137 HI SPEED OPTO ISOL	28480	HP OR EQUIV
U..16	24-10318-0A	ICP 6N137 HI SPEED OPTO ISOL	28480	HP OR EQUIV
U..17	24-10318-0A	ICP 6N137 HI SPEED OPTO ISOL	28480	HP OR EQUIV
U..18	24-10318-0A	ICP 6N137 HI SPEED OPTO ISOL	28480	HP OR EQUIV
U..19	24-10318-0A	ICP 6N137 HI SPEED OPTO ISOL	28480	HP OR EQUIV
U..20	24-10318-0A	ICP 6N137 HI SPEED OPTO ISOL	28480	HP OR EQUIV
U..21	24-10318-0A	ICP 6N137 HI SPEED OPTO ISOL	28480	HP OR EQUIV
U..22	24-10318-0A	ICP 6N137 HI SPEED OPTO ISOL	28480	HP OR EQUIV
U..23	24-10318-0A	ICP 6N137 HI SPEED OPTO ISOL	28480	HP OR EQUIV



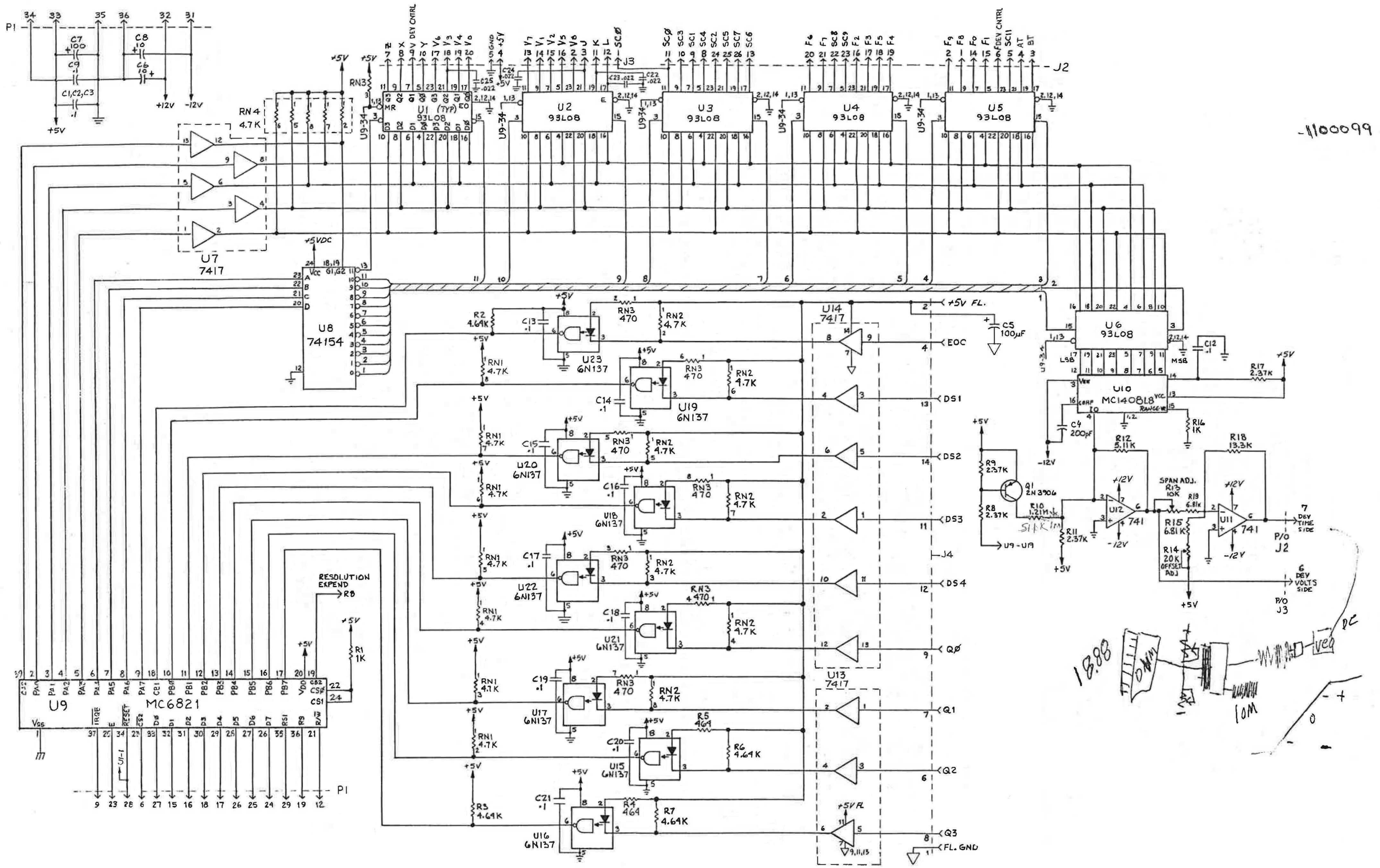


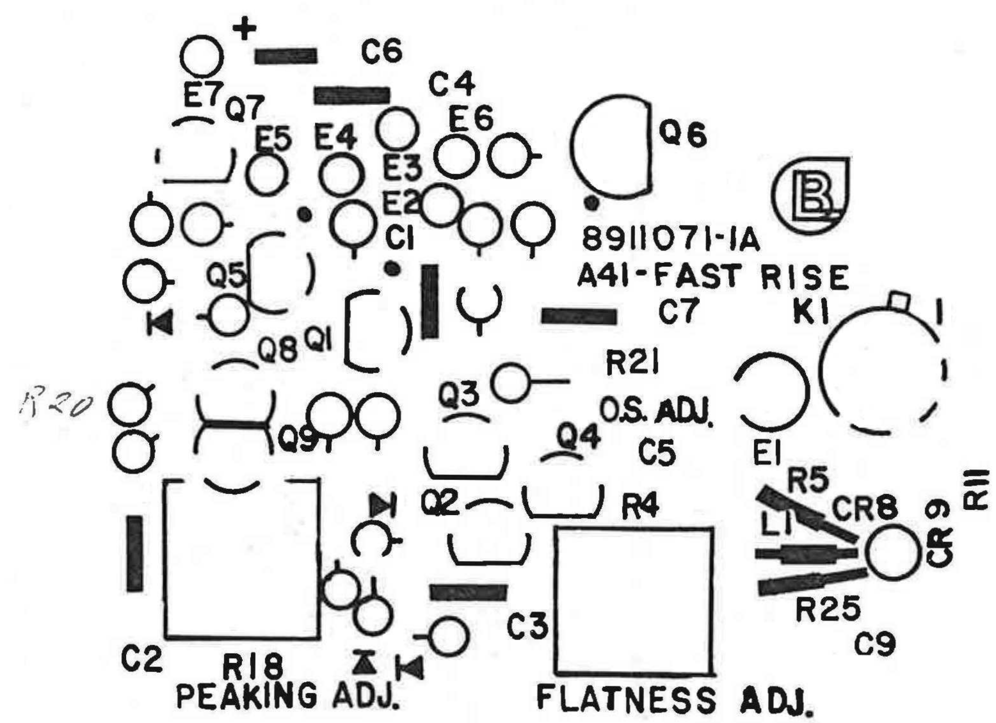
Figure 6-15. SIGNAL CONTROL DECODER (A31)

PARTS LIST, A40 STANDARD OUTPUT/FAST RISE (89-11164-1A)

SCHEM REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
P...1	31-07340-0A	CON BNC, DAGE#30220-1	29587	94375 847 81800

PARTS LIST, A41 FAST RISE TIME PULSE CIRCUIT (89-11071-1A)

SCHEM REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
C...1	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...2	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...3	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...4	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C...5	07-02458-0A	CVP .25- 1.5 PF 2 KV	74970	JOHNSON TYPE 273-1-1
C...6	07-20108-0A	CET 10.0UF 20.0 V 10%	81349	CS13BE106K
C...7	07-10562-0A	CCR 0.1UF 50V .3	04222	AVX CERAMICS MD015E104ZAA
C...9	07-02246-0A	1.5 NF 1.0KV +/-20%	84171	ARCO TYPE CCD-152 CERAMIC
CR..1	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR..2	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR..5	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR..6	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR..7	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR..8	05-10160-0A	DSR 5082-0830 STEP RECOVERY	50423	BLI
CR..9	05-10164-0A	DHF MBD102 4V SHOTTKY	4713	MOTOROLA MBD102
K...1	14-10031-0A	RLY RF DPDT TO5 CASE 12V	50423	BLI
L...1	03-10068-0A	CRF 1.5UF MIN. +-10%	71895	DELEVAN 1025-24 O/C
Q...1	10-10080-0A	TRQ 2N4403 PNP	4713	MOTOROLA
Q...2	10-10127-0A	TRQ 2N2222A NPN 1 40 MTO-180	40713	MOT .500 300M 100
Q...3	10-10079-0A	TRQ MPSA13 OR D16P1	7263	FCI MPSA13 ADV34938
Q...4	10-10009-0A	TRQ MPS6519 PNP 1 25 PTO-92	4713	MOT 1 340M 250
Q...5	10-10009-0A	TRQ MPS6519 PNP 1 25 PTO-92	4713	MOT 1 340M 250
Q...6	10-10009-0A	TRQ MPS6519 PNP 1 25 PTO-92	4713	MOT 1 340M 250
Q...7	10-10005-0A	TRQ MPS6515 NPN 1 25 PTO-92	4713	MOT .350 390M 150
Q...8	10-10005-0A	TRQ MPS6515 NPN 1 25 PTO-92	4713	MOT .350 390M 150
Q...9	10-10005-0A	TRQ MPS6515 NPN 1 25 PTO-92	4713	MOT .350 390M 150
R...1	12-12168-0A	RFF 51.1 250.0MW F+- 1%	16299	CGW RN55D 51R1 F
R...2	12-12264-0A	RFF 464.0 250 MW F+-1%	16299	CGW RN55D 4640 F
R...3	12-12280-0A	RFF 681.0 250 MW F+-1%	16299	CGW RN55D 6810 F
R...4	09-10107-0A	RVF 200.0 250.0MW K CER	73138	HEL TYPE 72PM-200
R...5	12-12316-0A	RFF 1.47 K 250 MW F+-1%	16299	CGW RN55D 1471 F
R...6	12-12120-0A	RFF 16.2 250.0MW F+- 1%	16299	CGW RN55D 16R2 F
R...7	12-12128-0A	RFF 19.6 250.0MW F+- 1%	16299	CGW RN55D 19R6 F
R...8	12-12220-0A	RFF 162.0 250.0MW F+- 1 5	16299	CGW RN55D 1620 F
R..11	12-13289-0A	RFF 50 OHM 1%	50423	BLI
R..13	12-12400-0A	RFF 10.0 K 250.0MW F+- 1%	16299	CGW RN55D 1002 F
R..15	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
R..16	12-12228-0A	RFF 196.0 250 MW F+-1%	16299	CGW RN55D 1960 F
R..17	12-12269-0A	RFF 523.0 250.0MW F+-1%	16299	CGW RN55D 5230 F
R..18	09-10151-0A	RVF 2.0K 500.0MW	73138	HELIPOT 72PM
R..19	12-12120-0A	RFF 16.2 250.0MW F+- 1%	16299	CGW RN55D 16R2 F
R..20	12-12256-0A	RFF 383.0 250 MW F+-1%	16299	CGW RN55D 3830 F
R..21	12-12356-0A	RFF 3.83K 250.0MW F+- 1%	16299	CGW RN55D 3831 F



