FLUKE®

Instruction Manual

NOTE

This manual documents the Mdoel 1953A and its assemblies at the revision levels shown in Appendix 7A. If your instrument contains assemblies with different revision letters, it will be necessary for you to either update of backdate this manual. Refer to the supplemental change/errata sheet for newer assemblies, or the backdating sheet in Appendix 7A for older assemblies.

Model

1953A

Counter-Timer

P/N 396622

JANUARY 1975

REV. 1 12/75
REV. 2 2/77
REV. 3 6/77
REV. 4 1/79

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Rev. 9/78

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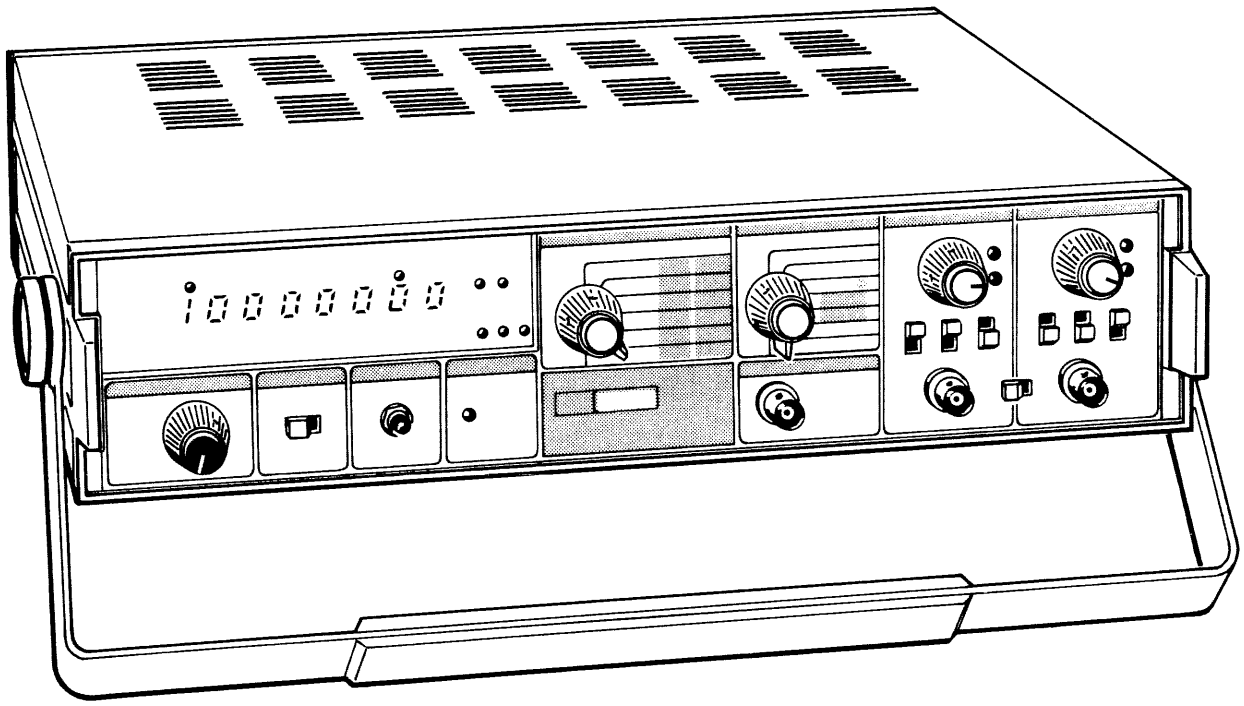

Model 1953A Counter–Timer

Section 1
Introduction & Specifications

1-1. INTRODUCTION

1-2. The Fluke Model 1953A is a universal, 0-to-125 MHz digital counter/timer capable of precisely measuring frequency, frequency ratio, period, time interval and total events. Each measurement function is switch selectable and uses any of six sampling ranges, also switch selectable. Measurement results are displayed by a nine-digit readout, with overflow indication and leading-zero suppression. Frequency is displayed in units of either kHz or MHz; time in units of us, ms, or s. The unit also features a self-check function and selection of automatic or manual measurement cycle triggering. Signal input is via BNC connectors.

1-3. The Model 1953A has three input channels designated A, B, and C. Channels A and B are the main input channels. Each is provided with a trigger-level control and signal conditioning switches. Channel C is provided for use with one of three option, plug-in prescalers. The prescalers extend the measuring capability of the unit to 520 MHz, 1 GHz, and 1.25 GHz, respectively.

1-4. The trigger-level controls for channels A and B allow the operator to select a preset trigger level (0V dc), or to vary the level at which the input signal will trigger the counter. Two light-emitting diode (LED) indicators operate in conjunction with each level control to indicate whether the input signal is more positive or more negative than the selected trigger level. Three conditioning switches allow the operator to select positive or negative slope triggering, ac or dc coupling, and X1 or X10 attenuation of the input signal.

1-5. Each measurement cycle is triggered by a reset signal. The reset signal can be automatically and continuously generated (at an adjustable rate), manually generated (at an adjustable rate), manually generated (by pushbutton switch) once for each measurement cycle desired, or externally generated (optional). The external reset signal is introduced to the 1953A by way of a pin on an optional rear panel connector and may be either manually or automatically generated.

1-6. The front panel display on the 1953A consists of a nine-digit readout, plus one overflow and five measurement unit annunciators (indicators). The readout has leading-zero suppression for all but the right-most digit (the least significant digit). The decimal point and the unit annunciators are controlled by the selected function and the selected range.

1-7. The self-check function provides a convenient method of verifying the operation of the 1953A and is very useful during troubleshooting. During this function the counter automatically selects the 10 MHz output of the internal frequency standard to be the input signal for the digital counter circuits. A valid readout for each of the six selected ranges verifies proper digital operation. This function does not, however, verify the accuracy of the unit. Since the internal frequency standard is being used as the time base, as well as the input signal, detection of inaccuracy in the internal frequency standard is not possible. In addition, when the self-check function is selected and the manual reset switch is depressed, every display LED segment that is operating properly will illuminate.

1-8. Several options are available with the 1953A. Each is listed by option number and name in Table 1-1. A detailed description of each option is included in Section 6, Option and Accessory Information.

1-9. The Model 1953A is designed as a bench-top instrument. However, an accessory rack mounting kit (part number of kit without slides is M00-200-622, that for kit with slides is M00-200-626) is available that will permit the unit to be mounted in a standard 19-inch equipment rack. Input power requirements are 100,120,

220 or 240V ac ±10 percent, 50 to 400 Hz, 30W. The input voltage is selectable by positioning a pcb in the power receptacle to display the desired voltage in the viewing port.

1-10. SPECIFICATIONS

1-11. The specifications for the Model 1953A are listed in Table 1-2. Physical dimensions of the unit are shown in Figure 1-1. Option specifications are given in Table 1-3.

Table 1-1. Available Options

OPTION	NAME	INSTALLATION	
		FACTORY	FIELD (SERVICE CENTER)
–02	Data Output Unit (DOU)	Yes	Yes
–04	Temperature Compensated Crystal Oscillator (TCXO)	Yes	No
–05	External Time Base Multiplier	Yes	No
–07	520 MHz Prescaler	Yes	No
–10	Oven-Stabilized Time Base	Yes	No
–11	Basic Remote Control Unit (RCU)	Yes	No
–12	Full Remote Control Unit (RCU)	Yes	No
–13	1000 MHz Prescaler	Yes	No
–14	1250 MHz Prescaler	Yes	No
–15	IEEE-488 Standard Interface	Yes	No
–16	Rear Panel Inputs	Yes	No
–20	Superior Oven-Stabilized Time Base	Yes	No

Table 1-2. 1953A Specifications

FREQUENCY MEASUREMENTS

Range	0 to 125 MHz (dc coupled) 5 Hz to 125 MHz (ac coupled). Optional prescalers to 1250 MHz (see Options –07, –13, –14).
Gate Time	0.1 ms to 10s in 6 decade steps (prescaled input increases gate time by a factor of 4 or 8).
Resolution	0.1 Hz at 10s gate time to 10 kHz at 0.1 ms gate time.
Accuracy	Time Base accuracy ±1 count.
Readout	kHz or MHz automatically displayed with decimal point.

RATIO MEASUREMENTS

Displays	f_1/f_2, where f_1 and f_2 are applied at the two input channels, A and B, respectively.
Range	f_1: 0 to 120 MHz (dc coupled). 5 Hz to 120 MHz (ac coupled). f_2: 0 to 25 MHz (dc coupled). 5 Hz to 25 MHz (ac coupled).
Accuracy	±1 count of signal on input A + trigger error of signal on input B*.
Readout	Decimal point without unit annunciation.

Table 1-2. 1953A Specifications (cont)

PERIOD MEASUREMENTS	
Range	0 to 25 MHz (dc coupled). 5 Hz to 25 MHz (ac coupled).
Periods Averaged	1 period to 10^5 periods.
Frequency Counted	10 MHz.
Resolution	1 ps at 10^5 periods to 0.1 μs at 1 period.
Accuracy	Time Base accuracy ±1 count + trigger error of signal on input A*.
Readout	ms or μs automatically displayed with decimal point.
TIME INTERVAL MEASUREMENT	
Range	0.1 μs to 10^7s.
Input	Channels A and B; common or separate.
Resolution	0.1 μs to 10 ms in 6 decade steps.
Accuracy	±1 count + time base accuracy + trigger error**.
Readout	ms or s automatically displayed with decimal point.
TOTALIZE MEASUREMENT	
Totalizing	A gated by B.
Range	0-125 MHz (dc coupled). 5 Hz-125 MHz (ac coupled).
SENSITIVITY	
Channel A	
Sinewave	30 mV rms from dc to 75 MHz increasing to 50 mV at 125 MHz.
Pulse	100 mV pulse amplitude with minimum pulse width of 10 ns.
Channel B	
Sinewave	30 mV rms from dc to 25 MHz.
Pulse	100 mV, with minimum pulse width of 50 ns.
Channel C	
(Prescaled)	15 mV from 50 MHz to 520 MHz (AGC) (Option –07). 15 mV from 50 MHz to 1000 MHz (Options –13 or –14), increasing to 30 mV at 1250 MHz (Option –14 only).
INPUT IMPEDANCE	
Channel A or B	1 mΩ in parallel with 30 pf maximum.
Channel C (Prescaled)	50Ω nominal, VSWR 2:1 max when not limiting.
Dynamic Range without Limiting	–3.5 to +3.5V (Channel A and B) 1V rms (Channel C).
Impedance in Limiting Conidition	120 kΩ in parallel with 75 pf (Channel A and B). VSWR less than 3:1 (Channel C).
ATTENUATOR	
Channel A and B only	Sensitivity is decreased by a factor of approximately 10 in the X10 position.

Table 1-2. 1953A Specifications (cont)

SLOPE

Channel A and B only . . . . . Front panel slide switch selects positive or negative slope triggering.

TRIGGER LEVEL

Channel A and B only . . . . . Front panel control has ±1V range when attenuator is in X1 position, and ±10V in the X10 position. Preset position is fully counterclockwise.

TIME BASE

	STANDARD	–04 OPTION	–10 OPTION	–20 OPTION
Frequency	10.00 MHz	10.00 MHz	10.00 MHz	10.00 MHz
Aging Rate (constant temp)	$<\pm 3 \times 10^{-7}$/mo	$<\pm 3 \times 10^{-7}$/mo	$<\pm 1 \times 10^{-7}$/mo	$<\pm 1.5 \times 10^{-8}$/mo
Temperature Stability				
0°C-50°C	$<\pm 2 \times 10^{-8}$	$<\pm 5 \times 10^{-7}$	$<\pm 1 \times 10^{-8}$	$<\pm 2 \times 10^{-10}$/°C
20°C-30°C	$\pm 5 \times 10^{-7}$ typ	$\pm 2 \times 10^{-7}$ typ	$\pm 3 \times 10^{-9}$ typ	$\pm 5 \times 10^{-10}$/day
Line Voltage (±10% Change)	$<\pm 1 \times 10^{-7}$	$<\pm 5 \times 10^{-8}$	$<\pm 3 \times 10^{-9}$	$<\pm 1 \times 10^{-9}$
Warm-up Time (to 1 X 10^{-8})	–	–	20 min.	20 min.

** Trigger error of channel A or B is less than ±0.3% (fA/fB) for signals with better than 40 dB signal to noise ratio and 100 mV rms amplitude.*

*** Trigger error in time interval mode is less than ±0.0025/signal slope (V/μs) in μs with trigger levels set to 0V dc.*

EXTERNAL TIME BASE INPUT

Frequency Required . . . . 10 MHz. **Impedance** . . . . . 1 MΩ, 20 pF.

Sensitivity . . . . . 250 mV rms. **Dynamic Range without Limiting** . . . 5V peak-to-peak.

Input Impedance during Limiting . . . 470Ω in parallel with 30 pF.

DISPLAY . . . . . 9-digit LED display incorporating large 7-segment character. Full leading zero suppression.

CYCLE RATE. . . . . When in the "CONT" mode, the time interval between successive measurements can be varied by means of a cycle rate control between approximately 0.2 and 2.0 s. "Reset" button clears display and activates a new measurement

RESET . . . . . In TRIG (trigger) mode, the readings may be updated by pushing the RESET button or by shorting the external reset pin on the remote control connector to ground. With external reset the display is not cleared.

SELF-CHECK . . . . . A time base-derived 10 MHz signal is internally connected to the counter input.

GATE TIME . . . . . High true-TTL level output.

TIME INTERVAL MARKER . . . . Low true-TTL level output.

OPERATING TEMPERATURE . . . . 0°C to +50°C.

STORAGE TEMPERATURE . . . . –40°C to +75°C.

POWER REQUIREMENTS . . . . . 50-400 Hz; 120/240V ±10% (100V operation available), 30W nominal.

DIMENSIONS (See Figure 1-1)

Width . . . . . 36.2 cm (14.25 in.) **Depth** . . . . . 34.29 cm (13.5 in.)

Height . . . . . 8.76 cm (3.45 in.) **Weight** . . . . . 4.32 kg (9.5 lbs.)

Table 1-3. Option Specifications

–02 DATA OUTPUT UNIT (PARALLEL)

Provides BCD TTL outputs for each digit, plus overflow, unit annunciation, decimal point and print command.

–04 TEMPERATURE COMPENSATED CRYSTAL OSCILLATOR (TCXO)

See time base specifications.

–05 EXTERNAL TIME BASE MULTIPLIER

Allows use of external 1, 5 or 10 MHz reference clock (standard unit accepts 10 MHz). This option also permits burst measurements to be made when a "level" signal is available.

–07 520 MHz PRESCALER

Covers frequency range of 50 to 520 MHz, using a scaling ratio of 4. Sensitivity is 15 mV rms (AGC). Maximum allowable input is 5V rms (fuse protected). VSWR less than 2:1 into 50Ω for levels less than 1V rms.

–10 OVEN-STABILIZED TIME BASE

Oven is activated whenever instrument is connected to the AC line (see time base specifications).

–11 BASIC REMOTE CONTROL UNIT

Allows single-line programming (TTL or contact closure) of range, mode, slope and reset functions. Allows analog programming of trigger levels, and provides power sense, overflow status, and system ready outputs. Front panel lockout is provided.

–12 FULL REMOTE CONTROL UNIT

Includes all the features of Option –11, plus programming of ac/dc coupling, attenuation, separate/common, and digital trigger level. Trigger level of channels A and B is programmable over a +1V to –1V range (2 BCD digits plus sign), giving a resolution of 1% and an accuracy of 5% plus 2 mV. Temperature stability is better than 200 $\mu V/^{\circ}C$. Two analog input/output lines are provided for either checking the D/A performance, or programming via analog levels. Option –12 increases input capacitance to 37 pF maximum.

–13 1000 MHz PRESCALER

Covers 50 to 1000 MHz using a scaling ratio of 8. Sensitivity is 15 mV rms, and maximum allowable input is 5V rms (fuse protected). VSWR less than 2.5:1 (50Ω) for levels less than 1V rms.

–14 1250 MHz PRESCALER

Covers 50 to 1250 MHz using a scaling ratio of 8. Sensitivity is 15 mV to 1000 MHz, increasing to 30 mV rms at 1250 MHz. Maximum input 5V rms (fuse protected), and VSWR less than 2.5:1 for levels less than 1V rms.

–15 IEEE STD-488 INTERFACE (SERIAL)

Full remote programming of function, range, and all signal conditioning controls including trigger levels. Directly compatible with IEEE Interface Standard. Data output includes 9-digits of display information, decimal point and exponent for time or frequency units. Front panel lockout is provided. Write for application bulletin covering this option.

–16 REAR PANEL INPUTS

Two rear inputs in parallel with A and B front inputs (capacity 85 pF), plus one rear input for channel C.

–20 SUPERIOR OVEN-STABILIZED TIME BASE

Oven is activated whenever instrument is connected to the AC lineif the rear panel power switch is set to on. (See time base specifications).

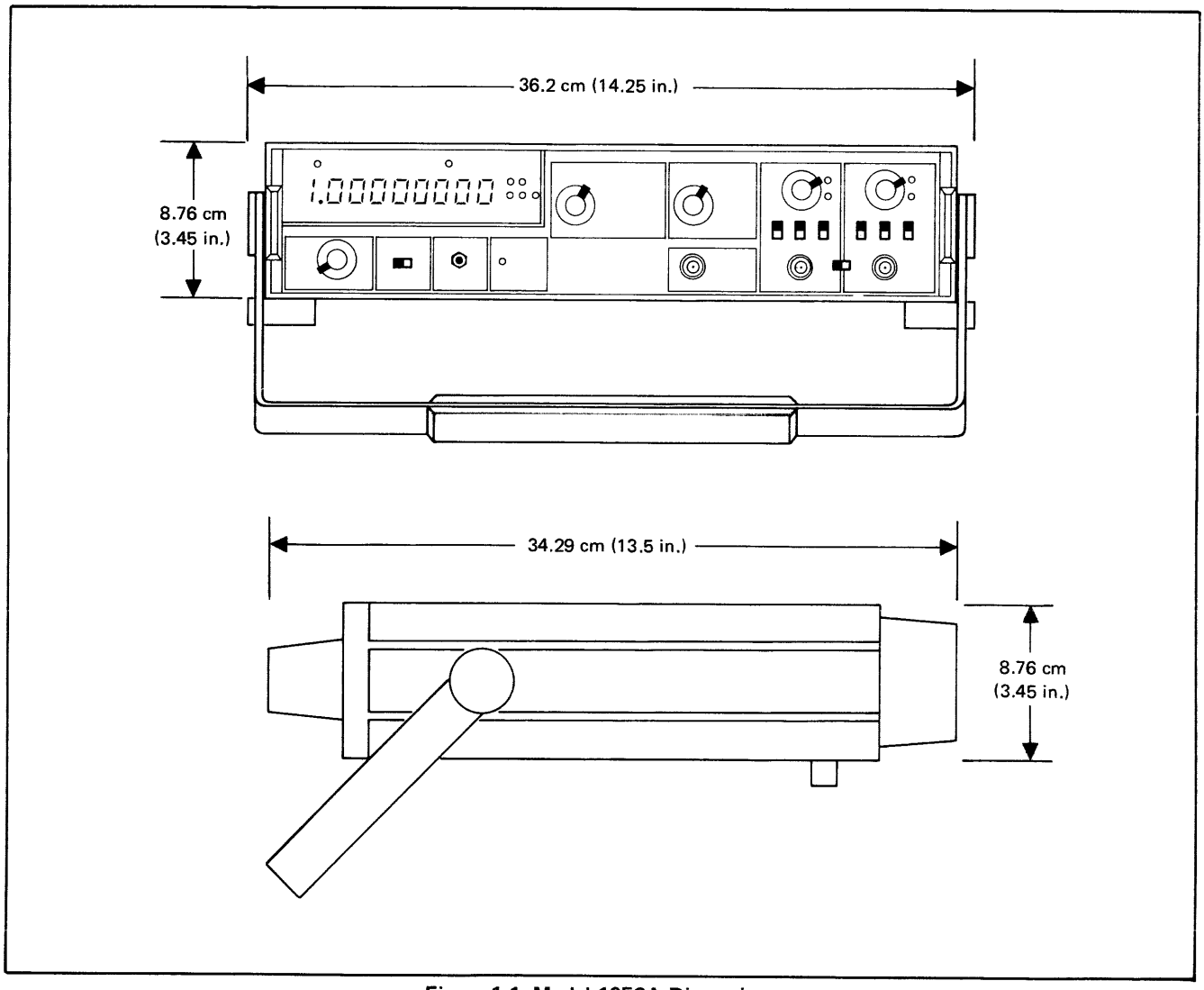

Figure 1-1. Model 1953A Dimensions

Section 2
Operating Instructions

2-1. INTRODUCTION

2-2. This section of the manual contains information regarding installation and operation of the Model 1953A Counter/Timer. It is recommended that the contents of this section be read and understood before any attempt is made to operate the counter. Should any difficulties arise during operation, please contact your nearest Fluke Sales Representative, or contact the John Fluke Mfg. Co., Inc. P.O. Box 43210, Mountlake Terrace, WA 98043; telephone (206) 774-2211. A list of Sales Representatives and their addresses is given in Section 7.

2-3. SHIPPING INFORMATION

2-4. The Model 1953A is packaged and shipped in a protective container. Upon receipt of the equipment, a thorough inspection should be made to reveal any possible shipping damage. Special instructions for inspection and claims are included on the shipping carton.

2-5. If reshipment of the equipment is necessary, the original container should be used. If the original container is not available, a new container can be obtained from the John Fluke Mfg. Co., Inc. Please specify the equipment model number when requesting a new shipping container.

2-6. INPUT POWER

2-7. The Model 1953A can be operated from a line voltage of either 100, 120, 220 or 240 volts. Before connecting the equipment to primary power visually inspect the present setting of the line switch. It can be read through the clear cover of the combination power receptacle/fuse holder on the rear panel. Use the following procedure to change to a different setting if required.

a. Disconnect the line power cord from the receptacle.

b. Slide the clear cover to the left to cover the power receptacle.

c. Grasp and pull to the left the handle labeled FUSE PULL until access to the fuse and pcb is clear.

d. Remove the fuse.

e. Remove the pcb and position it so the desired voltage figure is on top and to the left, i.e., toward the connector.

f. Replace the pcb and fuse. The desired voltage setting should be visible in the opening.

g. Replace the fuse with the applicable value for the line voltage selected (1A slo-blo for 115V ac, 0.5A slo-blo for 230V ac).

h. Return the holder to its normal position, slide the cover the right and connect the line power cord.

2-8. RACK INSTALLATION

2-9. The 1953A is designed for bench-top use or for installation in a standard 19-inch equipment rack using one of the option accessory rack mounting kits (part number M00-200-622 or M00-200-626). Installation instructions are supplied with the rack mounting kit and are also given in Section 6 of this manual.

2-10. OPERATING FEATURES

2-11. The 1953A front panel controls, indicators and connectors are shown in Figure 2-1 and described in Table 2-1. The same rear panel information is given in Figure 2-2 and Table 2-2, respectively.

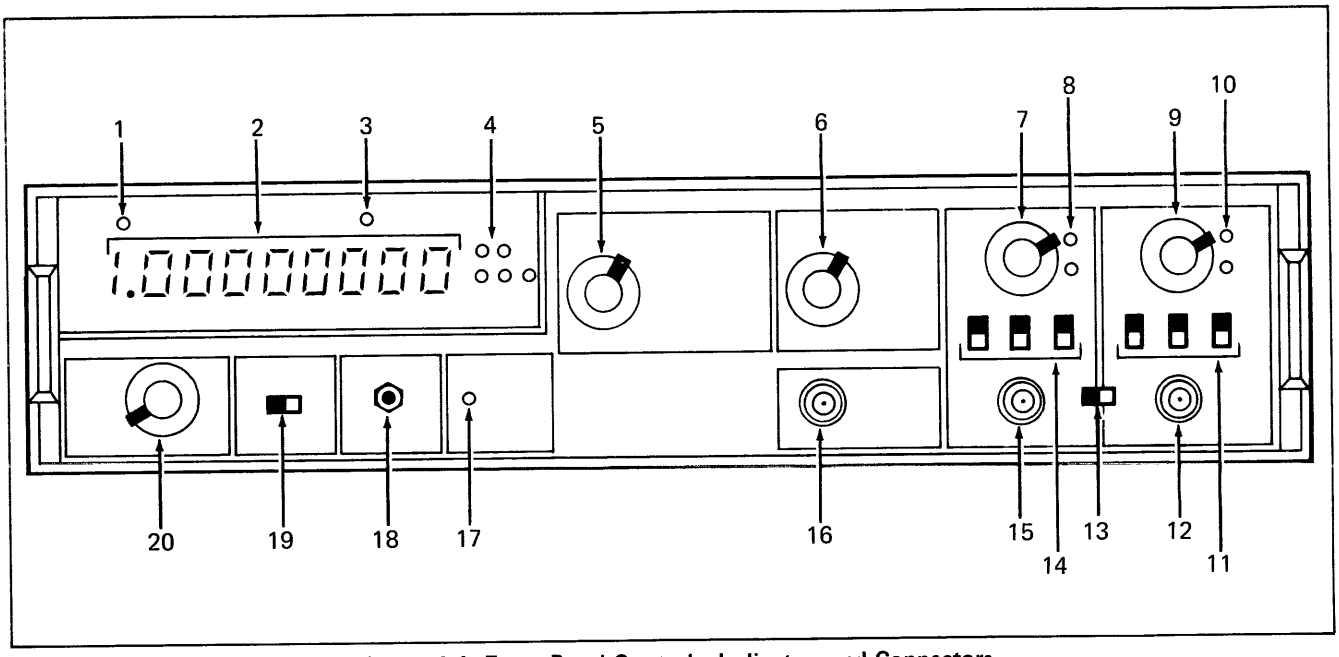

Figure 2-1. Front Panel Controls, Indicators and Connectors

Table 2-1. Front Panel Controls, Indicators and Connectors

ITEM NO.	NAME	FUNCTION
1	OVERFLOW Indicator	An LED that lights to indicate that the measurement has exceeded the display capacity.
2	Measurement Display	Nine-digit readout that digitally displays measurement results. The position of the decimal point, when present, is determined by positions of the RANGE and FUNCTION switches.
3	Remote Indicator	An LED that lights to indicate the instrument is under control of a remote device. Active with Option −11, −12 or −15 installed.
4	Measurement Unit Annunciator	Five LED's, one of which lights to define the displayed data. For frequency functions, kHz or MHz annunciator lights, for time functions, ms, μs or s annunciator lights; and for ratio, totalized and self-check functions none are lit. (Unit annunciators are controlled by the position of the RANGE and FUNCTION switches.)
5	RANGE Switch	Selects desired range for selected function. Switch positions are as follows: GATE . . . . Duration of measurement cycle (for frequency function). PER. AVGD . . Number of periods averaged (for period functions). T.I. RES. . . . Resolution or value of rightmost digit (for time interval function).
6	FUNCTION Switch	Selects operating function (type of measurment to be made) as follows: FREQ A . . . Enables frequency measurement of channel A input.

Table 2-1. Front Panel Controls, Indicators and Connectors (cont)

ITEM NO.	NAME	FUNCTION
		FREQ C . . . Enables frequency measurement of channel C input (channel C is operational only if Option −07, −13 or −14 is installed). FREQ (A/B) . . Enables ratio measurement of channel A frequency to channel B frequency. PERIOD A . . . Enables period measurement of channel A input. T.I. A-B . . . . Enables measurement of time interval between start signal at channel A and stop signal at channel B. Start and stop signals may be from separate sources or from the same source (see SEP/COM Switch). A GTD BY B . . Enable the measurement of total events occurring at channel A during time established by external Gate signal at channel B. (RANGE switch is inoperative during this totalize function). SELF-CHECK . . Enables check of counter and display circuits; all inputs are ignored and an internal 10 MHz clock frequency is counted and displayed.
7	CHANNEL A TRIGGER LEVEL Control	Controls the dc trigger level for input channel A. When set to PRESET (fully ccw), trigger level is 0V dc; when rotated cw, trigger level varies from approximately −1.2V dc (just off PRESET) to + 1.2V dc (fully cw).
8	CHANNEL A TRIG STAT + and − (Annunciators)	Two LED's that light alternately to indicate when the input signal level is more positive (+) or more negative (−) than the channel A Trigger Level setting.
9	CHANNEL B TRIGGER LEVEL Control	Same as item 7, but for channel B.
10	CHANNEL B TRIG STAT + and − (Annunciators)	Same as item 8, but for channel B.
11	CHANNEL B Input Signal Conditioners	Three slide switches that select trigger slope, coupling, and attenuation for channel B input signal. SLOPE Switch (+/−) . . Selects either positive or negative-going slope of input signal to be used to trigger counter. Coupling Switch (AC/DC) . Selects either ac (capacitive) or dc (direct) coupling for input signal. ATTEN Switch (X1/X10) . Selects either no attenuation (X1) or approximately 20 dB attenuation of input signal voltage for larger input signals. This allows TRIGGER LEVEL controls to adjust trigger level from approximately −12V to +12V dc.

Table 2-1. Front Panel Controls, Indicators and Connectors (cont)

ITEM NO.	NAME	FUNCTION
12	CHANNEL B Input Connector	A BNC Connector used to connect an input signal to channel B.
13	SEP/COM Switch	Sets up signal input connectors to receive either separate signals or a common signal, as desired. When set to COM channel A input is connected to channel A and channel B preamplifiers; when set to SEP, they are isolated.
14	CHANNEL A Input Signal Conditioners	Same as item 11, but for channel A.
15	CHANNEL A Input Connector	Same as item 12, but for channel A.
16	CHANNEL C Input Connector	Same as item 12, but for channel C (Channel C connector is supplied only with Option −07, −13 or −14).
17	GATE Indicator	An LED that lights to indicate that a measurement cycle is being executed.
18	RESET Push-Button	Resets readout to zero and initiates new measurement cycle.
19	MODE Switch (CONT/TRIG)	Selects either automatic or manual triggering of measurement cycles. When switch is set to CONT, measurement cycles are automatically and continuously initiated at adjustable repetition rate; when switch is set to TRIG, single measurement cycle is initiated each time RESET switch is pressed or whenever ground is applied to external reset pin on optional rear panel REMOTE CONTROL connector. (Automatic triggering is locked out in TRIG position, but manual and external triggering remain operational in CONT position.)
20	POWER/CYCLE RATE Control	Adjusts repetition rate of automatic measurement cycle triggering from approximately 0.2 to 2.0 seconds. When rotated to OFF detent (fully ccw), power to unit is turned off. For Options −11 and −12, controls the Remote/Local Status. For Options −10 and −20, provides standby power to the instrument. With one of each type of option installed (RCU and ovenized time base) the RCU feature is used and all power control of the instrument will be from the rear panel.

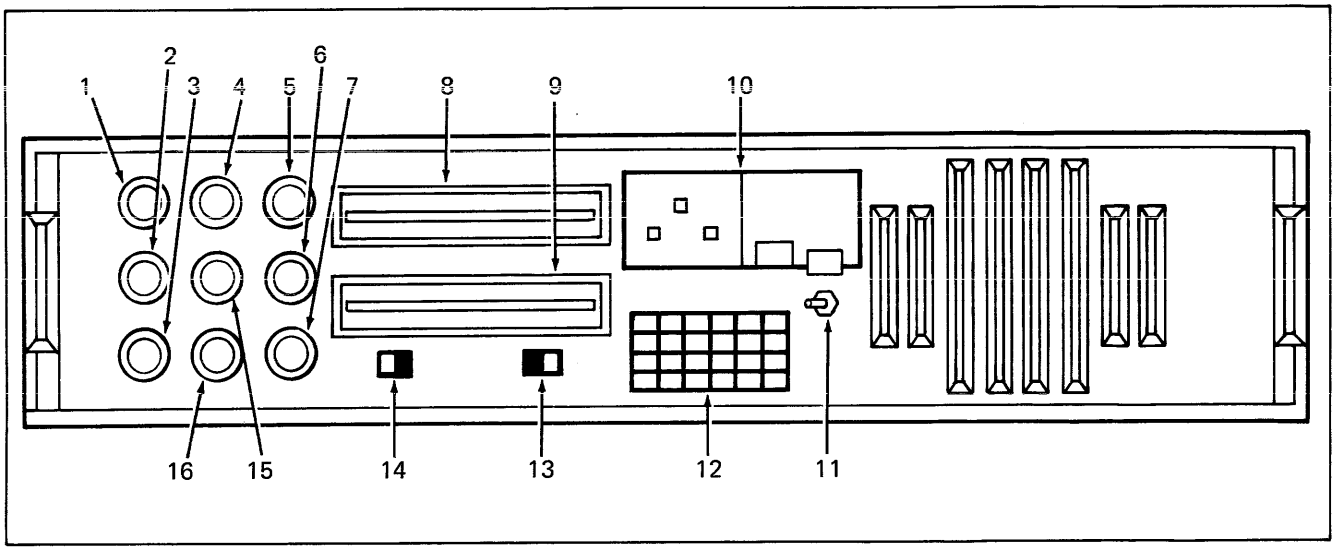

Figure 2-2. Rear Panel Controls and Connectors

Table 2-2. Rear Panel Controls and Connectors

ITEM NO.	NAME	FUNCTION
1	CHANNEL A Input Connector	Connector (J122) serves as rear panel input to channel A. This is part of Option –16 (see Section 6).
2	CHANNEL B Input Connector	Same as 1, but for channel B (J123).
3	CHANNEL C Input Connector	Same as 1, but for channel C, prescaled input (J121). Front panel channel C connector is not installed when rear panel channel C connector is installed (see Section 6).
4	MARKER Connector	Provides connection (J97) for Marker output signal. This signal is applied to Z-axis input of oscilloscope displaying 1953A input signal. The result is an intensified zone that indicates start-to-stop time of time interval measurement. In agreement with modulation requirements for Z-axis inputs of most oscilloscopes, the pulse is low active (and high, or +5V, when inactive).
5	GATE TIME Connector	Provides connection (J91) for Gate Time output signal This signal is an active high, TTL-compatible pulse generated for duration of measurement period.
6	CLOCK OUTPUT Connector	Provides connection (J92) to 10 MHz clock signal (internal or external) for use as time base standard. The output is buffered and is TTL compatible.
7	EXT 10 MHz CLOCK Connector	Provides connection for external 10 MHz clock input signal (J93). Minimum input level required is 100 mV, and input impedance is 1 Megohm.
8	BCD OUTPUT/IEEE ADDRESS Connector	Provides connection, when installed, for BCD parallel output (part of Option –02) or access to IEEE address controls (part of Option –15).

Table 2-2. Rear Panel Controls and Connectors (cont)

ITEM NO.	NAME	FUNCTION
9	REMOTE CONTROL Connector	Provides connection, when installed, for remote control of 1953A. (This is part of Options −11, −12 and −15.)
10	Input Power Connector	Provides connection for ac input power. Contains fuse receptacle and selection pcb to select between 100, 120, 220 or 240 input line voltage.
11	Rear Panel Power Switch	Part of Option -10, 11, 12 and -20. When on, with -10 or -20 installed and neither -11 or -12 installed, provides power to the oven filaments independent of the front panel power switch. When on with -11 or -12 installed, supplies operating power to the instrument, and the front panel power switch controls the remote/local command. When off, disconnects entire unit from line power.
12	Option Decal	Log of installed options.
13	NORMAL/BURST Select Switch	Installed as part of Option -05 (see Section 6), allows choice of normal signal measurements or RF burst measurements.
14	Clock Select Switch	Selects either internal or external clock for use as 1953A time base standard: INT . . . . . Selects output of internal clock. EXT . . . . . Selects external clock connected to Item 7.
15	LEVEL A Connector	A BNC Connector (J99) for monitoring the dc trigger level setting of channel A. The output level range is −1.2 to +1.2V dc and does not change with attenuator setting. With a X10 attenuator setting, an output level of 1.0 volts indicates a 10 volt trigger level setting.
16	LEVEL B Connector	Same as Item 15, but for trigger level B (J98).

2-12. OPERATING NOTES

2-13. The following paragraphs describe various conditions that should be considered before operating the Model 1953A Counter/Timer.

2-14. Measurement Errors

2-15. The 1953A, like all counters, is designed to respond to voltage transitions at the input channel. Since the input sensitivity of the 1953A is 30 mV minimum, care must be taken to suppress unwanted low-level transitions (noise, transients, spurs, etc.) that may accompany the measurement frequency. Otherwise, the unwanted transitions will be counted and displayed as a representation of the input frequency. To ensure the rejection of unwanted signals use the following guidelines, where applicable.

a. Use a scope to identify the presence of unwanted input signals.

b. Set the input attenuator to X10 if the unwanted signal is $\leq$300 mV, and the measurement signal is $\geq$300 mV.

c. Use a scope probe (X10) as an input cable when measuring high impedance circuits.

d. Use a low pass filter/attenuator when possible, to suppress unwanted noise and transients. The Fluke Model Y7201 (see accessories, Section 6) is designed for this purpose.

2-16. Input Channels A and B

2-17. Input Channels A and B are electrically similar, with bandwidths extending from 0 to 125 MHz for channel A, and 0 to 25 MHz for channel B. The output rise times for channels A and B are 5 ns and 20 ns, respectively. The input impedance of each channel is 1 megohm. A clamping circuit limits the voltage to the first stage of the input amplifier to ±3.5V, nominal. When the ATTEN switch is set to X1, the input impedance will decrease sharply to 120 kilohms for that portion of the input signal that exceeds the limit voltage. When the ATTEN switch is set to X10, the input impedance remains at 1 megohm for all input signal levels.

2-18. The sensitivity of channel A for sinewave inputs is 30 mV rms minimum from 0 to 75 MHz. The sensitivity gradually decreases to 50 mV rms minimum at 125 MHz. For channel B the sensitivity for sine wave inputs is 30 mV over the entire bandwidth (0 to 25 MHz). For pulse inputs the sensitivity is 100 mV peak-to-peak minimum for both channels with a minimum pulse width of 10 ns for channel A, and 50 ns for channel B.

2-19. Overload protection for input channels A and B permits a maximum signal level of 150V rms, from dc to 1 kHz, to be applied to either input without damaging the unit. The maximum allowable input signal level gradually decrease to 5V rms at 125 MHz when the ATTEN switches are set to X1; or to 50V rms, when set to X10.

2-20. SEP/COM Switch

2-21. The SEP/COM switch is used to isolate the A and B inputs when the switch is set to SEP, or to connect channel A input to both channel A and B pre-amplifiers when set to COM. The switch is normally left at SEP except in the case of time interval measurements using a single input signal. With the switch set to COM, channel A is used to establish the Start Signal trigger level conditions and channel B is used to establish the Stop Signal trigger level conditions.

2-22. Signal Conditioning

2-23. The signal conditioning features provided for each of the two main input channels (A and B) consist of a TRIGGER LEVEL control, a trigger status indicator (TRIG STAT), and three slide switches. The slide switches condition the input signal before it is used to trigger the counter, by selecting the desired trigger slope (+ or –), coupling (ac or dc) and attenuation (X1 or X10). The TRIGGER LEVEL control is continuously variable from approximately –1.2V to +1.2V dc (with the X1 attenuation selected; selecting the X10 attenuation increases the range of the TRIGGER LEVEL control by a factor of 10). When the control is rotated fully ccw to PRESET, the trigger level will be 0V dc. The trigger levels can be monitored separately by connecting a dc voltmeter to rear panel connector LEVEL A or LEVEL B.

2-24. The TRIG STAT indicator consists of two LED's, one marked +, the other marked –. For sine wave inputs these LED's indicate the relative trigger level selected. With the TRIGGER LEVEL control set to PRESET (0V dc trigger level), the two LED's will light with equal intensity. If the TRIGGER LEVEL control were adjusted to produce a –0.7V trigger level, as in case 1 of Figure 2-3, the + LED would light more brightly the –LED. This is due to the fact that the LED's are driven on a complementary basis. With negative trigger level, the +LED is on for a longer portion of the input waveform than the –LED and thus, appears to be brighter. For pulse inputs, the LED's fail to indicate relative trigger level since their brightness is related to the relative duty cycle of the waveform. With the pulse input waveform shown in case 2 of Figure 2-3, the –LED would glow more brightly regardless of the trigger level. In case 3, the LED's would have equal intensity, again regardless of the trigger level. However, if the waveform is case 3 were just half the peak voltage of that shown, the STAT TRIG indicators then provide a means of determining the effective range of the TRIGGER LEVEL control. When the TRIGGER LEVEL control is rotated either direction from the midpoint (approx 0V dc), as soon as the trigger level exceeds the peak voltage of the waveform, the corresponding LED will no longer light. This is best seen with pulse inputs, where the transition is sudden; with sinewaves the transition is gradual. Very narrow pulses may not light an LED to the point where it can be seen, even though proper triggering of the counter occurs.