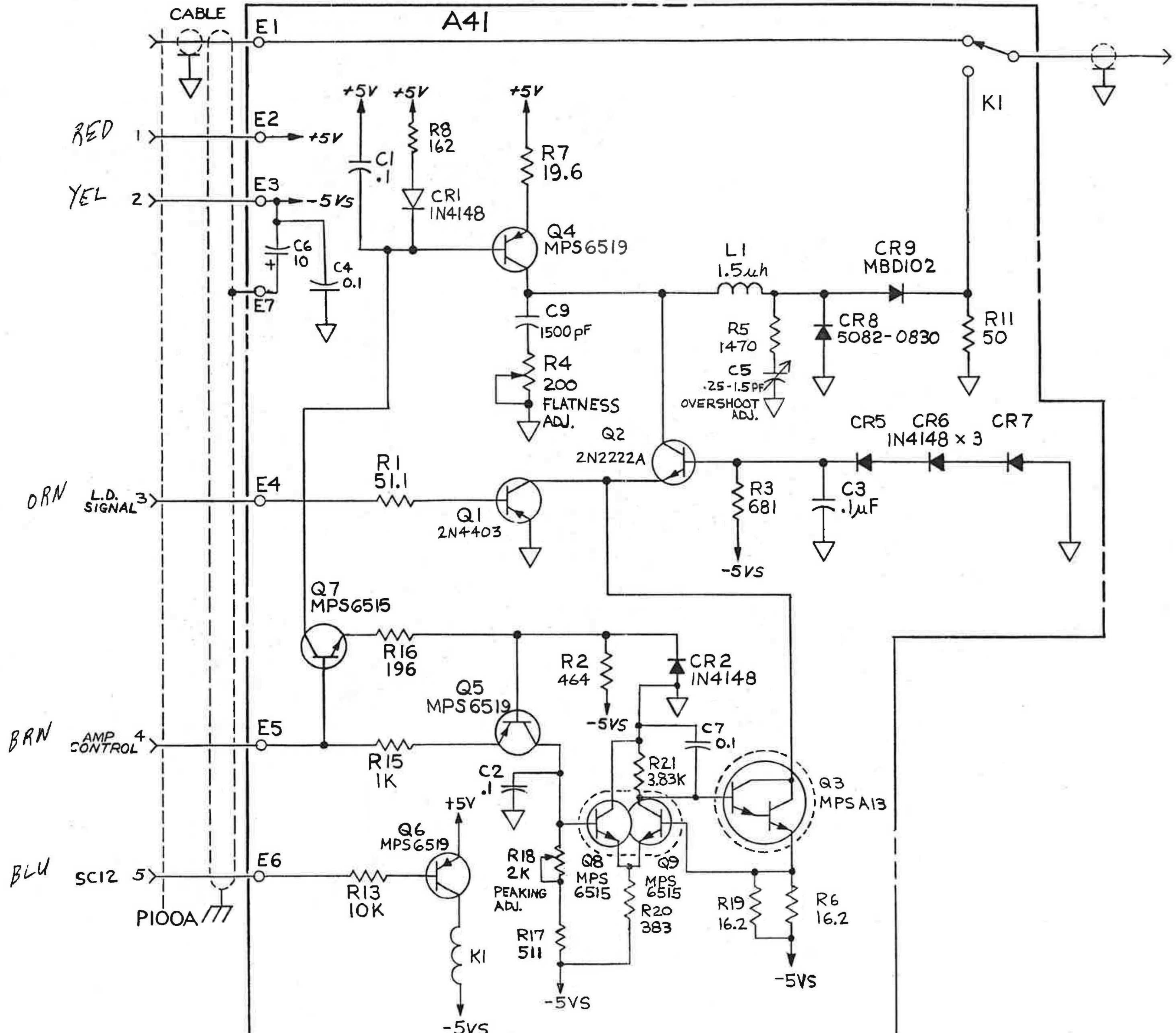


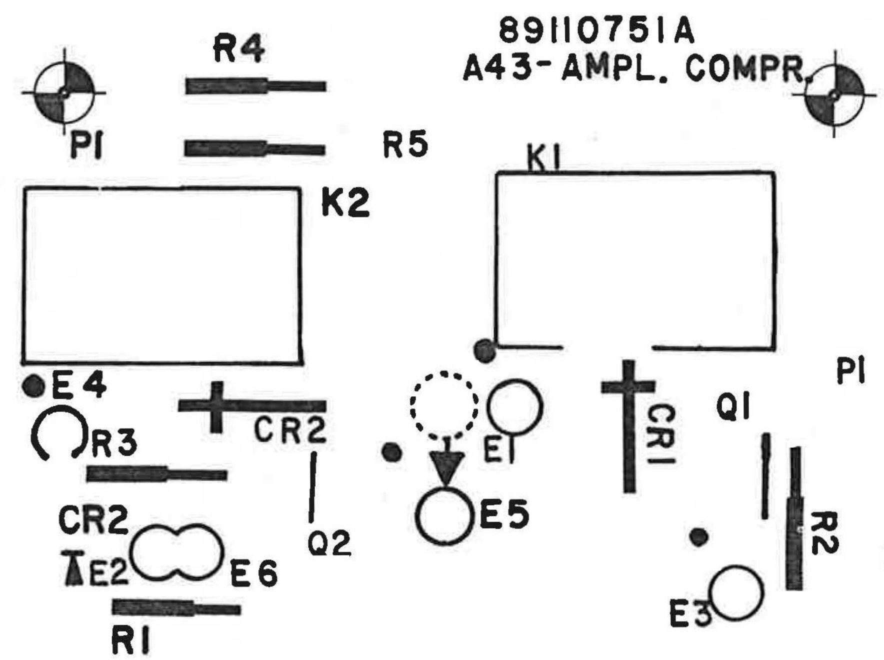
Figure 6-16. FAST RISE TIME PULSE CIRCUIT (A41)

PARTS LIST, A42 AMPLITUDE COMPARATOR ASSEMBLY (89-11163-1A)

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
P...1	31-07340-0A	CON BNC, DAGE#30220-1	50423	BLI
J...1	31-03379-0A	CON UG-1094/U BNC,DAGE	50423	BLI

PARTS LIST, A43 AMPLITUDE COMPARATOR ASSEMBLY (89-11075-1A)

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
CR..1	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR..2	16-10028-0A	LMP LED RED WIDE ANGLE	28480	HP 5082-4655
CR..3	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
K...1	14-10020-0A	RLY REED FORM C 5V 200OHM DI	50423	BLI
K...2	14-10021-0A	RLY REED FORM A 5V 500OHMDIP	50423	BLI
Q...1	10-10043-0A	TRQ 2N3904 NPN 1 40 PT0-92	4713	MOT 1 300M 40
Q...2	10-10043-0A	TRQ 2N3904 NPN 1 40 PT0-92	4713	MOT 1 300M 40
R...1	12-12228-0A	RFF 196.0 250 MW F+-1%	16299	CGW RN55D 1960 F
R...2	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
R...3	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
R...4	12-13205-0A	RFW 100.0 250.0MW A	50423	BLI
R...5	12-13205-0A	RFW 100.0 250.0MW A	50423	BLI