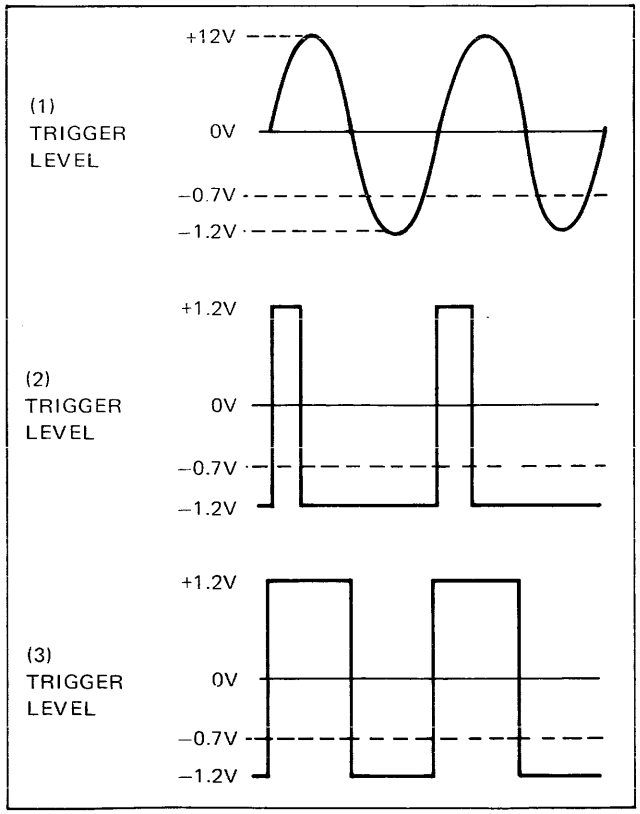

Figure 2-3. Effect of Input Wave Shape on Status Indicators

2-25. Marker Output

2-26. In the time interval function, a negative-going (low true) pulse is generated at the MARKER connector to provide an indication of the actual time interval being measured. The width of the Marker pulse is variable, depending on the trigger levels selected for channels A and B (Start and Stop signals). When the input signal is fed to the vertical input of an oscilloscope the marker pulse can be used to drive the Z-axis of the scope and cause the measured portion of the input signal to be intensified. Using this technique, the trigger levels for channels A and B (Start and Stop signals) can be individually adjusted for precise time interval measurements.

2-27. In the frequency A function, the Marker pulse can be used to precisely set the trigger level for channel A. However, the trigger level for channel B must also be adjusted to reset the Marker Generator. This is accomplished by setting the SEP/COM switch to COM and adjusting the TRIGGER LEVEL control for channel B so that the intensified zone is terminated shortly after it begins. Then adjust the TRIGGER LEVEL control for channel A to the desired position.

2-28. Gate Time Output

2-29. The GATE connector provides a high TTL output while the counter is executing a measurement cycle in any of the available functions. For Frequency A and C functions, the duration of the Gate signal is equal to the Gate time (GATE) selected by the RANGE switch. The signal is intended for use in remote applications; however, it can be used as a scope trigger or an external time gate. The GATE indicator lights for the duration of the Gate signal, plus approximately 100 ms. The extra 100 ms is provided by a pulse stretcher to ensure a sufficient on-time (duty cycle) for the GATE indicator to be seen when the shortest gate times are selected.

2-30. OPERATION

2-31. Turn-On Procedure

2-32. Use of the following procedure is suggested for initial turn-on of the 1953A:

a. Connect the 1953A to ac power line.

b. Turn the CYCLE RATE control cw, out of the OFF detent. The front panel display should illuminate.

2-33. Operating Functions

2-34. The following paragraphs describe the self-check frequency, ratio, period, time interval and totalize functions and give the procedures necessary to operate the 1953A in each mode. Complete the Turn-On Procedure before attempting to operate the unit.

2-35. SELF-CHECK

2-36. The self-check function is used to verify the digital operation of the 1953A. The frequency of the 10 MHz oscillator is measured to produce a predictable readout for each setting of the RANGE switch. Pressing the RESET switch when the counter is in the SELF-CHECK mode causes all digit segments to be illuminated. This provides immediate verification that all segments of the display LED's are operational. This LED check takes effect regardless of the position of the CONT/TRIG switch.

2-37. Use the following procedure to operate the 1953A in the Self-Check mode:

a. Set the rear panel Clock Select switch to INT.

b. Set FUNCTION switch to SELF-CHECK.

c. Set CONT/TRIG switch to CONT.

d. Adjust CYCLE RATE control for desired display period.

e. Sequentially select each GATE position of RANGE switch, pausing at each position to verify proper display in readout. (Table 2-3 shows proper display for each switch setting.)

Table 2-3. Display for Self-Check

GATE	READOUT*
0.1 ms	1000
1.0 ms	10000
10 ms	100000
0.1s	1000000
1.0s	10000000
10s	100000000

*±1 digit

2-38. FREQUENCY

2-39. Standard frequency measurements from 0 to 125 MHz are made using the frequency A function. The gate times available for each frequency measurement range from 0.1 ms to 10s in six decade steps and are selected by means of the RANGE switch. For a given input signal there will be a RANGE setting (gate time) which will give optimum resolution of the displayed frequency.

2-40. Use the following procedure to operate the 1953A in frequency A mode:

a. Set FUNCTION switch to FREQ A.

b. Set CONT/TRIG switch to CONT.

c. Connect input signal to be measured to CHANNEL A input connector.

d. Adjust CHANNEL A TRIGGER LEVEL control to establish desired trigger conditions. (Normal triggering occurs when both the + and - TRIG STAT indicators are lit.)

e. Adjust CYCLE RATE control for desired display period.

f. Set RANGE switch to obtain optimum resolution of the frequency displayed.

2-41. Used with any one of three optional prescalers, the frequency C function increase the frequency measurement capability of the 1953A to frequency ranges extending from 50 MHz to 520 MHz (using Option -07), or from 50 MHz to 1 GHz (using Option -13), or from 50 MHz to 1.25 GHz (using Option -14). Refer to Section 6 for operating instructions for the frequency C function.

2-42. RATIO

2-43. The ratio function is used to measure the frequency ratio of two input signals. One signal is coupled into channel A, the other into channel B. The resolution of the measurement can be increased or decreased by changing the setting of the RANGE switch. The higher frequency input signal must be connected to the CHANNEL A input or a zero reading will result.

NOTE

The channel B input frequency is limited to 25 MHz maximum.

2-44. Use the following procedure to operate the 1953A for the ratio function:

a. Set FUNCTION switch to FREQ (A/B).

b. Set CONT/TRIG switch to CONT.

c. Set SEP/COM switch to SEP.

d. Connect the higher of two frequencies to be measured to CHANNEL A input connector.

e. Connect other frequency to CHANNEL B input connector.

f. Adjust the CHANNEL A and the CHANNEL B TRIGGER LEVEL controls to establish desired trigger conditions. (Proper triggering occurs when both + and - TRIG STAT indicators are lit.)

g. Adjust CYCLE RATE control for desired display period.

h. Set RANGE switch to obtain optimum resolution of ratio displayed.

2-45. PERIOD

2-46. The period function is used to measure the period of input signals with frequencies up to 25 MHz. This function is also intended for use in measuring low frequencies, since a low frequency can be determined with higher resolution through a period measurement than through a direct frequency measurement. The measurement resolution increases with the number of periods used to obtain the average. For example, if the RANGE switch is set to 10^0 (PER AVGD. column), and an input frequency of 1 Hz is applied to channel A, the readout will display 1000.0000 ms (resolved to 100 ns). In the frequency mode, however, with a 1 Hz signal and a 10 second gate time the maximum resolution is 1 Hz. The setting of the RANGE switch indicates, in powers of ten, the number of periods (cycles) of the input signal that are sampled to produce the final display.

2-47. Use the following procedure to operate the 1953A in the period average mode:

a. Set FUNCTION switch to PERIOD A.

b. Set CONT/TRIG switch to CONT.

c. Connect signal to be measured to CHANNEL A input connector.

d. Adjust CHANNEL A TRIGGER LEVEL control to ensure proper triggering.

e. Adjust CYCLE RATE control for desired display period.

f. Set RANGE switch to the PER AVGD position that provides desired resolution.

2-48. TIME INTERVAL

2-49. With the time interval function, accurate measurements can be made of the time interval between the occurrence of two separate input signals or between two points on a single input signal. In either case, channel A is used to provide a Start signal, and channel B is used to provide a Stop signal. When a single input signal is to provide both the Start and Stop signals, the SEP/COM is set to COM so that both channels A and B receive the same signals. The SEP/COM switch is set the SEP when the Start and the Stop signals are to be provided by separate input signals.

2-50. Accurate pulse width, rise time and fall time measurements can be made with the time interval function. However, their accuracy depends upon the

trigger levels being set so that the Start and Stop signals occur at precise voltage levels of the input signal. The trigger levels can be visually set using an oscilloscope to display the input signal, while driving the Z-axis of the scope with the Marker signal (available at the rear panel). The measured time interval appears as an intensified zone on the scope trace and can be adjusted using the CHANNEL A and CHANNEL B TRIGGER LEVEL controls. Refer to the discussion of the MARKER output given earlier in this section under Operating Notes.

2-51. Use the following procedure to operate the 1953A in the time interval mode:

a. Set CONT/TRIG switch to CONT.

b. Set FUNCTION switch to TI A-B.

c. Set SEP/COM switch to SEP if Start/Stop signals are to be derived from separate input signals, or to COM, if from single input signal.

d. If separate input signals are used, connect Start signals to CHANNEL A input connector, and the Stop signal to CHANNEL B input connector. If single input is used, connect it to either input connector.

e. Adjust CHANNEL A and CHANNEL B TRIGGER LEVEL controls to establish desired Start/Stop trigger levels. Use the Marker output in conjunction with an oscilloscope to establish precise trigger levels.

f. Adjust CYCLE RATE control for desired display period.

g. Set RANGE switch to TI RES position that provides desired resolution.

2-52. TOTALIZE

2-53. In the totalize function, the 1953A can be used as a gateable totalizer. Each event that occurs at the CHANNEL A input connector is accumulated (totalized) during the time that a signal at the CHANNEL B input connector produces a gate pulse for the accumulator. The CHANNEL B SLOPE switch selects the portion of the channel B waveform that will produce the gate pulse. When the SLOPE switch is in the + position a gate pulse will be produced during the time the input waveform is more positive than the trigger level established for channel B; when in the - position, during the time the input signal is more negative. The RANGE switch is inoperative during this function.

NOTE

To prevent the enabling edge of the CHANNEL B gate pulse from triggering the counter, the SLOPE switch for channel A should be set to indicate the active polarity of the channel A input signal.

2-54. Use the following procedure to operate the 1953A in the totalize mode:

a. Set FUNCTION switch to A GTD BY B.

b. Set SEP/COM switch to SEP.

c. Connect signal to be totalized to CHANNEL A input connector.

d. Connect a signal to be used for gating to CHANNEL B input connector.

e. Adjust the CHANNEL A and CHANNEL B TRIGGER LEVEL controls to ensure proper triggering. The counter will totalize events on channel A as long as the channel B input is at an active level. In this mode the display will by updated only when the RESET switch is pressed, or when an External Reset signal is activated (no automatic recycling).

NOTE

If an input signal to channel B is not required or available, the gating of the accumulator can be manually controlled by the CHANNEL B SLOPE switch. Turn the CHANNEL B TRIGGER LEVEL control fully cw. Setting the SLOPE switch for CHANNEL B to - will now gate the accumulator, and the 1953A will totalize. Setting it back to + will inhibit the accumulator, and the totalizing will halt. To resume totalizing, set the SLOPE switch to - again; to start over from zero, momentarily press the RESET switch.

Section 3
Theory of Operation

3-1. INTRODUCTION

3-2. This section of the manual contains an overall functional description followed by a block diagram analysis of the Model 1953A counter. Block diagrams are used to supplement the text. A complete set of schematic diagrams is included in Section 8.

3-3. OVERALL FUNCTIONAL DESCRIPTION

3-4. Figure 3-1 is a simplified block diagram of the 1953A. It shows the major functional elements of the unit. The heart of the 1953A is the accumulator. The accumulator counts the clock pulses applied to it during the gate pulse. It retains this count, until a new measurement cycle is initiated, for use in driving the measurement results readout (nine-digit readout and overflow indicator). The accumulator receives the clock pulses from the function control logic circuits. In three functions (Frequency A, Ratio A/B and A Gtd by B) the clock pulses are fed straight through to the accumulator from channel A for the duration of the gate pulse. Under control of the FUNCTION switch, the function control logic circuits select the sources from which to derive the

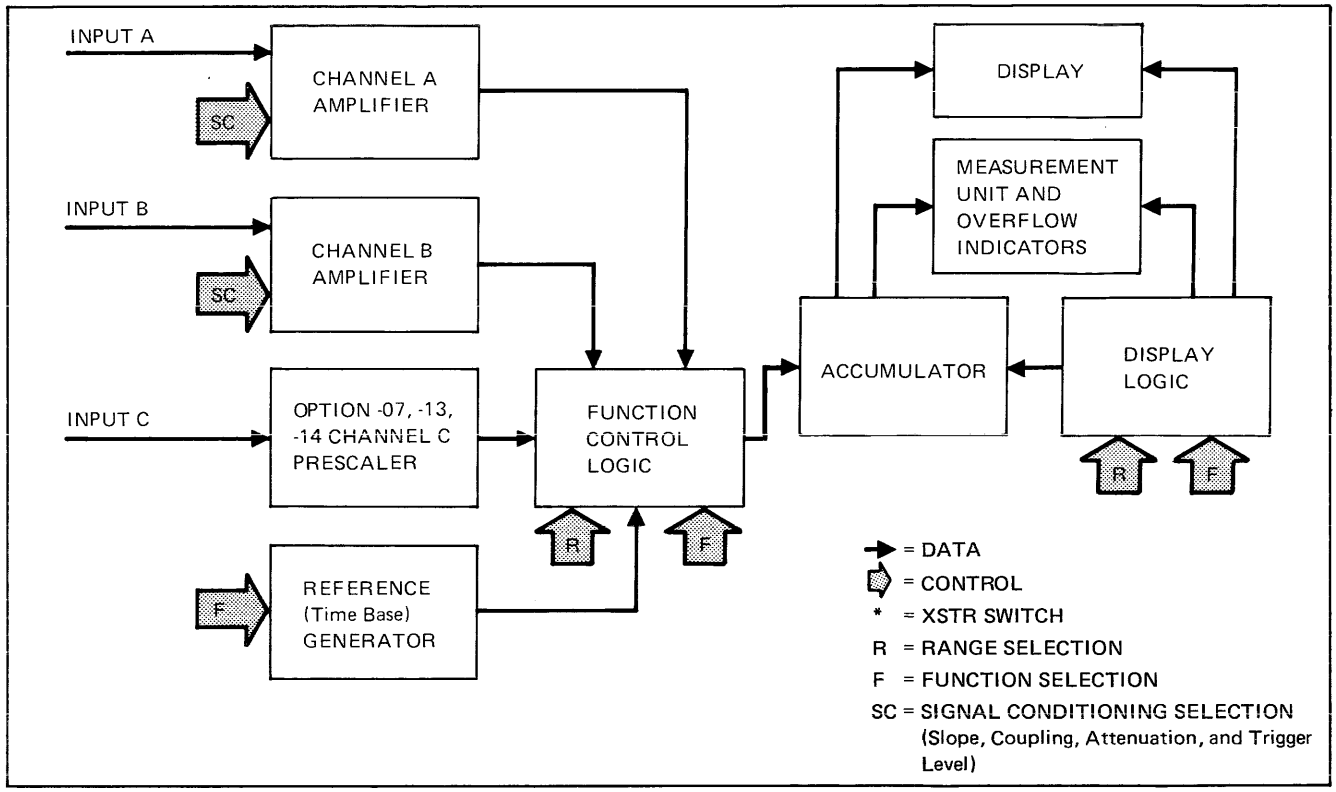

Figure 3-1. Model 1953A Simplified Block Diagram

Table 3-1. Accumulator Input Signal Summary

FUNCTION SWITCH	CLOCK DERIVED FROM	GATE DERIVED FROM
FREQ A	Channel A*	Ref. Generator
FREQ C	Channel C	Ref. Generator
FREQ A/B	Channel A*	Channel B
PERIOD A	Ref. Generator	Channel A
TI A-B	Ref. Generator	Channels A & B
A GTD BY B	Channel A*	Channel B**
SELF-CHECK	Ref. Generator	

* Direct feed-through, not derived.

** RANGE switch has no effect of gate pulse.

clock and the gate pulses. Table 3-1 lists sources for each measurement function. The duration of the gate pulse is a function of the RANGE switch. Decimal point location and measurement unit indication are automatically controlled by the RANGE and the FUNCTION switches through the display logic circuits.

3-5. When performing frequency measurements (with FREQ A or FREQ C of the FUNCTION selection), the counter accumulates cycles of the unknown input frequency for a pre-selected time interval termed the gate time. The total number of cycles accumulated is displayed in the readout and converted by the automatic placement of a decimal point into units of kHz or MHz (the units are indicated by the annunciators). There are six gate times available in the 1953A ranging from .1 ms to 10s in decade steps. These gate times are derived from the 10 MHz reference generator via the associated time base divider circuitry and are selected by means of the RANGE switch. In channel A frequency measurements the gate times are selected directly from the RANGE, while in channel C (prescaled frequency measurements) the gate times show in the RANGE are multiplied by a factor of either four (with Option -07) or eight (with Options -13 and -14).

3-6. Basically, measurements of period or of time intervals involve the counting of periods of the reference time base during a gate interval derived from an input signal. When performing period measurements on an input signal the counter accumulates clock pulses from the 10 MHz reference generator during a gate interval determined by a pre-selected number of periods of the input signal. The number of periods which establish the gate time are selected from the Periods Averaged column of the RANGE, which is scaled in six powers of ten giving from 1 to 10^5 periods of gating time. Direct period measurements are made when the gate interval is determined by a single period of the input signal, and period average measurements are made when more than one period comprises the gate interval. Since each cycle of the reference frequency has a period of 0.1 μs, the accumulator actually counts the number of 0.1 μs periods that occur during the gate time. This number is displayed in the readout and converted by the automatic placement of a decimal point and units annunciation, into units of either microseconds or milliseconds. To make time interval measurements, the counter accumulates cycles of a signal derived from the time base divider circuitry, during the gate interval. The 10 MHz reference time base is divided by power of ten to yield a selection of six reference signals ranging from 10 MHz to 100 Hz. Any of the six frequencies may be selected from the RANGE to be used as the clock input to the accumulator. This selected frequency is counted for the duration of the gate pulse. The duration of the gate pulse in time interval measurements is determined by the specific slope and trigger level conditions set on channels A and B in relation to the signals present on the respective channels. Channel A sets the conditions for the start of the gate pulse, channel B for the end of the gate pulse. The same signal may be used on both channels, or separate signals may be used on each channel.

3-7. During ratio and totalize functions (RATIO A/B and A GTD BY B), clock pulses from channel A are counted while the accumulator is gated by channel B. The number of pulses counted is displayed in the readout with no measurement units. When the ratio function is selected, the cycles of the channel A frequency are counted for a gate interval determined by a pre-selected number of cycles of the channel B frequency (the number of cycles is selected from the RANGE). The number, n, thus displayed, with decimal point automatically placed, is implied to be the ratio n:1. When the totalize function is selected, the number displayed represents the total number of triggering events that occurred at channel A during an operator-controlled or an externally programmed period of time. For this function, the gate pulse is a dc level obtained directly from channel B, rather than being a pulse derived from an input frequency as in the ratio function. Automatic recycling (resetting) is inhibited in the totalize function, and successive gate pulses cause the accumulator to resume counting without resetting to zero first. However, pressing the RESET button, or applying an external reset signal will manually reset the accumulator to zero.

3-8. The self-check function is used to test the 1953A for correct operation of the counting, gating and display circuits. In this function the display shows the total number of cycles of the 10 MHz reference frequency counted during a pre-selected gate time. The number displayed has no units annunciator, and the gate time used is any of the six available in the RANGE, as in the frequency measurement functions. The digit-check subfunction is used to test the display LED's. When a reset signal (either manual or external) is applied in the self-check mode, all of the segment drivers are enabled and all correctly operating segments illuminate (decimal points are not lit).

3-9. BLOCK DIAGRAM ANALYSIS

3-10. Channel A Amplifier

3-11. The function of the channel A input amplifier is to condition the input signal (type of coupling and attenuation), amplify it, and shape the signal before it is applied to the accumulator clock selector in the function control logic. As shown in Figure 3-2, the input signal to channel A can either be coupled across capacitor C402 (for AC coupling) or, by placing the front panel control to the DC position, applied directly to the attenuator. The attenuator switch can be place to the X1 position to use the full amplitude of low level input signals or to the X10 position to reduce the input signal level by approximately ten.

3-12. The conditioned signal is then applied to one side of dual FET Q5. The voltage level applied to the other side of the FET is determined by the TRIGGER LEVEL control (R406). The push-pull amplifier (Q7 and Q8) provides U2 with an input that can be shaped by the amplifier and Schmitt trigger section. The output of U2 is then applied to the accumulator clock input selector and to the TRIG STAT driver section, Q11 through Q15. The drivers insure that for higher frequency inputs the TRIG STAT indicators on the front panel will light.

3-13. Channel B Amplifier

3-14. As shown in Figure 3-3, the signal conditioning for the input signals applied to channel B (input coupling and attenuation) is the same as that for channel A. The buffer amplifier (Q1, Q3 and Q4) also comprises a dual-FET, push-pull amplifier configuration the same as that in channel A, with the trigger level being determined by the TRIGGER LEVEL control (R405) for channel B. The difference between the two input channels is in the final stage of the channel B wave shaping circuit (U1, Q9, and Q10). the outputs of the Schmitt trigger portion of U1 are applied to the bases of Q9 and Q10 so that the output of the channel B amplifier is at a true TTL level.

3-15. Reference Generator

3-16. The 10 MHz basic signal for the reference oscillator (Figure 3-4) is provided either by the internal oscillator (U7) or through the EXT 10 MHz clock input jack on the rear panel of the instrument. The 10 MHz signal is applied to the base of Q99, which is used to buffer the input of the Schmitt trigger U102.

3-17. Function Control Logic

3-18. The function control logic receives signal data from the channel A, channel B and channel C input amplifiers and from the reference generator. From these inputs, the control logic, as directed by the range and

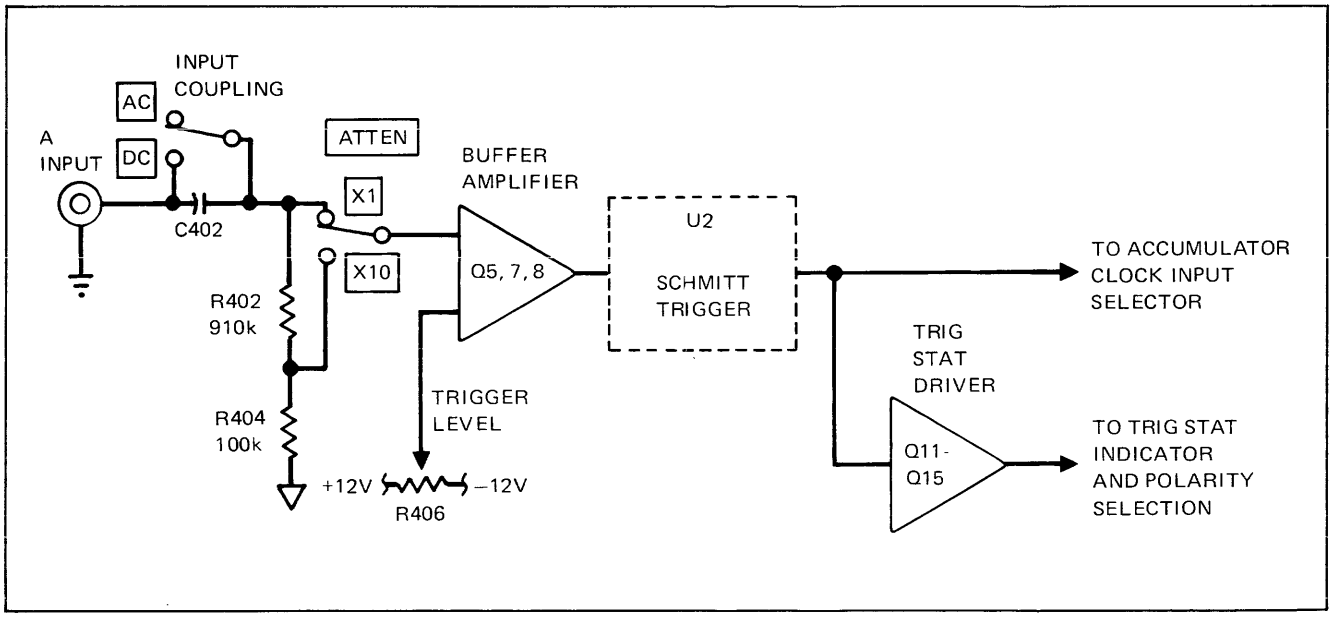

Figure 3-2. Channel A Input Amplifier

function switch positions, selects the signal to be applied to the accumulator and controls the time interval for which it is applied. The operation of the function control logic will be discussed for each separate position of the function switch.

3-19. FREQUENCY A

3-20. The basic signal processing that takes place in the control logic when the FREQ A function is selected is illustrated in Figure 3-5. The input selector (U4) will select either the leading or trailing edge (+ SLOPE, or -SLOPE) of the input A signal for triggering. The input A signal is then applied to one input of the main gate (U6).

3-21. The other input to U6 is the gate time signal. The gate time signal for the FREQ A function is derived from the 10 MHz reference generator signal. The 10 MHz signal is first applied to the reference frequency divider (U11-U15) where it is reduced to a 10 kHz output. Reference divider input select gate U24 is directed by the FREQ A function command to apply the 10 kHz, reference to the reference divider. The reference divider comprises a series of five decade counters that produce six separate frequency outputs; 10 kHz, 1 kHz, 100 Hz, 10 Hz, 1 Hz, and 0.1 Hz. The frequency at the range selector output (U26, U27, and U28) is controlled by the particular range selected. The gate selector (U42), also controlled by the FREQ A function command, applies the range selector output to the main gate. The main gate is enabled for one cycle of the gate time signal. The cycles of the input A frequency that occur during this single cycle of the gate time frequency are accumulated.

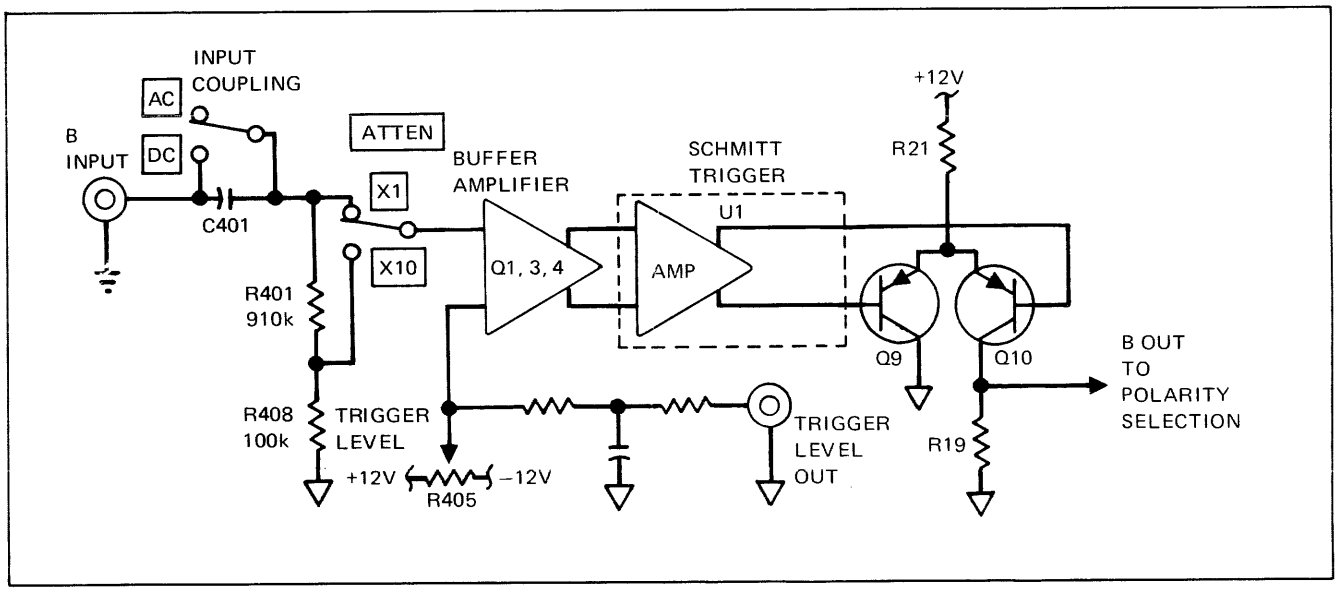

Figure 3-3. Channel B Input Amplifier

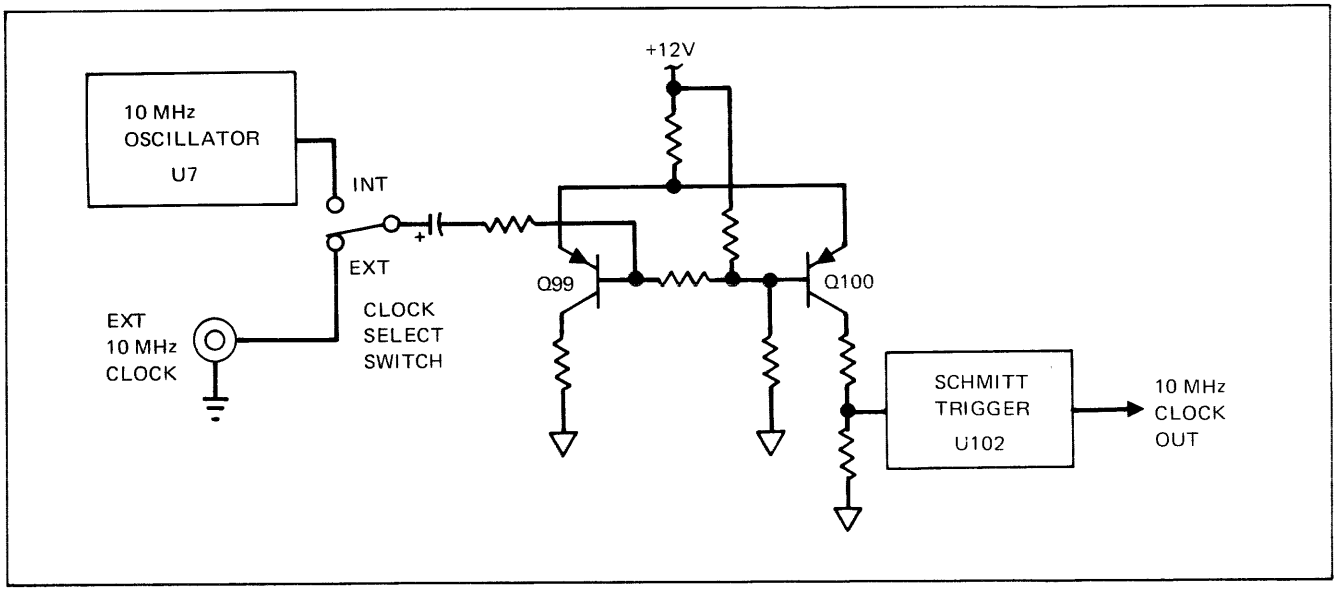

Figure 3-4. Reference Generator

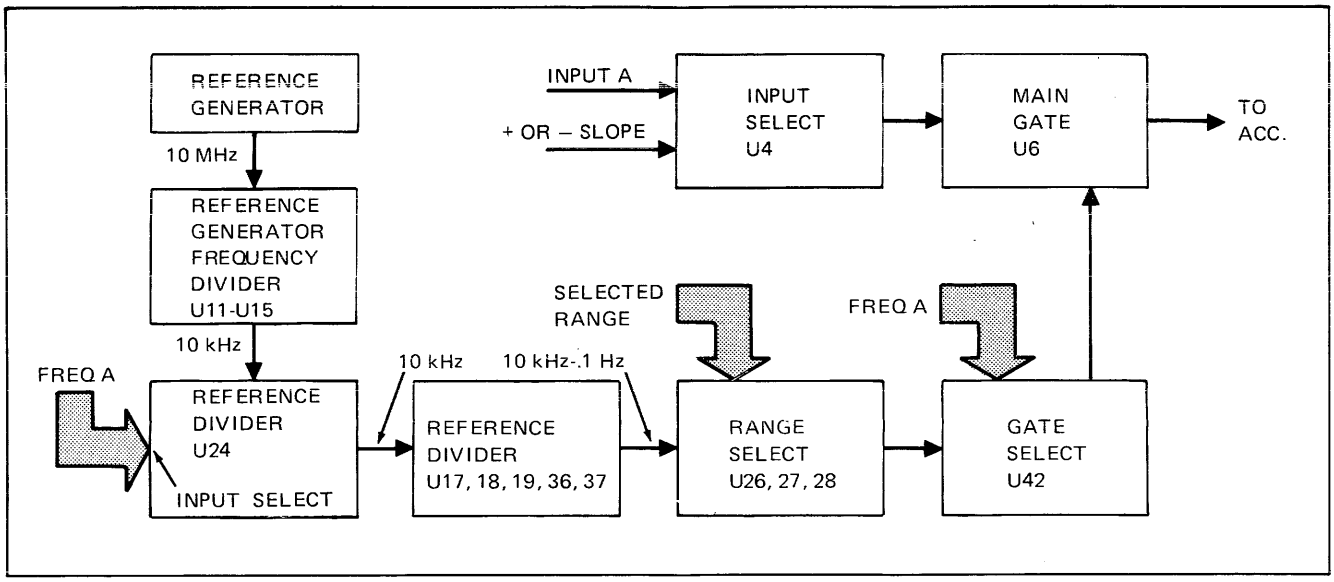

Figure 3-5. Function Control Logic: Frequency A

3-22. FREQUENCY C

3-23. The operation of the function control logic for the FREQ C function (see Figure 3-6) is similar to that for the FREQ A function. The input select gate (U4) applies the signal output from the prescaler (Options-07, -13 and -14 to the main gate input as directed by the FREQ C function command.

3-24. The gate time for this function is again derived from the 10 MHz reference generator. The reference frequency divider circuit, however, receives a command from the function switch that introduces an additional division factor. The 10 MHz reference frequency is divided by four (Option -07) or eight (Options -13 and -14) to compensate for a similar frequency division applied to the channel C input signal by the respective prescaler options. The reference divider input select gate (U24) directs this modified reference frequency to the reference divider circuit. The reference divider again provides six separate output frequencies, one for each range switch setting. The range selector gate (U26, U27, and U28), as directed by the RANGE switch, selects the proper gate signal to be applied to U42. The gate selector (U42) then applies this signal to the main gate to enable it to pass the input C signal to the accumulator.

3-25. FREQUENCY A/B

3-26. In this mode of operation the instrument will count the number of cycles of the input A signal that occur during a selected number of cycles of the input B signal. This configuration is illustrated in Figure 3-7.

3-27. The output of the channel B input amplifier is selected by the reference divider input select gate, in the FREQ A/B function, to be used as the reference signal. The input B signal is applied to the reference divider where it is divided by powers of ten from 10^0 through 10^5. The range selector will then select one of the six outputs of the reference divider, as determined by the range switch position, and apply it to the main gate to enable the gate to pass the input A signal to the accumulator.

3-28. PERIOD A

3-29. The input signal applied to channel A is used as the reference frequency to enable the main gate while the 10 MHz reference generator signal is counted by the accumulator. Figure 3-8 illustrates this function control logic configuration.

3-30. The 10 MHz reference generator signal is directed, in the PERIOD A function, through the input selector (U23 and U41) to the main gate. The output frequency of the channel A input amplifier is selected by the reference divider input select gate (U24) and applied to the reference divider. The six outputs of the reference divider consist, respectively, of the input A frequency divided by successive powers of 10 from 10^0 through 10^5. The range selector applies the proper frequency, as determined by the range switch position, to the gate selector. The gate selector then enables the main gate for the duration of one cycle of the selected frequency, during which time the 10 MHz reference generator signal is counted by the accumulator.

3-31. TIME INTERVAL A TO B

3-32. In the TI A-B function the instrument uses the input signal on channel A to start the gate time pulse and the input signal on channel B to stop it. The time is measured by counting the number of cycles of the 10 MHz reference generator signal that occur during this period. Figure 3-9 shows the function control logic configuration for the TI A-B function.