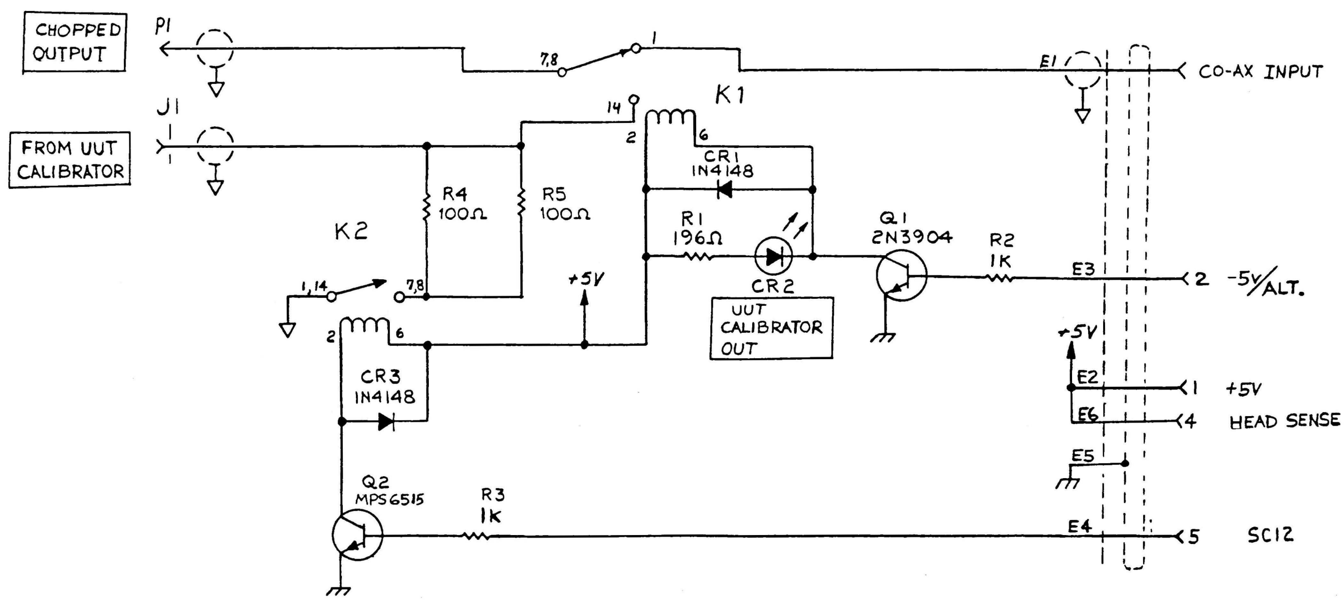
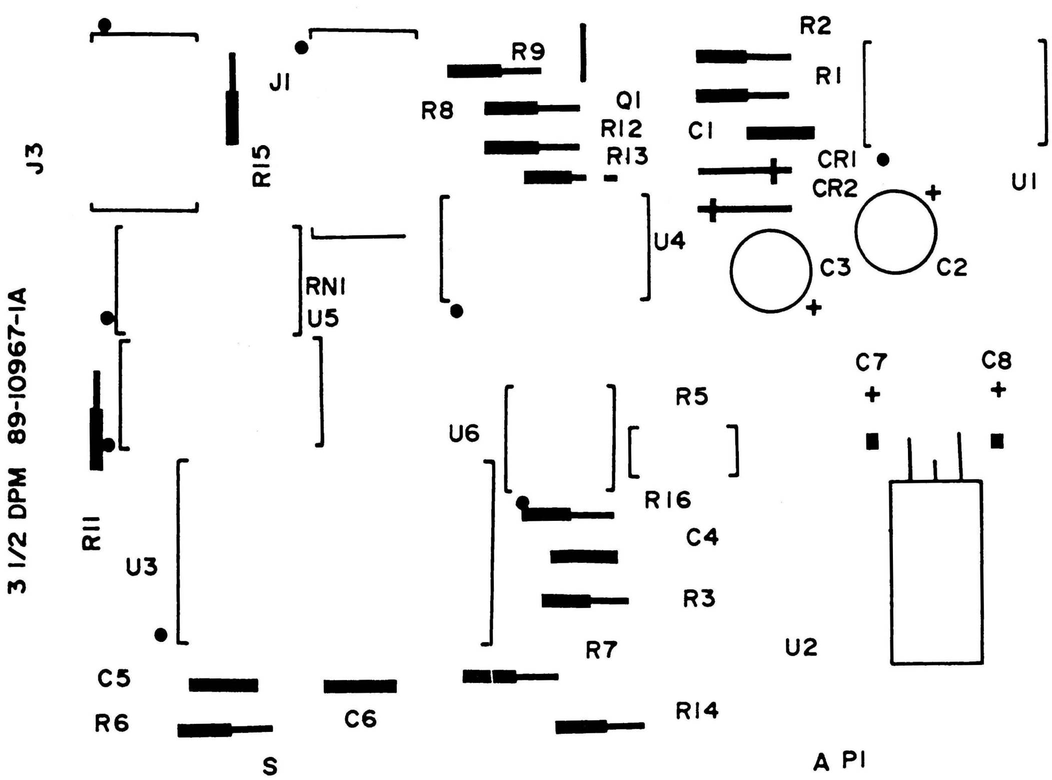
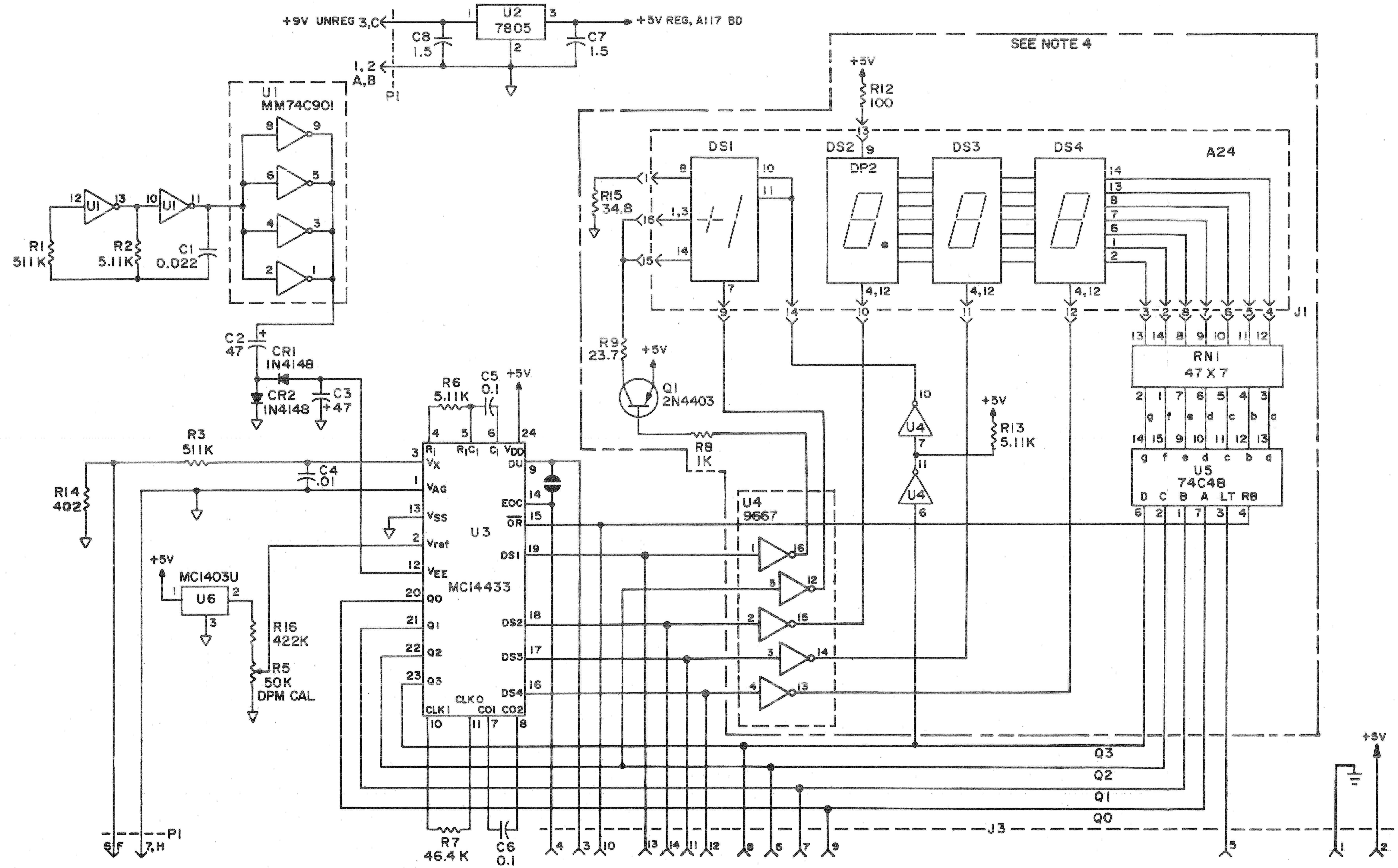


Figure 6-17. AMPLITUDE COMPARATOR ASSEMBLY (A43)

PARTS LIST, A117 A/D CONVERTER (89-11174-1A)

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
C...1	07-10340-0A	CBM 22.0NF 400.0 V +-10%	80031	MEPCO C280MCF/A22K
C...2	07-10492-0A	CEA 47.0UF 16.0 V	50423	BLI
C...3	07-10492-0A	CEA 47.0UF 16.0 V	50423	BLI
C...4	07-10441-0A	CBM 10.0NF 400.0 V	80031	MEPCO C280MCF/A10K
C...5	07-10223-0A	CYF 100. NF 250. VK	73445	AMPREX C280AE/A100K
C...6	07-10223-0A	CYF 100. NF 250. VK	73445	AMPREX C280AE/A100K
C...7	07-10083-0A	CET 1.5UF 35.0 V	56289	SPRAGUE 1960155X0035A3
C...8	07-10083-0A	CET 1.5UF 35.0 V	56289	SPRAGUE 1960155X0035A3
CR..1	05-10049-0A	DGP 1N4148 100 10M	1295	TI SI D035 4 5 JAN
CR..2	05-10049-0A	DGP 1N4148 100 10M	1295	TI SI D035 4 5 JAN
J...1	48-10007-0A	SOC 16 PIN SOLDER TAIL	1295	TI 016ST-7520(TABOR)
Q...1	10-10080-0A	TRQ 2N4403 PNP	4713	MOTOROLA
R...1	12-12568-0A	RFF 511.0 K 500.0MW F+- 1%	16299	CGW RN60D 5113 F
R...2	12-12368-0A	RFF 5.11K 250.0MW F+- 1%	16299	CGW RN55D 5111 F
R...3	12-12568-0A	RFF 511.0 K 500.0MW F+- 1%	16299	CGW RN60D 5113 F
R...5	09-10092-0A	RVF 50.0 K 500.0MW KVERT MT	73138	HELIPOT 72XW 50K
R...6	12-12368-0A	RFF 5.11K 250.0MW F+- 1%	16299	CGW RN55D 5111 F
R...7	12-12464-0A	RFF 46.4 K 250.0MW F+- 1%	16299	CGW RN55D 4642 F
R...8	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
R...9	12-12136-0A	RFF 23.7 250.0MW F+- 1%	16299	CGW RN55D 23R7 F
R..12	12-12200-0A	RFF 100.0 250.0MW F+- 1%	16299	CGW RN55D 1000 F
R..13	12-12368-0A	RFF 5.11K 250.0MW F+- 1%	16299	CGW RN55D 5111 F
R..14	12-12258-0A	RFF 402.0 250 MW F+-1%	16299	CGW RN55D 4020 F
R..15	12-12152-0A	RFF 34.8 250.0MW F+- 1%	16299	CGW RN55D 34R8 F
R..16	12-12560-0A	RFF 422.0 K 500 MW F+-1%	16299	CGW RN60D 4223 F
RN..1	13-10046-0A	RNF 47.0 14 PIN DIP 7 RES.	80053	BECKMAN 899-3-R47
U...1	24-10249-0A	ICP 74C90L HEX INV TT2 BUFFE	12040	NATIONAL MM74C901N
U...2	24-10153-0A	ICP UA7805 5V REG.	7263	FCH UGH7805393
U...3	24-10304-0A	ICP MC14433P 3 1/2 DGT A/D	4713	MOT CMOS LSI
U...6	24-10313-0A	ICP MC1403U V REF	4713	MOTOROLA 1403U





IC	GND PIN	+5V PIN
U1	7	14
U4	8	16
U5	8	5,16

NOTES:

1. ALL CAPACITANCE VALUES ARE IN MICROFARADS AND ALL RESISTANCE VALUES ARE IN OHMS, UNLESS OTHERWISE NOTED.
2. ⏚ DENOTES LOCAL GROUND.
3. ⟶ DENOTES CONTACT OF A117P1.
4. COMPONENTS IN OUTLINED AREA USED FOR FACTORY TEST.

Figure 6-18. A/D CONVERTER (A117)

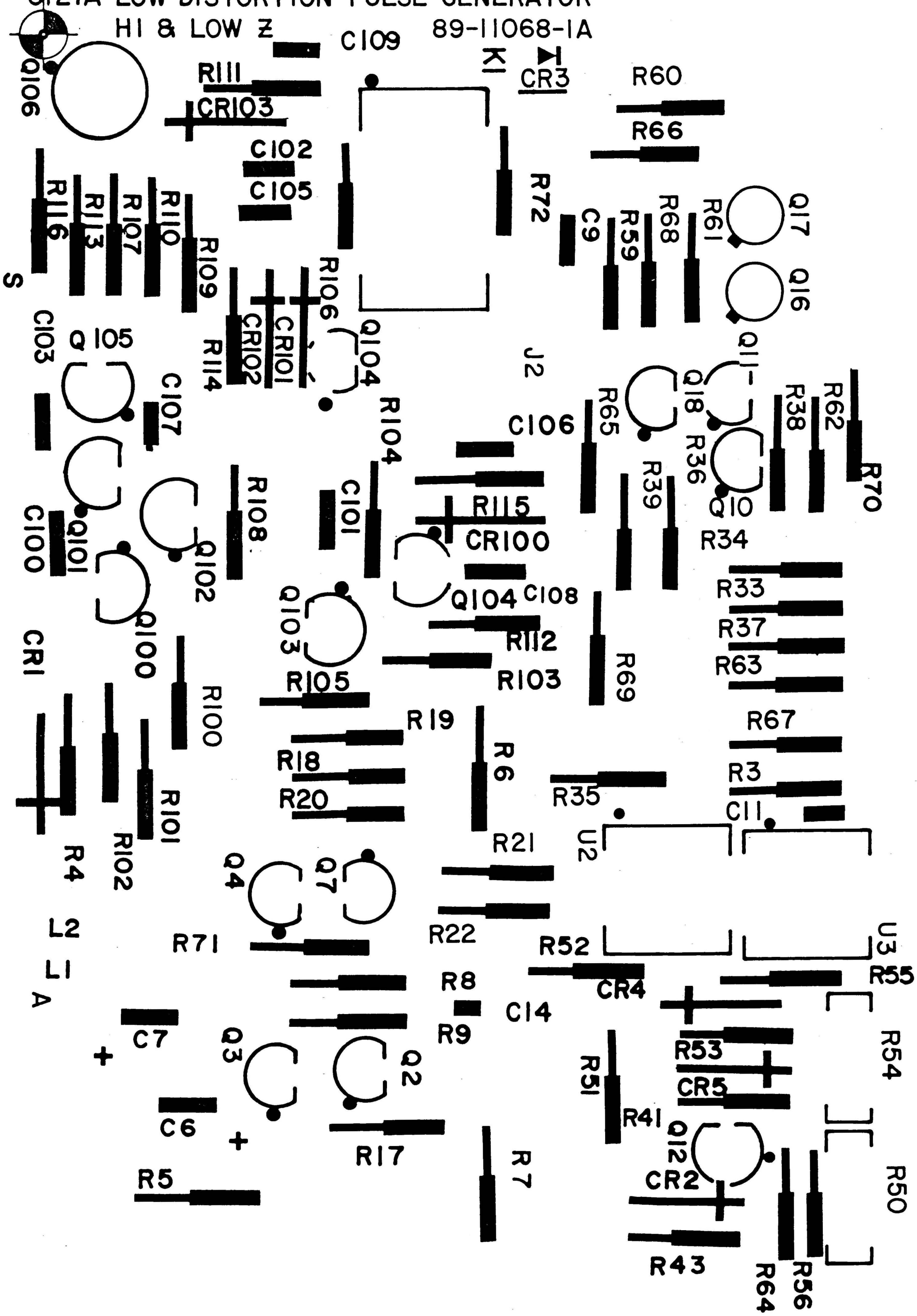
PARTS LIST, A127 LOW DISTORTION PULSE GENERATOR (89-11068-1A)

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
C...6	07-10053-0A	CET 10.0UF 35.0V M	56289	199D106X0035DA2
C...7	07-10053-0A	CET 10.0UF 35.0V M	56289	199D106X0035DA2
C...9	07-10152-0A	CCD 5.6PF 500.0 V NPO 10%	72982	ERIE 861 NPC 5.6PF 10X500
C..10	07-10112-0A	CCC 100.0NF 50.0V CHIP	71590	CENTRLB W005FH104M
C..11	07-10120-0A	CCD 22.0NF 25.0 VM	71590	CENTRLB UK25223 OR EQUIV
C..14	07-10053-0A	CET 10.0UF 35.0V M	56289	199D106X0035DA2
C..21	07-10112-0A	CCC 100.0NF 50.0 V CHIP	71590	CENTRLB W005FH104M
C..22	07-10112-0A	CCC 100.0NF 50.0 V CHIP	71590	CENTRLB W005FH104M
C..23	07-10112-0A	CCC 100.0NF 50.0 V CHIP	71590	CENTRLB W005FH104M
C..24	07-10112-0A	CCC 100.0NF 50.0 V CHIP	71590	CENTRLB W005FH104M
C..25	07-10112-0A	CCC 100.0NF 50.0V CHIP	71590	CENTRLB W005FH104M
C.100	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C.101	07-02246-0A	1.5NF 1.0KV +/- 20%	84171	ARCO TYPE CCD-152 CERAMIC
C.103	07-10223-0A	CYF 100. NF 250. VK	73445	AMPREX C280AE/A100K
C.105	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C.106	07-10562-0A	CCR 0.1 UF 50V .3 SPACE	04222	AVX CERAMICS MD015E104ZAA
C.107	07-20091-0A	CMD 47.0PF 5%	84171	DM15-470J
C.108	07-02292-0A	CMD 470.0PF 500.0 FJ+- 5%	84171	ARCO DM-15-471-J
C.109	07-10004-0A	CMD 300.0PF 500.0V DM15	84171	ARCO DM-15-301J
C.201	07-02246-0A	1.5NF 1.0KV +/- 20%	84171	ARCO TYPE CCD-152 CERAMIC
CR..1	05-10049-0A	DGP 1N4148 100 10M	1295	TI SI D035 4 5 JAN
CR..2	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR..3	05-10127-0A	DHF MBD101 4V SCHOTTKY	4713	MOT
CR..4	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR..5	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR100	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR101	05-07920-0A	DGP 1N4148 75 10M	7263	FCH SI D035
CR102	05-10049-0A	DGP 1N4148 100 10M	1295	TI SI D035 4 5 JAN
CR103	05-10049-0A	DGP 1N4148 100 10M	1295	TI SI D035 4 5 JAN
J...1	31-10173-0A	CON COAX MIN PC JACK SNAP ON	98291	SEALECTRO 51-051-0000 EQU
J...2	31-10173-0A	CON COAX MIN PC JACK SNAP ON	98291	SEALECTRO 51-051-0000 EQU
K...1	14-10024-0A	RLY SPDT 5V	50423	BLI
L...1	46-10000-0A	FRB FERRITE BEAD	78488	STACKPOLE 57-0180-70 MAT
L...2	46-10000-0A	FRB FERRITE BEAD	78488	STACKPOLE 57-0180-70 MAT
Q...2	10-08055-0A	TRQ 2N918 PNP 1 15 PTO-18	7263	FCH .300 900M 20
Q...3	10-08055-0A	TRQ 2N918 PNP 1 15 PTO-18	7263	FCH .300 900M 20
Q...4	10-10168-0A	TRQ 2N5771	07263	FAIRCHILD OR EQUIV 2N5771
Q...7	10-10168-0A	TRQ 2N5771	07263	FAIRCHILD OR EQUIV 2N5771
Q..10	10-10168-0A	TRQ 2N5771	07263	FAIRCHILD OR EQUIV 2N5771
Q..11	10-10168-0A	TRQ 2N5771	07263	FAIRCHILD OR EQUIV 2N5771
Q..12	10-08063-0A	TRQ 2N5087 PNP 1 50 PTO-92	4713	MOT 1 40M 150
Q..16	10-10157-0A	TRQ BFY90 NPN 1 15V S TO 72	50423	BLI
Q..17	10-10157-0A	TRQ BFY90 NPN 1 15V S TO 72	50423	BLI
Q..18	10-09485-0A	TRQ MPS6521 NPN 1 25 PTO-92	4713	MOT 1 390M 100
Q.100	10-10142-0A	TRQ 2N5401 PNP 1 160 TO-920	4713	MOTOROLA
Q.101	10-10142-0A	TRQ 2N5401 PNP 1 160 TO-920	4713	MOTOROLA
Q.102	10-10142-0A	TRQ 2N5401 PNP 1 160 TO-920	4713	MOTOROLA
Q.103	10-10043-0A	TRQ 2N3904 NPN 1 40 PTO-92	4713	MOT 1 300M 40
Q.104	10-10142-0A	TRQ 2N5401 PNP 1 160 TO-920	4713	MOTOROLA
Q.105	10-09473-0A	TRQ 2N3906 PNP 1 40 PTO-92	4713	MOT 1 200M 60
Q.106	10-10146-0A	TRQ 2N4925 NPN 1 150V TO39	4713	MOT
Q.107	10-10043-0A	TRQ 2N3904 NPN 1 40 PTO-92	4713	MOT 1 300M 40
R...3	12-12164-0A	RFF 46.4 250.0MW F+- 1%	16299	CGW RN55D 46R4 F
R...4	12-12268-0A	RFF 511.0 250 MW F+-1%	16299	CGW RN550 5110 F
R...5	12-12100-0A	RFF 10.0 250.0MW F+- 1%	16299	CGW RN55D 10R0 F
R...6	12-12228-0A	RFF 196.0 250 MW F+-1%	16299	CGW RN55D 1960 F
R...7	12-12168-0A	RFF 51.1 250.0MW F+- 1%	16299	CGW RN55D 51R1 F
R...8	12-12208-0A	RFF 121.0 250.0MW F+- 1%	16299	CGW RN55D 1210 F
R...9	12-12208-0A	RFF 121.0 250.0MW F+- 1%	16299	CGW RN55D 1210 F
R..17	12-12268-0A	RFF 511.0 250 MW F+-1%	16299	CGW RN550 5110 F
R..18	12-12280-0A	RFF 681.0 250 MW F+-1%	16299	CGW RN55D 6810 F
R..19	12-12280-0A	RFF 681.0 250 MW F+-1%	16299	CGW RN55D 6810 F

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
R..20	12-12132-0A	RFF 21.5 250.0MW F+- 1%	16299	CGW RN55D 21R5 F
R..21	12-12168-0A	RFF 51.1 250.0MW F+- 1%	16299	CGW RN55D 51R1 F
R..22	12-12168-0A	RFF 51.1 250.0MW F+- 1%	16299	CGW RN55D 51R1 F
R..33	12-12308-0A	RFF 1.21K 250 MW F+-1%	16299	CGW RN55D 1211 F
R..34	12-12308-0A	RFF 1.21K 250 MW F+-1%	16299	CGW RN55D 1211 F
R..35	12-12100-0A	RFF 10.0 250.0MW F+- 1%	16299	CGW RN55D 10R0 F
R..36	12-12132-0A	RFF 21.5 250.0MW F+- 1%	16299	CGW RN55D 21R5 F
R..37	12-12208-0A	RFF 121.0 250.0MW F+- 1%	16299	CGW RN55D 1210 F
R..38	12-12208-0A	RFF 121.0 250.0MW F+- 1%	16299	CGW RN55D 1210 F
R..39	12-12100-0A	RFF 10.0 250.0MW F+- 1%	16299	CGW RN55D 10R0 F
R..41	12-12168-0A	RFF 51.1 250.0MW F+- 1%	16299	CGW RN55D 51R1 F
R..43	12-12290-0A	RFF 866.0 250 MW F+-1%	16299	CGW RN55D 8660 F
R..50	09-10269-0A	RVF 100 OHM 500 MW K VERT	73138	HELIPOT 72X R100
R..51	12-12500-0A	RFF 100.0 K 250.0MW F+- 1%	16299	CGW RN55D 1003 F
R..52	12-12500-0A	RFF 100.0 K 250.0MW F+- 1%	16299	CGW RN55D 1003 F
R..53	12-08020-0A	RFC 10.0 M 250.0MW J+- 5%	1121	A-B TYP CB
R..54	09-10120-0A	RVF 100.0 K 250.0MW K CERMET	73138	POT HELIPOT 72XWR 100K
R..55	12-12408-0A	RFF 12.1 K 250.0MW F+- 1%	16299	CGW RN55D 1212 F
R..56	12-12408-0A	RFF 12.1 K 250.0MW F+- 1%	16299	CGW RN55D 1212 F
R..59	12-12168-0A	RFF 51.1 250.0MW F+- 1%	16299	CGW RN55D 51R1 F
R..60	12-12100-0A	RFF 10.0 250.0MW F+- 1%	16299	CGW RN55D 10R0 F
R..61	12-09839-0A	RFC 5.1 250.0MW J+- 5%	1121	AB TYP CB
R..62	12-12168-0A	RFF 51.1 250.0MW F+- 1%	16299	CGW RN55D 51R1 F
R..63	12-12232-0A	RFF 215.0 250 MW F+-1%	16299	CGW RN55D 2150 F
R..64	12-12328-0A	RFF 1.96K 250.0MW F+- 1%	16299	CGW RN55D 1961 F
R..65	12-12268-0A	RFF 511.0 250 MW F+-1%	16299	CGW RN550 5110 F
R..66	12-12200-0A	RFF 100.0 250.0MW F+- 1%	16299	CGW RN55D 1000 F
R..67	12-12328-0A	RFF 1.96K 250.0MW F+- 1%	16299	CGW RN55D 1961 F
R..68	12-12100-0A	RFF 10.0 250.0MW F+- 1%	16299	CGW RN55D 10R0 F
R..69	12-12168-0A	RFF 51.1 250.0MW F+- 1%	16299	CGW RN55D 51R1 F
R..70	12-12268-0A	RFF 511.0 250 MW F+-1%	16299	CGW RN550 5110 F
R..71	12-12232-0A	RFF 215.0 250 MW F+-1%	16299	CGW RN55D 2150 F
R..72	12-12168-0A	RFF 51.1 250.0MW F+- 1%	16299	CGW RN55D 51R1 F
R.100	12-12400-0A	RFF 10.0 K 250.0MW F+- 1%	16299	CGW RN55D 1002 F
R.101	12-12368-0A	RFF 5.11K 250.0MW F+- 1%	16299	CGW RN55D 5111 F
R.102	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
R.103	12-12192-0A	RFF 90.9 250.0MW F+- 1%	16299	CGW RN55D 90R9 F
R.104	12-12264-0A	RFF 464.0 250 MW F+-1%	16299	CGW RN55D 4640 F
R.105	12-12328-0A	RFF 1.96K 250.0MW F+- 1%	16299	CGW RN55D 1961 F
R.107	12-12308-0A	RFF 1.21K 250 MW F+-1%	16299	CGW RN55D 1211 F
R.108	12-12364-0A	RFF 4.64K 250.0MW F+- 1%	16299	CGW RN55D 4641 F
R.109	12-12328-0A	RFF 1.96K 250.0MW F+- 1%	16299	CGW RN55D 1961 F
R.110	12-12300-0A	RFF 1.0 K 250 MW F+-1%	16299	CGW RN55D 1001 F
R.111	12-12164-0A	RFF 46.4 250.0MW F+- 1%	16299	CGW RN55D 46R4 F
R.112	12-12364-0A	RFF 4.64K 250.0MW F+- 1%	16299	CGW RN55D 4641 F
R.113	12-12100-0A	RFF 10.0 250.0MW F+- 1%	16299	CGW RN55D 10R0 F
R.114	12-12368-0A	RFF 5.11K 250.0MW F+- 1%	16299	CGW RN55D 5111 F
R.115	12-12220-0A	RFF 162.0 250.0MW F+- 1 5	16299	CGW RN55D 1620 F
R.116	12-12264-0A	RFF 464.0 250 MW F+-1%	16299	CGW RN55D 4640 F
U...2	24-10212-0A	ICP CA3140E FET OP AM MINDIP	86684	RCA CA3140G FET OPAMP MINIDIP
U...3	24-10212-0A	ICP CA3140E FET OP AM MINDIP	86684	RCA CA3140G FET OPAMP MINIDIP