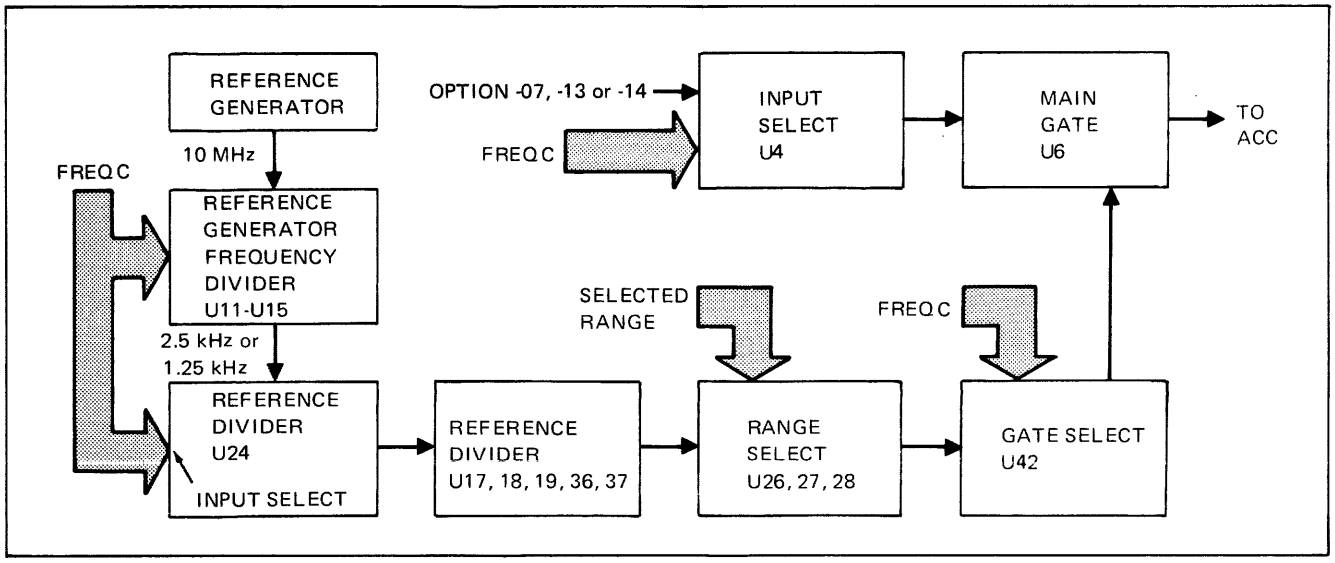

Figure 3-6. Function Control Logic: Frequency C

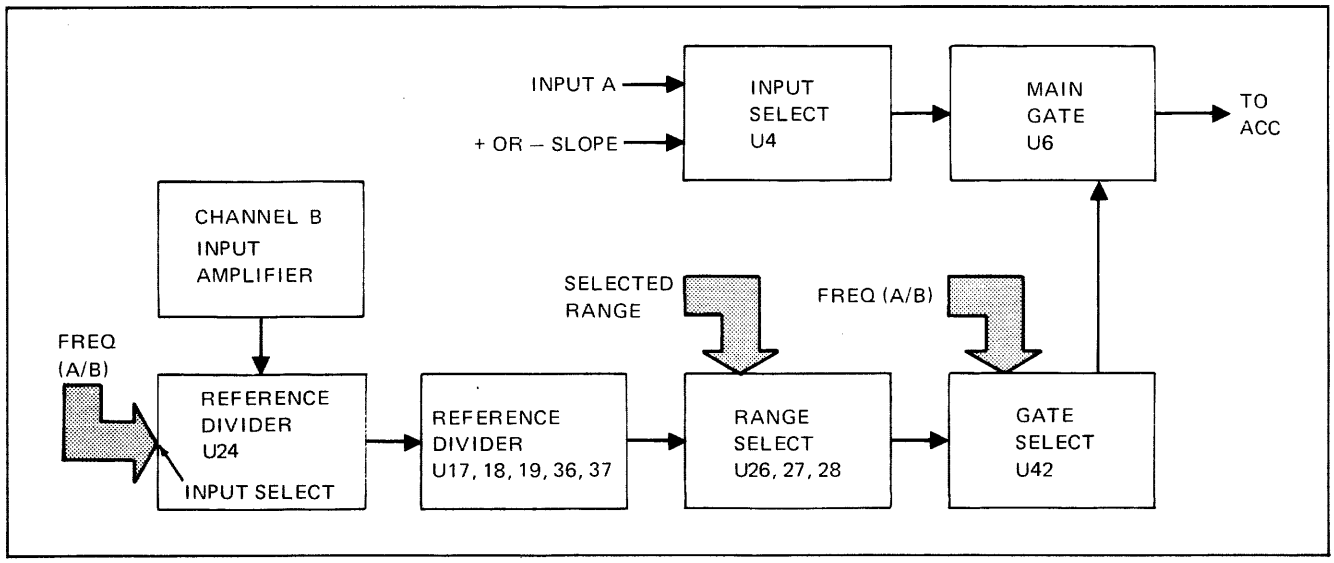

Figure 3-7. Function Control Logic: Frequency A/B

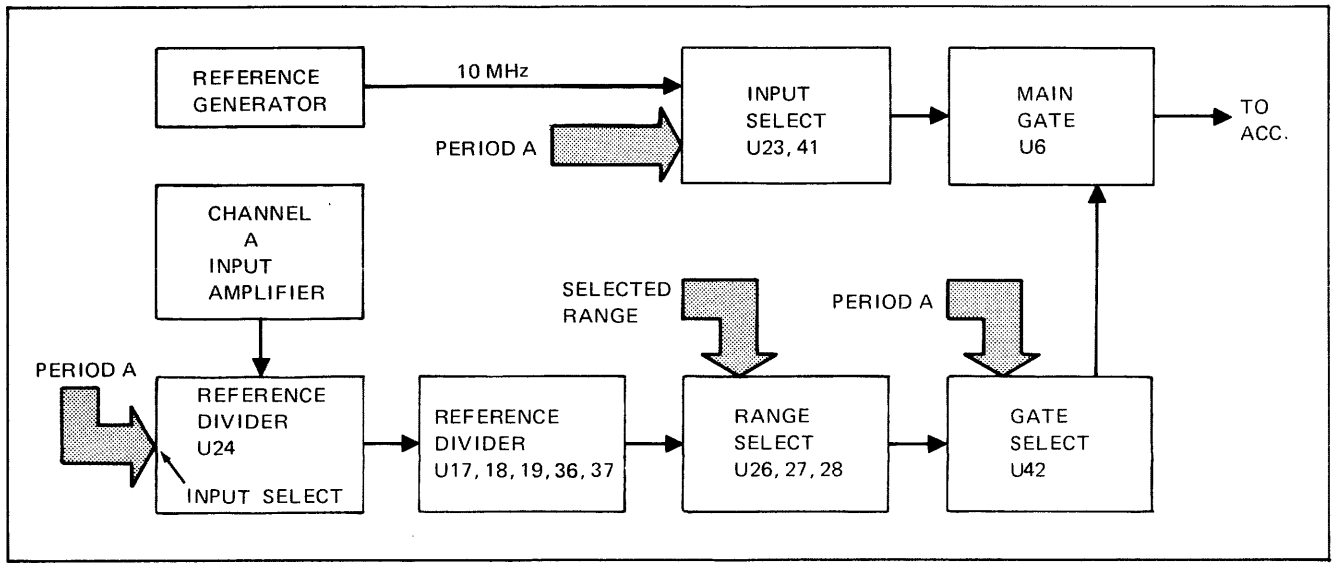

Figure 3-8. Function Control Logic: Period A

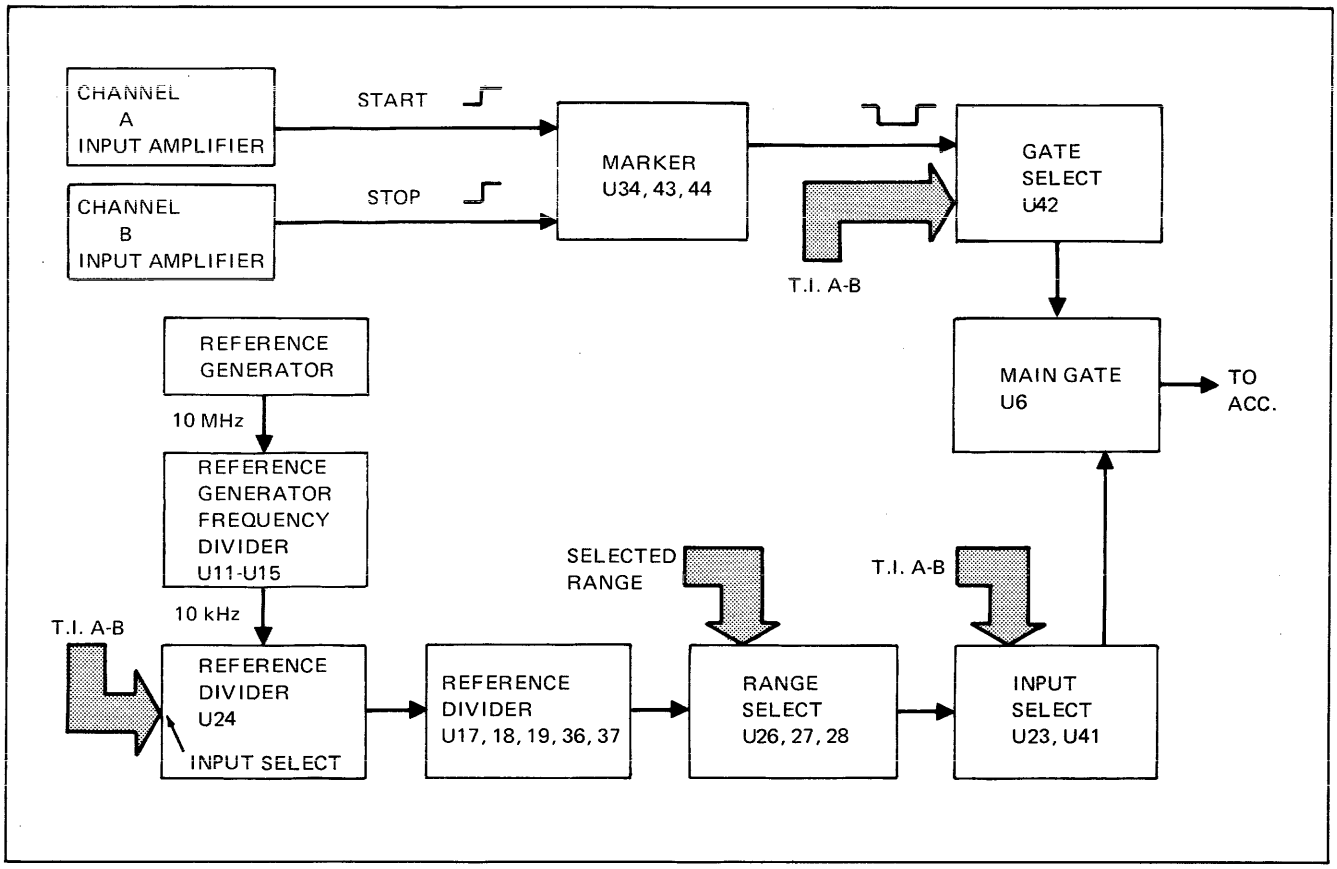

Figure 3-9. Function Control Logic: TI A-B

3-32. In the TI A-B function the instrument uses the input signal on channel A to start the gate time pulse and the input signal on channel B to stop it. The time is measured by counting the number of cycles of the 10 MHz reference generator signal that occur during this period. Figure 3-9 shows the function control logic configuration for the TI A-B function.

3-33. The 10 MHz reference generator signal is directed through the reference divider input select (U24) to the reference divider. The six outputs of the dividers are: 10 MHz, 1 MHz, 100 kHz, 10 kHz, 1 kHz, and 100 Hz. The range switch selects one frequency and applies it to the input selector which in turn applies it to the main gate. The gate time signal on the other input of the main gate is generated by the marker (U34, U43, U44) from the channel A and channel B inputs. The leading edge of the channel A input amplifier signal causes the output of the marker circuit to go low. This low signal causes the gate selector to enable the main gate. The leading edge of the channel B input amplifier signal causes the marker output to go high, which inhibits the main gate. The number of cycles of the reference frequency counted during this time is displayed as an amount of time in μs or ms.

3-34. CHANNEL A GATED BY B

3-35. In the A GTD BY B function the instrument will totalize the events that occur on the channel A input for a length of time determined by the channel B input. The function control logic for this mode of operation is illustrated in Figure 3-10.

3-36. The channel A input is directed through the input select gate (U4) to the main gate, in the A GTD BY B function. The enable signal for the main gate comes from the channel B input amplifier through gate selector U42 and enables the main gate to pass the input A signal to the accumulator for counting.

3-37. SELF-CHECK

3-38. The Self-Check function will check the control logic circuits for proper operation. Figure 3-11 shows the portions of the control logic used to perform the Self-Check function.

3-39. Both the clock input to the main gate and the gate time are derived from the 10 MHz reference generator. The input selector (U4) directs the 10 MHz signal to one input of the main gate, in the Self-Check function. The signal on the other input comes from the reference generator through the reference generator frequency divider to the reference divider input select gate. In the Self-Check mode, a 10 kHz signal is directed to the reference divider. The Range selector directs one of the six reference divider output frequencies to the gate selector. The selected output frequency is applied to the main gate by the gate selector, and constitutes the main gate enable signal.

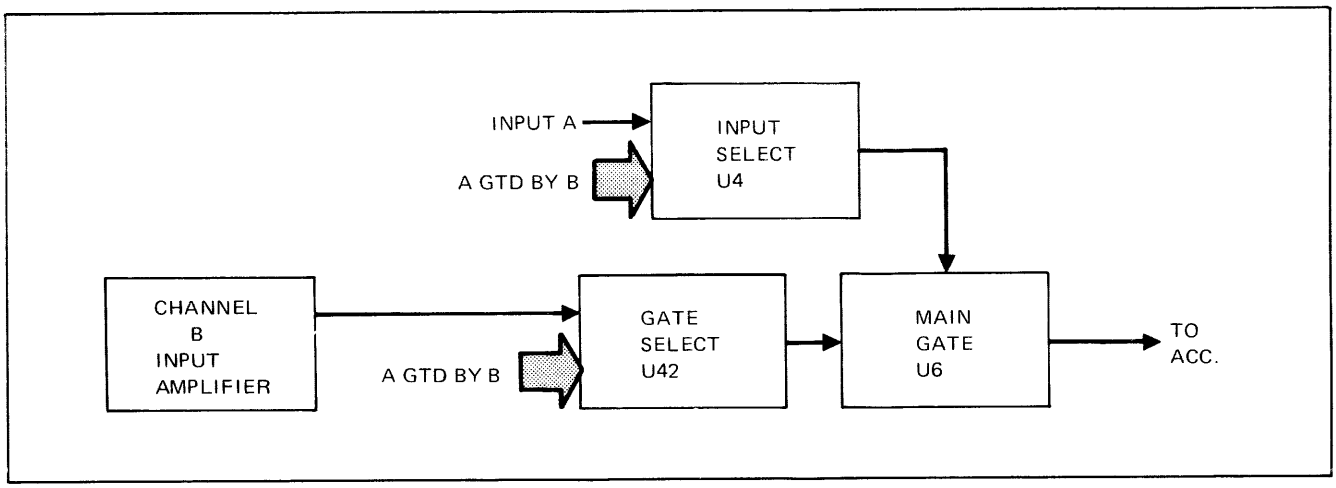

Figure 3-10. Function Control Logic A GTD by B

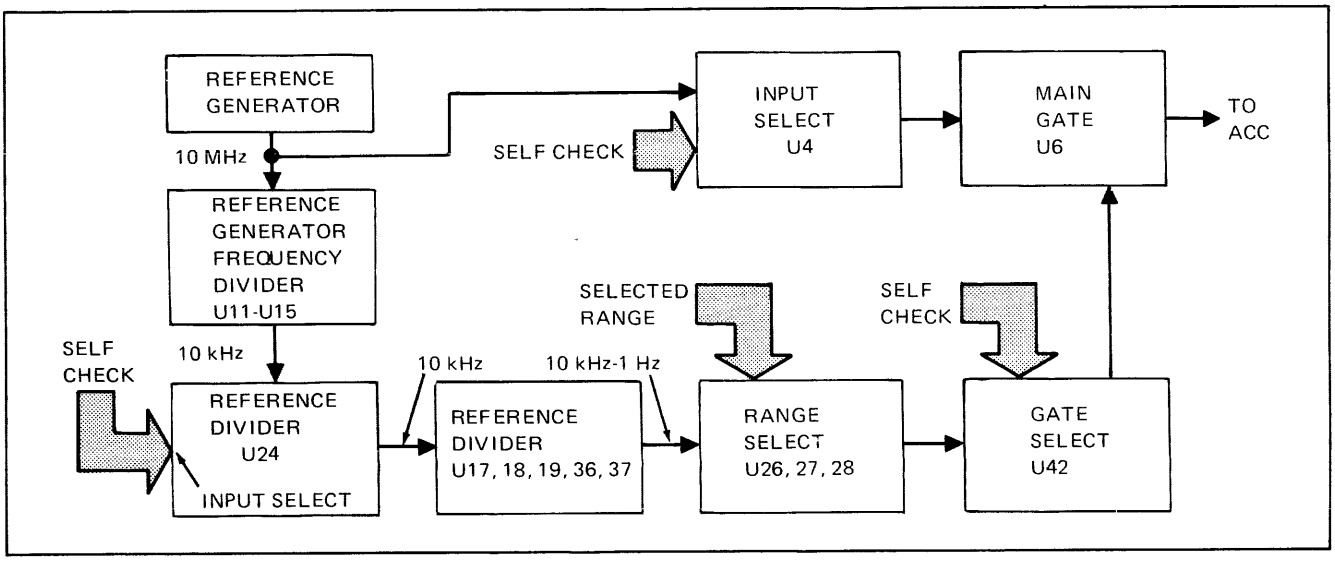

Figure 3-11. Function Control Logic: Self-Check

3-40. Accumulator

3-41. The frequency of the accumulator input signal is equal to one-half the frequency of the signal applied to the main gate, U6. The gate is a J-K flip-flop with the input being applied to the clock terminal and the output taken from the Ω terminal. The output of the main gate becomes the BCD A of the first digit. Figure 3-12 is a basic illustration of the accumulator.

3-42. Since the main gate is an integral part of the first decade counter of the accumulator, it is represented in this block diagram as the CLK IN and J-K IN to the first decade counter. The first digit of LSD (Least Significant Digit) produces a BCD output (A-B-C-D signals) and applies it to the LSI chip, U65. The carry output from the LSD is connected to the clock input of the next decade counter, U57. This counter also produces a BCD output which is applied to U65. The carry output is applied to the LSI chip U65 which contains the remaining seven decade counters used to produce the nine digits of the display.

3-43. When the decade counters have counted the input signal frequency for the duration of the main gate enable signal, the BCD output of each decade counter is applied to a four-bit latch. The memory update command that enables the latches to receive the BCD input is triggered by the trailing edge of the main gate enable signal.

3-44. The BCD digit information is moved from the latches to the display one digit at a time. An oscillator and a ten stage ring counter within U65 produce sequential enable signals for the four-bit gates and their corresponding digit drivers. The BCD digit information is gated out of the four-bit gates to the BCD-to-seven segment decoder. The seven-segment digit information for each significant digit is strobed by the digit driver signal so that it is displayed on the corresponding digit position of the display.

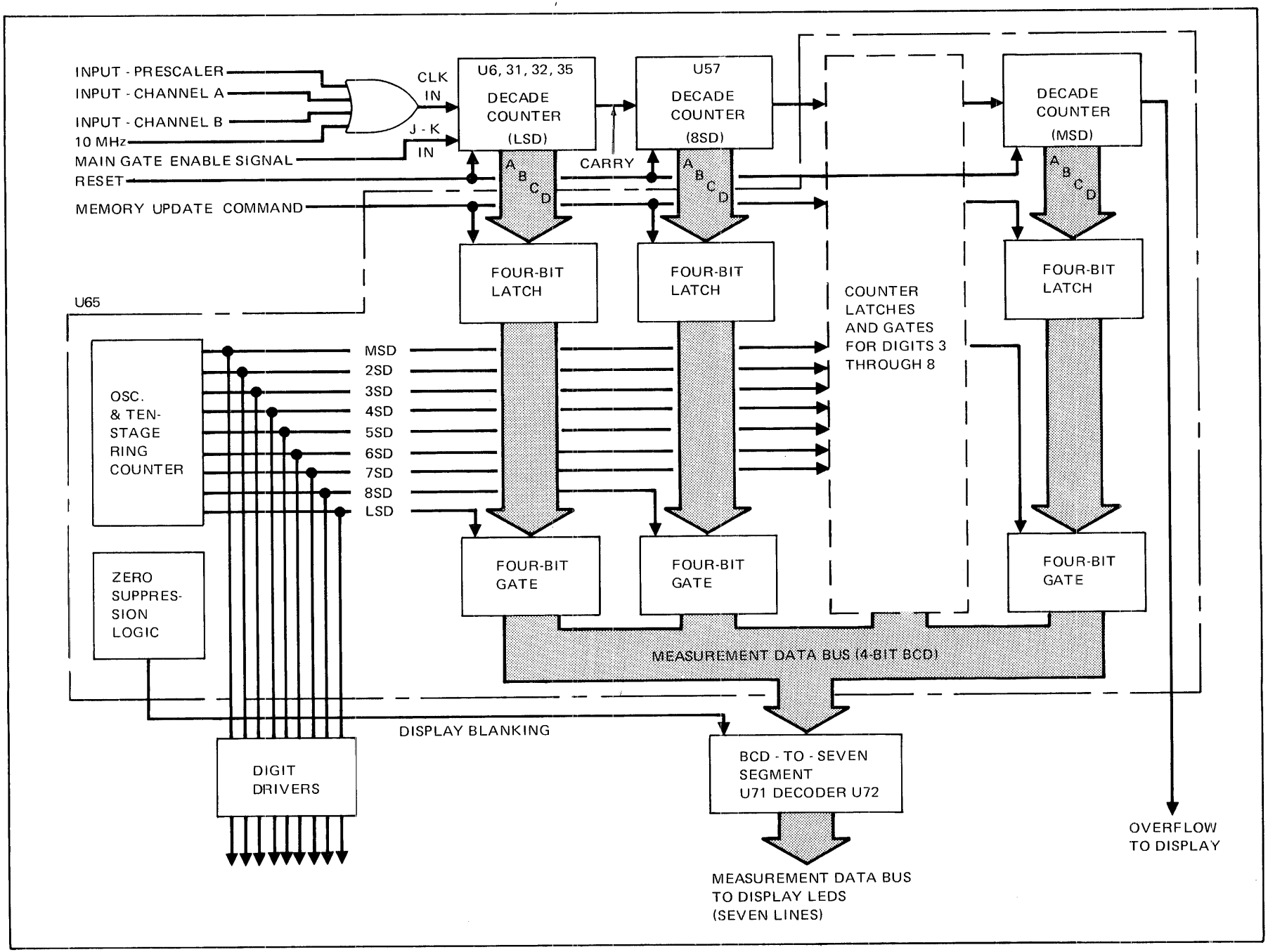

Figure 3-12. Accumulator Block Diagram

3-45. The zero suppression logic within the LSI chip will blank zeros to the left of the most significant digit displayed. If the most significant digit is to the right of the decimal point, suppression will occur to the left of the decimal point only. If the frequency of the signal applied to the accumulator clock input is high enough and the gate enable signal long enough the most significant digit (MSD) will produce a carry signal that will light the overflow indicator on the front panel. A reset command from the display logic circuit will return the decade counter to zero for each new measurement cycle.

3-46. Display Logic

3-47. The display logic performs three basic functions. First, it illuminates the proper annunciator (MHz, kHz, μs, ms or s) as needed for each function and range setting. Secondly, it enables the correct decimal point, as directed by the range and function controls. Finally, it will update the display and reset the counters as directed by the gate enable signal and cycle rate control.

3-48. The annunciator control is illustrated in Figure 3-13 in a simplified form. In the Frequency A or Frequency C function the MHz annunciator will light when the range switch is positioned to ranges 1, 2, or 3 (0.1 ms, 1.0 ms or 10 ms). When the range switch is positioned to ranges 5, 6, or 7 (0.1s, 1.0 or 10s) the output of U63 changes from a high to a low logic level. The low output, representing ranges 4, 5, or 6, is inverted and applied to one AND gate section of U62 to light the kHz annunciator. The TI A-B function will cause the ms annunciator to light in ranges 1, 2, and 3 and the μs annunciator to light in ranges 4, 5, or 6. The PERIOD A mode in ranges 1, 2, or 3 causes the ms annunciator to light and in the 4, 5, or 6 range the s annunciator will light.

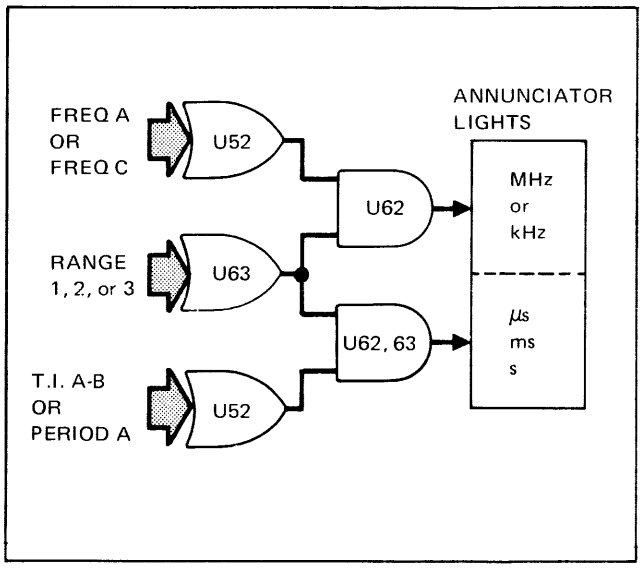

Figure 3-13. Annunciator Control Logic

3-49. The decimal point logic enables one input of one-of-six AND gates so that the correct decimal point will light when a strobe signal is applied to the other input of the gate (see Figure 3-14). The range inputs are paired by NOR gate U52 and U53 (1 and 4, 2 and 5, 3 and 6) so that the decimal point will return to the same digit when either range is selected. This is used in the FREQ A, FREQ C, and TI A-B Functions because the annunciator changes the scale of the display between ranges 3 and 4. The function command input is combined with individual range commands, in order to place the decimal point at the proper digit.

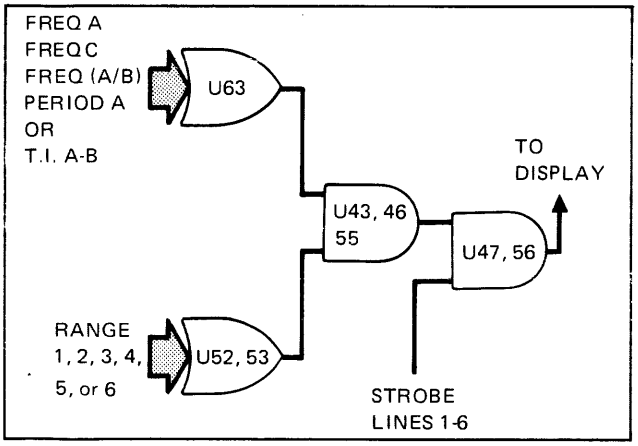

Figure 3-14. Decimal Point Control Logic

3-50. The update and reset control provides commands, at the proper time, to update the digit information being displayed and to reset the decade counters for a new input (see Figure 3-15). At the end of the main gate enable pulse, U59 is set which enables U67 and the 100 kHz signal input to U66. The reaction time of U67 is controlled by the cycle rate control on the front panel, which delays the set command from U59 by 0.2 to 2 seconds. While the cycle rate delay is taking place the 100 kHz signal is clocking U66 through its outputs. The first cycle of the 100 kHz signal is used as a spacer between commands. The second cycle, however, causes U66 to output an update command. The third is again a spacer and the fourth causes the reset command output. The fifth cycle in will disable the 100 kHz input signal to stop the action in U66. At the end of the cycle rate delay, U67 will reset U59 which in turn resets U66, preparing the circuit for a new measurement cycle.

3-51. Display

3-52. The display consists of nine, seven-segment LED's. Figure 3-16 illustrates how the seven-segment digit information and the decimal point information is applied to all nine display chips at the same time. The strobe lines, one to each display LED, enable the display digit that corresponds to the decade counter digit of the accumulator producing the digit information at that strobe time.

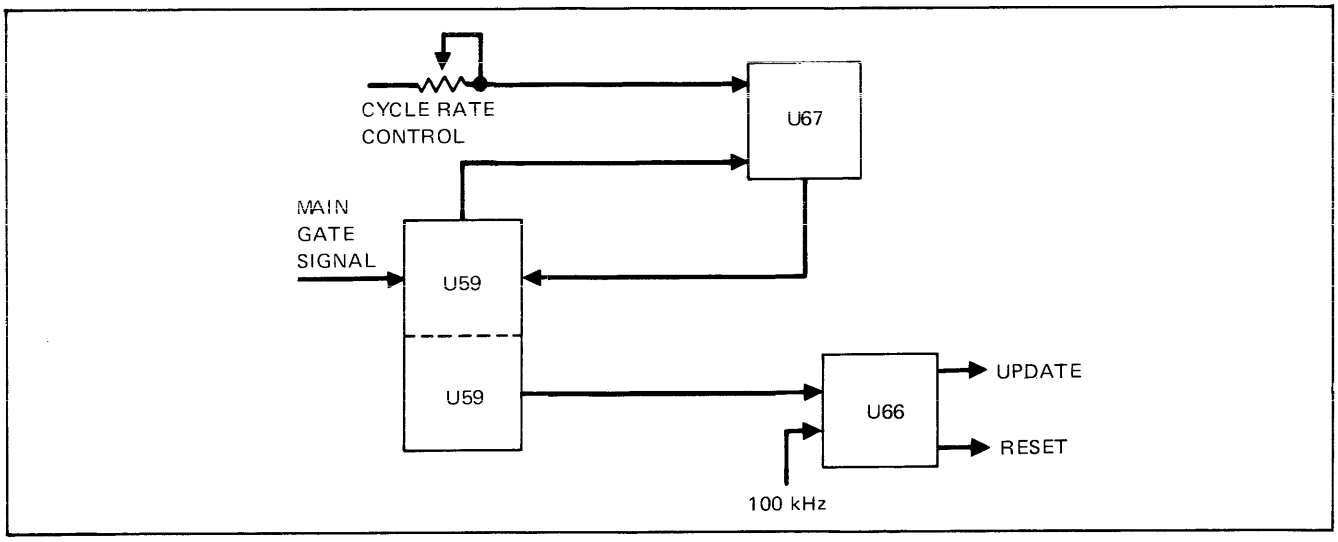

Figure 3-15. Update and Reset Control Logic

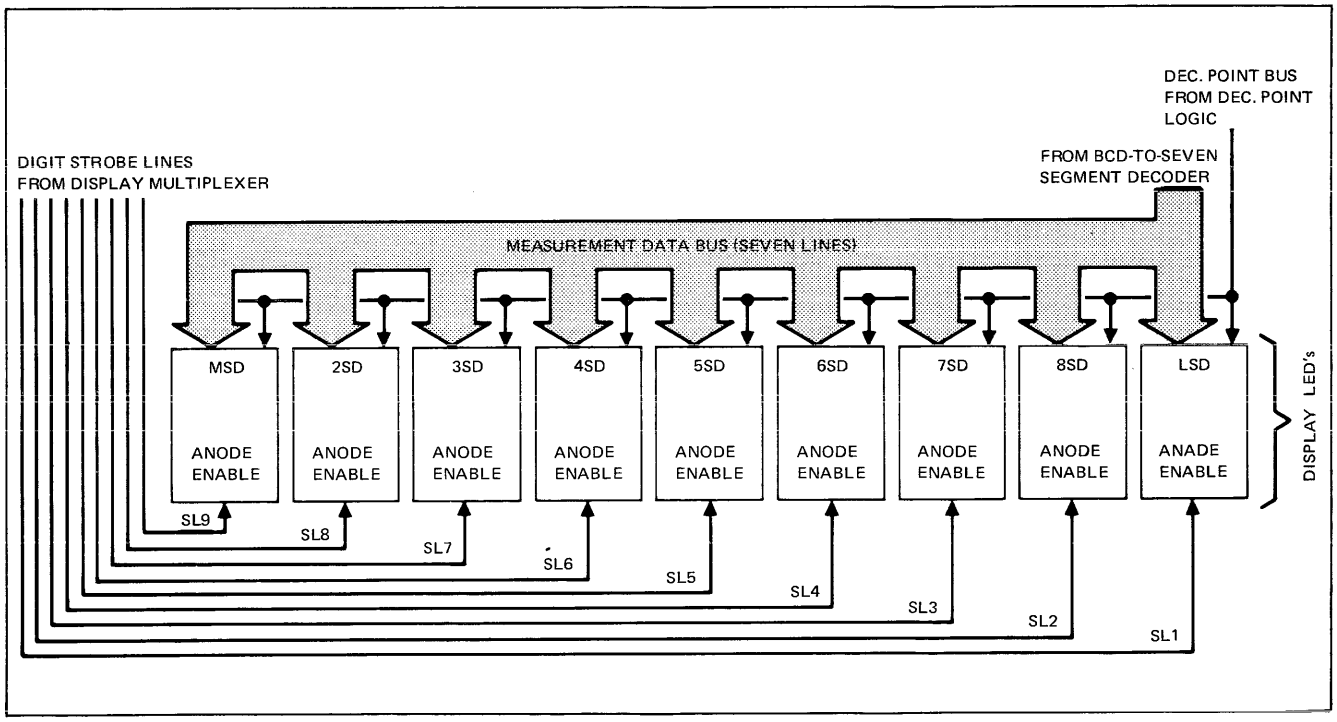

Figure 3-16. Display Section Block Diagram

Section 4
Maintenance

4-1. INTRODUCTION

4-2. This section contains maintenance information for the Model 1953A Counter/Timer. This includes service information, general maintenance, performance test, calibration and troubleshooting. The performance test is recommended as a preventive maintenance tool and should be executed every 90 days to verify proper instrument operation. Troubleshooting information is given in the form of flowcharts at the end of this section. Table 4-1 lists the recommended test equipment required for maintenance of the 1953A.

4-3. SERVICE INFORMATION

4-4. Each instrument that is manufactured by the John Fluke Mfg. Co., Inc. is warranted for a period of 1 year upon delivery to the original purchaser. The warranty is given on the back of the title page located in the front of this manual.

4-5. Factory authorized calibration and service for each Fluke product is available at various worldwide locations. A complete list of these service centers is included in Section 7. Shipping information is given in Section 2 of this manual. If requested, an estimate will be provided to the customer before work is begun on instruments that are beyond the warranty period.

4-6. GENERAL MAINTENANCE

4-7. Access and Removal Information

4-8. All pcb assemblies used in the 1953A can be accessed for maintenance purposes by removing the top

Table 4-1. Test Equipment Required for 1953A Maintenance

EQUIPMENT NOMENCLATURE	RECOMMENDED MODEL	WHERE USED
Quartz oscillator frequency standard with 10 MHz output	Select model with stability 10 times better than time base installed in 1953A.	Time base oscillator adjustment
Low frequency oscillator	HP204D	Performance check, calibration
High frequency oscillator	HP8654A HP612A (for 1 GHZ and 1.25 GHz options)	Performance check, calibration
RF millivoltmeter with 50 Ohm termination	Boonton 91C	Performance check, calibration
Multimeter	Fluke 8000A	Troubleshooting
Oscilloscope	Tektronix 465	Troubleshooting

and the bottom dust covers from the instrument. Six phillips-head screws hold each dust cover in place. Once both dust covers have been removed, the front panel assembly can be removed from the unit. Then the display, the switch, and the input pcb assemblies can be removed from the Front Panel assembly. Use the procedures given in the following paragraphs to remove these pcb's from the unit. Repaired or replacement pcb's can be installed by logically reversing the procedures.

4-9. FRONT PANEL

4-10. Remove the Front Panel from the 1953A as follows:

a. Remove top and bottom dust covers, by removing six phillips screws from each cover.

b. Unsolder input connector wires from input BNC jacks.

c. Remove all front panel control knobs and the mounting nuts for the RESET button, and RANGE and FUNCTION switches.

d. Remove signal screw, holding Main PCB to Front Panel support bracket (front center, underside of Main PCB).

e. Remove the two screws that hold the Display PCB and Input PCB to the front panel.

f. Remove four screws holding Front Panel to side brackets (two on each side).

CAUTION

During the next step, exercise care not to bend any of the pins that electrically interconnect the three pcb's to the Main PCB.

g. Slide the front panel straight forward until it clears the switch shafts.

4-11. DISPLAY PCB ASSEMBLY

4-12. Remove the Display PCB Assembly from the Front Panel Assembly as follows:

a. Remove the Front Panel.

b. Pull Display PCB away from front panel.

c. Unplug the data input cable from J4 on the Main PCB.

d. If power switch, CYCLE RATE control or entire pcb is to be replaced, unsolder wires from power switch at rear of CYCLE RATE control.

4-13. SWITCH PCB ASSEMBLY

4-14. Remove the Switch PCB assembly from the Front Panel as follows:

a. Remove the Front Panel.

b. Pull Switch PCB away from front panel.

4-15. INPUT PCB ASSEMBLY

4-16. Remove the Input PCB Assembly from the Front Panel Assembly as follows:

a. Remove the Front Panel.

b. Unsolder input connector leads.

c. Pull Input PCB away from front panel.

4-17. Cleaning

4-18. Clean the 1953A periodically to remove dust, grease and other contamination. Use the following procedure:

a. Clean the surface of all pcb's using clean, dry air at low pressure ($\leq$20 psi). If grease is encountered, spray with Freon T.F. Degreaser and remove grime with clean, dry air at low pressure.

b. Clean the front panel with a soft cloth dampened with a mild solution of detergent and water.

4-19. Fuse Replacement

4-20. The power fuse, F1, is located on the rear panel of the 1953A. If replacement is necessary, use a 1A slo-blo for 115V operation and a .5A slo-blo for 230V operation.

4-21. Service Tools

4-22. No special tools are required to maintain or repair the 1953A.

4-23. PERFORMANCE TEST

4-24. The performance test is designed to verify the overall operation of the 1953A. This test can be used as an acceptance check and/or periodic maintenance check. Table 4-1 lists the equipment required to perform this test. If the counter fails any part of the performance test, corrective action is indicated. Troubleshooting information for fault isolation is given later in this section.

4-25. Set-Up Procedure

4-26. Prior to executing the performance test, complete the following set-up procedure:

a. Connect the 1953A to line power.

b. Rotate CYCLE RATE control cw, from the OFF detent and set to maximum cw position. The front panel display should light.

NOTE

If the 1953A is equipped with the -10, -11 or -12 Option the rear panel Main Power switch must be in the ON position.

c. Set rear panel EXT/INT swtich to INT.

d. Set SEP/COM switch to SEP.

e. Set CHANNEL A and CHANNEL B controls to following positions:

1. TRIGGER LEVEL control to PRESET
2. SLOPE switch to +
3. Coupling (AC/DC) switch to AC
4. ATTEN switch to X1

4-27. Channel A Amplifier Test

4-28. Use the following procedure to test the Channel A amplifier:

a. Complete Set-Up Procedure.

b. Connect a 2V rms, 1 kHz signal to CHANNEL A connector.

c. Observe TRIG STAT annunciators. Both (+ and -) should be lit.

d. Change settings of SLOPE, coupling and ATTEN switches. Both TRIG STAT annunciators should remain lit.

e. Set the ATTEN switch to X10 and Coupling switch to AC.

f. Turn TRIGGER LEVEL control cw, too just off PRESET detent. The + TRIG STAT annunciator should be lit, and the - annunciator off.

g. Turn TRIGGER LEVEL control cw to center of its travel. Both TRIG STAT annunciators should be lit.

h. Turn TRIGGER LEVEL control fully cw. The -TRIG STAT annunciator should be lit, and the + annunciator off.

4-29. Channel B Amplifier Test

4-30. To test the channel B amplifier, repeat the procedure given in the previous paragraph, but use the CHANNEL B controls, indicators and connectors.

4-31. Display Test

4-32. Use the following procedure to test the front panel display:

a. Complete Set-Up Procedure.

b. Sequentially select each position of RANGE switch for each position of FUNCTION switch (except A GTD BY B). As each range is selected, verify that display is as described in Table 4-2. (A GTD BY B position requires external inputs to test readout display.)

c. Set FUNCTION switch to A GTD BY B.

d. Connect a 1V rms, 5 Hz signal to CHANNEL A connector.

e. Set CHANNEL A Coupling switch to DC.

f. Set CHANNEL B SLOPE switch to -.

g. Turn CHANNEL B TRIGGER LEVEL control cw until readout begins to display channel A input frequency. Observe least significant digit of readout and verify that each of 10 possible numerals (0 through 9) are displayed in sequence.

h. Increase input frequency to 10 Hz, 100 Hz, 1 kHz, 10 kHz, 100 kHz, and 1 MHz, pausing at each to verify proper operation of digits 2 through 7, respectively. (Digits are numbered from right to left.)

i. Use a 10 MHz signal to test digit 8 and a 100 MHz signal to test digit 9. Each digit will step through all ten numerals in ten seconds. Lower frequency signals will involve longer time intervals.

j. Verify the OVERFLOW indicator lights as digit 9 steps from a 9 to a 0.

k. Press RESET button (momentarily). Verify that OVERFLOW indicator goes out, readout resets to zero and totalizing process starts over.

Table 4-2. Display Readout Test

FUNCTION SWITCH	RANGE SW INDICATIONS	DISPLAY FOR AVAILABLE RANGE SETTINGS 1	2	3	4	5	6
DIGIT CHECK (SELF-CHECK WITH RESET DEPRESSED)	READOUT	888888888	(SAME)	(SAME)	(SAME)	(SAME)	(SAME)
	ANNUNCIATOR	(NONE)	(NONE)	(NONE)	(NONE)	(NONE)	(NONE)
SELF-CHECK	GATE	0.1 ms	1.0 ms	10 ms	0.1s	1.0s	10s
	READOUT	1000	10000	100000	1000000	1000000	100000000
	ANNUNCIATOR	(NONE)	(NONE)	(NONE)	(NONE)	(NONE)	(NONE)
T.I. A-B	T.I. RES	0.1 μs	1.0 μs	10 μs	0.1 ms	1.0 ms	10 ms
	READOUT	.0000	.000	.00	.0000	.000	.00
	ANNUNCIATOR	ms	ms	ms	s	s	s
PERIOD A	PER. AVGD.	10^0	10^1	10^2	10^3	10^4	10^5
	READOUT	.0000	.00000	.000000	.0000	.00000	.000000
	ANNUNCIATOR	ms	ms	ms	μs	μs	μs
FREQ A/B	PER. AVGD.	10^0	10^1	10^2	10^3	10^4	10^5
	READOUT	0	.0	.00	.000	.0000	.00000
	ANNUNCIATOR	(NONE)	(NONE)	(NONE)	(NONE)	(NONE)	(NONE)
FREQ C	GATE	0.1 ms	1.0 ms	10 ms	0.1s	1.0s	10s
	READOUT	.00	.000	.0000	.00	.000	.0000
	ANNUNCIATOR	MHz	MHz	MHz	kHz	kHz	kHz
FREQ A	GATE	0.1 ms	1.0 ms	10 ms	0.1s	1.0s	10s
	READOUT	.00	.000	.0000	.00	.000	.0000
	ANNUNCIATOR	MHz	MHz	MHz	kHz	kHz	kHz

4-33. Frequency A Test

4-34. Using the following procedure to test the frequency function:

a. Complete Set-Up Procedure.

b. Set FUNCTION switch to FREQ A.

c. Connect 1V rms, 100 kHz signal to CHANNEL A connector.

d. Sequentially select each GATE position of the RANGE switch, pausing at each to verify that the readout and measurement unit display are as described in Table 4-3.

Table 4-3. Frequency A Test

GATE	READOUT*	UNIT ANNUNCIATOR
0.1 ms	.10	MHz
1.0 ms	.100	MHz
10 ms	.1000	MHz
0.1s	100.00	kHz
1.0s	100.000	kHz
10s	100.0000	kHz

**The accuracy of the readout is dependent upon the accuracy of the 100 kHz input signal.*

4-35. Frequency C Test

4-36. The frequency C function is operational only when one of the Prescaler Options (-07, -13, or -14) has been installed. Refer to the appropriate option in Section 6 of this manual for performance test information.

4-37. Ratio Test

4-38. Use the following procedure to test the ratio (frequency A/B) function:

a. Complete Set-Up Procedure.

b. Set FUNCTION switch to FREQ A/B.

c. Set SEP/COM switch to COM.

d. Connect 1V rms 100 kHz signal to CHANNEL A connector.

e. Sequentially select each PER AVGD (periods averaged) position of RANGE switch, pausing at each to verify the readout display is as shown in Table 4-4. (No measurement unit annunciator will light.)

Table 4-4. Ratio Test

PER AVGD.	READOUT
10^0	1
10^1	1.0
10^2	1.00
10^3	1.000
10^4	1.0000
10^5	1.00000

4-39. Period A Test

4-40. Use the following procedure to test the period A function:

a. Complete Set-Up Procedure.

b. Set FUNCTION switch to FREQ A.

c. Connect 1V rms, 10 kHz signal to CHANNEL A connector.

d. Set RANGE switch to 10s (GATE) and adjust signal source to produce display of 10.000 kHz on readout.

e. Set FUNCTION switch to PERIOD A.

f. Sequentially select each PER AVGD position of RANGE switch, pausing at each to verify that display is as described in Table 4-5.

Table 4-5. Period A Test

PER AVGD.	READOUT	ANNUNCIATOR
10^0	.1000	ms
10^1	.10000	ms
10^2	.100000	ms
10^3	100.0000	μs
10^4	100.00000	μs
10^5	100.000000	μs

**The accuracy of the readout is dependent on the accuracy of the 10 kHz input signal.*

4-41. Time Interval Test

4-42. Use the following procedure to test the time interval function:

a. Complete Set-Up procedure.

b. Set FUNCTION switch to FREQ A.

c. Connect 1V rms, 5 Hz signal to CHANNEL A connector. (Use a squarewave with rise and fall times $\leqslant$ 15 ns.)

d. Set RANGE switch to 10s (GATE) and adjust signal source to produce display of .0050 on readout, (with kHz annunciator lit).

e. Set FUNCTION switch to T.I. A-B.

f. Set trigger level controls of channels A and B to PRESET. Set CHANNEL A slope switch to + and CHANNEL B slope switch to –.

g. Set SEP/COM switch to COM.

h. Sequentially select each T.I. RES. (Time Interval Resolution) position of RANGE switch, pausing at each to verify that display is as described in Table 4-6.

Table 4-6. Time Interval Test

T.I. RES	READOUT*	ANNUNCIATOR
0.1 μs	100.0000	ms
1.0 μs	100.000	ms
10 μs	100.00	ms
0.1 ms	.1000	s
1.0 ms	.100	s
10 ms	.10	s

**The accuracy of the readout is dependent upon the accuracy of the 5 Hz input signal.*

4-43. Totalize Test

4-44. Use the following procedure to test the totalize (A gated by B) function:

a. Complete Set-Up Procedure.

b. Set FUNCTION switch to A GTD BY B.

c. Connect 1V rms, 100 Hz signal to CHANNEL A connector.

d. Turn CHANNEL B TRIGGER LEVEL control cw until –TRIG STAT annunciator lights.

e. Press and release RESET button. Readout should display 0 (zero). (Decimal point and measurement units are not displayed.)

f. Turn CHANNEL B TRIGGER LEVEL control ccw until the + TRIG STAT annunciator lights. The 1953A should begin to count and display the total cycles of the 100 Hz input frequency. (Digit 3 should increment once per second.)

g. Turn CHANNEL B TRIGGER LEVEL control ccw until TRIG STAT annunciator lights. The 1953A should stop counting and display accumulated total.

h. Repeat steps f and g. The accumulation process should take place as long as +TRIG STAT annunciator is lit. Notice that as steps f and g are repeated, displayed total is not reset. Instead, new inputs are added to previous total (totalized).

4-45. Self-Check Test

4-46. Use the following procedure to test self-check function:

a. Complete Set-Up Procedure.

b. Set FUNCTION switch to SELF-CHECK.

c. Depress the RESET switch. All display digit segments should illuminate. (The measurement unit annunciators amd decimal points will not be lit.)

d. Sequentially select each GATE position of the RANGE switch, pausing at each to verify display is as shown in Table 4-7. (No measurement unit annunciator will light).

Table 4-7. Self-Check Test

GATE	READOUT
0.1 ms	1000
1.0 ms	10000
10 ms	100000
0.1s	1000000
1.0s	10000000
10s	100000000

4-47. CALIBRATION

4-48. The 1953A should be calibrated every 90 days or whenever repairs have been made. Calibration should be done at an ambient room temperature of 25° ±5°C. Table 4-1 lists the required test equipment. Test points locations are shown in Figure 4-1.

4-49. +12 Volt Power Supply Adjustment

4-50. The +5 volt and -12 volt power supplies depend on the +12 volt supply for regulating and operating power. The adjustment of the +12 volt power supply will affect the other power supplies.

4-51. Calibrate the +12 volt supply as follows:

a. Connect 1953A to line power.

b. Connect positive input lead of DMM to +12V test point (TP94).

c. Connect return lead of DMM to chassis ground.

d. Set DMM to VDC on the 20 volt range.

e. Turn CYCLE RATE control cw, off the OFF detent.

f. Adjust the +12V adjustment (R97) for +12 ±0.1V.

4-52. Trigger Level Preset Adjustment

4-53. This procedure outlines a check of the trigger level settings and, if required, an adjustment procedure. If desired the adjustment may be performed to achieve maximum sensitivity even though the trigger levels are within the listed specifications.

4-54. Check the channel A preset trigger as follows:

a. Perform or verify the following settings:

1953A connected to ac line power
POWER/CYCLE RATE fully clockwise
CONT-TRIG switch to CONT
RANGE to GATE - 10 msec
FUNCTION switch to FREQ A
CHANNEL A controls -
  TRIGGER LEVEL to PRESET
  SLOPE to +
  AC-DC to AC
  ATTEN to X1
CHANNEL B controls -
  TRIGGER LEVEL to PRESET
  SLOPE to +
  AC-DC to AC
  ATTEN to X1
SEP-COM switch to SEP

b. Connect the High Frequency Signal Generator and the RF Voltmeter Probe to the CHANNEL A

input connector through a 50Ω termination. Use a BNC "T" connector.

c. Set the High Frequency Signal Generator for an input to the 1953A of 75 MHz at 30 mV rms.

d. The display should be stable and read the input frequency.

e. Set the High Frequency Signal Generator for and input to the 1953A of 125 MHz at 50V rms.

f. The display should be stable and read the input frequency.

g. If either reading is unstable perform the adjustment procedure in the following step. If acceptable, proceed to the next paragraph.

h. Set the High Frequency Signal Generator for an input to the 1953A of 125 MHz at 45 mV rms.

i. Set the channel A internal trigger level trimpot, R142, fully counterclockwise. Rotate R142 slowly clockwise until the display is stable at the input frequency of 125 MHz. Note the position of the R142 setting.

j. Continue rotating R142 clockwise until the display becomes unstable again. Note the position of the R142 setting.

k. Set R142 at the midpoint between the two settings obtained in steps i and j.

l. Set the CHANNEL A SLOPE switch to – (minus) and verify that the display remains stable. Return the SLOPE switch to the + position.

m. Lower the amplitude of the Signal Generator until the display starts to become unstable.

n. Repeat steps i through m until maximum sensitivity is achieved.

4-55. Check the channel B preset trigger as follows:

a. Perform or verify the following settings:

1953A connected to ac line power
POWER/CYCLE RATE fully clockwise
CONT-TRIG switch to CONT
Range to PER AVGD -10^3
FUNCTION switch to FREQ (B)
CHANNEL A controls-
  TRIGGER LEVEL to PRESET
  SLOPE to +
  AC-DC to AC
  ATTEN to X1
CHANNEL B controls-
  TRIGGER LEVEL to PRESET
  SLOPE to +
  AC-DC to AC
  ATTEN to X1
  SEP/COM switch to COM

b. Connect the High Frequency Signal Generator and the RF Voltmeter Probe to the CHANNEL B input connector through a 50Ω terminal. Use a BNC "T" connector.

c. Set the High Frequency Signal Generator for an input to the 1953A of 25 MHz at 30 mV.

d. The display should be stable and read the input frequency.

e. If the reading is unstable perform the adjustment procedure in the following steps. If acceptable, proceed to the next paragraph.

f. Set the High Frequency Signal Generator for an input to the 1953A of 25 MHz at 25 mV.

g. Set the channel B internal trigger level trimpot, R141, slowly clockwise until the display is stable at the input frequency of 25 MHz. Note the position of the R141 setting.

h. Continue rotating R141 clockwise until the display becomes unstable again. Note the position of the R141 setting.

i. Set R141 at the midpoint between the two settings obtained in steps g and h.

j. Set the CHANNEL B SLOPE switch to – and verify that the display remains stable. Return the SLOPE switch to the + position.

k. Lower the amplitude of the Signal Generator until the display starts to become unstable.

l. Repeat steps g through k until maximum sensitivity is achieved.

4-56. Reference Generator Adjustment

4-57. Calibrate the 10 MHz reference oscillator as follows:

a. Connect 1953A to ac line power.

b. Turn CYCLE RATE control cw, off the OFF detent. Allow the unit to warm up for at least 1 hour.

c. Set the FUNCTION switch to FREQ A.

d. Set CONT/TRIG switch to TRIG.

e. Connect 10 MHz frequency standard to CHANNEL A connector.

f. Adjust CHANNEL A trigger level control to establish desired trigger condition. (Proper triggering occurs when + and - TRIG STAT annunciators are both lit.)

g. Set RANGE switch to 1s (GATE).

h. Momentarily press RESET switch. After 1 second 1953A should light and display 10000.0000 kHz.

i. If display is incorrect, locate adjustment screw on TCXO (U7) on Main Board (bottom dust cover has hole to admit tuning tool). Using insulated tuning tool, turn adjustment slightly. If the unit is equipped with an oven stabilized time base (Option -20) calibration access hole is on rear panel.

j. Repeat steps h and i until proper display is obtained.

4-58. TROUBLESHOOTING

CAUTION

Static discharge can damage MOS components contained in the 1953A. To prevent this possibility use the following precautions when troubleshooting and/or repairing the unit.

a. Never remove, install or otherwise connect or disconnect pcb's and/or components without first turning the POWER switch to OFF.

b. Perform all repairs at a static-free work station.

c. Do not handle IC's or pcb's by their connectors.

d. Use static ground straps to discharge repair personnel.

e. Use conductive foam to store replacement or removed IC's.

f. Remove all plastic, vinyl and styrofoam products from the work area.

g. Use a grounded soldering iron.

4-59. A troubleshooting guide for the 1953A is given in Table 4-8. The guide is in the form of a tabular flow chart and is recommended for use in isolating a mainframe malfunction to a component group. Details necessary to troubleshoot a component group to the component level can be derived from the schematic diagrams given in Section 8 and the Theory of Operation in Section 3.

4-60. When troubleshooting the unit in accordance with Table 4-8. The following notes apply.

a. Do not start in the middle of the procedure. Any given step assumes that the previous steps have been completed.

b. All measurements using external test equipment are referenced to logic common unless otherwise specified.

c. All connectors referenced for measurement are accessible from the top of the unit when the dust cover is removed. See Figure 4-1 for Test point identification.

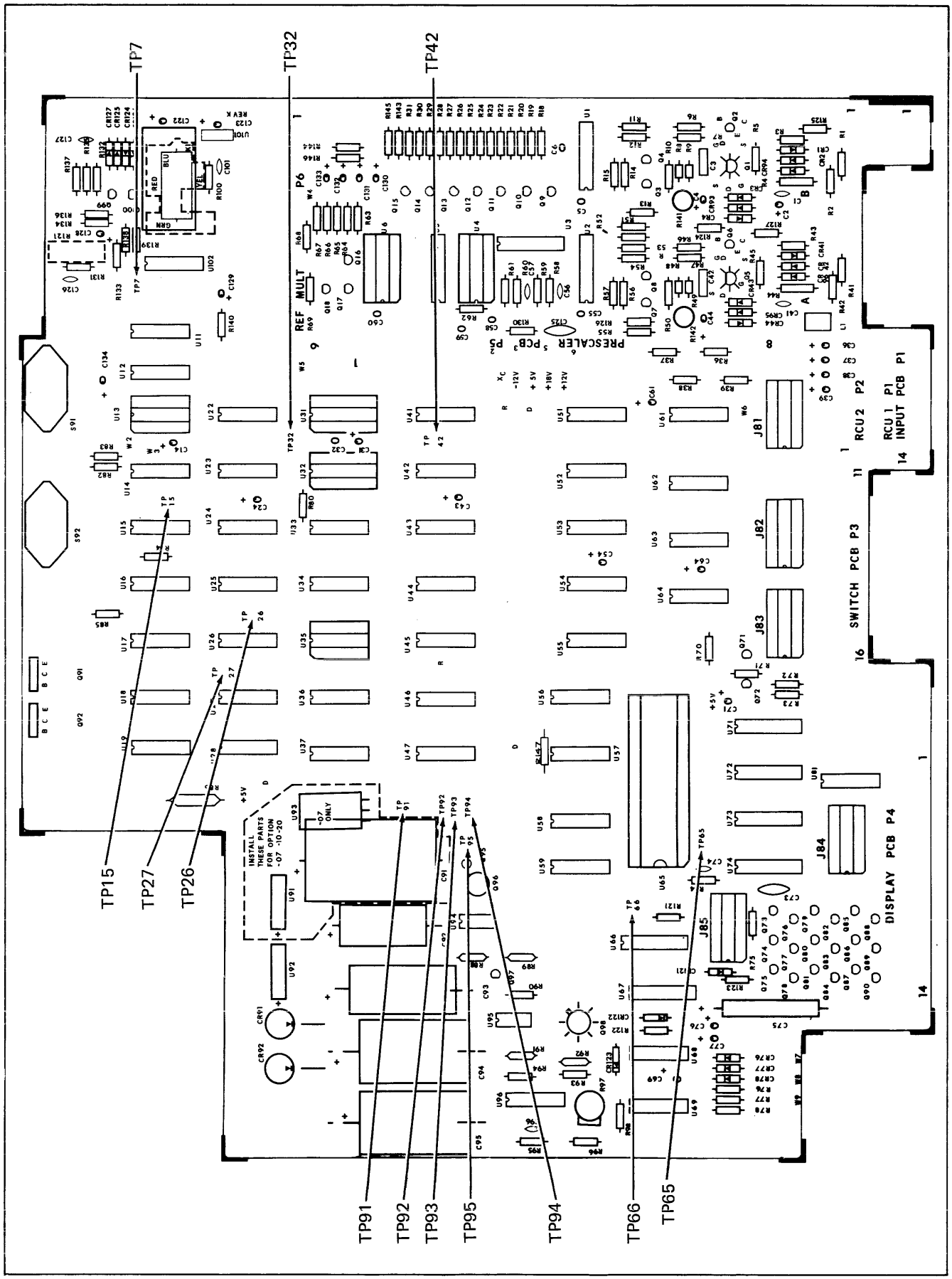

Figure 4-1. Test Point Locations, Main PCB

Table 4-8. Troubleshooting Guide

STEP NO.	INSTRUCTION	YES	NO	GO TO
1	Complete the set-up procedure given in paragraph 4-25.			2
2	Does the front panel display illuminate?	4	3	
3	Check power connection, fuse, 115/230 voltage selection switch, and/or the +5V dc power supply.			1
4	Execute steps a through c of the channel B Amplifier Test (part of the Performance Test).			5
5	Are both status indicators lit?	9	6	
6	Is one of the status indicators lit?	8	7	
7	Check + and – status indicator LED's and their drivers.			4
8	Check TRIG STAT LED's and Q11, Q12, Q13 and Q14 for channel B test. If channel A is being tested, check U61 and TRIG STAT LED's.			4
9	Execute the step d of the channel B Amplifier Test.			10
10	Do both status indicators remain on?	12	11	
11	Calibrate the channel's (A or B as req.) preset trigger level.			9
12	Execute steps e through f of the channel B Amplifier Test.			13
13	Do the status indicator LED's respond properly?	15	14	
14	Check the trigger level potentiometer.			12
15	Test channel A Amplifier by repeating steps 4 through 14 of this procedure and substituting channel A for channel B.			16
16	Perform steps a and b of the Display Test (part of Performance Test).			17
17	Are all of the measurement units displayed correctly?	19	18	
18	Check the measurement units LED's and U31, U52, U62, U63 and U64.			16
19	Are the decimal points correct?	21	20	
20	Check the control gates in the decimal point logic and the decimal point blanking and/or multiplexing logic.			16
21	Perform steps c through j of the Display Test.			22
22	Do all display decades respond correctly?	24	23	
23	If a segment of each display decade does not light, check the bcd-to-seven segment decoder, U71 and U72. If an entire digit will not light, check the associated strobe driver.			21
24	Does the OVERFLOW LED light when an overflow occurs?	26	25	
25	Check the overflow logic and the OVERFLOW LED.			21
26	Perform step k of the Display Test.			27
27	Does the display reset properly?	29	28	

Table 4-8. Troubleshooting Guide (cont)

STEP NO.	INSTRUCTION	YES	NO	GO TO
28	Check the memory update and counter reset control section, U66, U68 and U58.			26
29	Perform steps a through d of the Frequency A Test (part of Performance Test).			30
30	Are all measurements displayed correctly?	39	31	
31	Does the channel A input signal reach the main gate?	33	32	
32	Troubleshoot the channel A Input Amplifier.			29
33	Is the 10 MHz time base signal present at U11-14?	35	34	
34	Troubleshoot the Reference Generator.			29
35	Is the 10 kHz clock present at TP26?	37	36	
36	Check the reference frequency dividers U11 through U15, and/or the reference counter inputs selector gate U24, U33 and U41.			29
37	Is the gate signal present at the main gate, U6?	39	38	
38	Check the reference divider circuit and range select gate. Also check the clock input to the accumulator.			29
39	Perform steps a through e of the Ratio Test (part of Performance Test).			40
40	Are all measurements displayed correctly?	45	41	
41	Does the channel A output frequency appear at the output of U6-6?	43	42	
42	Troubleshoot the channel A input amplifier.			39
43	Does the channel B output frequency appear at TP26?	45	44	
44	Check channel B input amplifier and reference counter input selector.			39
45	Perform steps a through f of the Period A Test (part of Performance Test).			46
46	Are all measurements displayed correctly?	51	47	
47	Does the 10 MHz time base clock appear at U6-5?	49	48	
48	Check the operation of the accumulator input gate U41 and U23.			45
49	Does the channel A output frequency appear at TP26?	51	50	
50	Check the operation of the reference counter clock selector; U24, U33, U41 and U44.			45
51	Perform steps a through g of the Time Interval Test (part of Performance Test).			52
52	Are all measurements displayed correctly?	59	53	
53	Does the 10 MHz time base clock appear at the rear panel CLOCK OUTPUT connector?	55	54	
54	Troubleshoot the reference generator.			51
55	Does the front panel GATE LED cycle on and off?	57	56	
56	Check the gate selector and U67.			51
57	Does the display advance from zero?	59	58	

Table 4-8. Troubleshooting Guide (cont)

STEP NO.	INSTRUCTION	YES	NO	GO TO
58	Check the reference divider and the main gate.			51
59	This completes the troubleshooting procedure. The 1953A is operational.			----

Section 5
List of Replaceable Parts

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5-1 INTRODUCTION

5-2. This section contains an illustrated parts breakdown of the instrument. Components are listed alpha-numerically by assembly. Electrical components are listed by reference designation and mechanical components are listed by item number. Each listed part is show in an accompanying illustration.

5-3. Parts lists include the following information:

a. Reference Designation or Item Number.

b. Description of each part.

c. Fluke Stock Number.

d. Federal Supply Code for Manufacturers. (See Section 7 for Code-to-Name list.)

e. Manufacturer's Part Number or Type.

f. Total Quantity per assembly or component.

g. Recommended Quantity: This entry indicates the recommended number of spare parts necessary to support one to five instruments for a period of two years. This list presumes an availability of common electronic parts at the maintenance site. For maintenance for 1-year or more at an isolated site it is recommended that at least one of each assembly in the instrument be stocked. In the case of optional subassemblies, plug-ins, etc. that are not always part of the instrument, or are deviations from the basic instrument mode, the REC QTY column lists the recommended quantity of the item in that particular assembly.

5-4. HOW TO OBTAIN PARTS

5-5. Components may be ordered directly from the manufacturer by using the manufacturer's part number, or from the John Fluke Mfg. Co., Inc. factory or authorized representative by using the FLUKE STOCK NUMBER. In the event the part you order has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions, if necessary.

5-6. To ensure prompt and efficient handling of your order, include the following information:

a. Quantity

b. FLUKE Stock Number

c. Description

d. Reference Designation or Item Number

e. Printed Cirucit Board Part Number and Rev Letter

f. Instrument Model and Serial Number.

⊗ CAUTION

Indicated devices are subject to damage by static discharge.

Table 5-1. Final Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	FINAL ASSEMBLY, 1953A FIGURE 5-1						
A1	MAIN ASSEMBLY, STANDARD	396317	89536	396317	1		
A2	FRONT PANEL ASSEMBLY	396358	89536	396358	1		
A3	DISPLAY PCB ASSEMBLY	396218	89536	396218	1		
A4	SWITCH PCB ASSEMBLY	396119	89536	396119	1		
MP1	KNOB, PUTTY GREY	341388	89536	341388	2		
MP2	KNOB, POINTER, PUTTY GREY	341404	89536	341404	2		
MP3	KNOB, PUTTY GREY, GREEN DECAL	365015	89536	365015	1		
MP4	COVER, BOTTOM	395970	89536	395970	1		
MP5	COVER, TOP	395962	89536	395962	1		
MP6	FOOT, PLASTIC	292870	89536	292870	4		
MP7	INSERT, FOOT, NON-SKID	302026	89536	302026	4		
MP8	LENS	395921	89536	395921	1		
MP9	HANDLE, FRAME	398198	89536	398198	1		
MP10	GRIP, HANDLE	284836	89536	284836	2		
MP11	WASHER, FLAT, HANDLE	309054	89536	309054	2		
MP12	WASHER, SHOULDER, HANDLE	309047	89536	309047	2		
MP13	WASHER, SPRING, HANDLE	228981	89536	228981	2		
MP14	DECAL, HANDLE WASHER	285221	89536	285221	2		
MP15	LINE CORD (NOT SHOWN)	343723	89536	343723	1		
U7	TCXO (STANDARD OSCILLATOR)	461871	89536	461871	1		

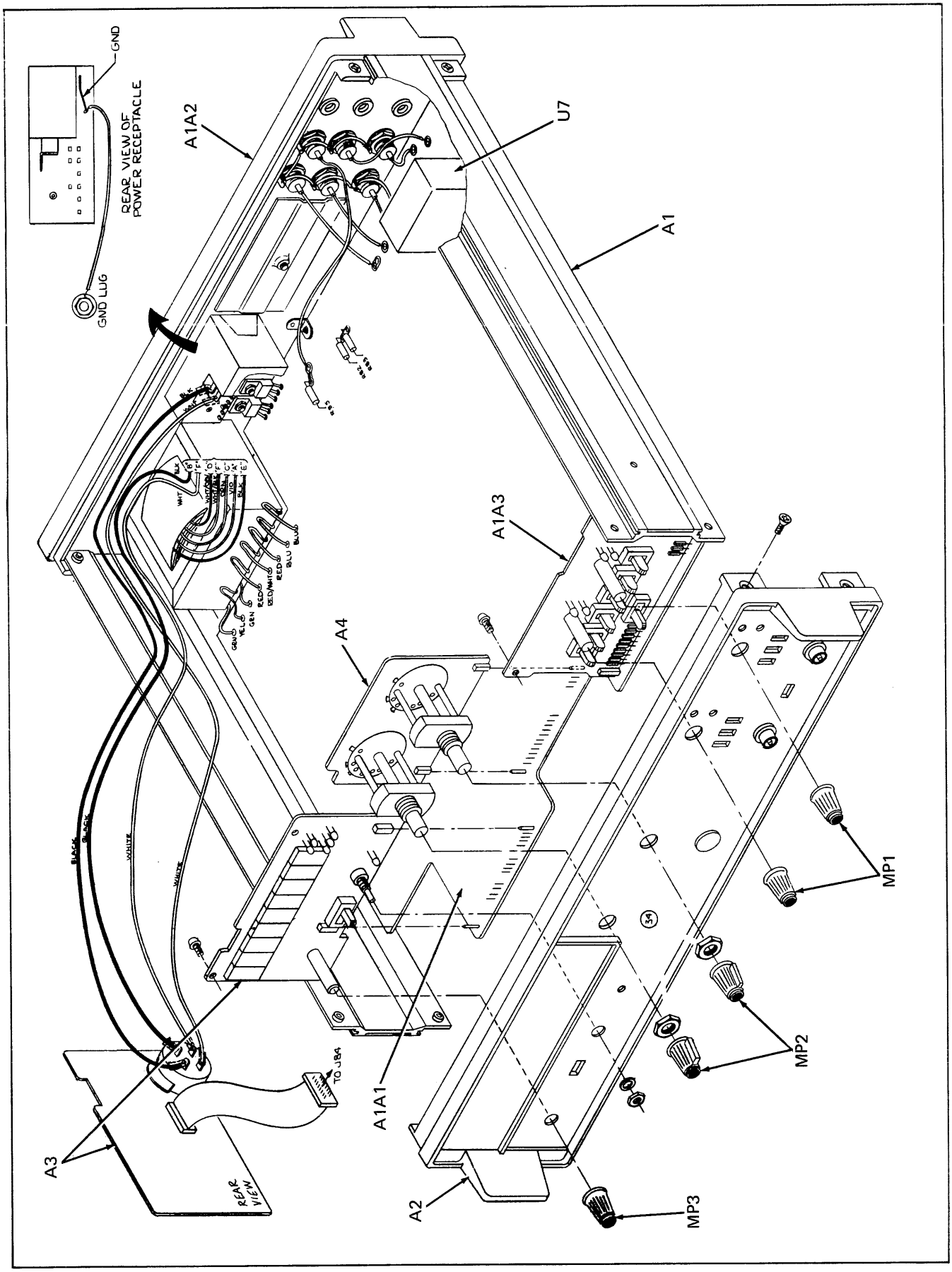

Figure 5-1. Final Assembly

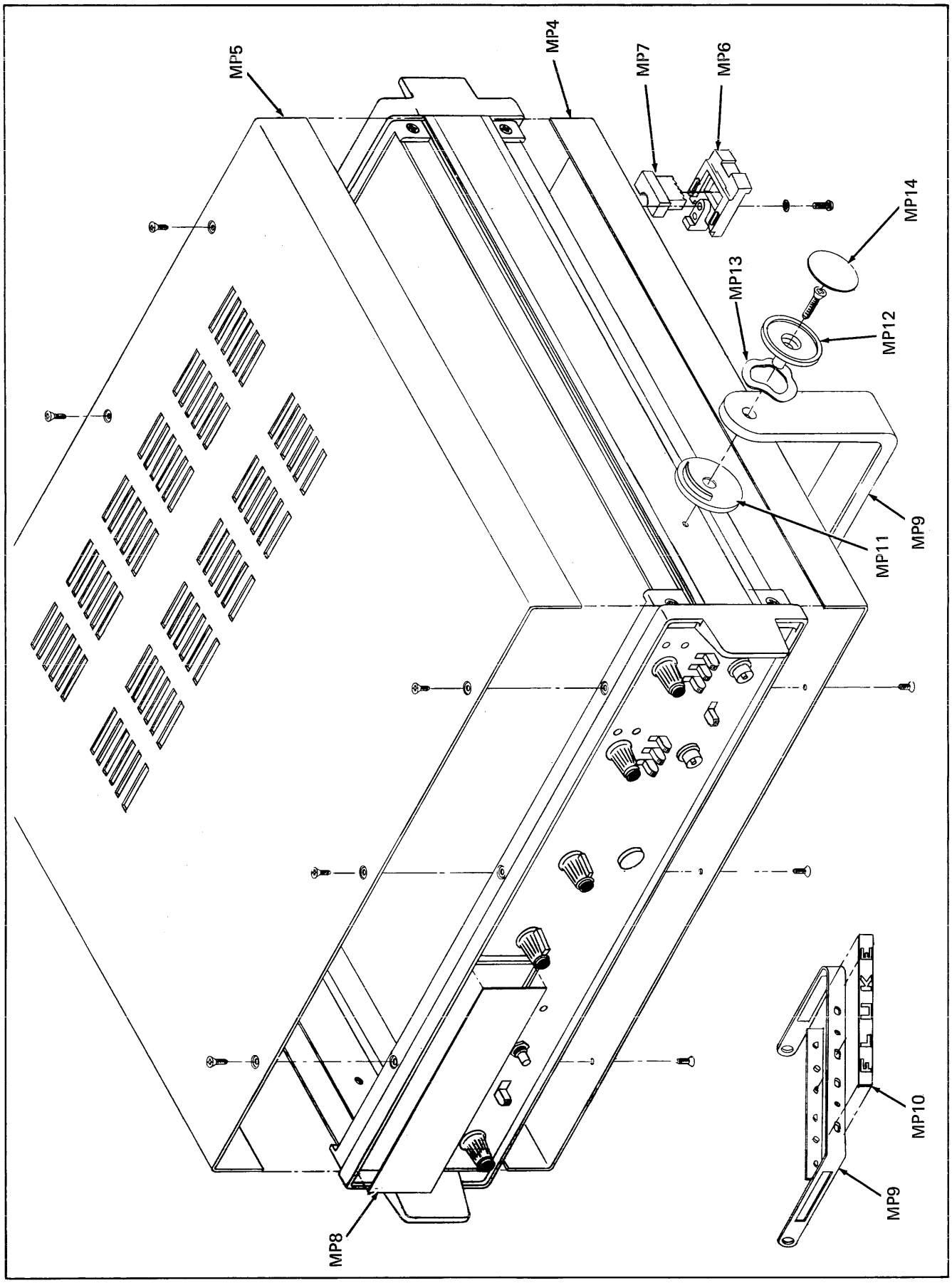

Figure 5-1. Final Assembly (cont)

Table 5-2. A1 Main Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A1	MAIN ASSEMBLY (1953A-4101) FIGURE 5-2	396317	89536	396317	REF		
A1A1	MAIN PCB ASSEMBLY	396093	89536	396093	1		
A1A2	REAR PANEL ASSEMBLY	396366	89536	396366	1		
A1A3	INPUT PCB ASSEMBLY	396127	89536	396127	1		
MP1	CHASSIS, SIDE, LEFT	395954	89536	395954	1		
MP2	CHASSIS, SIDE, RIGHT	395947	89536	395947	1		
MP3	DECAL, SIDE	401224	89536	401224	1		

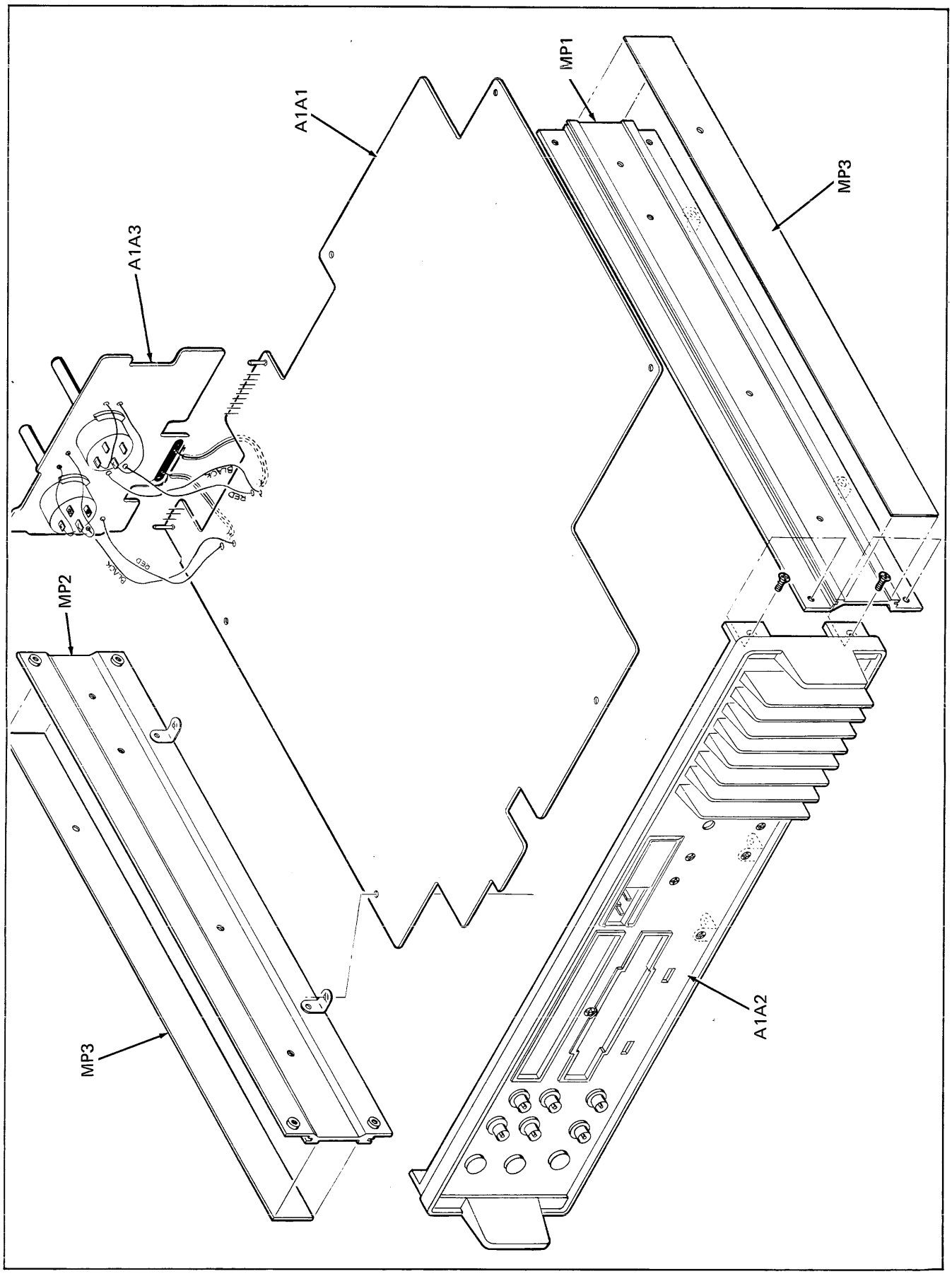

Figure 5-2. A1 Main Assembly

Table 5-3. A1A1 Main PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A1A1	⊗MAIN PCB ASSEMBLY (1953A-4001) FIGURE 5-3	396200	89536	396200	REF		
C1	CAP, CER, 47 PF +/-20%, 1000V	369132	56289	C030B102H470J	4		
C2	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA4	26		
C3	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C224K	2		
C4	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA4	REF		
C5	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA4	REF		
C6	CAP, CER. 0.01 UF +/-20%, 100V	407361	72982	8121-A100-W5R-103M	5		
C24	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA4	REF		
C31	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA4	REF		
C32	CAP, CER. 0.01 UF +/-20%, 100V	407361	72982	8121-A100-W5R-103M	REF		
C36	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA4	REF		
C38	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA4	REF		
C39	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA4	REF		
C41	CAP, CER, 47 PF +/-20%, 1000V	369132	56289	C030B102H470J	REF		
C42	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C224K	REF		
C43	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA4	REF		
C44	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA4	REF		
C54	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA4	REF		
C55	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA4	REF		
C56	CAP, CER, 47 PF +/-20%, 1000V	369132	56289	C030B102H470J	REF		
C57	CAP, CER, 47 PF +/-20%, 1000V	369132	56289	C030B102H470J	REF		
C58	CAP, CER. 0.01 UF +/-20%, 100V	407361	72982	8121-A100-W5R-103M	REF		
C59	CAP, CER. 0.01 UF +/-20%, 100V	407361	72982	8121-A100-W5R-103M	REF		
C60	CAP, CER. 0.01 UF +/-20%, 100V	407361	72982	8121-A100-W5R-103M	REF		
C61	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA4	REF		
C64	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA4	REF		
C69	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA4	REF		
C71	CAP, TA, 22 UF +/-20%, 25V	357780	56289	196D226X0025-PE4	1		
C73	CAP, CER, 1000 PF +/-10%, 500V	357806	56289	C106B102G102	2		
C74	CAP, CER, 10 PF +/-10%, 3 KV	105536	56289	40C362A1	1		
C75	CAP, ELECT, 220 UF, -10/+50%, 35V	369181	25403	ET221X025A00	1	1	
C76	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA4	REF		
C77	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA4	REF		
C92	CAP, ELECT, 470 UF, -10/+50%, 25V	168153	73445	ET471X0025A0-1	1	1	
C93	CAP, ELECT, 1000 UF, -10/+100%, 40V	340901	80031	3050FJ202U015	1	1	
C94	CAP, ELECT, 4700 UF, -10/+100%, 15V	379370	80031	3050HJ472U015	1	1	
C95	CAP, ELECT, 4700 UF, -10/+100%, 15V	379370	80031	3050HJ472U015	REF		
C96	CAP, CER, 500 PF +/-10%, 500V	105692	71590	2DDH60N501K	1		
C101	CAP, CER, 0.01UF, -20/+100%, 40V	369579	72982	8121-A050-651-103Z	1		
C125	CAP, CER, 1000 PF +/-10%, 500V	357806	56289	C106B102G102	REF		
C126	CAP, CER, 1200 PF +/-10%, 500V	106732	71590	CF-122	1		
C127	CAP, CER, 0.05 UF, -20/+80%, 25V	148924	72982	5855-000-Y5U0-104Z	1		
C128	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA4	REF		
C129	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA4	REF		
C130	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA4	REF		
C131	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA4	REF		
C132	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA4	REF		
C133	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA4	REF		
C134	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA4	REF		

Table 5-3. A1A1 Main PCB Assembly (cont)