6127A LOW DISTORTION PULSE GENERATOR

HI & LOW Z 89-11068-1A



NOTES:
1. ALL CAPACITANCE VALUES ARE IN MICROFARADS, AND ALL RESISTANCE VALUES ARE IN OHMS, UNLESS NOTED OTHERWISE.
2. ⟶ DENOTES CONTACT OF A116P1.
3. ALL RESISTOR VALUES SHOWN ARE FOR 1% RESISTORS, UNLESS NOTED OTHERWISE.
4. ASSEMBLY NUMBER IS 89110681A

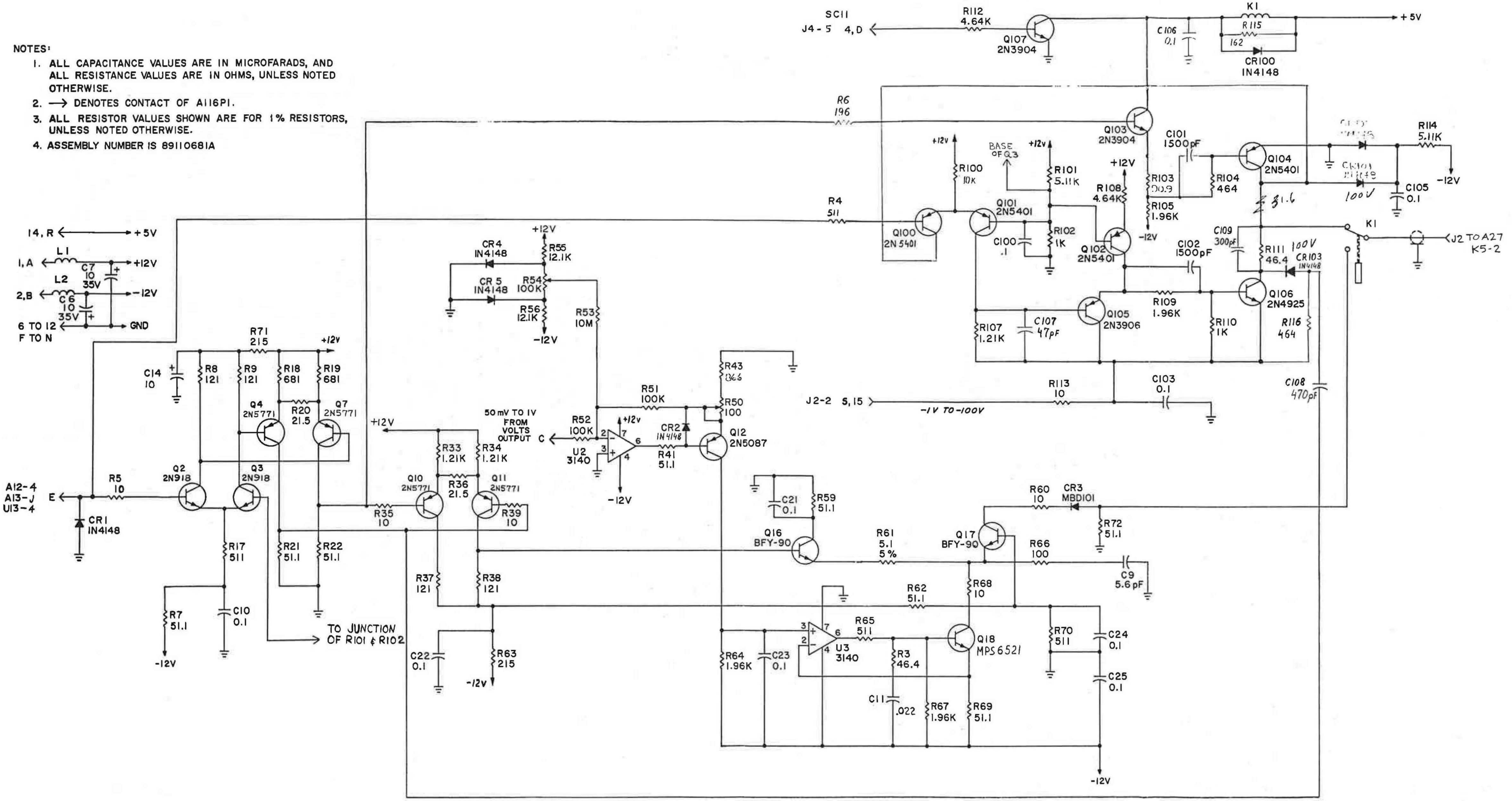


Figure 6-19. LOW DISTORTION PULSE GENERATOR (A127)

PARTS LIST, A50 REAR PANEL ASSEMBLY (89-11160-1A)

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
J..30	31-03379-0A	CON UG-1094/U BNC, DAGE	29587	STATE ELEC. PARTS
U...5	24-10373-0A	ICP LM323 3 AMP POS VOLT REG	4713	MOT OR EQUIV LM323

PARTS LIST, A52 FRAME ASSEMBLY (89-11159-1A)

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
U...1	24-10147-0A	ICP MC7812CP 12V 1AM REG	4713	MOT MC78126
U...2	24-10258-0A	ICP 7912 -12V REG 1 AMP	12040	NAT LM7912 OR EQUAL
U...6	24-10153-0A	ICP UA7805 5V REG.	7263	FCH UGH7805393
U..6A	24-10153-0A	ICP UA7805 5V REG.	7263	FCH UGH7805393

PARTS LIST, A53 FINAL ASSEMBLY (89-11177-1A)

SCHEMATIC REF	BALLANTINE PART NO.	DESCRIPTION	MFR CODE	MFR PART NUMBER
S...1	25-10187-0A	SWC DIP SWC 8 POSITION	50423	BLI
S...2	25-10187-0A	SWC DIP SWC 8 POSITION	50423	BLI
S...3	25-10187-0A	SWC DIP SWC 8 POSITION	50423	BLI
S...4	25-10187-0A	SWC DIP SWC 8 POSITION	50423	BLI
S...5	25-10187-0A	SWC DIP SWC 8 POSITION	50423	BLI
S...6	25-10187-0A	SWC DIP SWC 8 POSITION	50423	BLI
S...7	25-10187-0A	SWC DIP SWC 8 POSITION	50423	BLI
S...8	25-10187-0A	SWC DIP SWC 8 POSITION	50423	BLI
Y...1	68-10001-1G	OSC 6127A 1 GHZ OSC	50423	BLI

ADDENDUM

TO INSTRUCTION MANUAL: **MODEL No.** 6127A

Units thru Serial Prefix 021

INSTRUCTION MANUAL

Page 3-1. Add the following NOTE at the end of paragraph 3-8.

NOTE

To check the setting of the Calibrator's IEEE-488 bus address selector switch A50-S1/58 wait for the prompt lines to appear in every display window and press the CLEAR touch key. The two digits of bus address to which the 6127A is set, will appear in the DEVIATION display window. Be sure the 6127A bus address matches the command program from the bus controller. Refer to paragraph 3-25 for bus address switch setting. The bus address display capability is active only after a SELF TEST cycle.

Page 3-23. Add the following to table 3-11.

TABLE 3-11. MODEL 6127A OPERATING HINTS-(Cont'd)

12. Unit self test checks okay after SELF TEST cycle, but will not respond to the bus controller.	6127A bus address may not match controller program. Determine controller program address requirement for the 6127A. Then SELF TEST again and wait for all prompt lines to appear. Press CLEAR touch key and observe 6127A bus address display in DEVIATION window. If 6127A and controller bus address do not coincide, reset 6127A address.
13. When using the VOLTS/DIV and LOW DISTORTION PULSE modes at low amplitudes below 500 mV, always select reduced bandwidth below 20 MHz on the scope under test.	This minimized noise and permits viewing the cleanest calibrating signal in the 5 millivolt to 500 millivolt amplitude range.

ref:

Ballantine Laboratories, Inc.

ADDENDUM

TO INSTRUCTION MANUAL: **MODEL No.** 6127A VOLUME 2

(P/N 90-10275-5A #1)
APPLIES TO ALL UNITS WITH SERIAL NO.
PREFIX 030- AND ABOVE.

Page 5-8. Para. 5-15a change last sentence to read:

Connect the 61271A Head to the sampling oscilloscope through BNC to GR874 adapter, a 6 dB (X2) 50 ohm attenuator pad and a 30 cm GR-874 50 ohm air line.

Page 5-8. Para. 5-15c change:

100 ps/div to 2 ns/div

Page 5-8. Para. 5-15f add:

Note that aberrations and flatness are ± 3% of peak-to-peak of pulse amplitude (0 to 100%).