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
CR1	DIODE, ZENER, 3.3V +5%	309799	07263	1N746A	6	1	
CR2	DIODE, SI	381806	07263	1N3062	4	1	
CR3	DIODE, SI	381806	07263	1N3062	REF		
CR4	DIODE, ZENER, 3.3V +5%	309799	07263	1N746A	REF		
CR41	DIODE, ZENER, 3.3V +5%	309799	07263	1N746A	REF		
CR42	DIODE, SI	381806	07263	1N3062	REF		
CR43	DIODE, SI	381806	07263	1N3062	REF		
CR44	DIODE, ZENER, 3.3V +5%	309799	07263	1N746A	REF		
CR76	DIODE, SI	203323	07910	1N4448	8	2	
CR77	DIODE, SI	203323	07910	1N4448	REF		
CR78	DIODE, SI	203323	07910	1N4448	REF		
CR85	DIODE BRIDGE,100V,2A,FULLWAVE(CR85-CR88)	296509	14936	KBF02	REF		
CR86	DIODE BRIDGE,100V,2A,FULLWAVE(CR85-CR88)	296509	14936	KBF02	REF		
CR87	DIODE BRIDGE,100V,2A,FULLWAVE(CR85-CR88)	296509	14936	KBF02	REF		
CR88	DIODE BRIDGE,100V,2A,FULLWAVE(CR85-CR88)	296509	14936	KBF02	REF		
CR91	DIODE, SI	187716	04713	MR1032B/1N4999	2	1	
CR92	DIODE, SI	187716	04713	MR1032B/1N4999	REF		
CR93	DIODE, SI	272252	07263	FD333	4	1	
CR94	DIODE, SI	272252	07263	FD333	REF		
CR95	DIODE, SI	272252	07263	FD333	REF		
CR96	DIODE, SI	272252	07263	FD333	REF		
CR121	DIODE, SI	203323	07910	1N4448	REF		
CR122	DIODE, SI	203323	07910	1N4448	REF		
CR123	DIODE, SI	203323	07910	1N4448	REF		
CR124	DIODE, SI	203323	07910	1N4448	REF		
CR125	DIODE, SI	203323	07910	1N4448	REF		
CR126	DIODE, ZENER, 3.3V +5%	309799	07263	1N746A	REF		
CR127	DIODE, ZENER, 3.3V +5%	309799	07263	1N746A	REF		
H1	CONNECTOR PIN, MALE	376574	00779	3-87022-1	60		
H2	CONNECTOR PIN, TEST POINT	379438	00779	1-87022-0	15		
J81	SOCKET, IC, 16 PIN DIP	387324	91506	316G37D	5		
J82	SOCKET, IC, 16 PIN DIP	387324	91506	316G37D	REF		
J83	SOCKET, IC, 16 PIN DIP	387324	91506	316G37D	REF		
J84	SOCKET, IC, 16 PIN DIP	387324	91506	316G37D	REF		
J85	SOCKET, IC, 16 PIN DIP	387324	91506	316G37D	REF		
L1	INDUCTOR, 6-TURN	320911	89536	320911	1		
Q1	XSTR, DUAL FET, N-CHANNEL	379271	17856	E421	2	1	
Q2	XSTR, SI, NPN	333898	04713	MPSH10	2	1	
Q3	XSTR, SI, PNP	369629	07263	2N5771	11	3	
Q4	XSTR, SI, PNP	369629	07263	2N5771	REF		
Q5	XSTR, DUAL FET, N-CHANNEL	379271	17856	E421	REF		
Q6	XSTR, SI, NPN	333898	04713	MPSH10	REF		
Q7	XSTR, SI, PNP	369629	07263	2N5771	REF		
Q8	XSTR, SI, PNP	369629	07263	2N5771	REF		
Q9	XSTR, SI, PNP	369629	07263	2N5771	REF		
Q10	XSTR, SI, PNP	369629	07263	2N5771	REF		
Q11	XSTR, SI, PNP	369629	07263	2N5771	REF		
Q13	XSTR, SI, NPN	369645	07263	2N4274	2	1	
Q14	XSTR, SI, NPN	369645	07263	2N4274	REF		
Q15	XSTR, SI, PNP	369603	07263	2N4257	1	1	

Table 5-3. A1A1 Main PCB Assembly (cont)

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
Q16	XSTR, SI, PNP	369629	07263	2N5771	REF		
Q17	XSTR, SI, PNP	369629	07263	2N5771	REF		
Q18	XSTR, SI, PNP	369629	07263	2N5771	REF		
Q71	XSTR, SI PNP	218396	04713	2N3904	12	3	
Q72	XSTR, SI PNP	218396	04713	2N3904	REF		
Q73	XSTR, SI PNP	218396	04713	2N3904	REF		
Q74	XSTR, SI PNP	218396	04713	2N3904	REF		
Q75	XSTR, SI PNP	218396	04713	2N3904	REF		
Q76	XSTR, SI, PNP	352369	12040	2N4403	10	2	
Q77	XSTR, SI, PNP	352369	12040	2N4403	REF		
Q78	XSTR, SI, PNP	352369	12040	2N4403	REF		
Q79	XSTR, SI PNP	218396	04713	2N3904	REF		
Q80	XSTR, SI PNP	218396	04713	2N3904	REF		
Q81	XSTR, SI PNP	218396	04713	2N3904	REF		
Q82	XSTR, SI, PNP	352369	12040	2N4403	REF		
Q83	XSTR, SI, PNP	352369	12040	2N4403	REF		
Q84	XSTR, SI, PNP	352369	12040	2N4403	REF		
Q85	XSTR, SI PNP	218396	04713	2N3904	REF		
Q86	XSTR, SI PNP	218396	04713	2N3904	REF		
Q87	XSTR, SI PNP	218396	04713	2N3904	REF		
Q88	XSTR, SI, PNP	352369	12040	2N4403	REF		
Q89	XSTR, SI, PNP	352369	12040	2N4403	REF		
Q90	XSTR, SI, PNP	352369	12040	2N4403	REF		
Q95	XSTR, SI PNP	218396	04713	2N3904	REF		
Q96	XSTR, SI, NPN	150359	07263	2N3053	1	1	
Q97	XSTR, SI, PNP	35269	12040	2N4403	REF		
Q98	XSTR, SI, PNP	269076	04713	2N4890	1	1	
Q99	XSTR, SI NPN	195974	04713	2N3906	2		
Q100	XSTR, SI NPN	195974	04713	2N3906	REF		
R1	RES, COMP, 180K +/-5%, 1/4W	193441	01121	CB1845	2		
R2	RES, COMP, 22 +/-5%, 1/4W	147884	01121	CB2205	2		
R3	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	6		
R4	RES, COMP, 120K +/-5%, 1/2W	108779	01121	EB1245	2		
R5	RES, COMP, 180 +/-5%, 1/4W	147942	01121	CB1813	2		
R6	RES, COMP, 3.3K +/-5%, 1/4W	148056	01121	CB3325	3		
R7	RES, COMP, 2.7K +/-5%, 1/4W	170720	01121	CB2725	2		
R8	RES, COMP, 430 +/-5%, 1/8W	461012	01121	BB4315	4		
R9	RES, COMP, 430 +/-5%, 1/8W	461012	01121	BB4315	REF		
R10	RES, COMP, 150 +/-5%, 1/4W	147934	01121	CB1515	3		
R11	RES. COMP, 560 +/-5%, 1/4W	147991	01121	CB5615	5		
R12	RES, COMP, 820 +/-5%, 1/4W	148015	01121	CB8215	5		
R13	RES, COMP, 270 +/-5%, 1/4W	160804	01121	CB2715	5		
R14	RES, COMP, 820 +/-5%, 1/4W	148015	01121	CB8215	REF		
R15	RES. COMP, 560 +/-5%, 1/4W	147991	01121	CB5615	REF		
R18	RES, COMP, 220 +/-5%, 1/4W	147959	01121	CB2215	4		
R19	RES, COMP, 100 +/-5%, 1/4W	147926	01121	CB1015	12		
R20	RES, COMP, 330 +/-5%, 1/4W	147967	01121	CB3315	4		
R21	RES, COMP, 270 +/-5%, 1/4W	160804	01121	CB2715	REF		
R22	RES, COMP, 100 +/-5%, 1/4W	147926	01121	CB1015	REF		

Table 5-3. A1A1 Main PCB Assembly (cont)

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R23	RES, COMP, 390 +/-5%, 1/4W	147975	01121	CB3915	1		
R24	RES, COMP, 100 +/-5%, 1/4W	147926	01121	CB1015	REF		
R25	RES, COMP, 270 +/-5%, 1/4W	160804	01121	CB2715	REF		
R26	RES, COMP, 100 +/-5%, 1/4W	147926	01121	CB1015	REF		
R27	RES, COMP, 100 +/-5%, 1/4W	147926	01121	CB1015	REF		
R28	RES, COMP, 3.9K +/-5%, 1/4W	148064	01121	CB3925	1		
R29	RES, COMP, 5.6K +/-5%, 1/4W	148080	01121	CB5625	7		
R30	RES, COMP, 21 +/-5%, 1/4W	229484	01121	CB2135	2		
R31	RES, COMP, 21 +/-5%, 1/4W	229484	01121	CB2135	REF		
R36	RES, COMP, 56 +/-5%, 1/4W	147900	01121	CB5605	5		
R37	RES, COMP, 56 +/-5%, 1/4W	147900	01121	CB5605	REF		
R38	RES, COMP, 56 +/-5%, 1/4W	147900	01121	CB5605	REF		
R39	RES, COMP, 56 +/-5%, 1/4W	147900	01121	CB5605	REF		
R41	RES, COMP, 180K +/-5%, 1/4W	193441	01121	CB1845	REF		
R42	RES, COMP, 22 +/-5%, 1/4W	147884	01121	CB2205	REF		
R43	RES, COMP, 680 +/-5%, 1/4W	148007	01121	CB6815	1		
R44	RES, COMP, 120K +/-5%, 1/2W	108779	01121	EB1245	REF		
R45	RES, COMP, 180 +/-5%, 1/4W	147942	01121	CB1813	REF		
R46	RES, COMP, 3.3K +/-5%, 1/4W	148056	01121	CB3325	REF		
R47	RES, COMP, 2.7K +/-5%, 1/4W	170720	01121	CB2725	REF		
R48	RES, COMP, 430 +/-5%, 1/8W	461012	01121	BB4315	REF		
R49	RES, COMP, 430 +/-5%, 1/8W	461012	01121	BB4315	REF		
R50	RES, COMP, 150 +/-5%, 1/4W	147934	01121	CB1515	REF		
R51	RES, COMP, 330 +/-5%, 1/4W	147967	01121	CB3315	REF		
R52	RES, COMP, 330 +/-5%, 1/4W	147967	01121	CB3315	REF		
R53	RES. COMP, 560 +/-5%, 1/4W	147991	01121	CB5615	REF		
R54	RES, COMP, 820 +/-5%, 1/4W	148015	01121	CB8215	REF		
R55	RES, COMP, 270 +/-5%, 1/4W	160804	01121	CB2715	REF		
R56	RES, COMP, 820 +/-5%, 1/4W	148015	01121	CB8215	REF		
R57	RES. COMP, 560 +/-5%, 1/4W	147991	01121	CB5615	REF		
R58	RES, COMP, 220 +/-5%, 1/4W	147959	01121	CB2215	REF		
R59	RES, COMP 240 +/-5%, 1/4W	221895	01121	CB1225	2		
R60	RES, COMP, 220 +/-5%, 1/4W	147959	01121	CB2215	REF		
R61	RES, COMP 240 +/-5%, 1/4W	221895	01121	CB1225	REF		
R63	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	3		
R64	RES, COMP, 820 +/-5%, 1/4W	148015	01121	CB8215	REF		
R65	RES, COMP, 220 +/-5%, 1/4W	147959	01121	CB2215	REF		
R66	RES, COMP, 150 +/-5%, 1/4W	147934	01121	CB1515	REF		
R67	RES, COMP, 1.2K +/-5%, 1/4W	190371	01121	CB1225	1		
R68	RES. COMP, 560 +/-5%, 1/4W	147991	01121	CB5615	REF		
R69	RES, COMP, 270 +/-5%, 1/4W	160804	01121	CB2715	REF		
R70	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	REF		
R71	RES, COMP, 5.6K +/-5%, 1/4W	148080	01121	CB5625	REF		
R72	RES, COMP, 47 +/-5%, 1/4W	147982	01121	CB4705	1		
R73	RES, COMP, 5.6K +/-5%, 1/4W	148080	01121	CB5625	REF		
R74	RES, COMP, 100K +/-5%, 1/4W	148189	01121	CB1045	1		
R75	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R76	RES, COMP, 5.6K +/-5%, 1/4W	148080	01121	CB5625	REF		
R77	RES, COMP, 2.2K +/-5%, 1/4W	148049	01121	CB2225	2		
R78	RES, COMP, 10K +/-5%, 1/4W	148106	01121	CB1035	3		

Table 5-3. A1A1 Main PCB Assembly (cont)

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R80	RES, COMP, 10K +/-5%, 1/4W	148106	01121	CB1035	REF		
R82	RES, COMP, 100 +/-5%, 1/4W	147926	01121	CB1015	REF		
R83	RES, COMP, 100 +/-5%, 1/4W	147926	01121	CB1015	REF		
R84	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	REF		
R85	RES, COMP, 100 +/-5%, 1/4W	147926	01121	CB1015	REF		
R86	RES, WW, 0.2 +/-5%, 2W	352914	75042	AS-2	1	1	
R88	RES, MF, 10K +/-1%, 1/8W	168260	91637	MFF1-81002F	3		
R89	RES, MF, 14K +/-1%, 1/8W	379057	91637	MFF1-81402F	1		
R90	RES, COMP, 2.7 +/-5%, 1/4W	246744	01121	CB27G5	1		
R91	RES, MF, 10K +/-1%, 1/8W	168260	91637	MFF1-81002F	REF		
R92	RES, MF, 10K +/-1%, 1/8W	168260	91637	MFF1-81002F	REF		
R93	RES, MF, 1 +/-5%, 1/4W	357665	80031	CR251-4P51E	1		
R94	RES, COMP, 56 +/-5%, 1/4W	147900	01121	CB5605	REF		
R95	RES, COMP, 3.3K +/-5%, 1/4W	148056	01121	CB3325	REF		
R96	RES, COMP, 5.6K +/-5%, 1/4W	148080	01121	CB5625	REF		
R97	RES, VAR, 1K +/-20%, 0.2W	402685	PIHER	PT10V-1K	1		
R98	RES, COMP, 5.6K +/-5%, 1/4W	148080	01121	CB5625	REF		
R100	RES, COMP, 10 +/-5%, 1/4W	147868	01121	CB1005	1		
R121	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	REF		
R122	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	REF		
R123	RES, COMP, 10K +/-5%, 1/4W	148106	01121	CB1035	REF		
R124	RES, COMP, 27K +/-5%, 1/4W	148148	01121	CB2735	4		
R125	RES, COMP, 27K +/-5%, 1/4W	148148	01121	CB2735	REF		
R126	RES, COMP, 27K +/-5%, 1/4W	148148	01121	CB2735	REF		
R127	RES, COMP, 27K +/-5%, 1/4W	148148	01121	CB2735	REF		
R130	RES, COMP, 100 +/-5%, 1/4W	147926	01121	CB1015	REF		
R131	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R132	RES, COMP, 100 +/-5%, 1/4W	147926	01121	CB1015	REF		
R133	RES, COMP, 100 +/-5%, 1/4W	147926	01121	CB1015	REF		
R134	RES, COMP, 510 +/-5%, 1/4W	218032	01121	CB5115	1		
R135	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	REF		
R136	RES, COMP, 1.8K +/-5%, 1/4W	175042	01121	CB1825	1		
R137	RES, COMP, 2.2K +/-5%, 1/4W	148049	01121	CB2225	REF		
R138	RES, COMP, 100 +/-5%, 1/4W	147926	01121	CB1015	REF		
R139	RES, COMP, 330 +/-5%, 1/4W	147967	01121	CB3315	REF		
R140	RES, COMP, 39 +/-5%, 1/4W	193391	01121	CB3905	1		
R141	RES, VAR, 100 +/-20%, 1/2W	193052	80031	ET50W101	2		
R142	RES, VAR, 100 +/-20%, 1/2W	193052	80031	ET50W101	REF		
R143	RES, MF, 10.5K +/-1%, 1/4W	234096	91637	MFF1-41052F	4		
S91	SWITCH, SLIDE, DPDT	404814	79727	G1-52	2	1	
S92	SWITCH, SLIDE, DPDT	404814	79727	G1-52	REF		
U1	IC, ECL TRIPLE DIFF LINE RECEIVER	402727	07263	F95116DC	2	1	
U2	IC, ECL TRIPLE DIFF LINE RECEIVER	402727	07263	F95116DC	REF		
U3	RES, NETWORK, 680 +/-5%, 1/4 (OR 8 DISCRETE RESISTORS P/N 147892)	402644	89536	402644	2	1	
U4	IC, ECL, TRIPLE 4-3-3-INPUT OR GATE	402735	07263	F95106DC	1	1	
U5	RES, NETWORK, 680 +/-5%, 1/4 (OR 8 DISCRETE RESISTORS P/N 147892)	402644	89536	402644	REF REF		
U6	IC, ECL, EDGE-TRIGGERED JK FLIP-FLOP	402743	07263	F95029DC	1	1	
U7	OSCILLATOR, CRYSTAL (SEE FINAL ASSY)						

Table 5-3. A1A1 Main PCB Assembly (cont)

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U11	IC, TTL, MSI, DECADE COUNTER	402545	01295	SN74LS90N	3	1	
U12	IC, TTL, MSI, DECADE COUNTER	402545	01295	SN74LS90N	REF		
U14	IC, TTL, QUAD 2-INPUT AND GATE	393033	01295	SN74LS00N	6	2	
U15	IC, TTL, MSI, DECADE COUNTER	402545	01295	SN74LS90N	REF		
U16	IC, TTL, HEX INVERTER	393058	01295	SN74LS04N	4	1	
U17	IC, TTL, DECADE COUNTER	473314	01295	SN7490AN	1	1	
U18	IC, TTL, MSI, DECADE COUNTER	293159	01295	SN7490N	4		
U19	IC, TTL, MSI, DECADE COUNTER	293159	01295	SN7490N	REF		
U22	IC, TTL, QUAD 2-INPUT EXCLUSIVE OR GATE	379297	01295	SN74S86N	1	1	
U23	IC, TTL, QUAD 2-INPUT AND GATE	393033	01295	SN74LS00N	REF		
U24	IC, TTL,4-2-3-2-INPUT AND-OR-INVERT GATE	379289	01295	SN74S64N	2	1	
U25	IC, TTL, DUAL D-FLIP-FLOP	418269	01295	SN74S74N	1	1	
U26	IC, TTL, QUAD 2-INPUT OR GATE	393108	01295	SN74LS32N	2	1	
U27	IC, TTL, 8-INPUT NAND	407338	01295	SN74S30N	1	1	
U28	IC, TTL, QUAD 2-INPUT OR GATE	393108	01295	SN74LS32N	REF		
U31	IC, TTL, DUAL J-K FLIP-FLOP	363440	01295	SN74S112N	2	1	
U32	IC, TTL, DUAL J-K FLIP-FLOP	363440	01295	SN74S112N	REF		
U33	IC, TTL, HEX INVERTER	393058	01295	SN74LS04N	REF		
U34	IC, TTL, DUAL D-TYPE EDGE-TRIGGERED F-F	393124	01295	SN74LS74N	1	1	
U35	IC, TTL, QUAD 2-INPUT NOR GATE	403626	01295	SN74S02N	1	1	
U36	IC, TTL, MSI, DECADE COUNTER	293159	01295	SN7490N	REF		
U37	IC, TTL, MSI, DECADE COUNTER	293159	01295	SN7490N	REF		
U41	IC, TTL, TRIPLE 3-INPUT NAND GATE	393074	01295	SN74LS10N	1	1	
U42	IC, TTL,4-2-3-2-INPUT AND-OR-INVERT GATE	379289	01295	SN74S64N	REF		
U43	IC, TTL, QUAD 2-INPUT NOR GATE	288845	01295	SN7402N	1		
U44	IC, TTL, QUAD 2-INPUT AND GATE	393033	01295	SN74LS00N	REF		
U45	IC, TTL, QUAD 2-INPUT AND GATE	393033	01295	SN74LS00N	REF		
U46	IC, TTL, QUAD 2-INPUT OR GATE	393108	01295	SN74LS32N	1	1	
U47	IC, TTL, QUAD 2-INPUT NAND GATE OPEN COLLECTORS	292961	01295	SN7403N	2	1	
U51	IC, TTL, 8-INPUT NAND GATE	404889	01295	SN74LS30N	1	1	
U52	IC, TTL, QUAD 2-INPUT AND GATE	393033	01295	SN74LS00N	REF		
U53	IC, TTL, QUAD 2-INPUT AND GATE	393033	01295	SN74LS00N	REF		
U54	IC, TTL, QUAD 2-INPUT NOR GATE	393041	01295	SN74LS02N	3	1	
U55	IC, TTL, QUAD 2-INPUT NOR GATE	393041	01295	SN74LS02N	REF		
U56	IC, TTL, QUAD 2-INPUT NAND GATE OPEN COLLECTORS	292961	01295	SN7403N	REF REF		
U57	IC, TTL, DECADE COUNTER	320754	01295	SN74196N	1	1	
U58	IC, TTL, HEX INVERTER	393058	01295	SN74LS04N	REF		
U59	IC, TTL, DUAL D-TYPE EDGE-TRIGGERED F-F	310227	01295	SN7474N	1		
U61	IC, TTL, HEX INVERTER, OPEN COLLECTORS	379305	01295	SN7405N	1	1	
U62	IC, TTL, QUAD 2-INPUT AND GATE	292953	01295	SN7400N	1		
U63	IC, TTL, TRIPLE 3-INPUT NAND GATE	292995	01295	SN7410N	1		
U64	IC, TTL, HEX INVERTER	393058	01295	SN74LS04N	REF		
U65	IC, MOS, 2.5 MHZ, SEVEN DECADE COUNTER	380238	89536	380238	1	1	
U66	IC, TTL, DUAL 5-BIT SHIFT REGISTER	293399	01295	SN7496N	1	1	
U67	IC, TTL, DUAL MONOSTABLE MULTIVIBRATOR	310235	01295	SN74123N	1	1	
U68	IC, TTL, QUAD 2-INPUT NOR GATE	393041	01295	SN74LS02N	REF		
U69	IC, TTL, DUAL 4-INPUT NAND GATE	393280	01295	SN74LS20N	1	1	
U71	IC, TTL, BCD-TO-7 SEGMENT DECODER/DRIVER	340109	01295	SN7447N	2	1	

Table 5-3. A1A1 Main PCB Assembly (cont)

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U72	IC, TTL, BCD-TO-7 SEGMENT DECODER/DRIVER	340109	01295	SN7447N	REF		
U73	⊗IC, CMOS, HEX BUFFER/INVERTER	381830	95303	SD4050AE	2	1	
U74	⊗IC, CMOS, HEX BUFFER/INVERTER	381830	95303	SD4050AE	REF		
U81	RES, NETWORK, 47 +/-5%, 1/4W (OR 7 DISCRETE RESISTORS, P/N 147892)	402636	89536	402636	1	1	
U92	DIODE BRIDGE,100V,2A,FULLWAVE(CR85-CR88)	296509	14936	KBF02	1	1	
U94	IC, LINEAR, OP AMP	402750	07263	741TC	2	1	
U95	IC, LINEAR, OP AMP	402750	07263	741TC	REF		
U96	IC, LINEAR, VOLTAGE REGULATOR	379420	04713	MC1723C	1	1	
U102	IC, TTL, DUAL NAND SCHMITT TRIGGER	453076	01295	SN74LS13	1		
	HEAT SINK, XSTR Q98	104646	05820	204CB	1		
	TRANSIPAD, Q96, Q98	152207	07047	10123-DAP	2		
XU4	SOCKET, IC, 16-PIN DIP	370312	01295	C931602	4		
XU6	SOCKET, IC, 16-PIN DIP	370312	01295	C931602	REF		
XU13	SOCKET, IC, 14-PIN DIP	291542	00779	582527-1	2		
XU31	SOCKET, IC, 16-PIN DIP	370312	01295	C931602	REF		
XU32	SOCKET, IC, 16-PIN DIP	370312	01295	C931602	REF		
XU35	SOCKET, IC, 14-PIN DIP	291542	00779	582527-1	REF		
XU65	SOCKET, IC, 40-PIN DIP	386060	89536	386060	1		

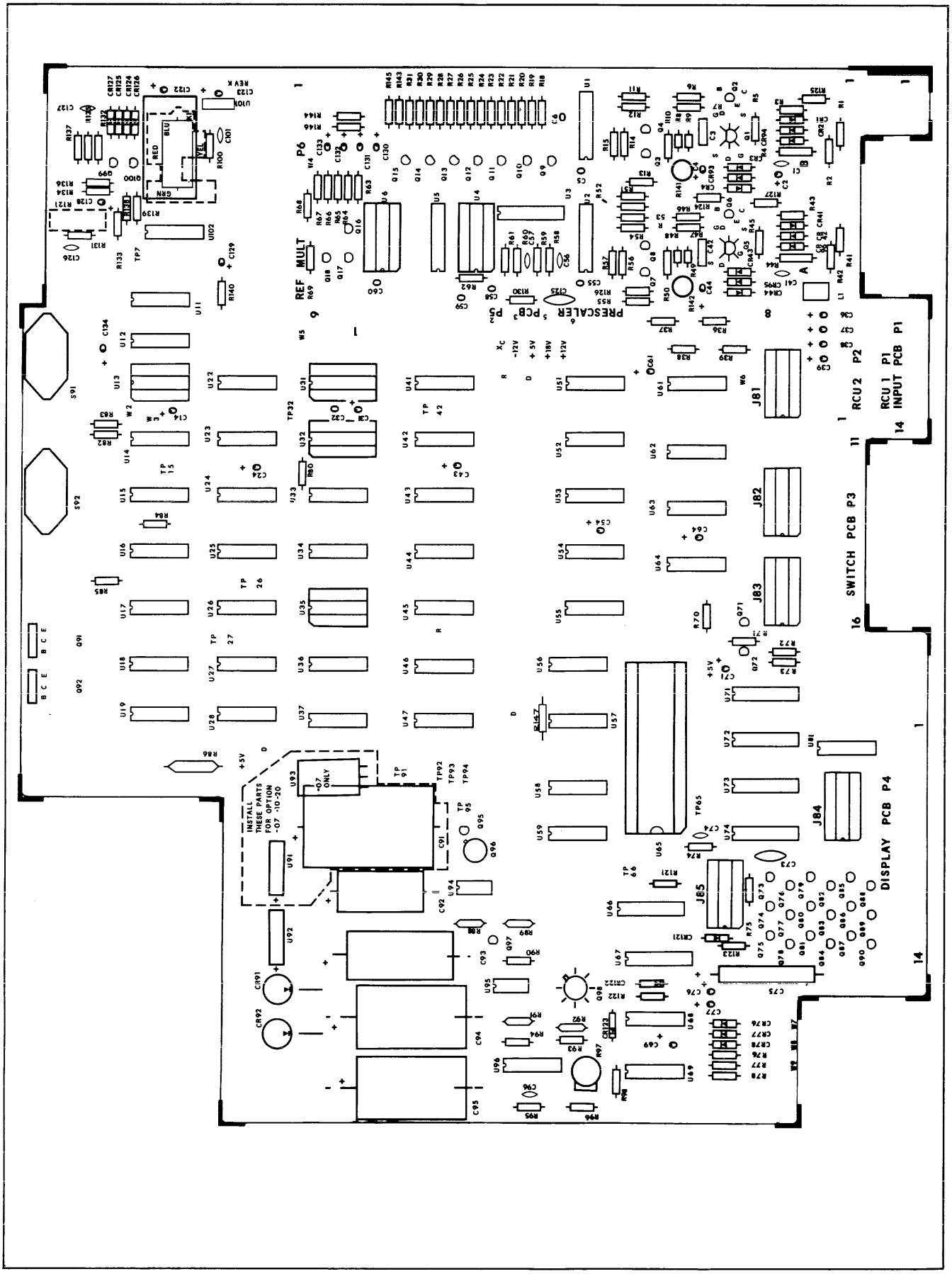

Figure 5-3. A1A1 Main PCB Assembly

Table 5-4. A1A2 Rear Panel Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A1A2	REAR PANEL ASSEMBLY (1953A-4452) FIGURE 5-4	396366	89536	396366	REF		
F91	FUSE, 1 AMP	369819	71400	AGC1	1		
J91	CONNECTOR, BNC	152033	13511	UG1094A/U	6		
J92	CONNECTOR, BNC	152033	13511	UG1094A/U	REF		
J93	CONNECTOR, BNC	152033	13511	UG1094A/U	REF		
J97	CONNECTOR, BNC	152033	13511	UG1094A/U	REF		
J98	CONNECTOR, BNC	152033	13511	UG1094A/U	REF		
J99	CONNECTOR, BNC	152033	13511	UG1094A/U	REF		
MP1	REAR PANEL	449469	89536	449469	1		
MP2	DECAL, REAR PANEL	452748	89536	452748	1		
MP3	COVER, CONNECTOR PORT	398024	89536	398024	1		
MP4	PLUG, BUTTON	101766	83330	654	1		
MP5	LUG, SOLDER, BNC	441972	83330	761	6		
MP6	BRACKET, ANGLE	401869	89536	401869	2		
MP7	PLUG, BUTTON	398206	89536	398206	3		
P96	PWR RECEPTACLE ASSY (S93,P96,XF91) FUSEHOLDER & VOLTAGE CHANGE OVER SWITCH	446328	89536	446328	1		
Q91	XSTR, SI, PNP	369660	01295	TIP32	2		
Q92	XSTR, SI, PNP	369660	01295	TIP32	REF		
S93	PWR RECEPTACLE ASSY (S93,P96,XF91) FUSEHOLDER & VOLTAGE CHANGE OVER SWITCH	446328	89536	446328	REF REF		
T91	TRANSFORMER, POWER	449843	89536	449843	1		
XF91	PWR RECEPTACLE ASSY (S93,P96,XF91) FUSEHOLDER & VOLTAGE CHANGE OVER SWITCH	446328	89536	446328	REF REF		

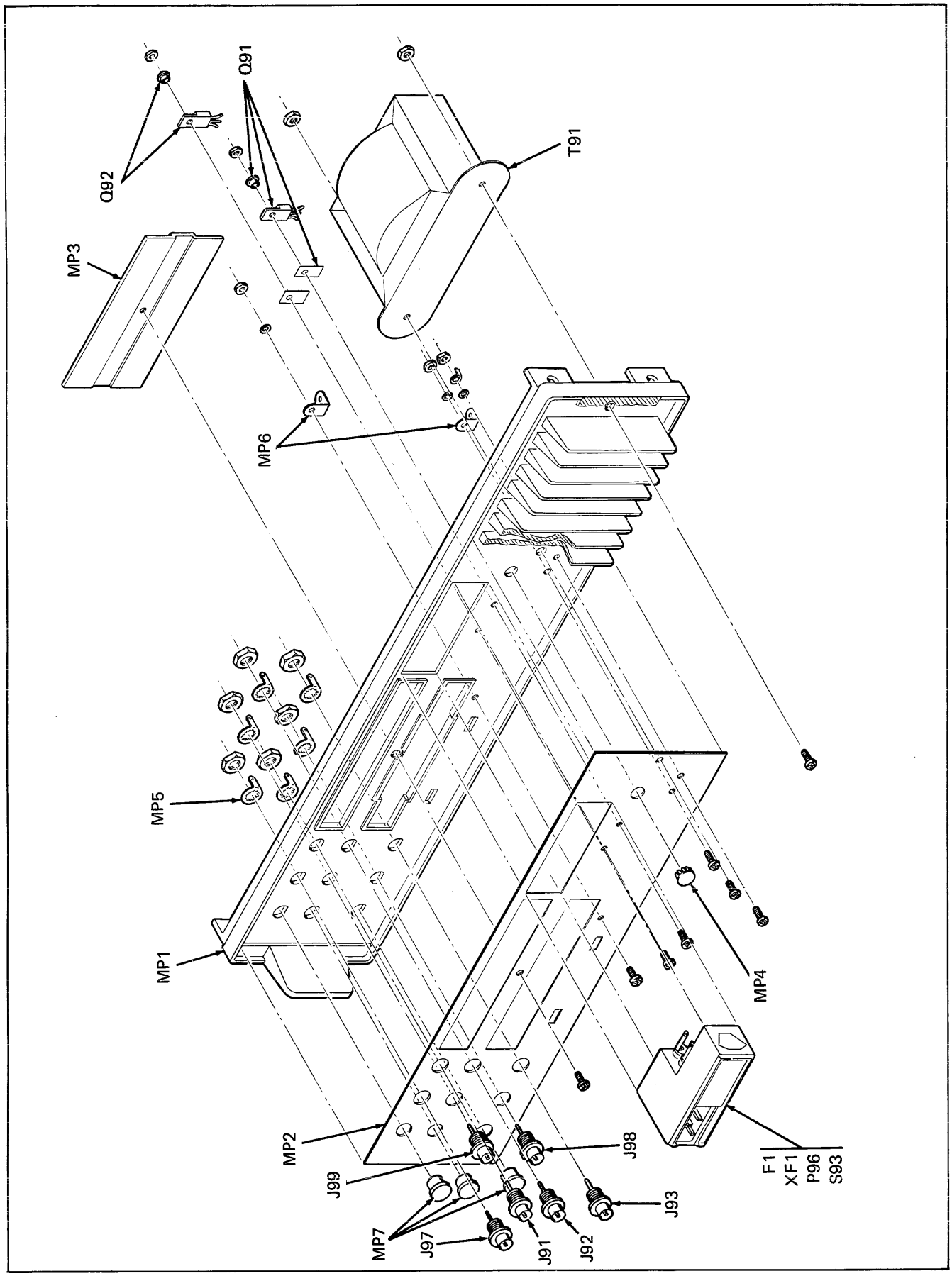

Figure 5-4. A1A2 Rear Panel Assembly

Table 5-5. A1A3 Input PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A1A3	INPUT PCB ASSEMBLY (1953A-4004) FIGURE 5-5	396234	89536	396234	REF		
C401	CAP, MYLAR 0.1 UF +10%, 400V	447573	73445	C280MF/A100K	2		
C402	CAP, MYLAR 0.1 UF +10%, 400V	447573	73445	C280MF/A100K	REF		
DS401	LIGHT, EMITTING DIODE	385898	28480	5082-4887	2		
DS402	LIGHT, EMITTING DIODE	385898	28480	5082-4887	REF		
DS403	LIGHT, EMITTING DIODE	385898	28480	5082-4887	REF		
DS404	LIGHT, EMITTING DIODE	385898	28480	5082-4887	REF		
J1	CONNECTOR						
	PIN, FEMALE, SMALL	375329	00779	35863-3	12		
	PIN, FEMALE, LARGE	149112	74970	105-0753	2		
R401	RES, COMP, 910K +/-5%, 1/4W	285338	01121	CB9145	2		
R402	RES, COMP, 910K +/-5%, 1/4W	285338	01121	CB9145	REF		
R403	RES, COMP, 100K, +/-5%, 1/4W	148189	01121	CB1045	2		
R404	RES, COMP, 100K, +/-5%, 1/4W	148189	01121	CB1045	REF		
R405	RES,VAR,10K,+/-30%,1/2W W/ SPDT SWITCH	370247	71450	FR-VF-UPE45-4	2	1	
R406	RES,VAR,10K,+/-30%,1/2W W/ SPDT SWITCH	370247	71450	FR-VF-UPE45-4	REF		
R410	RES, COMP, 47 OHMS +/-5%, 1/4W	147892	01121	CB4705	4		
R411	RES, COMP, 47 OHMS +/-5%, 1/4W	147892	01121	CB4705	REF		
R412	RES, COMP, 47 OHMS +/-5%, 1/4W	147892	01121	CB4705	REF		
R413	RES, COMP, 47 OHMS +/-5%, 1/4W	147892	01121	CB4705	REF		
R420	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	2		
R421	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	REF		
S106	PART OF R406						
S107	PART OF R405						
S108	SWITCH, SLIDE, SPDT	380113	79727	GF-124-SPDT	6	2	
S109	SWITCH, SLIDE, SPDT	380113	79727	GF-124-SPDT	REF		
S110	SWITCH, SLIDE, SPDT	380113	79727	GF-124-SPDT	REF		
S111	SWITCH, SLIDE, SPDT	380113	79727	GF-124-SPDT	REF		
S112	SWITCH, SLIDE, SPDT	380113	79727	GF-124-SPDT	REF		
S113	SWITCH, SLIDE, SPDT	380113	79727	GF-124-SPDT	REF		
S114	SWITCH, SLIDE, DPDT	436691	34828	GF-126	1	1	

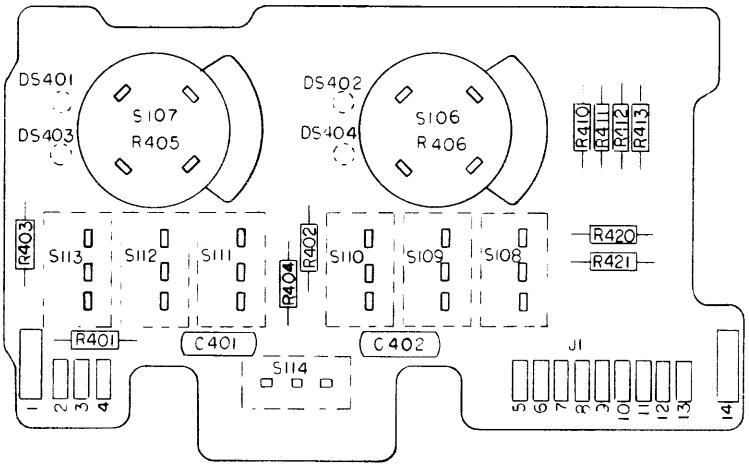

Figure 5-5. A1A3 Input PCB Assembly

Table 5-6. A2 Front Panel Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A2	FRONT PANEL ASSEMBLY (1953A-4451) FIGURE 5-6	396358	89536	396358	REF		
H1	LUG, SOLDER, BNC	441972	83330	761	2		
J102	CONNECTOR, BNC	152033	13511	UG1094A/U	2		
J103	CONNECTOR, BNC	152033	13511	UG1094A/U	REF		
MP1	FRONT PANEL	433516	89536	433516	1		
MP2	DECAL, FRONT PANEL	394106	89536	394106	1		
MP3	BRACKET, ANGLE	401869	89536	401869	1		
MP4	PLUG, BUTTON	398206	89536	398206	1		
MP5	NAMEPLATE	393975	89536	393975	1		