Page 5-8. Para. 5-15g add:

Change scope time base to 100 ps/div and correct for sampling scope rise time by using:

$$T_{pulse} = \sqrt{(T_{Display})^2 - (T_{Scope})^2}$$

For a 1 GHz sampling scope the displayed rise time should, therefore, be no slower than 406 pico seconds to verify the 200 ps pulse rise time.

Page 5-8. Para. 5-15h change to read:

Change scope time base to 2 ns/div and activate the 6127A % DEVIATION by pressing the DEV touch key pad.

Page 5-8. Para. 5-15i add after .... divisions:

and that the top edge near the corner remains nominally flat.

Page 5-9. Para. 5-15j add after .... divisions:

and that the top edge near the corner remains nominally flat.

Page 5-9. Figure 5-5. FAST RISE PULSE Output Check, Test Set-Up

Delete and replace with new Figure 5-5, which includes 6 dB (X2) attenuator and 30 cm GR874 50 ohm air line between BNC to GR874 adapter (Ballantine Model 12625A) and sampling scope input.

Page 5-17. Para. 5-46a add:

Allow 20 minutes warmup with covers on the 6127A.

Page 5-17. Para. 5-46b change to read:

Select special 6127A Deviation Calibration check routine by first pressing TIME/DIV and 1 ms touch key pads then press the hidden touch key pads located directly above the DEV key pad and sequentially press the column of 5 touch key pads below.

Page 5-17. Para. 5-47c change first sentence to read:

If necessary, adjust A18-R8 until +11.00 to +11.50 is displayed in the AMPLITUDE/DIV and DIVISIONS windows.

Page 5-17. Para. 5-47e change first sentence to read:

If necessary, adjust A18-R6 until -11.00 to -11.50 is displayed in the AMPLITUDE/DIV and DIVISIONS windows.

Page 5-17. Para. 5-48f change:

111 ms to read: 111 ms $\pm$ 5 ms.

Page 5-17. Para. 5-48i change:

91 ms to read: 91 ms $\pm$ 4 ms.

Page 5-18. Para. 5-49 change to read:

5-49. 200 ps FAST RISE ADJ. (A41-R9, A41-R18, A41-R30, A41-R31, R41-C5, A41-C9)

Page 5-18. Para. 5-49b change to read:

Connect the 61271A OUTPUT BNC to the sampling oscilloscope through a BNC to GR874 adapter, 6 dB (X2) 50 ohm attenuator and 30 cm of GR874 50 ohm air line. See Figure 5-5.

Page 5-18. Para. 5-49e change to read:

Press STANDBY/OPERATE touch key pad and set 6127A to OPERATE.

Page 5-18. Figure 5-12. Location of Adjustments, 61271A

Delete: Figure 5-12
Add: Figure 5-12a. (see attached)

Add: Figure 5-12b. (see attached)

Page 5-18. Para 5-49f delete and add:

f. Refer to Figure 5-12a for location of adjustments in the 61271A Head. See Figure 5-12b for pulse shape.

g. Set sampling scope to 2 ns/DIV and position the pulse rise one DIV from the left of the CRT graticule when making pulse shape adjustments. Obtain a stable internally triggered display of 5 divisions amplitude on the sampling scope. Be certain the sampling scope pulse response provides a flat pulse top and good corner. Check the sampling scope with a known pulse generator such as the Ballantine Model 61252A Tunnel Diode Pulse Generator if the pulse response of the sampling scope is in doubt. The sampling scope may not have an ideal response so it will be necessary to record its response and deconvolute the displayed 61271A Fast Rise Pulse against the pulse response of the sampling scope.

h. Except for A14-C5 the corner overshoot adjustment, all the 61271A adjustments have some interaction and interdependence. If the 61271A is operative and had no parts replaced, it is best to make only minor touch up adjustments to restore the pulse shape to original factory calibration.

i. For full recalibration set 6127A for DEV off. Set A14-C9 to the center of its range with plates half meshed. Set A14-R4 to midrange. Then adjust A14-R18 for best flatness of the top of the pulse. While re-adjusting A14-C9 and A14-R4, which interact, continue trimming all three adjustments until the pulse top has maximum flatness and a square corner.

j. Set 6127A to DEV and ∇ to -9.9%. Note the pulse corner and the first 10 ns of the pulse top. If the corner is:

(1) Overpeaked -
Adjust DEV TRACK Adj. A14-R31 so as to double the overpeaking, then adjust

A14-R8 to flatten the pulse and produce the best corner. Reset to DEV off. Check for flat pulse top and adjust A14-R18 for maximum flatness. Repeat these adjustments at DEV -9.9%, 0.0% and +9.9% until maximum pulse flatness is observed at all DEV levels. Some slight trimming of A14-R4 and A14-C9 may also be helpful.

(2) Rounded corner (underpeaked) -

Adjust DEV Track Adj. A14-R31 so as to double the corner rounding. Then adjust A14-R18 to flatten the pulse and produce the best corner. Reset to DEV off. Check for flat pulse top and adjust A14-R18 for maximum flatness. Repeat these adjustments at DEV -9.9%, 0.0% and +9.9% until maximum pulse flatness is observed at all DEV levels. Some slight trimming of A14-R4 and A14-C9 may also be helfpul.

k. Set sampling scope time base to 500 ps/div. Set 6127A for DEV off. Adjust A14-C5 for best overshoot at the extreme corner. A setting of 1% to 2% is recommended, since replacing the cover on the 61271A Head will slightly lower the overshoot.

l. Replace the top cover and again check pulse aberrations to be within ± 3%, rise time to be no slower than 200 ps, and best flatness of the pulse top.

Page 6-2. Table 6-1. Replaceable Assemblies

Change: A18 to A18 (Prefix 029- and below)

Add: A18 (Prefix 030- and above)

89-11244-1A, Time/Div Deviation Control

NOTE

For instruments with Prefix 029- and below contact factory when replacing assemblies, 61271A Heads, 61272A Heads and other components. 61271A and 61272A Heads are not interchangeable between 6127A units with Serial Prefix of 029- and below and those marked 030- and above.

Page 6-12. A7 Parts List, 89-10524-1A

DELETE:	U4	24-10183-0A	ICP	L111 OPT. INSULATOR	1295	T.I. TIL111
ADD:	U4	24-10183-1A	ICP	L111 SELECTED	50423	BLI

Page 6-14. A11 Parts List, 89-11051-1A

DELETE:	C6	07-10488-0A	CMD	10.0PF 300.0 VJ	84171	ARCO TYPE DM-15-BC10JN1
ADD:	C6	07-10437-0A	CMD	18.0PF 500.0 VD	84171	ARCO CM05CD180D03 OR EQUIV.

Page 6-20. A18 Parts List 89-10526-1A is for reference only to Prefix 029- and below.

The following parts are added or deleted to convert Assembly A18, 89-10526-1A, to 89-11244-1A.

Delete: K2 and R12

Add:	K2	14-10034-0A	RLY	2A2B 5 V COIL	50423	BLI
	R12	12-12290-0A	RFF	866.0k 250.0 MW F+-1%	16299	CGW RN55D 8660 F
	R19	12-12328-0A	RFF	1.96 k 250.0 MW F+-1%	16299	CGW RN55D 1961 F
	R21	12-12428-0A	RFF	19.6 k 250.0 MW F+-1%	16299	CGW RN55D 1962 F
	R22	12-12267-0A	RFF	499.0k 250.0 MW F+-1%	16299	CGW RN55D 4990 F
	R23	12-12328-0A	RFF	1.96 k 250.0 MW F+-1%	16299	CGW RN55D 1961 F
	C10	07-10483-0A	CCD	47.0NF 250.0 V +-20%	56289	APRAGUE 563CY5SBA-250AG473M

Page 6-21. Figure 6-10. TIME/VOLTS Deviation Control (A18)

Delete: Figure 6-10.

Add: Figure 6-10. (See new schematic attached)

Page 6-22. A22 Parts List, 89-11084-1A (For Serial Prefix 031- and Above)

ADD:	C11	07-10547-0A	CMD 100.0PF 500.0 VJ +-5%	84171	ARCO CM04FD101J03 O/E
	C12	07-10547-0A	CMD 100.0PF 500.0 VJ +-5%	84171	ARCO CM04FD101J03 O/E
	C13	07-10547-0A	CMD 100.0PF 500.0 VJ +-5%	84171	ARCO CM04FD101J03 O/E

Page 6-25. Figure 6-11. Display Driver/IEEE Interface (A22) & Display Board (A23)

ADD: C11 to U1 Pin 11
C12 to U2 Pin 11
C13 to U3 Pin 11

Page 6-28, 6-29, 6-30. A27 Parts List 89-11070-1A.

Delete: C8, Q21, R60, CR31, CR33

Add:	C8	07-10083-0A	CET 1.5UF 35.0 V	56289	SPRAGUE 1960155X-0035A3
	C60	07-10083-0A	CET 1.5UF 35.0 V	56289	SPRAGUE 1960155X-0035A3

Page 6-31. Figure 6-13. Time PCB Interconnect Board Schematic A27-1.

Change: C8 to 1.5 uF

Add: C60 from pin 1 to pin 3 of U4.
1.5uF with + at pin 1.

Add: -5 V at pin 3 of U4.

Delete: Q21, R60, CR31 and connect K11 pin 7, 8 to J100 pin 4.

Delete: +5 V at J100 pin 1.

Add: +12 V at J100 pin 1.

Change: Arrow at K5 pin 8 to K5 pin 6.

Page 6-38. A41 Parts List, 89-11071-1A

Delete R15, R8, R7, R4, C9, CR9, R5, L1, Q2, R1, R6, R19, R18, R17, & R13.

Add:	R8	12-12300-0A	RFF 1.0k 250 MW F+-1%	16299	CGW RN55D 1001 F
	R7	12-12208-0A	RFF 121.0 250.0 MW F+-1%	16299	CGW RN55D 1210 F
	R4	09-10001-0A	RVC 500.0 0.5W K	73138	HEL TYP 72PM
	C9	07-10455-0A	CVC 2-22.0PF 300.0 V	80031	MEPCO C010EA/20E
	CR9	05-10021-0A	DGP 5082-2835 LOW OFF-SET	28480	HP SCHOTTKY .3X FWD 5VRVS
	R5	12-13302-0A	RFC 130 125.0 MW J+-5%	1121	A-B TYPE BB
	L1	03-10074-0A	CRF .27UH INDUCTOR	50423	BLI
	Q2	10-10157-0A	TRQ 8YF90 NPN 1 15V S TO 72	50423	BLI
	R1	12-12200-0A	RFF 100.0 250.0 MW F+-1%	16299	CGW RN55D 1000 F
	R6	12-12148-0A	RFF 31.6 250.0 MW F+-1%	16299	CGW RN55D 31R6 F
	R19	12-12240-0A	RFF 261.0 250 MW F+-1%	16299	CGW RN55D 2610 F

Page 6-38. A41 Parts List, 89-11071-1A (Cont'd)

ADD:	R17	12-12317-0A	RFF	1.50k 250 MW F+-1%	16299	CGW RN55D 1501 F
	R18	09-10063-1A	RVC	1.0k 0.5 W M	11236	CTS 450 1k/1k FR-080 SWC
	R13	12-12372-0A	RFF	5.62k 250.0 MW F+-1%	16299	CGW RN55D 5621 F
	L2 thru L14	46-10004-0A	FRB	FERRITE BD CERAMAG 70	78488	STACKPOLE 570082
	R30	12-12272-0A	RFF	562. 250.0 MW F+-1%	16299	CGW RN55D 5620 F
	R31	09-10157-0A	RVF	100.0 500.0 MW K 18TURN	73138	HELIPOT 68X R100
	R32	12-13318-1A	RFC	56 125 MW J+-5%	1121	AB TYPE BB
	R33	12-12400-0A	RFF	10.0k 250.0 MW F+-1%	16299	CGW RN55D 1002 F
	Q10	10-10009-0A	TRQ	MPS6519 PNP 1 25 PTO-92	4713	MOT 1 340M 250
	CR10	05-09477-0A	DZG	IN5231A 5.1 .5W 20M 10%	4713	MOT SI D07
	C10 thru C14	07-10562-0A	CCR	0.1 UF 50 V .3	50423	BLI

Page 6-29. Figure 6-16.