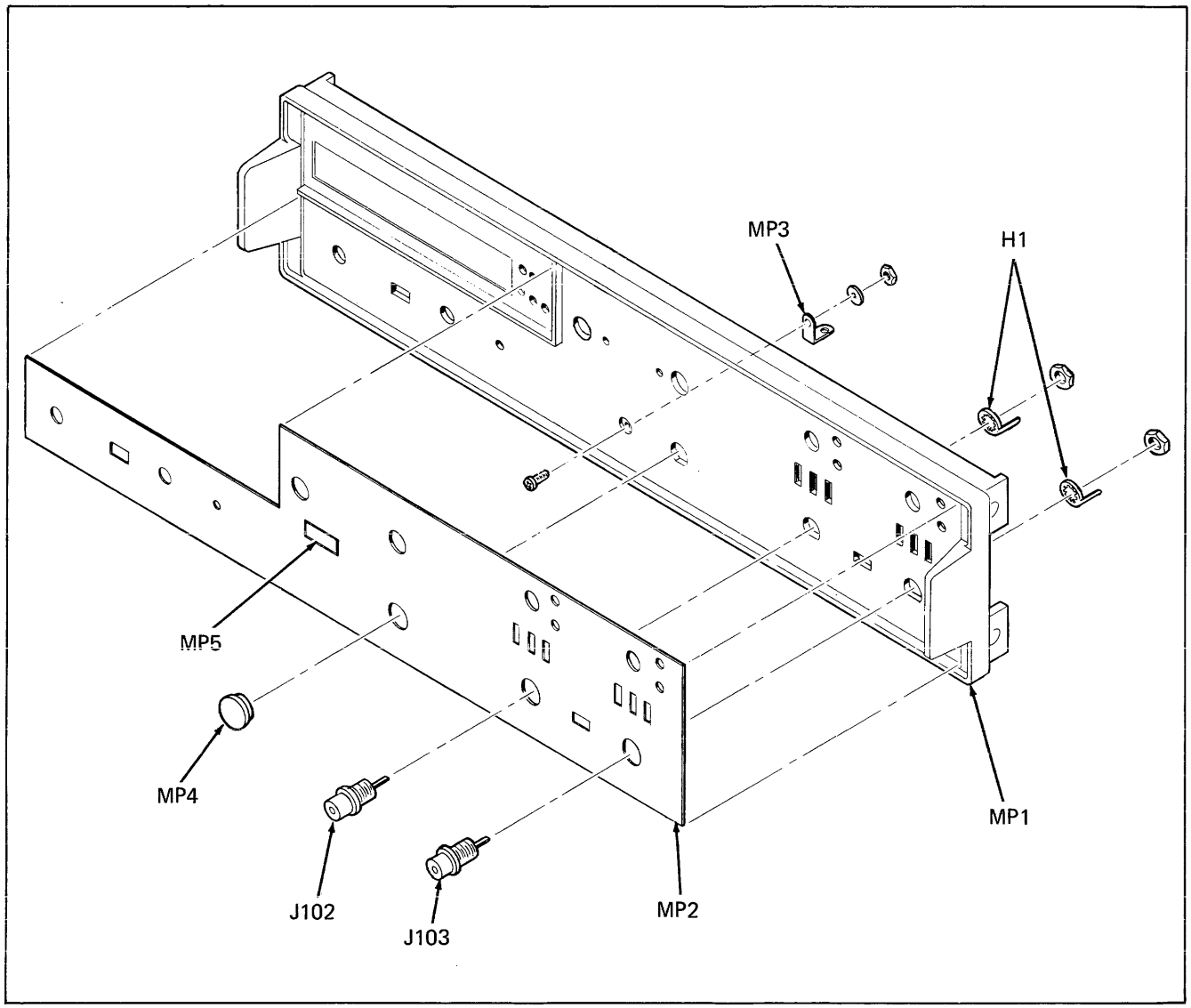

Figure 5-6. A2 Front Panel Assembly

Table 5-7. A3 Display PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A3	DISPLAY PCB ASSEMBLY (1953A-4002T) FIGURE 5-7	396218	89536	396218	REF		
DS101	LIGHT EMITTING DIODE	385898	28480	5082-4887	8	3	
DS102	LIGHT EMITTING DIODE	385898	28480	5082-4887	REF		
DS103	LIGHT EMITTING DIODE	385898	28480	5082-4887	REF		
DS104	LIGHT EMITTING DIODE	385898	28480	5082-4887	REF		
DS105	LIGHT EMITTING DIODE	385898	28480	5082-4887	REF		
DS106	LIGHT EMITTING DIODE	385898	28480	5082-4887	REF		
DS107	LIGHT EMITTING DIODE	385898	28480	5082-4887	REF		
DS108	LIGHT EMITTING DIODE	385898	28480	5082-4887	REF		
J4	CONNECTOR						
	PINS, FEMALE, SMALL	375329	00779	85863-3	12		
	PINS, FEMALE, LARGE	149112	74970	105-0753	2		
J84	FLAT CABLE ASSEMBLY	393520	08261	5142-006	1		
Q1	XSTR, SI, PNP	218396	04713	2N3904	1	1	
R102	RES, VAR, 25K WITH DPST SWITCH	379446	89536	379446	1	1	
R103	RES, COMP, 10K +/-5%,1/4W	148106	01121	CB1035	1		
R104	RES, COMP, 110 +/-5%, 1/4W	193474	01121	CB1115	1		
R105	RES, COMP, 3.3K +/-5%, 1/4W	148056	01121	CB3325	1		
S101	RES, VAR, 25K WITH DPST SWITCH	379446	89536	379446	REF		
S102	SWITCH, SLIDE	380113	79727	GF-124-SPDT	1	1	
S103	SWITCH, PUSHBUTTON	370353	08353	8532	1	1	
S131	RES, VAR, 25K WITH DPST SWITCH	379446	89536	379446	REF		
U101	LED, DISPLAY SEVEN-SEGMENT, ORANGE	429985	28480	5082-7728	9	3	
U102	LED, DISPLAY SEVEN-SEGMENT, ORANGE	429985	28480	5082-7728	REF		
U103	LED, DISPLAY SEVEN-SEGMENT, ORANGE	429985	28480	5082-7728	REF		
U104	LED, DISPLAY SEVEN-SEGMENT, ORANGE	429985	28480	5082-7728	REF		
U105	LED, DISPLAY SEVEN-SEGMENT, ORANGE	429985	28480	5082-7728	REF		
U106	LED, DISPLAY SEVEN-SEGMENT, ORANGE	429985	28480	5082-7728	REF		
U107	LED, DISPLAY SEVEN-SEGMENT, ORANGE	429985	28480	5082-7728	REF		
U108	LED, DISPLAY SEVEN-SEGMENT, ORANGE	429985	28480	5082-7728	REF		
U109	LED, DISPLAY SEVEN-SEGMENT, ORANGE	429985	28480	5082-7728	REF		
U113	RES, NETWORK, 110 +/-5%, 1/4W (OR 7 DISCRETE RESISTORS, P/N 147926)	386938	89536	386938	1	1	

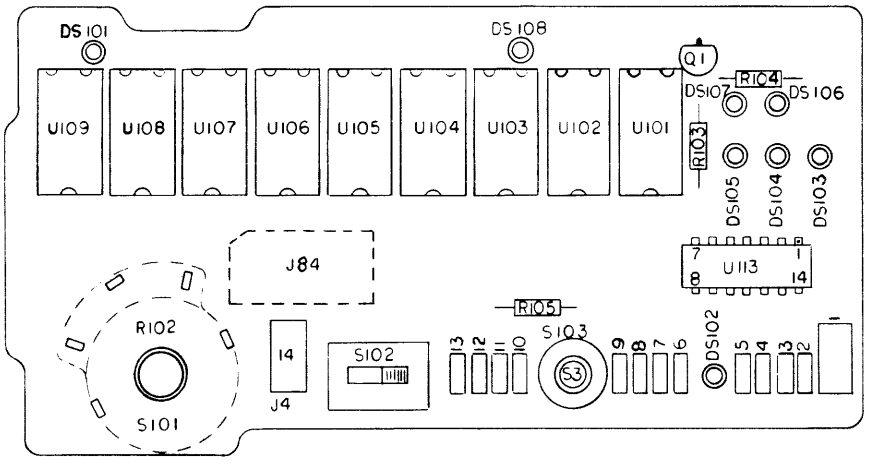

Figure 5-7. A3 Display PCB Assembly

Table 5-8. A4 Switch PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A4	SWITCH PCB ASSEMBLY (1953A-4003) FIGURE 5-8	396119	89536	396119	REF		
J3	CONNECTOR						
	PINS, FEMALE, SMALL	375329	00779	85863-3	14		
	PIN, FEMALE, LARGE	149112	74970	105-0753	2		
S104	SWITCH, ROTARY, TIME BASE	376988	89536	376988	1		
S105	SWITCH, ROTARY, FUNCTION	376970	89536	376970	1		
U301	RESISTOR NETWORK, 13 RES, 6K +/-5%, 1/4W (OR 13 DISCRETE RESISTORS, P/N 148080)	355131	71450	760-1	1	1	

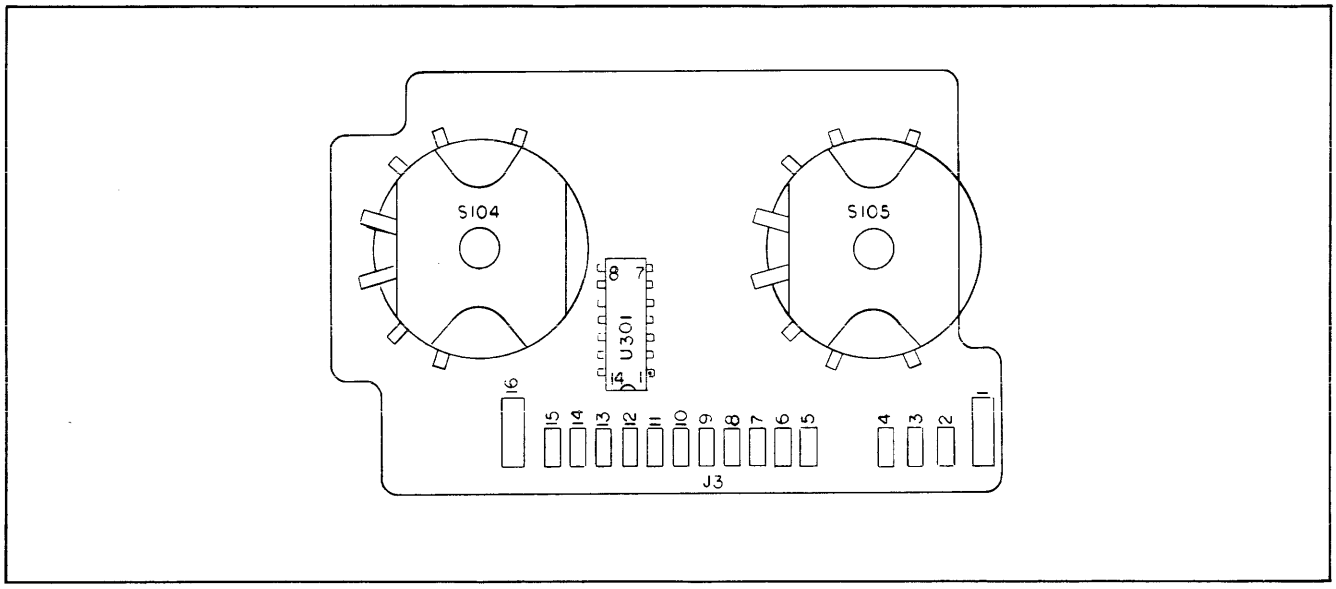

Figure 5-8. A4 Switch PCB Assembly

Section 6
Option & Accessory Information

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-04	Temperature Compensated Crystal Oscillator (TCXO)	604-1
-05	External Time Base Multiplier	605-1
-07	520 MHz Prescaler	607-1
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-11	Basic Remote Control Unit	611-1
-12	Full Remote Control Unit	612-1
-13	1000 MHz Prescaler	613-1
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6-1. INTRODUCTION

6-2. This section of the manual contains information concerning the options and accessories available for use with the Model 1953A. It consists of a series of subsections that include introduction, accessories, and options. Each option and accessory is listed by Model or Option number in the table of contents on page 6-2.

6-3. Accessories include rack mounting kits, an extender cable, and an input attenuator/filter. Each is discussed in the Accessories subsection.

6-4. Each option of the 1953A is documented in an individual subsection. All of the information necessary to install, operate, and maintain an option is included in its subsection. This includes a list of replaceable parts. The detailed schematic for each option is included in Section 8.

6-5. Each subsection is uniquely identified by page and paragraph numbering that relates to the accessories or a particular option. For example, a 600-X series identifies the accessories subsection, and a 602-X series identifies the subsection for the -02 Option (where X is a sequential page or paragraph number).

Accessories

600-1. INTRODUCTION

600-2. The 1953A can be rack-mounted in a standard 19-inch equipment rack by using Rack Mounting Kit M00-200-622. Use the following procedure to install the kit.

a. Peel off the 1953A handle trim and side trim decals.

b. Remove the handles and the feet from the 1953A.

c. Fasten side brackets (2) to the 1953A using six 8-32 x 1/2″ machine screws. See Figure 600-1.

d. Secure the front panel plate (1) to the brackets. Use eight 6-32 nuts supplied with kit.

600-3. RACK SLIDE KIT

600-4. The 1953A can be rack-mounted in a 24-inch deep equipment rack by using Rack Slide Kit M00-200-626. Use the following procedure to install the kit.

a. Peel off the 1953A handle trim and side trim decals.

b. Remove the handles and feet from the 1953A.

c. Disassemble the rack slides into sections A, B, and C as shown in Figure 600-2. (Press release buttons.)

d. Fasten the four mounting brackets (1) to the inside of the equipment rack (console).

e. Anchor slide section C to the brackets (1) mounted in the console. Use eight 10-32 x 1/2″ machine screws.

f. Fasten section A of the rack slide and the rack ear (4) to the side of the 1953A. Use eight 10-32 x 1/2″ machine screws. See Detail 1 of Figure 600-2.

g. Attach front panel plate (3) to the rack ears (4) using eight 6-32 nuts.

h. Slide rack sections B into section C as shown in Figure 600-2.

i. Slide the 1953A (and rack section A) into section B in the equipment console.

600-5. ATTENUATOR/LOW PASS FILTER

600-6. Introduction

600-7. The Model Y7201, as shown in Figure 600-3, is a combination variable attenuator and selectable low-pass filter intended for use as an input signal noise suppressor for Fluke counters. It features a continuously variable X5 to X100 attenuator and a set of three switch-selectable frequency filters; DC to 1 kHz, DC to 20 kHz, or DC to 100 kHz. A BNC connector is provided for convenient attachment to the counter input and a set of 0.75″ spaced banana jacks serve as the input signal connections.

600-8. In operation the Y7201 attenuates and/or filters unwanted noise/transients from the input signal. This isolates the counter from the noise levels and, thereby, eliminates the possibility of measurement errors. See Measurement Errors in Section 2 of this manual for a detailed discussion of the problem.

600-9. Specifications

Input Impedance: 47 kΩ
Attenuation Range: X5 to X100 continuously variable
Low Pass Filter: 1 kHz, 20 kHz, or
100 kHz switch-selectable

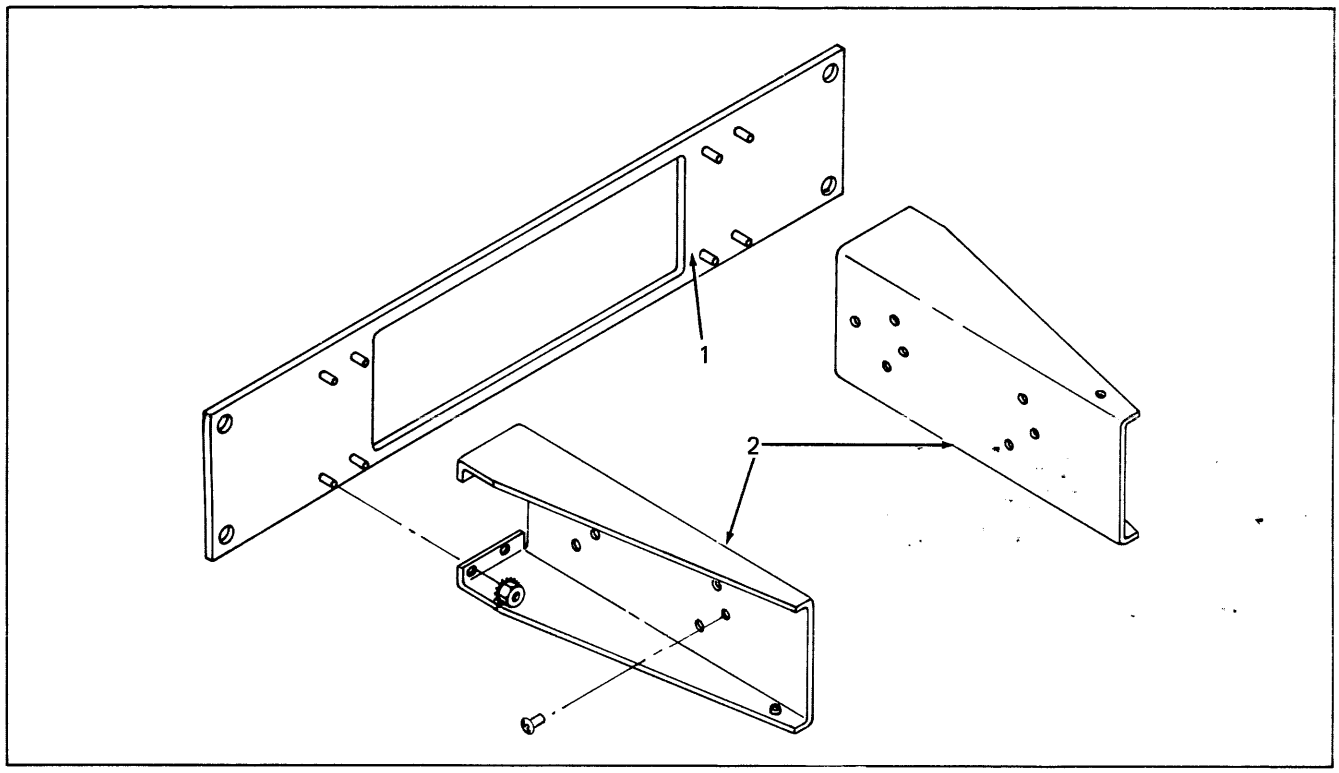


Figure 600-1. Rack Mounting Kit

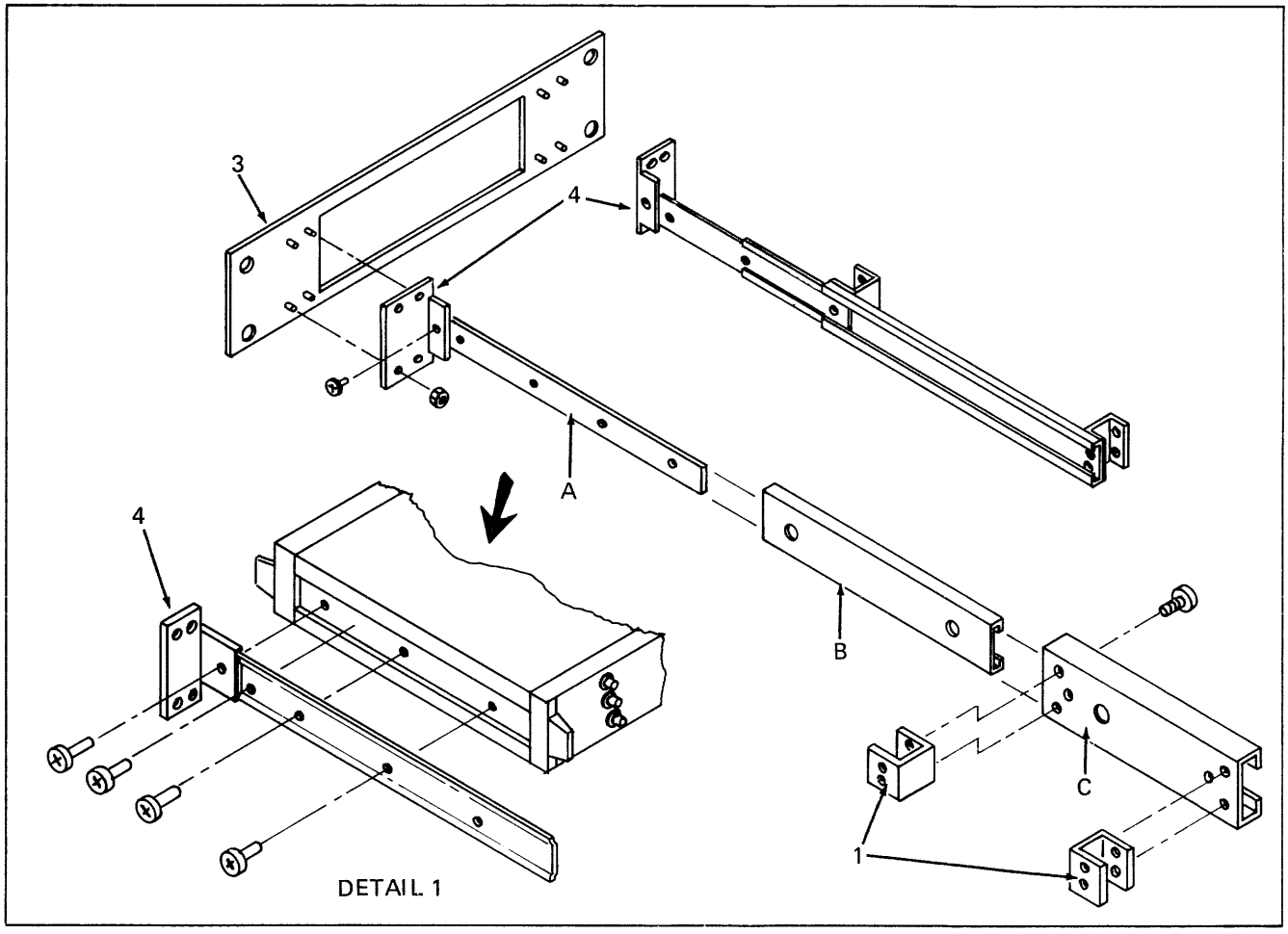


Figure 600-2. Rack Slide Kit

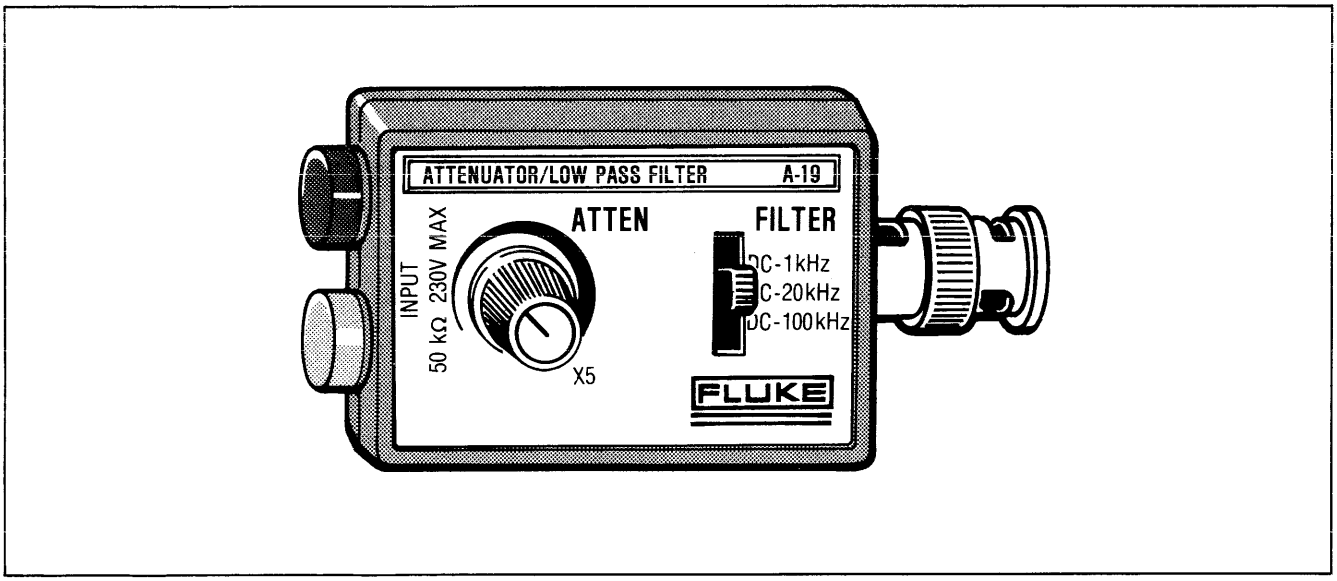


Figure 600-3. Y7201 Attenuator/Low Pass Filter

Option -02
Data Output Unit

602-1. INTRODUCTION

602-2. The data output unit (DOU) permits the Model 1953A to operate in a systems environment where digital acquisition of the measurement data is necessary. The option comprises a single pcb assembly which mounts within the 1953A case and provides all nine digits of measurement data (in BCD format), units indication, decimal point, position, and control signals to the external system by a rear panel pcb connector. The DOU option may be ordered at the time of purchase or at a later data and field-installed. The model number of the DOU when ordered as a field-installable kit is 1953A-02K.

602-3. INSTALLATION

602-4. The 1953A-02K DOU kit comprises the following items:

a. DOU PCB Assembly.

b. Set of four stand-offs.

c. Mounting hardware.

602-5. Install the DOU as follows:

a. Remove the top and bottom dust covers. Remove the upper cover plate from the rear panel.

b. Attach the four stand-offs to the underside (non-component side) of the DOU PCB.

c. Position the DOU down on the Main PCB in the position shown in Figure 602-1 so that the stand-offs align with the matching holes in the Main PCB.

d. Secure the DOU stand-offs to the Main PCB from the underside.

e. Connect the DOU cable assemblies to the Main PCB so that J83 connects to J83 and J85 connects to J85 as shown in Figure 602-1.

602-6. DATA OUTPUT FORMAT

602-7. The DOU output is available via the upper rear panel connector, labeled BCD OUTPUT. The output data is in positive-true BCD format, TTL compatible and is transferred to the external device by means of an interconnecting cable used with the Fluke Model 2010A Digital Printer. The cable is called the Model 2010A-7000 and is available from the factory.

602-8. To fabricate a cable assembly for any other application, use a 50-pin connector made up of the following items:

a. Connector body, AMP part no. 1-583717-1.

b. Connector pins (50), AMP part no. 585616-5.

c. Connector backshell, Fluke part no. 398005.

d. 50-conductor cable.

602-9. The type and length of cable used is not critical since the measurement data is static. However, loading of the signals at the recording device must be TTL compatible, with fan-in less than 2. Refer to Table 602-1 for the particular pin assignments at the DOU output. The DOU output connector is numbered/lettered from A to C from left to right (as viewed from the rear) on the top side of the pcb, and from 1 to 25 from left to right on the underside of the pcb. All data is positive-true TTL compatible. The decimal point information is binary-coded to permit the six different decimal point positions to be indicated on the three available output lines (i.e. pins 1, 2, and A). Refer to Table 602-2 for the decimal point decoding.

602-10. The DOU connector also provides an external reset input at pin 24. A logic low (ground) signal on this line resets all counter functions except the DOU itself. The DOU ready command is a low-true pulse having a duration of 1.5 milliseconds, and signifies that the measurement data is stored in the DOU and ready for transfer. (When connected back to the external reset input, the DOU ready command causes the 1953A to operate in a continuous mode, and at optimum speed, to drive a printing device.) The print command is a positive (or high)-true signal of 1 millisecond duration to activate the printing or data logging device.

602-11. LIST OF REPLACEABLE PARTS

602-12. Table 602-3 is a list of replaceable parts for Data Output Unit. Refer to Section 5 for ordering information.

CAUTION

Indicated devices are subject to damage by static discharge.

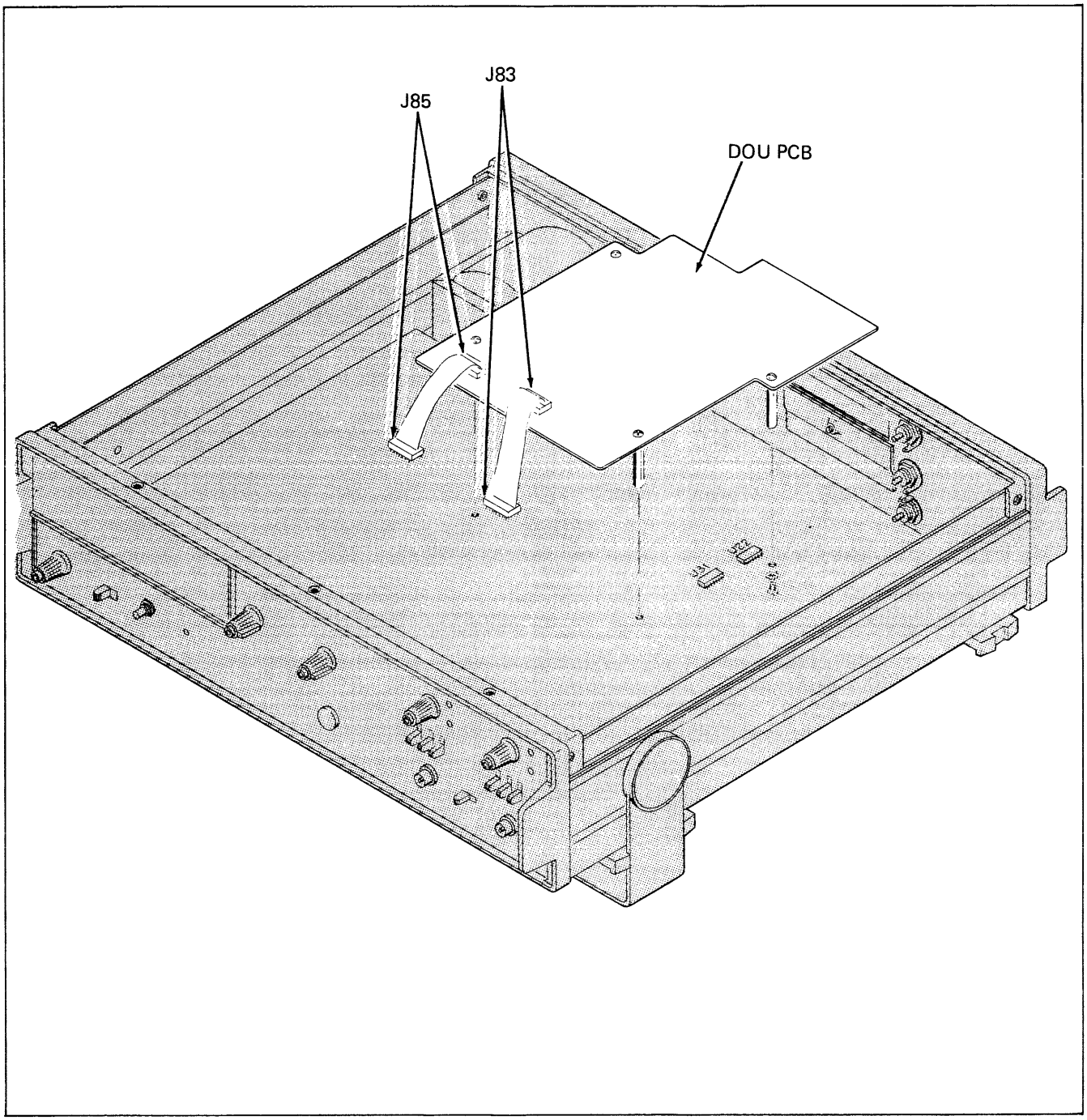


Figure 602-1. DOU Option Location

Table 602-1. DOU Output Pin Assignments

PIN NO.	FUNCTION	PIN NO.	FUNCTION				
A	Decimal Point 3	1	Blank	R	5SD-BCD 4	14	5SD-BCD 2
B	Decimal Point 1	2	Decimal Point 2	S	5SD-BCD 4	15	5SD-BCD 8
C	MHz Units	3	Print	T	6SD-BCD 1	16	6SD-BCD 2
D	Milliseconds	4	kHz Units	U	6SD-BCD 4	17	6SD-BCD 2
E	Seconds	5	Microseconds	V	7SD-BCD 1	18	7SD-BCD 2
F	MSD-BCD 1	6	MSD-BCD 2	W	7SD-BCD 4	19	7SD-BCD 8
H	MSD-BCD 4	7	MSD-BCD 8	X	8SD-BCD 1	20	8SD-BCD 2
J	2SD-BCD 1	8	2SD-BCD 2	Y	8SD-BCD 4	21	8SD-BCD 8
K	2SD-BCD 4	9	2SD-BCD 8	Z	LSD-BCD 1	22	LSD-BCD 2
L	3SD-BCD 1	10	3SD-BCD 8	a	LSD-BCD 4	23	LSD-BCD 9
M	3SD-BCD 4	11	3SD-BCD 8	b	Overflow	24	External Reset
N	4SD-BCD 1	12	4SD-BCD 2	c	Ground	25	DOU Ready
P	4SD-BCD 4	13	4SD-BCD 8				

Table 602-2. Decimal Point Position Coding

DECIMAL POINT POSITION ON DISPLAY	(PIN A)	(PIN 2)	(PIN B)
XXXXXXXXX	1	1	1
XXXXXXXX.X	1	1	0
XXXXXXX.XX	1	0	1
XXXXXX.XXX	1	0	0
XXXXX.XXXX	0	1	1
XXXX.XXXXX	0	1	0
XXX.XXXXXX	0	0	1

Goes high in FREQ (A/B), A GTD By B, and SELF-CHECK functions.

Table 602-3. -02 Option, Data Output Unit

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
-02	DATA OUTPUT UNIT, OPTION -02 FIGURE 602-2						
A6	DOU PCB ASSY	396283	89536	396283			
MP1	COVER, CONNECTOR, PORT, REAR PANEL	398016	89536	398016			
MP2	CONNECTOR KIT (NOT SHOWN)	410241	89536	410241			

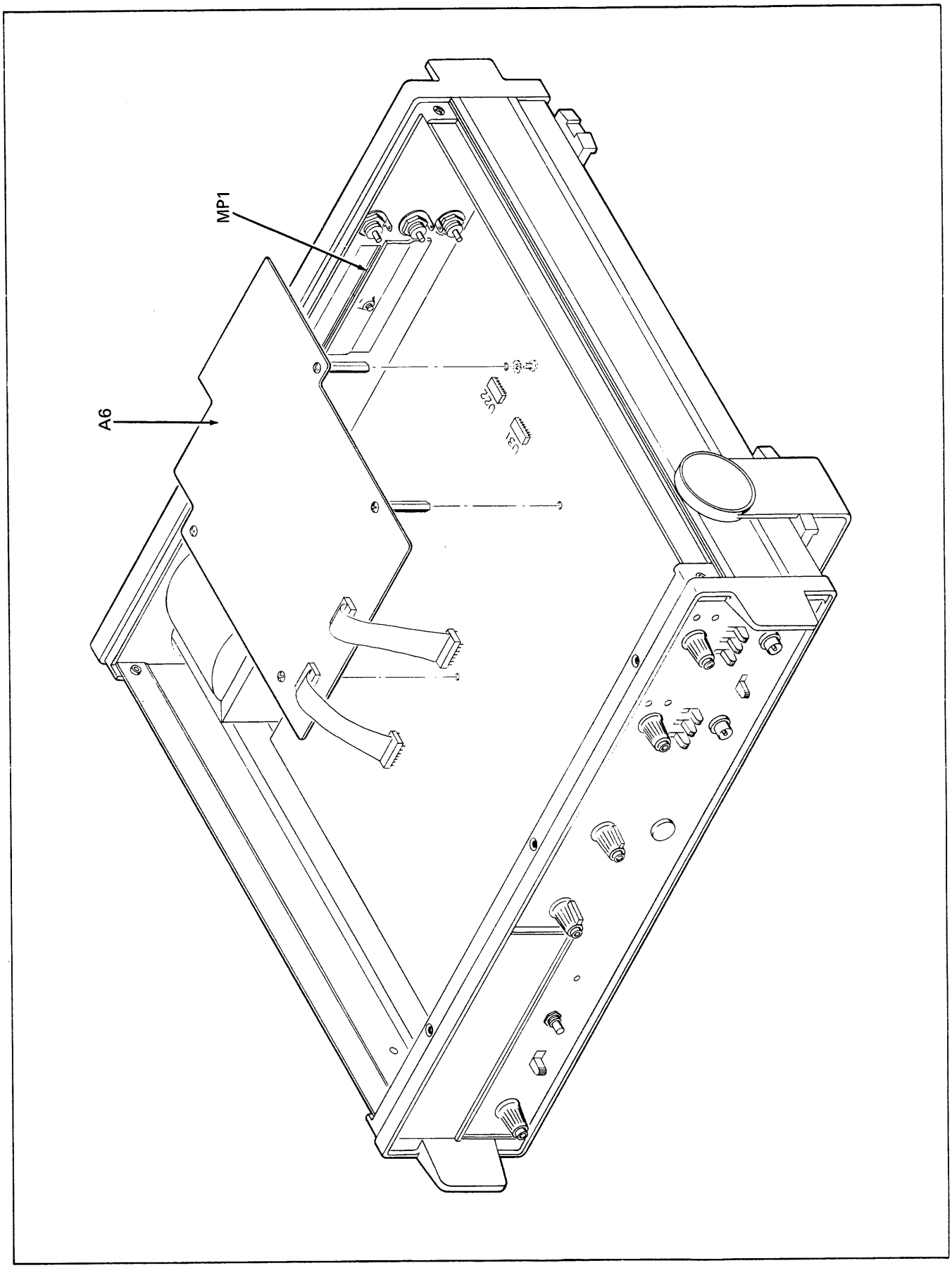


Figure 602-2. -02 Option, Data Output Unit

Table 602-4. A6 Data Output Unit PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A6	Ⓧ DATA OUTPUT UNIT PCB ASSY (1953A-4025T) FIGURE 602-3	396283	89536	396283	REF		
C801	CAP, TA, 10 UF +/-20%	193623	56289	196D106X0015JA1	1		
C802	CAP, CER DISC 100 PF +/-10%, 1 KV	105593	71590	DD-101	1		
C803	CAP, CER DISC, 0.01 UF +80/-20%, 16V	368639	71590	UK-16-103	1		
C804	CAP, CER DISC, 0.1 UF, GMV, 25V	369199	71590	UK-25-104	3		
C805	CAP, CER DISC, 0.1 UF, GMV, 25V	369199	71590	UK-25-104	REF		
C806	CAP, CER DISC, 0.1 UF, GMV, 25V	369199	71590	UK-25-104	REF		
H1	STAND OFF	436493	89536	436493	4		
J83	FLAT CABLE ASSEMBLY	393520	08261	5142-006	2		
J85	FLAT CABLE ASSEMBLY	393520	08261	5142-006	REF		
R801	RES, COMP, 47K +/-5%, 1/4W	148163	01121	CB4735	1		
R802	RES, COMP, 33K +/-5%, 1/4W	148155	01121	CB3335	1		
U801	Ⓧ IC, CMOS, TRIPLE 3-INPUT NAND GATE	375147	95303	CD4023AE	1		
U802	IC, TTL, TRIPLE 3-INPUT NOR GATE	392951	01295	SN7427	1		
U803	Ⓧ IC, CMOS, QUAD D-LATCH	355149	95303	CD4042AE	9		
U804	Ⓧ IC, CMOS, QUAD D-LATCH	355149	95303	CD4042AE	REF		
U805	Ⓧ IC, CMOS, QUAD D-LATCH	355149	95303	CD4042AE	REF		
U806	IC, TTL, DUAL MONOSTABLE MULTIVIBRATOR	310235	01295	SN74123N	1		
U807	Ⓧ IC, CMOS, HEX BUFF/INVERTER	381848	95303	CD4049AE	2		
U808	Ⓧ IC, CMOS, HEX BUFF/INVERTER	381848	95303	CD4049AE	REF		
U809	Ⓧ IC, CMOS, QUAD D-LATCH	355149	95303	CD4042AE	REF		
U810	Ⓧ IC, CMOS, QUAD D-LATCH	355149	95303	CD4042AE	REF		
U811	Ⓧ IC, CMOS, QUAD D-LATCH	355149	95303	CD4042AE	REF		
U812	Ⓧ IC, CMOS, QUAD D-LATCH	355149	95303	CD4042AE	REF		
U813	Ⓧ IC, CMOS, QUAD D-LATCH	355149	95303	CD4042AE	REF		
U814	Ⓧ IC, CMOS, QUAD D-LATCH	355149	95303	CD4042AE	REF		
U815	IC, TTL, HEX INVERTER	352039	01295	SN74L04	6		
U816	IC, TTL, HEX INVERTER	352039	01295	SN74L04	REF		
U817	IC, TTL, HEX INVERTER	352039	01295	SN74L04	REF		
U818	IC, TTL, HEX INVERTER	352039	01295	SN74L04	REF		
U819	IC, TTL, HEX INVERTER	352039	01295	SN74L04	REF		
U820	IC, TTL, HEX INVERTER	352039	01295	SN74L04	REF		

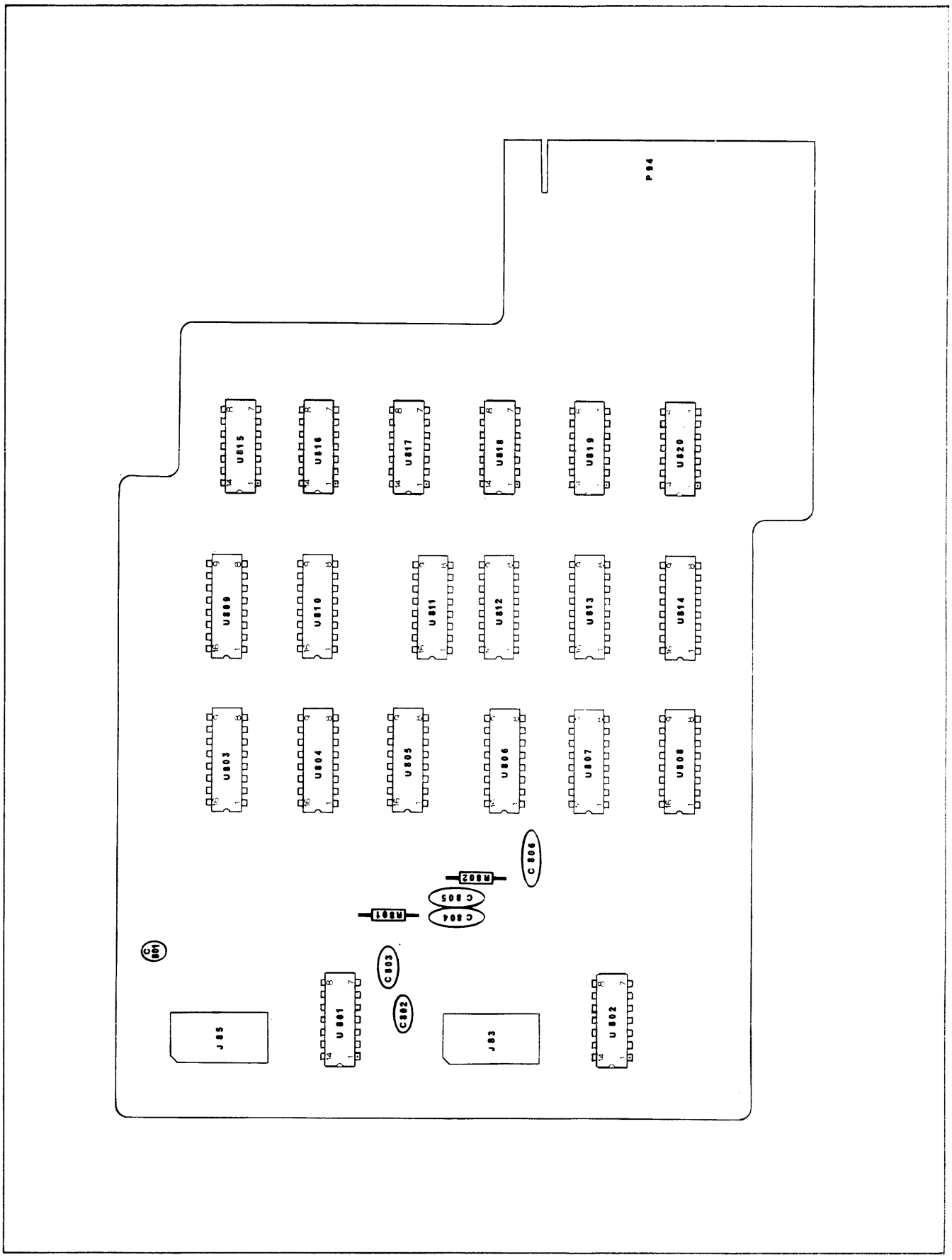


Figure 602-3. A6 Data Output Unit PCB Assembly

Option -04
Temperature Compensated Crystal Oscillator

604-1. INTRODUCTION

604-2. Option -04 is a Temperature Compensated Crystal Oscillator (TCXO) which exhibits stability and temperature dependent characterisitics superior to the oscillator normally installed in the standard unit. The specifications for the -04 Option are included in Section 1 of this manual.