Delete: Figure 6-16.

Add: Figure 6-16. FAST RISE PULSE HEAD (A41) (see attached)

Page 6-40. A43 Parts List, 89-11075-1A.

Add: CR4 05-10165-0A DZG IN4736A 6.8 V 5% 1 W 50423 BLI

Page 6-41. Figure 6-17. AMPLITUDE COMPARATOR ASSEMBLY A43

Add: CR4, IN4736A, 6.8V between E2 and input pin 1 with cathode at pin 1.

Change: +5 V at input pin 1 to + 12 V.

Page 6-42. A117 Parts List, 89-11174-1A

Delete: C4

Add: C4 07-10223-0A CYF 100. NF 250. VK 73445 AMPEREX C280AE/A100K

Page 6-44. A127 Parts List, 89-11068-1A

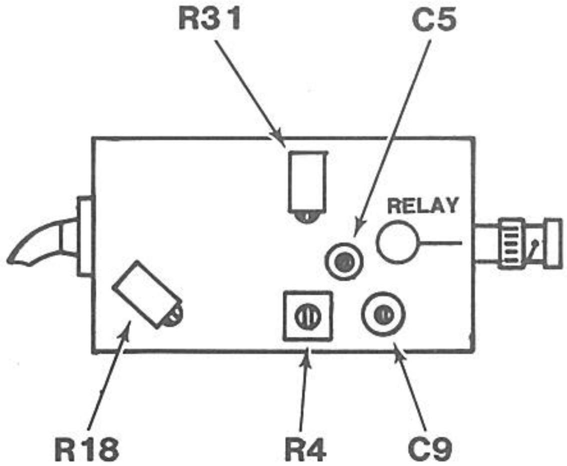
Delete: R53

Add:	R53	12-09823-0A	RFC	2.2M 250.0MW J+-5%	1121	A-B TYP CB
	CR6	05-10161-0A	DGL	5082-4160 SUBMIS LED RED	28480	HP 5082-4160
	CR7	05-10161-0A	DGL	5082-4160 SUBMIS LED RED	28480	HP 5082-4160

Page 6-47. Figure 6-19. Low Distortion Pulse Generator (A127)

Change: R53 10 M to 2 M.

Add: CR6 and CR7 in series across R64 with cathode of CRT to -12V and anode of CR6 to pin 3 of U3.



NOTE

The parts layout of your 61271A and use the location diagram conforming to your unit.

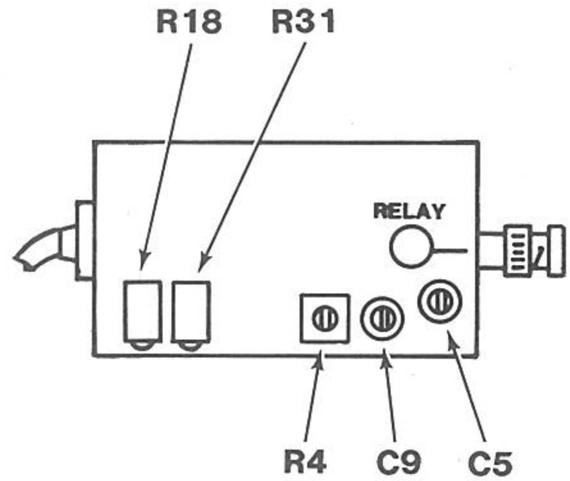


Figure 5-12a. Location of Adjustments, 61271A

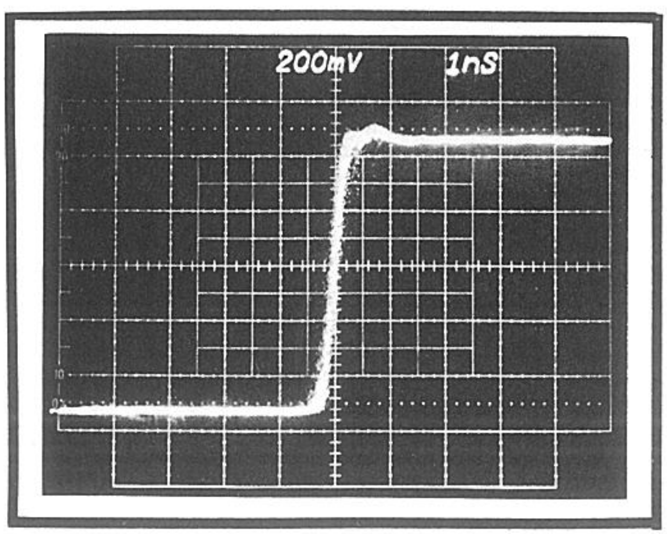
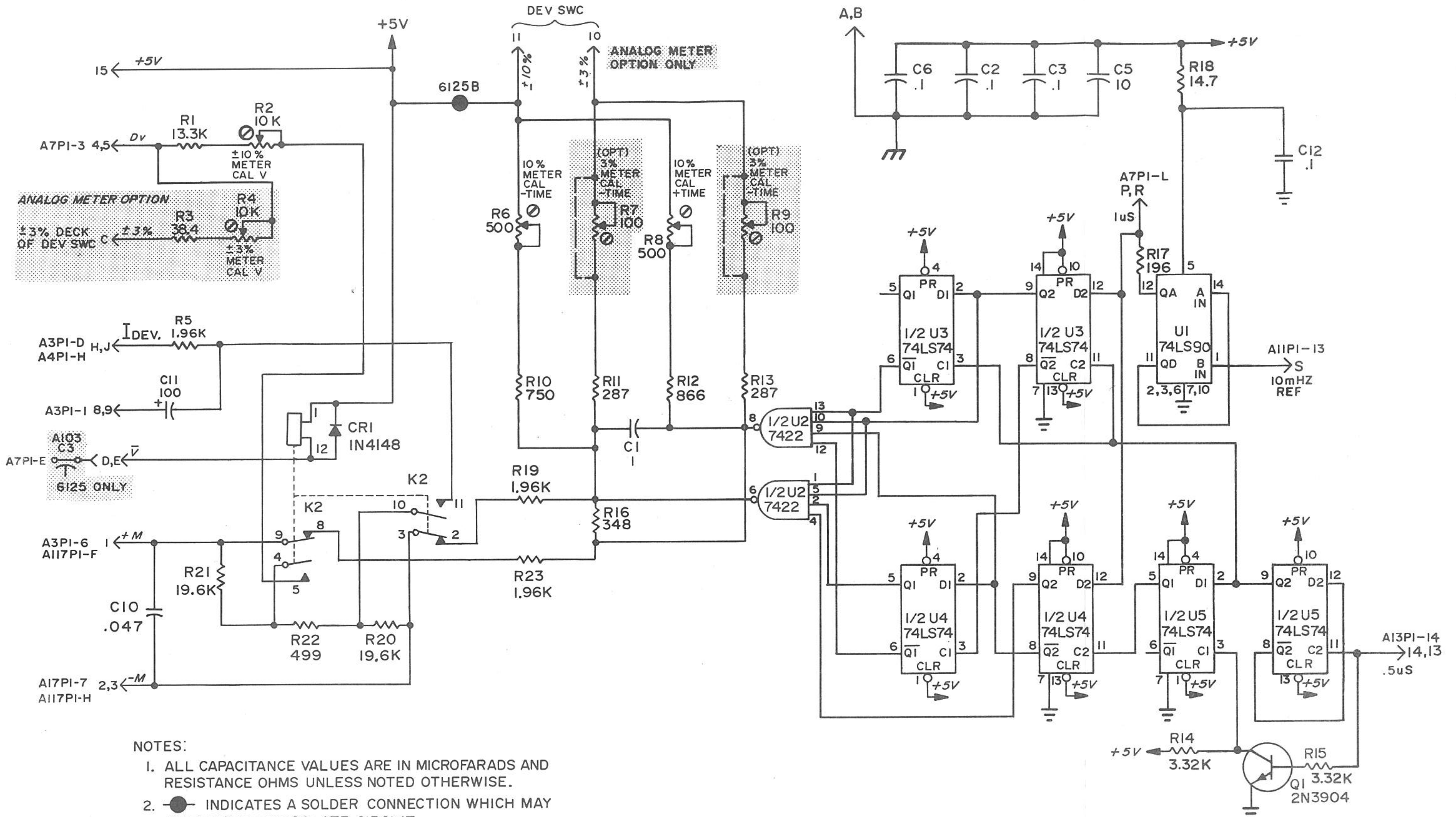


Figure 5-12b. Fast Rise Pulse Display, 200 ps Rise Time



NOTES:

1. ALL CAPACITANCE VALUES ARE IN MICROFARADS AND RESISTANCE OHMS UNLESS NOTED OTHERWISE.
2. —●— INDICATES A SOLDER CONNECTION WHICH MAY BE REMOVED TO ISOLATE CIRCUIT.
3. ALL RELAYS SHOWN IN POSITION WHEN COIL IS NOT ENERGIZED.
4. → DENOTES CONTACT OF A18P1.

Figure 6-10. TIME/VOLTS Deviation Control (A18)

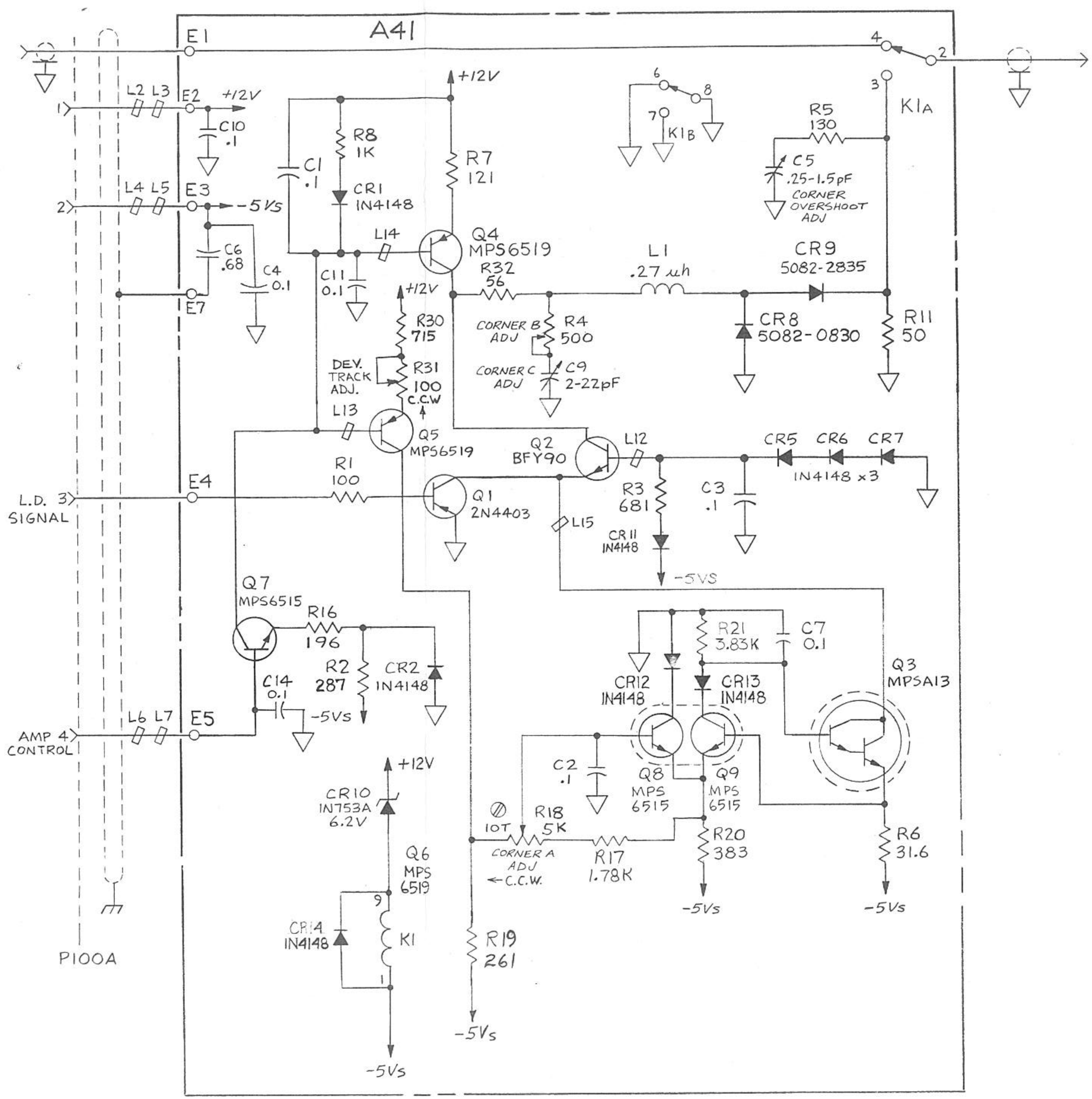


Figure 6-16. Fast Rise Pulse Head (A41)

Ballantine Laboratories, Inc.

ADDENDUM

TO INSTRUCTION MANUAL:

MODEL No. 6127A

INSTRUCTION MANUAL
VOLUME 2 (90-10275-5A #2)

APPLIES TO ALL UNITS

Page 5-6. Paragraph 5-10.c.

Change 100 mV to read: ± 1 Volt Full Scale

Page 5-6. Paragraph 5-10.e.

Change ± 500 uV to read: ± 500 mV

Page 5-22. PERFORMANCE ASSURANCE CHECKS TEST RECORD (7. VOLT/DIV OUTPUT (50 Ω) CHECK)

Change 200 mV (ERROR LIMITS) column to read ± 7.0 mV

Ballantine Laboratories, Inc.

ADDENDUM

TO INSTRUCTION MANUAL: **MODEL No.** 6127A

INSTRUCTION MANUAL (Volume 2)
Applies to all units.
(90-10275-5A #3)

Page 5-31/5-32. Figure 5-15.

ADD: Figure 5-15. Model 6127A FAST RISE TROUBLESHOOTING FLOWCHART (See Attached)

Page 6-23. ADD THE FOLLOWING:

NOTE

If the Assembly 89-11084-1A, A22 DISPLAY DRIVER AND IEEE INTERFACE is built using printed circuit board 55-10237-1Q, then the following three jumpers must be added to the solder side of the board:

Jumper U11 from pin 4 to pin 12
Jumper U11 from pin 8 to pin 12
Jumper U14 from pin 8 to pin 12

This change implemented on all units with S/N prefix 032- and above. It must be implemented when more than three 6127A are connected in parallel across the IEEE-488 Bus.

Page 6-34. ADD THE FOLLOWING:

PARTS LIST, A25 FRONT PANEL KEYBOARD (89-11210-1A)

DS..2	05-10161-0A	DGL 5082-4160 SUBMIN LED RED	28480	HP 5082-4160
DS..3	05-10161-0A	DGL 5082-4160 SUBMIN LED RED	28480	HP 5082-4160
DS..4	05-10161-0A	DGL 5082-4160 SUBMIN LED RED	28480	HP 5082-4160
DS..5	05-10161-0A	DGL 5082-4160 SUBMIN LED RED	28480	HP 5082-4160
DS..6	05-10161-0A	DGL 5082-4160 SUBMIN LED RED	28480	HP 5082-4160
DS..7	05-10161-0A	DGL 5082-4160 SUBMIN LED RED	28480	HP 5082-4160
DS..8	05-10161-0A	DGL 5082-4160 SUBMIN LED RED	28480	HP 5082-4160
DS..9	05-10161-0A	DGL 5082-4160 SUBMIN LED RED	28480	HP 5082-4160
DS.10	05-10161-0A	DGL 5082-4160 SUBMIN LED RED	28480	HP 5082-4160
DS.11	05-10161-0A	DGL 5082-4160 SUBMIN LED RED	28480	HP 5082-4160
DS.12	05-10161-0A	DGL 5082-4160 SUBMIN LED RED	28480	HP 5082-4160
DS.13	05-10161-0A	DGL 5082-4160 SUBMIN LED RED	28480	HP 5082-4160
DS..1	05-10162-0A	DGL 5082-4190 SUBMIN LED GRN	28480	HP 5082-4190
KB...	38-10242-1Q	PAN 6127A FRONT PANEL PWB	50423	BLI
	61-10036-0A	WAS NO. 2 SHOULDER NYLON	83330	H.H.SMITH #2657
	66-10032-0A	FER 6127A CURRENT LOOP FERRULE	00000	UNICORP 13-101-BLK-OX
	66-10036-1B	HAN 6127A CURRENT LOOP FIN.	50423	BLI (For .1" jaw probe)

Page 6-48. ADD THE FOLLOWING:

MECHANICAL PARTS

40-10056-1M	KNB PUSHBUTTON 3028A-WHITE	50423	BLI
44-10037-1A	FEE BAIL 12" LENGTH 2 FRONT FEET	50423	BLI
57-10095-1B	SHF 6127A SHAFT EXT ON/OFF	50423	BLI

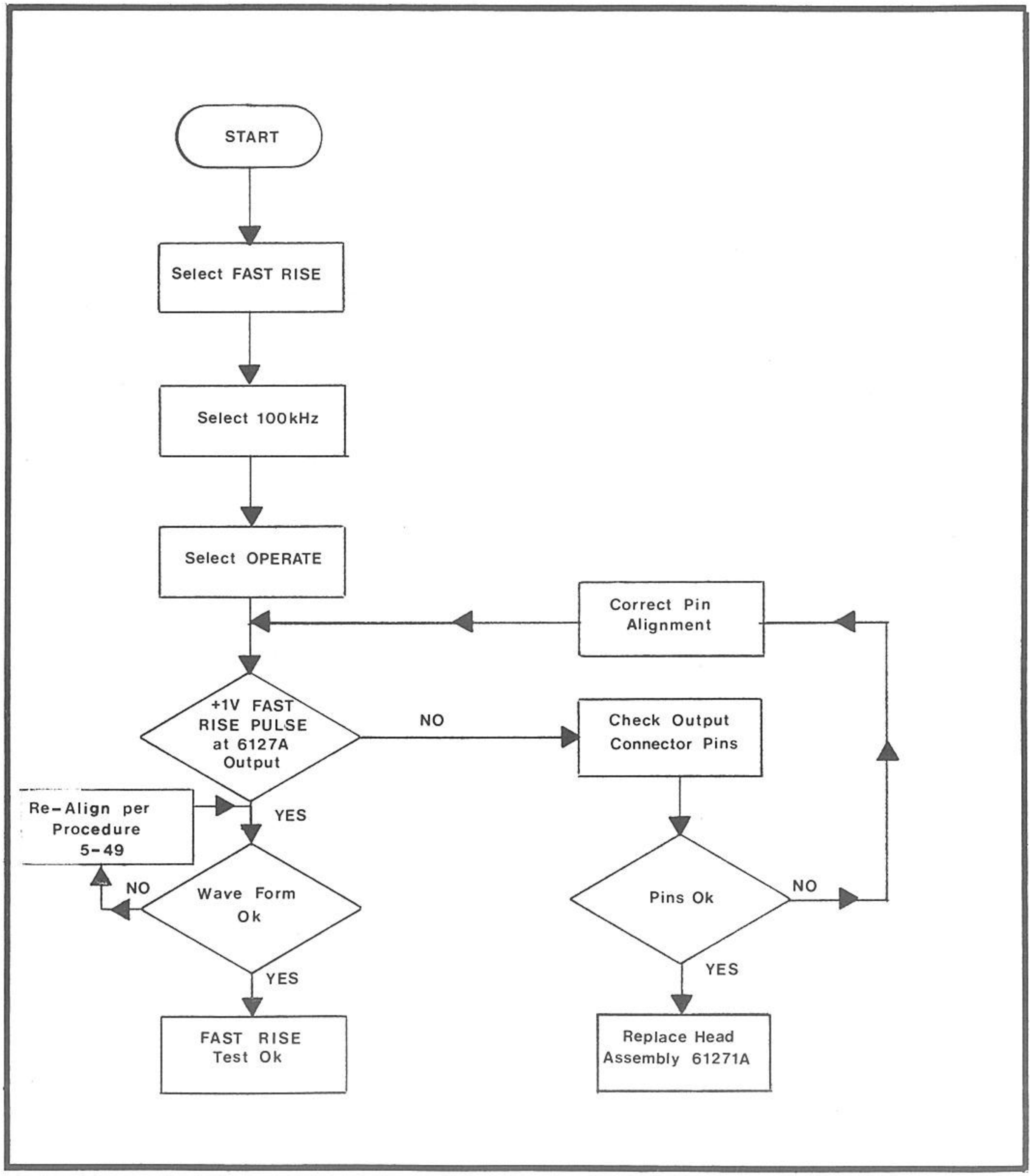


Figure 5-15. (Sheet 1)
Model 6127A FAST RISE
TROUBLESHOOTING FLOW-
CHART

Ballantine Laboratories, Inc.

ADDENDUM

TO INSTRUCTION MANUAL:

MODEL No. 6127A

INSTRUCTION MANUAL (VOLUME 2)
APPLIES TO ALL UNITS.
(90-10275-5A #4)

Page 6-22. PARTS LIST, A22 DISPLAY DRIVER & IEEE INTERFACE (89-11084-1A)

DELETE:	U..15	24-10264-0A	ICP MC68488P GPI ADAPTER	4713	MOT MC68488P
ADD:	U..15	24-10264-1A	ICP IEEE-488 BUS ADAPTER	50423	BLI

ref: AUGUST 1983 (90-10275-5A #4)

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