604-3. LIST OF REPLACEABLE PARTS

604-4. Parts for Option -04 consist only of the TCXO which replaces the standard oscillator U7. Replacements can be ordered using the Fluke Part No. 461855. The manufacturing Federal Supply Code is 89536 and the manufacturer's part no. also 461855. See Figure 604-1.

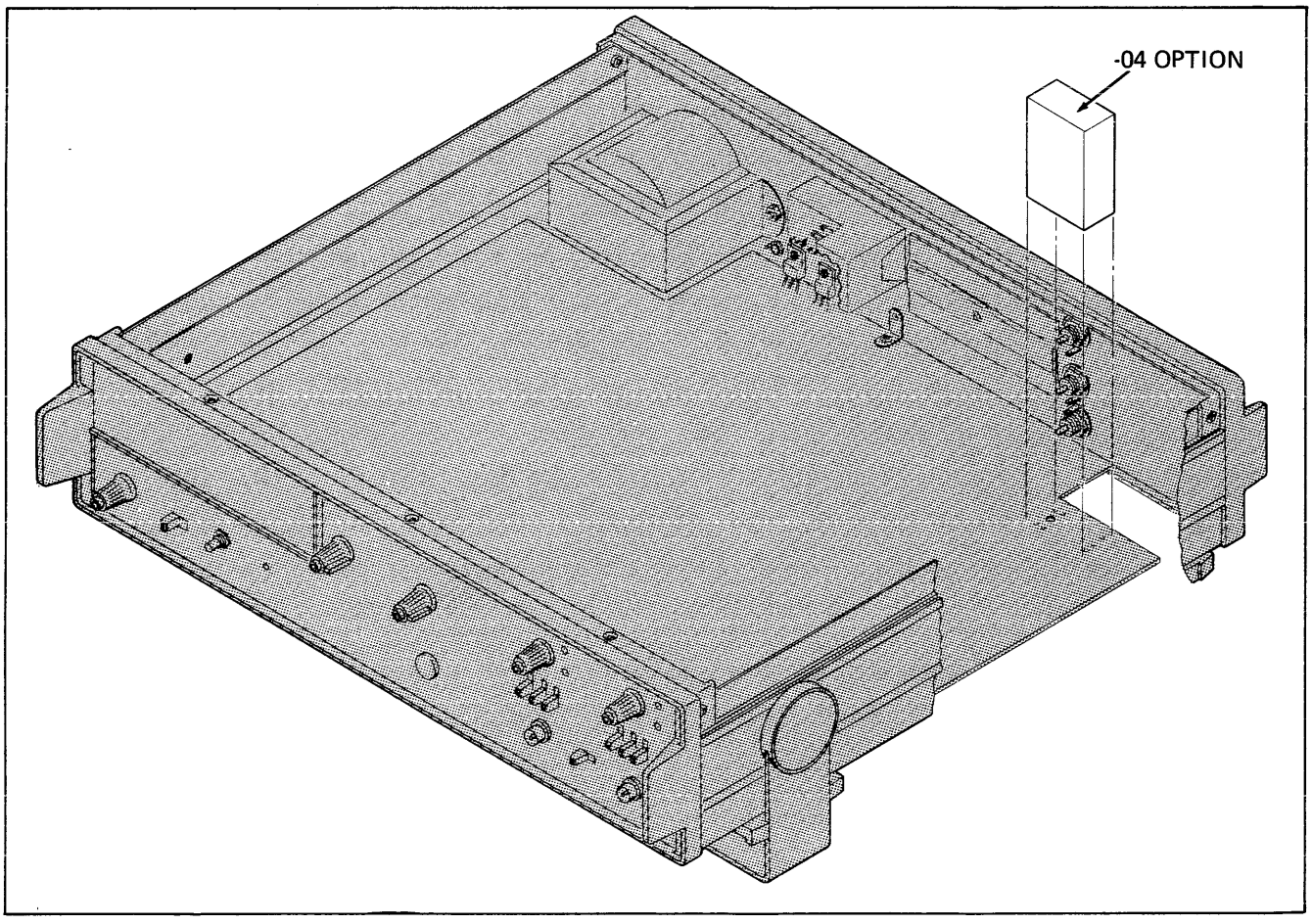


Figure 604-1. Temperature Compensated Crystal Oscillator

Option -05
External Time Base Multiplier

605-1. INTRODUCTION

605-2. The External Time Base Multiplier Option adds two operating features to the 1953A Counter-Timer. External reference inputs of 1, 5, or 10 MHz, having a minimum amplitude of 250 mV rms, may be substituted for the internal time base reference of the instrument. Burst (pulsed oscillator) measurements may be made using control circuitry on the -05 Option.

605-3. The original External Time Base Multiplier Option has been superceded by an updated design, both of which will be covered in this section of the manual. The original version is contained on a single pcb. The later design consists of two pcbs, one mounted on the other, and is installed in instruments with serial numbers 615000 or greater (main pcb revision letter R-1 and on). The later design (two pcb version) is covered first. This information is applicable to the original version (single pcb) with the exceptions of the Time Base Multiplier theory of operation, parts list, and component location drawing, which will be covered second. Schematic diagrams for both versions are contained in Section 8.

605-4. OPERATING NOTES

605-5. External Time Base

605-6. To substitute an external reference frequency for the internal time base, the desired input frequency (1, 5, or 10 MHz) must be selected with a three-position slide switch located on the External Multiplexer PCB. Refer to Section 4 for internal access information. Apply the reference signal to the CLOCK IN connector. The EXT/INT switch controls which time base is used in the instrument: EXT for external, INT for internal.

605-7. Burst Measurement

605-8. The burst measurement feature allows measurement of the frequency of pulsed oscillator signals within the frequency measurement capability of the instrument. Burst frequency measurements are made by selecting a gate time for the counter of shorter duration than the pulse width of the signal to be measured. The gate time is initiated or triggered by a transition on channel B. If this transition is due to the start of the burst, and the gate time is shorter than the burst pulse width, the frequency developed during the burst is measured or counted. Burst frequency measurement made in this manner are accurate only if the pulsed oscillator being measured is not "pulled" in frequency by the start of the pulse.

605-9. There are three procedures for using the 1953A with the -05 Option to measure burst frequencies. Select one of the following procedures according to the frequency range of the unknown burst frequency.

605-10. Unknown burst frequency less than 25 MHz.

a. Select the FREQ A function and apply the unknown burst frequency to channel A.

b. Select BURST on the rear panel switch.

c. Select a gate time less than the width of the burst.

d. Select COM on the SEP/COM front panel switch.

e. Adjust channel A and channel B trigger levels for satisfactory triggering, i.e., a stable display.

f. The counter displays the burst frequency.

605-11. Unknown burst frequency between 25 MHz and 125 MHz.

a. Select the FREQ A function and apply the unknown burst frequency to channel A.

b. Select BURST on the rear panel switch.

c. Select a gate time less than the width of the burst.

d. Apply a trigger signal at the burst repetition rate to channel B. The trigger should coincide with the start of the burst but not start before the burst. The pulse width of the trigger does not need to be as wide as the burst, only wide enough to trigger channel B.

e. Adjust channel A and channel B trigger levels for satisfactory triggering, i.e., a stable display. The slope adjustment on channel B must be set at the polarity of the trigger, e.g., + slope for a positive trigger.

f. The counter displays the burst frequency.

605-12. Unknown burst frequency greater than 125 MHz.

a. Select the FREQ C function and apply the unknown burst frequency to channel C.

b. Perform steps b through f in paragraph 605-11 above.

605-13. THEORY OF OPERATION

605-14. Time base frequency inputs to the multiplier as shown in Figure 605-1, are switch selectable between internal (10 MHz) or external (1, 5, or 10 MHz). The time base frequency is applied through U3 to a decade counter, U2 (board 1), wired for 5 and 10. The undivided input and the 5 and 10 outputs from U2 are applied to a data selector/multiplexer, U1 (board 1), which is programmed by three sections of U3 (board 1) for a 1 MHz output. The three NOR gate of U3 (board 1) used to program U1 are controlled by S1 (board 1) and SW + 12 (J6 pin 8). SW + 12 is grounded for EXT (rear panel EXT/INT switch) and is at +12V for INT. When INT is selected, the three outputs from U3 go low, programming U1 for the D0 input which is the 10 output of U2. When EXT is selected, S1 controls which of the three outputs will be high to program U1 for either the D1 input (1), the D2 input (5), or the D4 input (10) so there will always be a 1 MHz output from U1 (board 1).

605-15. On board 2, the 1 MHz output from U1 (board 1) is multiplied to 10 MHz using a phase-locked oscillator. U3 is a phase comparator with the 1 MHz from board 1 applied to the reference input. The output of U3 controls the frequency of oscillation of U1. U1 oscillates at 10 MHz which is divided by a decade divider, U2, for application to the variable input of U3. The output of U1 (board 2) is used as the reference time base for the counter. Inside U3 are three operational blocks: a digital phase detector, a charge pump, and an amplifier. Pins 2 and 11 connect the output of the phase detector, D1 (1 MHz pulses), to the input of the charge pump, PD. The output of the charge pump, DF, is a pulse train whose average value increases or decreases to increase or decrease the frequency of the oscillator, U1. DF is connected to the input of the amplifier, A, through R4. The output of the amplifier is applied to the VTUNE input of U1. R4, R2, C4 and R5 make the amplifier an active integrator to average the output of the charge pump. R1 and C3 provide additional filtering. R3 sets the phase detector pulse width to a finite value to maintain loop gain.

605-16. Burst measurement operations are controlled by a D flip-flop, U4 and four NAND gates, U5, located on board 1. When normal operation is selected with the BURST/NORMAL rear panel switch, a low is applied to one input of U5-11 through J6 pin 9. U5-11 goes high and U5-8 goes low putting U4 in the preset condition (U4-5 high) enabling U5-3 to pass the 10 MHz reference frequency. When BURST is selected, J6 pin 9 is high and either channel A or C must be selected producing a high at J6 pin 5 (A + C). U5-11 goes low and U5-8 goes high removing the preset condition from U4. At the end of a measurement, READY (J6 pin 2) goes low, clearing U4. U4-5 goes low inhibiting the reference frequency by placing a low on one input of U5-3. When the 1953A is ready for another measurement, READY goes high. The first negative transition on XB (derived from the channel B input) clocks U4-5 high enabling U5-3 to pass the reference frequency. When the measurement is complete, READY goes low, inhibiting the reference frequency.

605-17. PARTS LIST

605-18. Table 605-1 gives a parts breakdown for the updated version (2 pcbs) of the External Time Base Multiplier. Refer to Section 5 for ordering information.

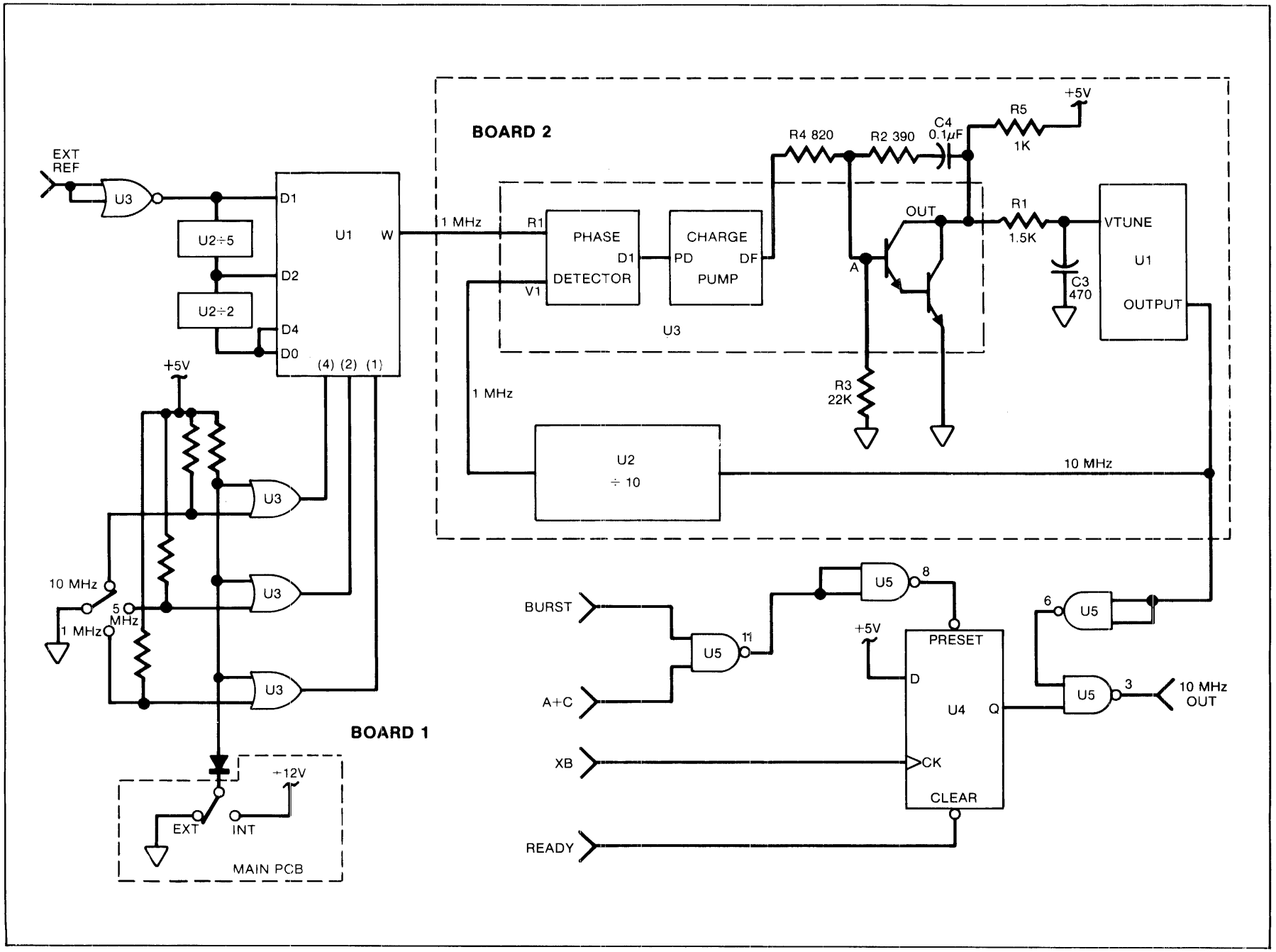


Figure 605-1. External Time Base Multiplier Simplified Schematic

Table 605-1. -05 Option, External Time Base Multiplier

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
-05	EXTERNAL TIME BASE MULTIPLIER OPTION 05 FIGURE 605-2						
A7	MULTIPLIER PCB ASSEMBLY #1	467811	89536	467811	1		
A8	MULTIPLIER PCB ASSEMBLY #2	467621	89536	467621	1		

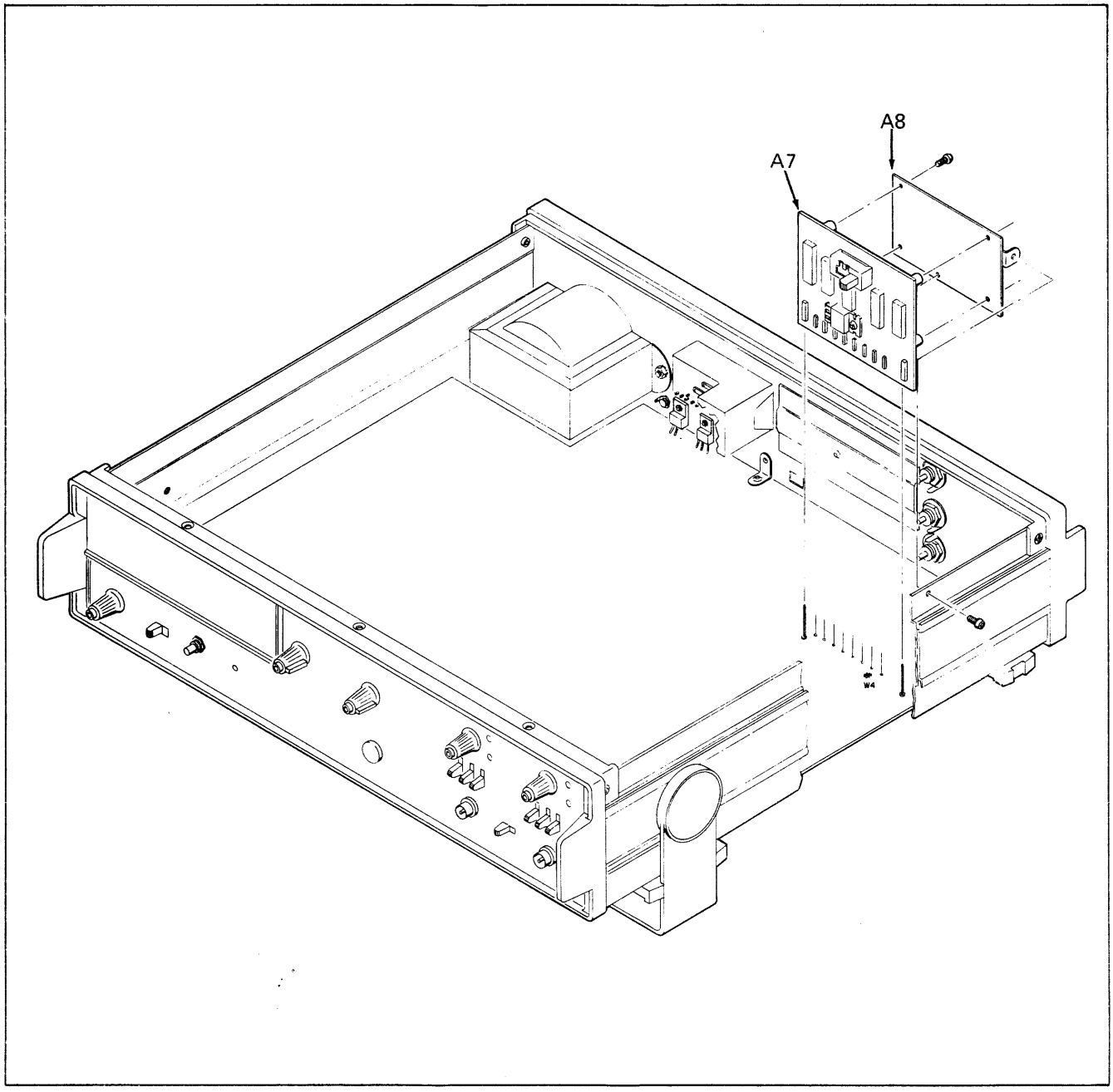


Figure 605-2. -05 Option, External Time Base Multiplier

Table 605-2. A7 and A8 Multiplier PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A7	MULTIPLIER PCB ASSEMBLY #1 (1953A-4034) FIGURE 605-3	467811	89536	467811	REF		
C1	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA1	3		
C2	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA1	REF		
C3	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA1	REF		
CR1	DIODE, SI HI-SWITCH	203323	07910	1N4448	1	1	
J6	CONNECTOR						
	PIN, FEMALE, LARGE	149112	74970	105-0753	2		
	PIN, FEMALE, SMALL	375329	00779	85863-3	8		
L1	INDUCTOR, BEAD, 6-TURN	320911	89536	320911	2		
L2	INDUCTOR, BEAD, 6-TURN	320911	89536	320911	REF		
R1	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	4		
R2	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	REF		
R3	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	REF		
R4	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	REF		
S1	SWITCH, SLIDE	453183	34828	G-128-L	1		
U1	IC, TTL, DATA SELECTOR/MULTIPLEXER	393173	01295	SN74LS151	1	1	
U2	IC, TTL, DECADE COUNTER	402545	01295	SN74LS90N	1	1	
U3	IC, TTL, QUAD 2-INPUT NOT GATE	393041	01295	SN74LS02N	1	1	
U4	IC, TTL, DUAL D-TYPE EDGE-TRIGGERED F-F	310227	01295	SN7474N	1	1	
U5	IC, TTL, QUAD 2-INPUT NAND GATE	393033	01295	SN74LS00N	1	1	
U6	IC, LINEAR, VOLTAGE REGULATOR, +5V	355107	04713	MC7805PC	1	1	
A8	MULTIPLIER PCB ASSEMBLY #2 (1953A-4035) FIGURE 605-3	467621	89536	467621	REF		
C1	CAP, TA, 10 UF +/-10%, 15V	193623	56289	196D106X0015KA1	3	1	
C2	CAP, CER 27 PF +/-2%, 100V	362749	72982	8121-A100-C0G-270G	1		
C3	CAP, CER, 470 PF +/-10%, 1000V	368613	71590	DD471	1		
C4	CAP, POLYESTER FILM, 0.1 UF +/-10%, 100V	393439	73449	C280MAH/A100K	1		
C5	CAP, TA, 10 UF +/-10%, 15V	193623	56289	196D106X0015KA1	REF		
C6	CAP, TA, 10 UF +/-10%, 15V	193623	56289	196D106X0015KA1	REF		
L1	INDUCTOR, BEAD, 6-TURN	320911	89536	320911	3		
L2	INDUCTOR, BEAD, 6-TURN	320911	89536	320911	REF		
L3	INDUCTOR, BEAD, 6-TURN	320911	89536	320911	REF		
R1	RES, COMP, 1.5K +/-5%, 1/4W	148031	01121	CB1525	1		
R2	RES, COMP, 390 +/-5%, 1/4W	147975	01121	CB3915	1		
R3	RES, COMP 22K +/-5%, 1/4W	148130	01121	CB2235	1		
R4	RES, COMP, 820 +/-5%, 1/4W	148015	01121	CB8215	1		
R5	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	1		
U1	IC, TTL, DUAL VOLT-CONTROLLED MV	320713	04713	MC4024P	1	1	
U2	IC, TTL, DECADE COUNTER	402545	01295	SN74LS90N	1	1	
U3	IC, TTL, PHASE-FREQUENCY DETECTOR	320721	04713	MC4044P	1	1	

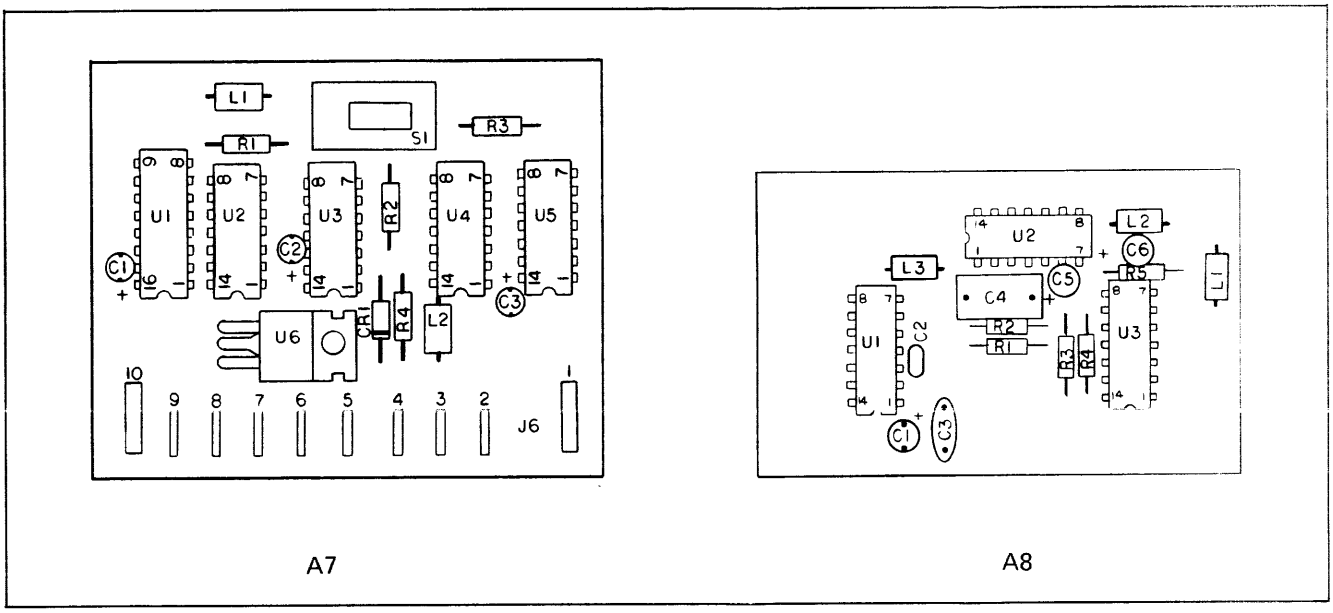


Figure 605-3. A7 and A8 Multiplier PCB Assembly

Option -07
520 MHz Prescaler

607-1. INTRODUCTION

607-2. The channel C input, of the Model 1953A is intended for use with an optional frequency-prescaler. Option -07 is a prescaler which extends the operating range of the counter to 520 MHz. This prescaler has a frequency range extending from 50 MHz to 520 MHz with a specified sensitivity of 15 mV rms throughout the range. The option comprises a plug-in PCB assembly, a front panel mounted BNC connector, and the related components required both to adjust the power supply for correct operating voltages and to compensate the counter circuitry for the prescaling divisor. Option -07 must be ordered factory installed in the 1953A. It is not field installable.

607-3. THEORY OF OPERATION

607-4. The main function of the prescaler is to reduce the frequency of the input signal to below 130 MHz for application to the main gate and decade counter. The prescaler also provides the necessary conditioning of the input signal to provide sufficient gain and the proper waveshaping. The frequency division factor for the prescaler is four.

607-5. As shown in Figure 607-1, the input signal is fed through an input protection fuse, F1, to the input of the first amplifier. Input limiting is provided by CR1 and CR2. The output of the second amplifier is applied to the input of a divider circuit which divides by a factor of four to reduce the input frequency to below 130 MHz. The prescaled signal, amplifed by U1 and U2, divided and shaped by U3, is then fed to the Main PCB Assembly for application to the main gate and decade counter.

607-6. The output of the second amplifier is also fed to an AGC circuit where it is rectifed by CR7, filtered by C11/R12 and amplified by U4. The dc output of U4 is the AGC signal and controls the overall input signal level by means of CR5 and C4. Diode CR5 is a PIN-type diode whose impedance varies with the amount of bias applied. When AGC signal decreases due to a reduced input signal level the bias across CR5 is reduced causing an increase in impedance. This action results in a reduced shunting action of the input signal by CR5 and C4.

607-8. The AGC signal is also used to block the output of the prescaler when the input is below minimum acceptable amplitude. When this occurs, Q1 turns off and Q4 turns on to clamp the output to +5 volts.

607-9. PERFORMANCE CHECKS

607-10. The performance check for the 520 MHz prescaler is actually a sensitivity check made at the upper and lower frequency limits. Proceed as follows:

a. Connect a 1 GHz RF generator, terminated into 50 ohms, to a T-connector on the CHANNEL C input. Set the generator output for 50 MHz at approximately 15 mV rms.

b. Connect the RF millivoltmeter (refer to Table 4-1) to the T-connector on the input of the prescaler.

c. Adjust the generator output for a reading of 15 mV rms on the RF milllivoltmeter.

d. Confirm that the counter reads 50 MHz ± generator accuracy.

e. Change the generator output to 520 MHz and adjust the output for 15 mV rms on the RF millivoltmeter.

f. Confirm that the counter reads 520 MHz ± generator accuracy.

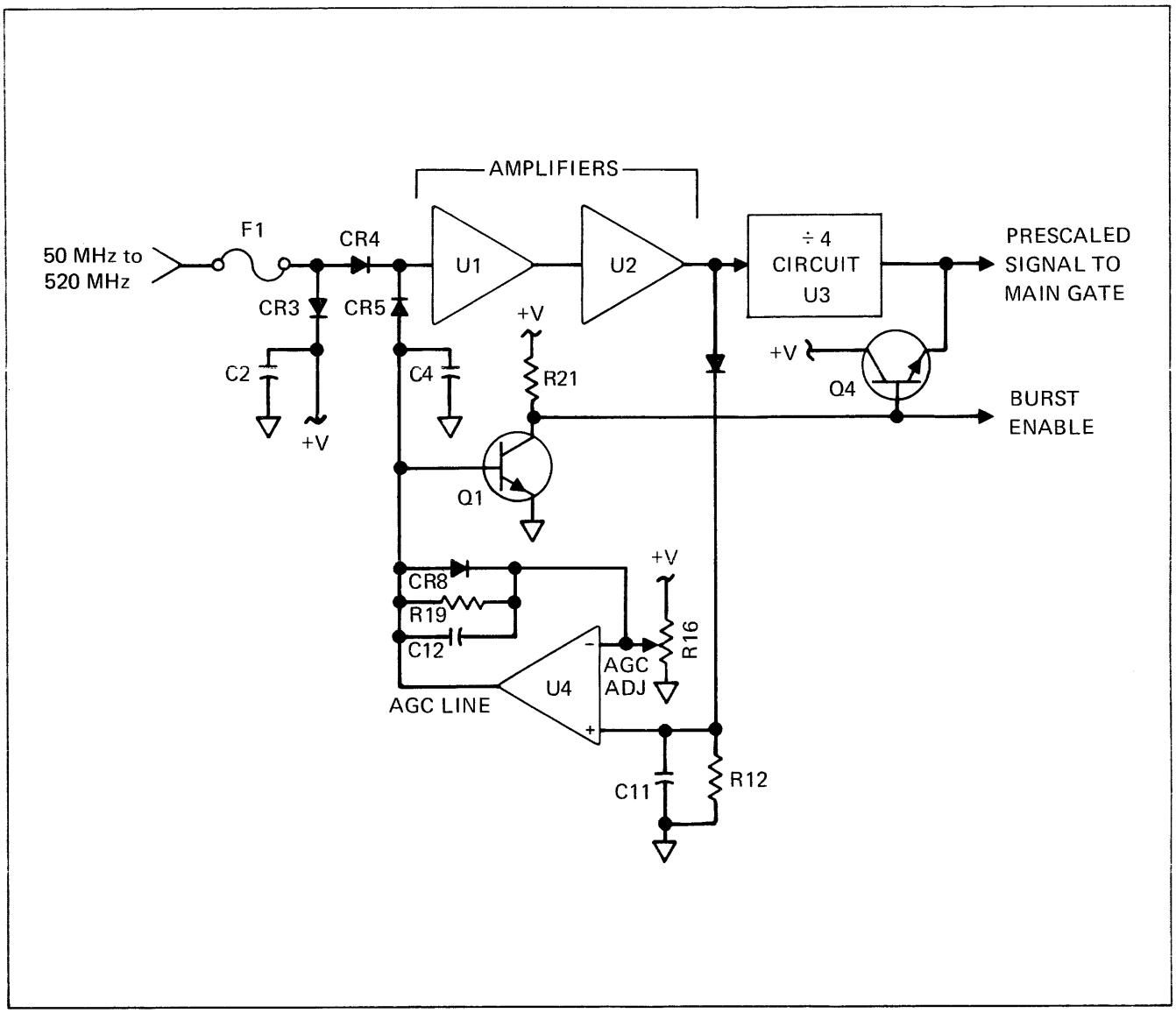


Figure 605-1. 520 MHz Prescaler Block Diagram

607-11. CALIBRATION

607-12. Calibration of the prescaler amounts to adjustment of the AGC level control located on the top edge of the Prescaler PCB assembly. Proceed as follows:

a. Remove the top dust cover from the instrument.

b. Energize the counter and connect the RF generator to the CHANNEL C input connector. Select an output of 100 MHz at approximately 15 mV rms.

c. On the counter, adjust the AGC control (R15) to a midpoint which produces a stable display.

d. Reduce the input signal level until the display becomes unstable.

e. Readjust the AGC control until the display is again stable.

f. Repeat steps d and e until no additional sensitivity can be achieved.

607-13. LIST OF REPLACEABLE PARTS

607-14. Table 607-1 is a list of replaceable parts for the 520 MHz Prescaler, Option -07. Refer to Section 5 for an explanation of the column entries.

Table 607-1. -07 Option, 520 MHz Prescaler

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
-07	520 MHZ PRESCALER, OPTION -07 FIGURE 607-2						
A9	520 MHZ PRESCALER PCB ASSEMBLY	396291	89536	396291	1		
C91	CAP, ELECT, 470 UF _10/+100%, 40V	403030	99392	39CS50FJ52	1	1	
H1	GROUND CLIP	462101	89536	462101	1		
U13	IC, TTL, 4-BIT BINARY COUNTER	320739	01295	SN7493N	1		
U91	DIODE BRIDGE	296509	09423	FB200	1		
U93	IC, LINEAR, VOL REG	429225	07263	F7817UC	1	1	
W1	CABLE ASSEMBLY (FRONT PANEL TO PCB)	406942	89536	406942	1		

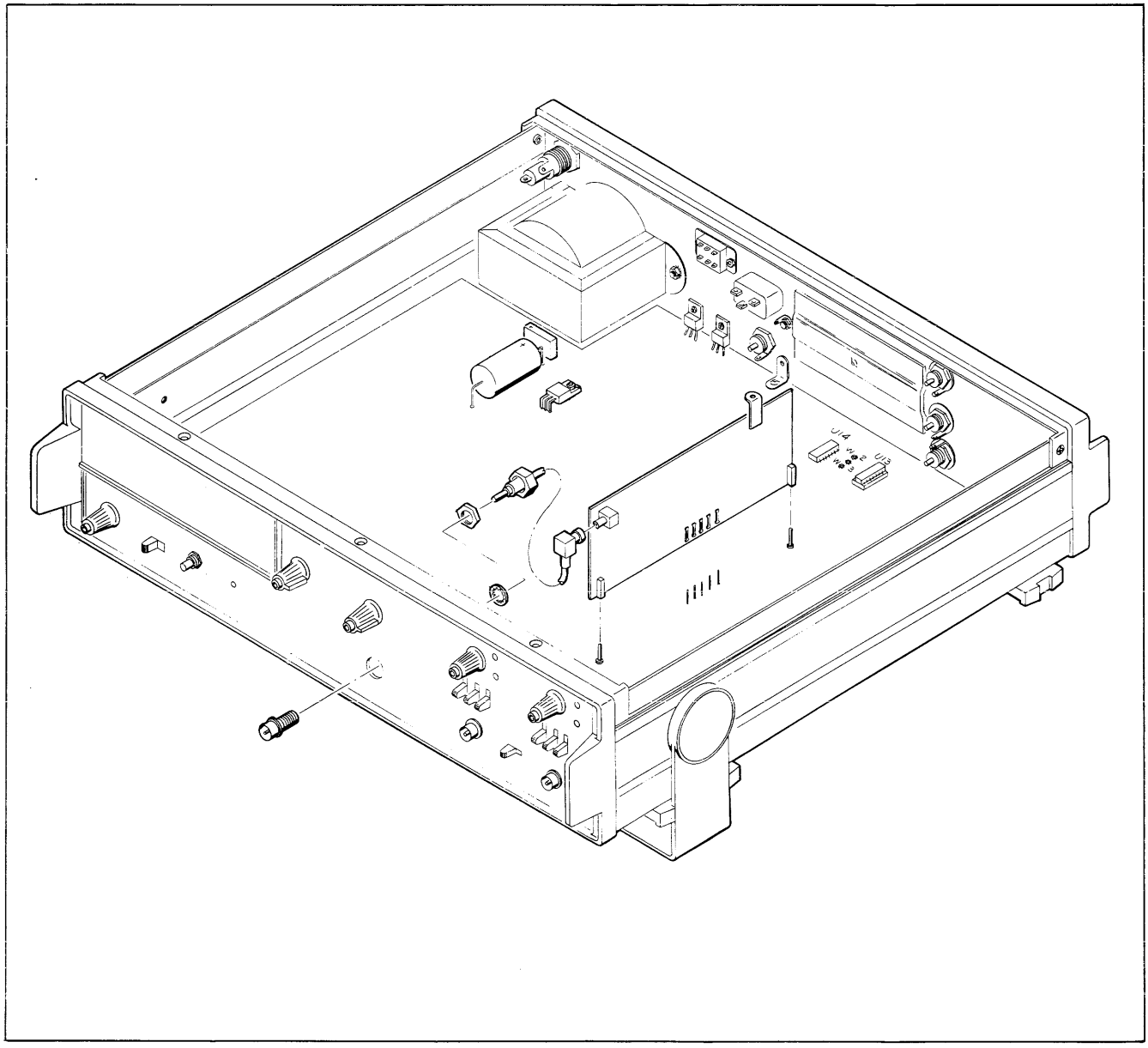


Figure 607-2. -07 Option, 520 MHz Prescaler

Table 607-2. A9 520 MHz Prescaler PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A9	520 MHZ PRESCALER PCB ASSEMBLY (1953A-4026T) FIGURE 607-3	396291	89536	396291	REF		
C1	CAP, CER, .001 UF +/-20%, 100V	402966	72982	8121-A100-W5R102M	6		
C2	CAP, CER, .001 UF +/-20%, 100V	402966	72982	8121-A100-W5R102M	REF		
C3	CAP, CER, 1000 PF +/-10%, 500V	357806	71590	CF102	3		
C4	CAP, CER, .001 UF +/-20%, 100V	402966	72982	8121-A100-W5R102M	REF		
C5	CAP, CER, 0.01 UF +/-20%, 100V	407361	72982	8121-A100-W5R-103M	2		
C6	CAP, CER, .001 UF +/-20%, 100V	402966	72982	8121-A100-W5R102M	REF		
C7	CAP, CER, .001 UF +/-20%, 100V	402966	72982	8121-A100-W5R102M	REF		
C8	CAP, CER, 22 PF +/-20%, 500V	369157	72982	831-000-C060-220M	1		
C9	CAP, CER, .001 UF +/-20%, 100V	402966	72982	8121-A100-W5R102M	REF		
C10	CAP, CER, 0.01 UF +/-20%, 100V	407361	72982	8121-A100-W5R-103M	REF		
C11	CAP, CER, 1000 PF +/-10%, 500V	357806	71590	CF102	REF		
C12	CAP, CER, 1000 PF +/-10%, 500V	357806	71590	CF102	REF		
C13	CAP, CER, 0.01 UF +/-20%, 100V	149153	56289	C023B101F103M	2		
C14	CAP, CER, 0.01 UF +/-20%, 100V	149153	56289	C023B101F103M	REF		
C15	CAP, CER, 2700 PF +/-20%, 100V	362889	80031	2222-630-01-272	1		
C16	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA1	1		
CR1	DIODE, SI	203323	07919	1N4448	2		
CR3	DIODE, SI	402776	28480	HP5082-3379	3		
CR4	DIODE, SI	402776	28480	HP5082-3379	REF		
CR5	DIODE, SI	402776	28480	HP5082-3379	REF		
CR6	DIODE, HOT CARRIER	369595	07263	FH1100	2		
CR7	DIODE, HOT CARRIER	369595	07263	FH1100	REF		
CR8	DIODE, SI	203323	07919	1N4448	REF		
CR9	DIODE, ZENER	159798	07263	1N751A	1		
F1	FUSE, .2 AMP	370577	75915	273200	2		
F2	FUSE, .2 AMP	370577	75915	273200	REF		
J5	CONNECTOR						
	PIN, FEMALE, LARGE	149112	74270	105-0753	2		
	PIN, FEMALE, SMALL	375329	00779	85863-3	6		
J20	CONNECTOR, COAXIAL	353243	98291	51-053-000	1		
Q1	XSTR, SI, NPN	177105	07263	2N3565	2		
Q2	XSTR, SI, PNP	352369	07263	2N4403	1	1	
Q3	XSTR, SI, NPN	177105	07263	2N3565	REF		
Q4	XSTR, SI, NPN	369645	07263	2N4274	1		
R1	RES, COMP, 82 OHMS +/-5%, 1/4W	149484	01121	CB8205	2		
R2	RES, COMP, 22 OHMS +/-5%, 1/4W	147884	01121	CB2205	1		
R3	RES, COMP, 470 OHMS +/-5%, 1/4W	147983	01121	CB4715	2		
R4	RES, COMP, 680 OHMS +/-5%, 1/4W	148007	01121	CB6815	1		
R5	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	4		
R6	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	REF		
R7	RES, COMP, 2.7K +/-5%, 1/4W	170720	01121	CB2725	4		
R8	RES, COMP, 68 +/-5%, 1/4W	147918	01121	CB6805	1		
R9	RES, 10K +/-5%, 1/4W	148106	01121	CB1035	3		
R10	RES, COMP, 2.7K +/-5%, 1/4W	170720	01121	CB2725	REF		
R11	RES, COMP, 470 OHMS +/-5%, 1/4W	147983	01121	CB4715	REF		
R12	RES, COMP, 2.7K +/-5%, 1/4W	170720	01121	CB2725	REF		
R13	RES, COMP, 2.7K +/-5%, 1/4W	170720	01121	CB2725	REF		

Table 607-2. A9 520 MHz Prescaler PCB Assembly (cont)

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R14	RES, COMP, 82 OHMS +/-5%, 1/4W	149484	01121	CB8205	REF		
R15	RES, 10K +/-5%, 1/4W	148106	01121	CB1035	REF		
R16	RES, VAR, COMP, 10K +/-20%, 20W	385393	54869	PT10(25)10K	1	1	
R17	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	REF		
R18	RES, COMP, 1M +/-5%, 1/4W	182204	01121	CB1055	1		
R19	RES, COMMP, 330K +/-5%, 1/4W	192948	01121	CB3345	1		
R20	RES, 10K +/-5%, 1/4W	148106	01121	CB1035	REF		
R21	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	REF		
R22	RES, COMP, 100K +/-5%, 1/4W	148149	01121	CB1045	1		
U1	IC, LINEAR, VHF/UHF, WIDE BAND AMPLIFIER	392977	35784	OM185	1	1	
U2	IC, LINEAR, 5-400 MHZ AMPLIFIER	402594	24539	GPD402	1	1	
U3	IC, ECL, DIVIDE BY 4 COUNTER	444034	07263	F11C05PC	1	1	
U4	IC, OP AMP	4Q2750	07263	741TC	1	1	
XF1	FUSE SOCKET, SPRING TYPE	403642	00779	50863-8	4		
XF2	FUSE SOCKET, SPRING TYPE	403642	00779	50863-8	REF		
XU3	SOCKET, IC, 14-PIN DIP	291542	00779	583527	1		

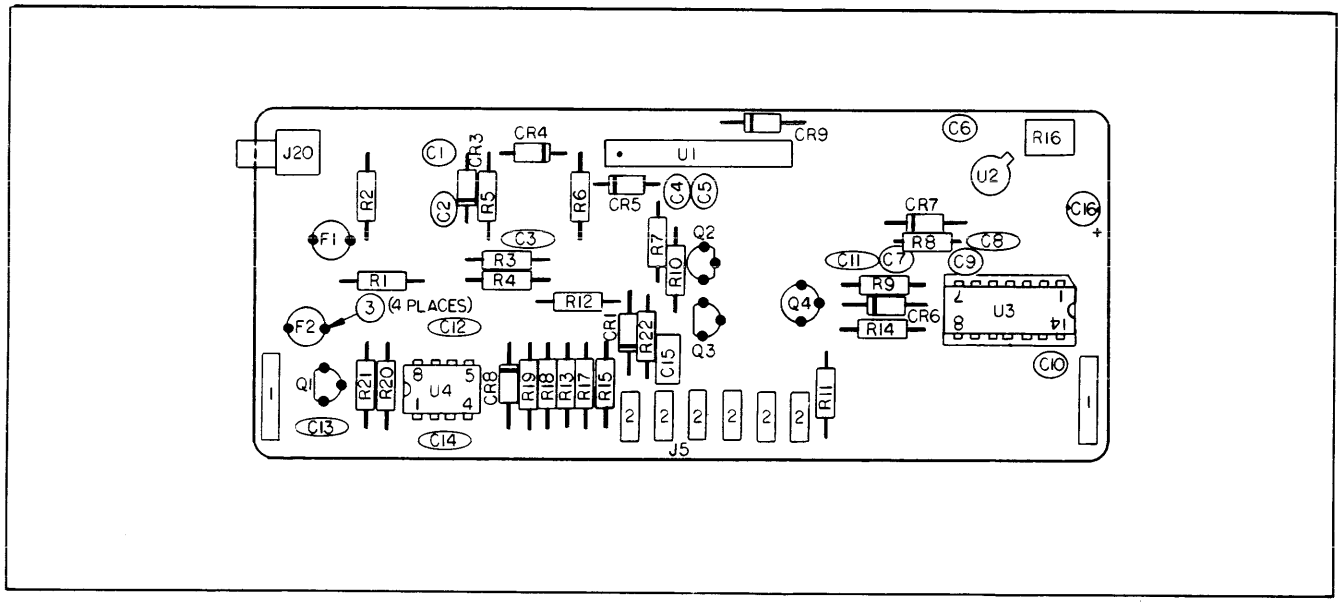


Figure 607-3. A9 520 MHz Prescaler PCB Assembly

Option -10
Oven-Stabilized Time Base

610-1. INTRODUCTION

610-2. The Option -10 Oven-Stabilized Time Base affords a higher degree fo time base stability to the Model 1953A than either of the TCXO's available. The specifications for Option -10 are given in Section 1. The unit is installed on the inside of the rear panel of the 1953A and requires re-arrangement of the instrument's power switching. A switch installed on the rear panel of the 1953A is used to activate the heaters independently of the power switch for the instrument itself. The option must be ordered factory-installed in the 1953A when the instrument is purchased; it is not field installable.

610-3. LIST OF REPLACEABLE PARTS

610-4. A list of replaceable parts for the Oven-Stabilized Time Base is given in Table 610-1. Refer to Section 5 for ordering information.

Table 610-1. -10 Option, Oven-Stabilized Time Base

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
-10	OVEN-STABILIZED TIME BASE, OPTION -10 FIGURE 610-1						
C91	CAP, ELECT, 2100 UF -10/+100%, 35V	370742	80031	3050JJ12U035	1	1	
C122	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA4	1		
C123	CAP, TA 10 UF +/-20%, 35V	417683	56289	196D106X0035PE4	1		
K1	RELAY, REED, 12V	352658	71707	UF-40063	1		
MP1	DECAL (NOT USED WITH -11 OR -12 OPTIONS)	428052	89536	428052	1		
R121	RES, VAR, 10K +/-20%, 1/2W	267880	11236	190PC103B	1	1	
S121	SWITCH, TOGGLE, DPDT	327734	09353	7201LHPZG1	1		
U7	OSCILLATOR	441170	12020	73-43	1		
U91	RECTIFIER BRIDGE	296509	09423	FB200	1		
U101	VOLTAGE REGULATOR, +18V	443713	89536	443713	1		
W1	CABLE ASSEMBLY	443705	89536	443705	1		

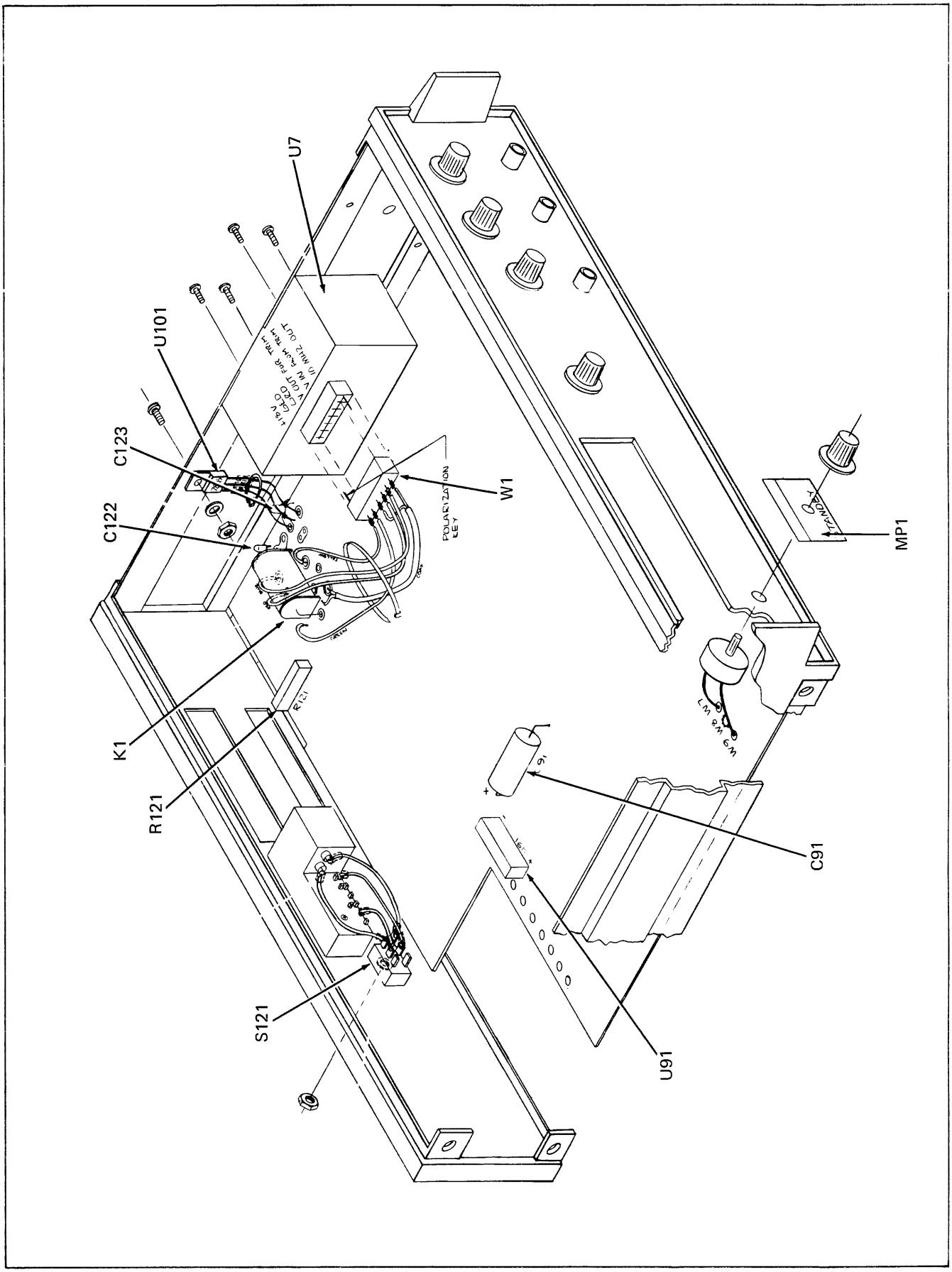


Figure 610-1. -10 Option, Oven-Stabilized Time Base

Option -11
Basic Remote Control Unit

611-1. INTRODUCTION

611-2. Option -11 is a remote control unit allowing remote operation of the 1953A. Option -11 is the Basic Remote Control Unit, permitting control of the essential functions required for remote operation of the 1953A.

611-3. BASIC REMOTE CONTROL UNIT

611-4. Option -11 is the basic remote programming option. It consists of a single pcb and ribbon-cable assembly. When installed it allows the 1953A to be operated from a remote station. The option allows full Range and Function selection; control of the trigger edge selectors Slope A and Slope B, and a "Front panel lockout" command (low true) which disables the manual front panel controls corresponding to these functions and places the functions under remote control. In addition, this option provides for remote analog control of the channel A and B trigger levels. When under remote control the 1953A always operates in a single-shot mode, and the Cycle Rate and CONT/TRIG controls are disabled. All inputs are TTL compatible, low true commands that can also be controlled by contact-closure to ground.

611-5. INSTALLATION

611-6. Remote control Option -11 can be installed at the factory upon request when ordering the 1953A, it is not field installable.

611-7. OPERATION

611-8. The following lists and Table 611-1 give the relevant data for operating the 1953A is the Basic Remote Control mode.

a. Function (One line of 7 to be low)

FREQ A	(A)	fan-in = 1
FREQ C	(C)	fan-in = 1
FREQ A/B	(A/B)	fan-in = 1
PERIOD A	(PA)	fan-in = 1
TIME INTERVAL	(TI)	fan-in = 1
A GTD BY B	(A x B)	fan-in = 1
CHECK	(CH)	fan-in = 1

b. Range (One line of 6 to be low)

0.1 ms	10^0	0.1 μs	(1)	fan-in = 1
1 ms	10^1	1 μs	(2)	fan-in = 1
10 ms	10^2	10 μs	(3)	fan-in = 1
0.1s	10^3	0.1 ms	(4)	fan-in = 1
1s	10^4	1 ms	(5)	fan-in = 1
10s	10^5	10 ms	(6)	fan-in = 1

c. Slope (One line per channel)

Slope A (EXT SA) low = positive fan-in = 3

Slope B (EXT SB) low = positive fan-in = 1

d. Reset (One line, low true)

When the reset line is brought low and released, a new measurement sequence will start without resetting the display. This same line is used on DOU option.

e. The following outputs are provided:

1. Power Sense (SP) high (on) A+5 Volt level indicates that the instrument is on.

2. Overflow Status (OVFL) high trueOutputs a high level when an overflow condition exists.

3. System Ready low true signals the completion of a measurement cycle. (Note that the System Ready appears about 3 ms before the DOU ready.)

4. Channels A and B signal outputs (SMA; SMB) TTL. These are not normally connected, except by special request. To connect these outputs, jumper both W5 and W6 on the Main PCB.

CAUTION

These outputs should be connected only in applications where the maximum channel A or B count frequency is below 25 MHz. Exposed wiring external to the unit should be kept to a minimum to prevent signal feedback.

f. Also provided are two Analog Trigger Level input/outputs (ATL-A and ATL-B) which can be used for measuring the internally-generated trigger levels with an external voltmeter, or for defining the trigger levels from an external dc source. The input impedance is 20k, and the response time is 2 ms. The usable range is ±1 volt, and the maximum safe level is ±5 volts. Operation with X10 attenuation extends the apparent range to ±10V.

g. Although the counter will operate in a single-shot mode when under remote control, automatic measurement cycling can be established by connecting the System Ready output into the Reset input. The cycle rate will be the maximum attainable with the instrument and will be equal to the gate time plus the conversion time (50 μs).

611-9. EXTERNAL CONNECTIONS

611-10. The input commands needed to operate the Remote Control Unit are provided in Table 611-1. The pin numbers identified in the table correspond to the pin numbers on the 50 pin connector supplied with the option.

611-11. LIST OF REPLACEABLE PARTS

611-12. Table 611-2 is a list of replaceable parts for the Remote Control Unit, Option -11. Refer to Section 5 for an explanation of the column entries.

Table 611-1. RCU I/O Connections

PIN	SIGNAL	DESCRIPTION		FAN IN*
		LOW LOGIC EQUALS	HIGH LOGIC EQUALS	
B	ATL A	Analog Tigger Level A Input / Trigger Level Monitor Output		
C	ATL B			
P	SA	+ Slope	– Slope	1
R	SYSTEM READY	System Ready	System Not Ready	
U	PA	Period A Function		1
V	4	0.1 ms Range		1
W	2	1.0 ms Range		1
X	AXB	A GTD by B Function		1
Z	6	10s Range		1
a	OVFL		Overflow Output	
b	A	FREQ A Function		1
c	SR	Sense Remote		
3	SP		Positive (Down on)	

Table 611-1. RCU I/O Connections (cont)

PIN	SIGNAL	DESCRIPTION		FAN IN
		LOW LOGIC EQUALS	HIGH LOGIC EQUALS	
12	SMA	TTL Ouput Equal to CHL-A Input	Not Normally	
13	SMB	TTL Output Equal to CHL-B Input	Connected	
14	SB	+ Slope	– Slope	1
17	C	FREQ C Function		1
18	TI	T.I. A-B Function		1
19	1	0.1 ms Range		1
20	Remote EXT	Front Panel Lockout		5
21	A/B	FREQ A/B Function		1
22	5	1.0s Range		1
23	EXT-RESET	Resets Counter		
24	3	10 ms Range		1
25	Ground			

* TTL fan-ins are given where relevant. The remaining inputs are CMOS compatible with internal 100 kΩ pull-up to +5 volts.

Table 611-2. -11 Option, Basic Remote Control Unit

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	BASIC REMOTE CONTROL UNIT, OPTION -11 FIGURE 611-1						
A10	BASIC RCU PCB ASSEMBLY	405563	89536	405563	1		
MP1	COVER, CONNECTOR PORT, REAR PANEL	398016	89536	398016	1		
MP2	CONNECTOR KIT (NOT SHOWN)	410241	89536	410241	1		
MP3	REMOTE DECAL	408617	89536	408617	1		
S121	SWITCH, TOGGLE, DPDT (INSTALLED ON REAR PANEL)	327734	09353	7201LHPZG1	1	1	

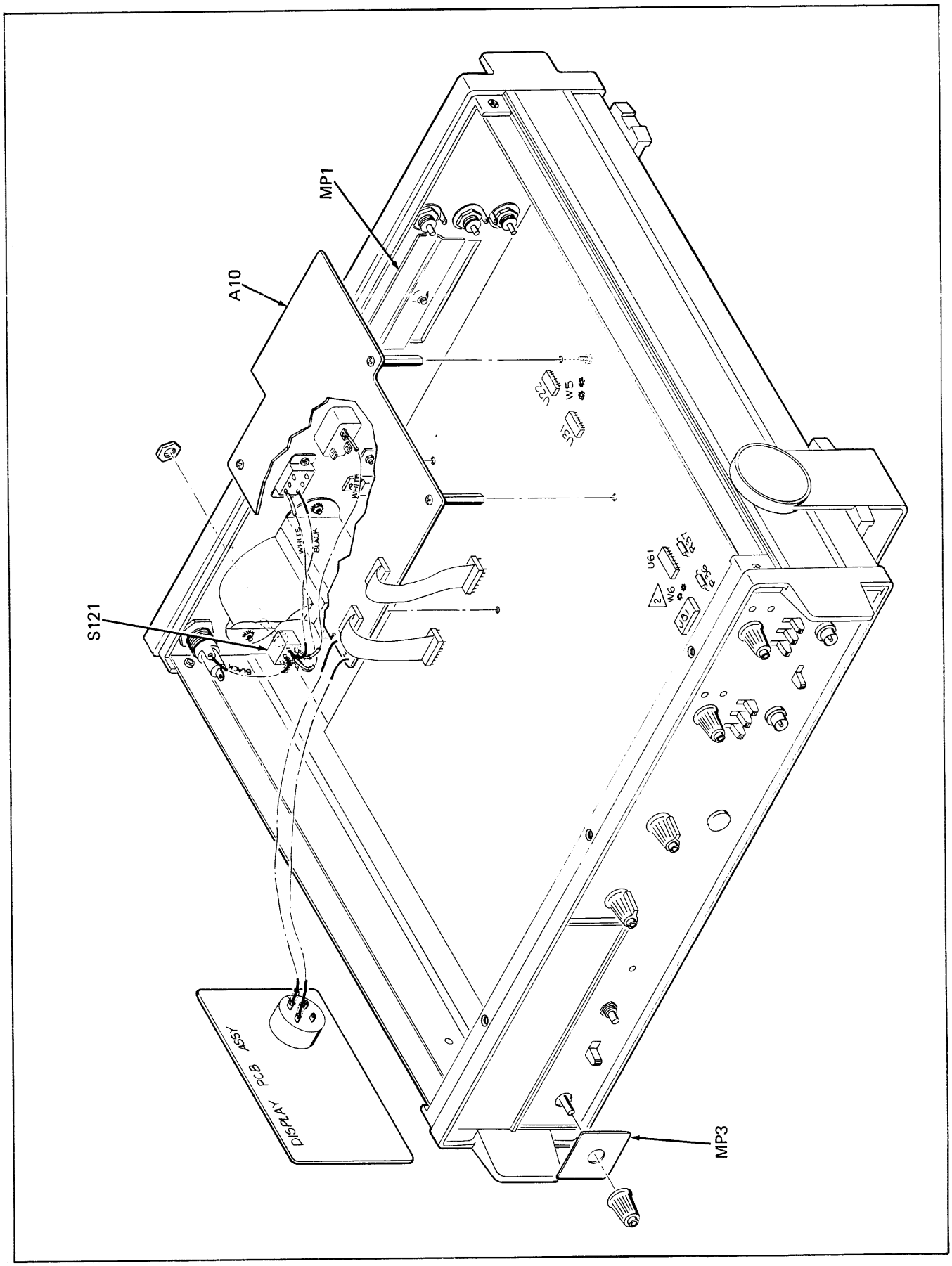


Figure 611-1. -11 Option, Basic Remote Control Unit

Table 611-3. A10 Basic Remote Control Unit PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A10	BASIC REMOTE CONTROL UNIT PCB ASSEMBLY (1953A-4029T) FIGURE 611-2	405563	89536	405563	REF		
C711	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA4	1		
C712	CAP, CER, 0.002 UF +/-GMV, 1 KV	105569	71590	DA140-139CB	1		
CR702	DIODE, SI	203323	07919	1N4448	4	1	
CR703	DIODE, SI	203323	07919	1N4448	REF		
CR704	DIODE, SI	203323	07919	1N4448	REF		
CR705	DIODE, SI	203323	07919	1N4448	REF		
J81	FLAT CABLE ASSEMBLY	393520	08261	5142-006	2		
J82	FLAT CABLE ASSEMBLY	393520	08261	5142-006	REF		
R751	RES, COMP, 100 OHMS +/-5%, 1/4W	147926	01121	CB1015	2		
R752	RES, COMP, 82 OHMS +/-5%, 1/4W	149484	01121	CB8205	2		
R753	RES, COMP, 82 OHMS +/-5%, 1/4W	149484	01121	CB8205	REF		
R758	RES, COMP, 390 +/-5%, 1/4W	147975	01121	CB3915	1		
R759	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	3		
R760	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	REF		
R762	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	REF		
R763	RES, COMP, 100 OHMS +/-5%, 1/4W	147926	01121	CB1015	REF		
U711	IC, TTL, TRI-STATE, HEX BUFFER	408146	12040	DM8095N	3	1	

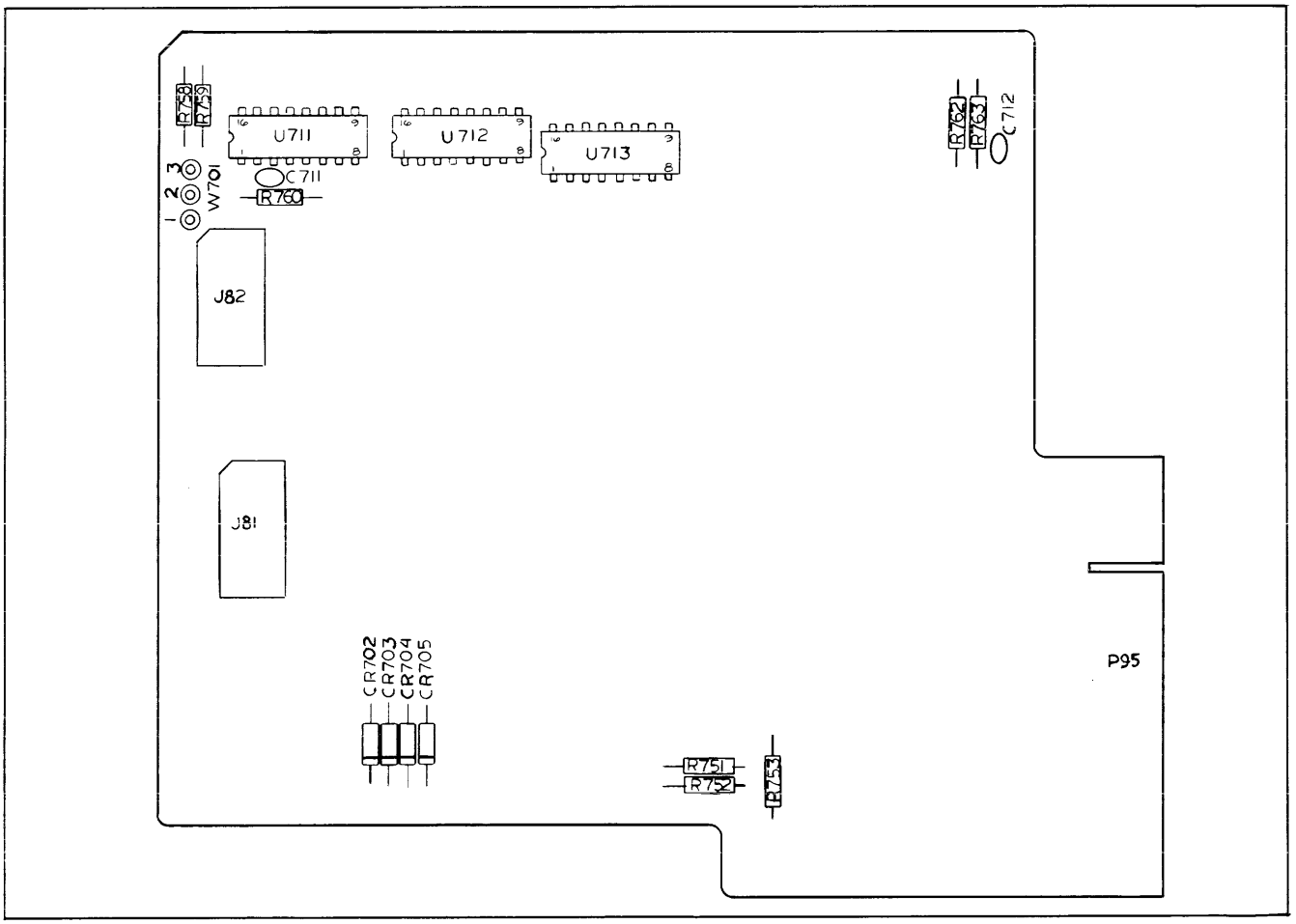


Figure 611-2. A10 Basic Remote Control Unit PCB Assembly

Option -12
Full Remote Control Unit

612-1. INTRODUCTION

612-2. Option -12 is a remote control unit allowing remote operation of the 1953A. Option -12 is the Full Remote Control Unit, comprising the same features as the -11 Option including, in addition, the remaining functions necessary for complete remote digital control of the 1953A.

612-3. FULL REMOTE CONTROL UNIT

612-4. Option -12 includes all of the programming features of the Option -11 plus remote control of the AC/DC coupling, attenuation selectors, separate/common input status between channels A and B, and the trigger levels of channel A and B. The Basic configuration allows full range and function selection, control of trigger edge selectors Slope A and Slope B, and a "Front Panel Lockout" command to disable the manual front panel controls corresponding to those functions to place them under exclusive remote control. Under remote control, the 1953A operates in a single-shot mode and the Cycle Rate and CONT/TRIG controls are disabled.

612-5. Two internal D/A converters are used for programming the trigger levels over a -1 to +1 volt range in 10 mV steps. A separate local trigger disable allows control of the local trigger under remote control operations. Two BCD digits, plus a sign, are provided for each channel (A and B). All analog function switches are operated by means of relays working from TTL or contact level closures. No inputs should be forced low when the system is used in the local operating mode.

612-6. INSTALLATION

612-7. Option -12 requires installation at the factory. The option includes three PCB assemblies, RCU 1, RCU 2 and RCU 3.

612-8. OPERATION

612-9. The following lists and Table 612-1 give the relevant data for operating the 1953A in the Full Remote Control mode.

a. Function (One line of 7 to be low)

FREQ A	(A)	fan-in = 1
FREQ C	(C)	fan-in = 1
FREQ A/B	(A/B)	fan-in = 1
PERIOD A	(PA)	fan-in = 1
TIME INTERVAL	(TI)	fan-in = 1
A GTD BY B	(A x B)	fan-in = 1
CHECK	(CH)	fan-in = 1

b. Range (One line of 6 to be low)

0.1 ms	10^0	0.1 μs	(1)	fan-in = 1
1 ms	10^1	1 μs	(2)	fan-in = 1
10 ms	10^2	10 μs	(3)	fan-in = 1
0.1s	10^3	0.1 ms	(4)	fan-in = 1
1s	10^4	1 ms	(5)	fan-in = 1
10s	10^5	10 ms	(6)	fan-in = 1

c. Slope (One line per channel)

Slope A (EXT SA) low = positive fan-in = 3

Slope B (EXT SB) low = positive fan-in = 1

d. D/A Converters:

Resolution	= 1%
Accuracy	= ±5% of setting +2 mV
Temperature Stability	= 200 μV/°C

All inputs are high true

The x10 attenuator extends the apparent range to ±10V in 100 mV steps.

e. AC/DC Coupling (One line per channel)

Channel A (DA) low = AC Coupling fan-in = 1
Channel B (DB) low = AC Coupling fan-in = 1

f. Attenuator (One line per channel)

Channel A (TA) low = x1 fan-in =1
Channel B (TB) low = x1 fan-in =1

g. Separate/Common (One line)

(SC) low = separate fan-in = 1

h. The two Analog Trigger lines are also provided for checking the operation of the internal D/A's or analog programming the trigger levels whenever the D/A's are disabled.

i. Reset (One line, low true)

When the reset line is brought low and released, a new measurement sequence will start without resetting the display.

Note: This same line is used on DOU option.

j. The following outputs are provided:

1. Power Sense (SP) High = on

A +5 Volt level indicates that the instrument is on.

2. Overflow Status (OVFL) high true

Outputs a high level when an overflow condition exists.

3. SYSTEM READY Low true

Signals the completion of a measurement cycle. (Note that the System Ready appears about 3 ms before the DOU Ready.)

4. Channels A and B signal outputs (SMA; SMB) TTL.

These are not normally connected, except by special request. To connect these outputs, jumper both W5 and W6 on the Main PCB.

CAUTION

These outputs should be connected only in applications where the maximum channel A or B count frequency is below 25 MHz. Exposed wiring external to the unit should be kept to a minimum to prevent signal feedback.

k. Also provided are two Analog Trigger Level input/outputs (ATL-A and ATL-B) which can be used for measuring the internally-generated trigger levels with an external voltmeter, or for defining the trigger levels from an external dc source. The input impedance is 20k and the response time is 2 ms. Usable range is ±1 volt, and the maximum safe level is ±5 volts. Operation with X10 attenuation extends the apparent range to ±10V.

l. Although the counter will operate in a single-shot mode when under remote control, automatic measurement cycling can be established by connecting the System Ready output into the Reset input. The cycle rate will be the maximum attainable with the instrument and will be equal to the gate time plus the conversion time (50 μs).

m. Whenever Option -12 is installed, the overall 1953A specifications are changed in two areas:

1. Input capacity increases to 45 pF max.
2. Overload capability becomes:

DC + Peak AC must not exceed 250 volts, when in steady state condition, this decreases to 100 volts maximum whenever any of the following lines are switched:

DA	Channel A Coupling
DB	Channel B Coupling
TA	Attenuation, Channel A
TB	Attenuation, Channel B
SC	Separate/Common

612-10. EXTERNAL CONNECTIONS

612-11. The input commands needed to operate the Remote Control Unit are provided in Table 612-1. The pin numbers identified in the table correspond to the pin numbers on the 50 pin connector supplied with the option.

612-12. THEORY OF OPERATION OF THE DIGITAL-TO-ANALOG CONVERTER

612-13. The Full Remote Control Unit, Option -12, provides the remote operating station with the ability to digitally program the trigger level. Figure 612-1 is a basic illustration of the remote trigger level control circuit.

612-14. The digital inputs for channel A and channel B are applied to two Digital to Analog Converters each containing current sourcing amplifiers connected to resistors of selected value. The resistor values are selected to provide a trigger level ouput, in 10 mV steps, up to ±1 volt in the x1 ATTEN setting. When the x10 ATTEN setting is selected the trigger level output is in 100 mV steps up to ±10 volts.

Table 612-1. RCU I/O Connections

PIN	SIGNAL	DESCRIPTION		FAN IN
		LOW LOGIC EQUALS	HIGH LOGIC EQUALS	
A	Sign A	Negative	Positive	
B	ATL A	Analog Trigger Level A Input/Trigger Level Monitor Output		
C	ATL B			
D	A "1"		True	
E	A "4"		True	
F	A"10"		True	
H	A "40"		True	
J	B "1"		True	
K	B "4"		True	
L	B "10"		True	
M	B "40"		True	
N	SC	A, B Inputs SEP	A, B Input COM	
P	$\overline{SA}$	+ Slope	– Slope	
R	$\overline{SYSTEM\ READY}$	System Ready	System Not Ready	
S	$\overline{DB}$	CH-B AC Coupled	CH-B DC Coupled	1
T	$\overline{DA}$	CH-A AC Coupled	CH-A DC Coupled	1
U	$\overline{PA}$	Period A Function		1
V	$\overline{4}$	0.1s Range		1
W	$\overline{2}$	1.0 ms Range		1
X	$\overline{AXB}$	A GTD by B Function		1
Y	$\overline{CH}$	Self-check Function		1
Z	$\overline{6}$	10s Range		1
a	$\overline{OVFL}$		Overflow Output	
b	$\overline{A}$	FREQ A Function		1
c	$\overline{SR}$	Sense Remote		
1	$\overline{EXT\text{-}T}$	Local Trigger Disable	Local Trigger Enable	
2	Sign B	Negative	Positive	
3	SP		Positive (Down on)	
4	A "2"		True	
5	A "8"		True	
6	A "20"		True	
7	A "80"		True	
8	B "2"		True	
9	B "8"		True	
10	B "20"		True	
11	B "80"		True	
12	$\overline{SMA}$	TTL Output Equal CHL-A Input	Not Normally Connected	
13	$\overline{SMB}$	TTL Output Equal to CHL-B Input		
14	$\overline{SB}$	+ Slope	– Slope	1

Table 612-1. RCU I/O Connections (cont)

PIN	SIGNAL	LOW LOGIC EQUALS	HIGH LOGIC EQUALS	FAN IN
15	$\overline{TB}$	CH-B Atten X1	CH-B Atten X10	1
16	$\overline{TA}$	CH-A Atten X1	CH-A Atten X10	1
17	$\overline{C}$	FREQ C Function		1
18	$\overline{TI}$	T.I. A-B Function		1
19	$\overline{1}$	0.1 ms Range		1
20	$\overline{EXT}$	Front Panel Lockout		5
21	$\overline{A/B}$	FREQ A/B Function		1
22	$\overline{5}$	1.0s Range		1
23	$\overline{EXT\text{-}RESET}$	Reset Counter		
24	$\overline{3}$	10 ms Range		1
25	Ground			

NOTES ON RCU CONNECTIONS TABLE

(1) Pins D through M and 4 through 11, as per the table, represent the binary coded decimal inputs for the trigger level controls of channels A and B. The trigger level is divided into 10 mV steps, requiring two sets of binary coded decades, one for units and one for tens. The trigger level signs are provided by pins A and 2. Pins B and C, named ATL-A and ATL-B respsectively, can be used as either analog inputs for an externally applied dc trigger level, or as output terminals for external measurement of the trigger level when that level stems from either the D/A converter of the front panel trigger level adjustments.

(2) TTL fan-ins are given where relevant. The remaining inputs are CMOS compatible with internal 100k ohm pull-up to +5 volts.

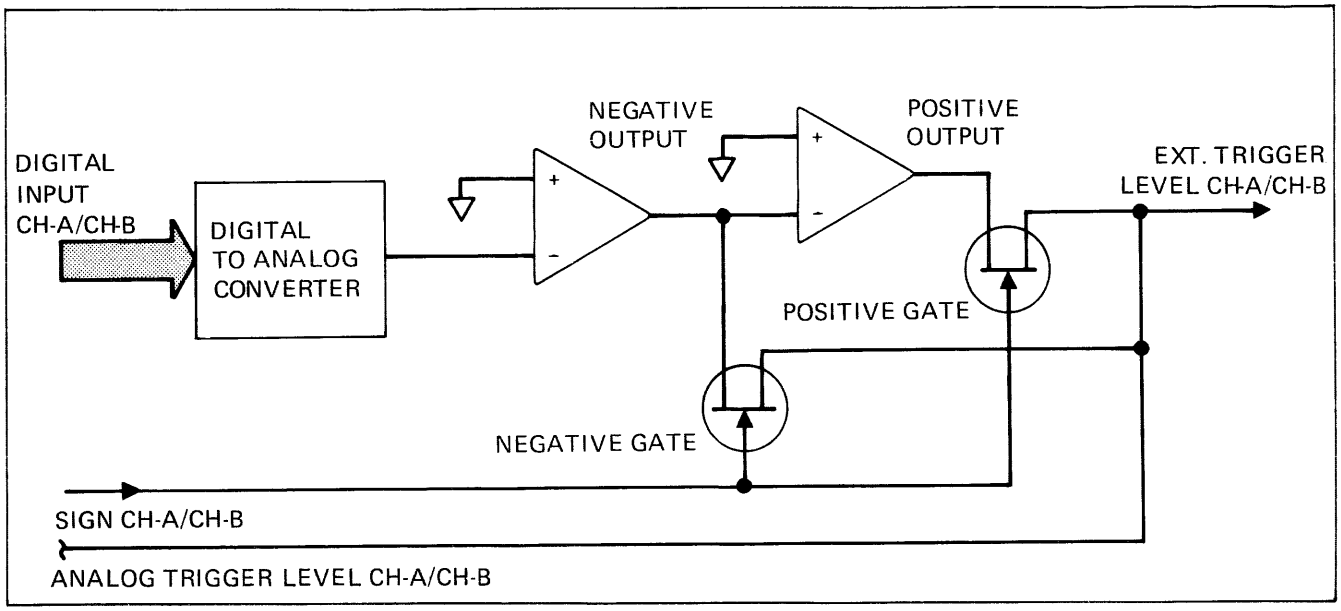


Figure 612-1. Trigger Level Control Block Diagram

612-15. For both channels A and B the SIGN input controls switching FET's that select either a positive output or a negative output for the trigger level control. The external trigger level control is enabled by a LOW input to the EXT-T pin on the RCU rear panel connector.

612-16. CALIBRATION PROCEDURE FOR DIGITAL TRIGGER LEVEL CONTROL

612-17. The calibration requires use of a DVM. See Table 4-1 for recommended type. Make reference to Table 612-1 as necessary for pin designations on P95, and reference desigator Figure 612-4 (RCU 3 PCB Assembly) for location of trimpots R701, R704, R705, R708.

612-18. Calibrate Digital Trigger Level Controls of Channels A and B as follows:

a. Connect 1953A to line power.

b. Rotate Cycle Rate control cw, off the OFF detent.

c. Channel A calibration

1. Connect EXT-T to ground. This enables the digital trigger.

2. Connect Digital Input pins, D, E, F, H, 4, 5, 6, 7) of channel A to ground (0 state).

3. Connect DVM to pin B (ATL-A) of P95 (RCU input).

4. Set SIGN-A to negative (ground pin A).

5. Adjust timpot R708 until DVM reads zero ±0.1 mV.

6. Set SIGN-A to positive (open pin A).

7. Adjust trimpot R705 until DVM reads zero ±0.1 mV.

d. Channel B calibration

1. Connect EXT-T to ground. This enables the digital trigger.

2. Connect Digital Input pins (J, K, L, M, 8, 9, 10, 11) of channel B to ground (0 state).

3. Connect DVM to pin C (ATL-B) of P95 (RCU input).

4. Set SIGN-B to negative (ground pin 2).

5. Adjust trimpot R704 until DVM reads zero ±0.1 mV.

6. Set SIGN-B to positive (open pin 2).

7. Adjust trimpot R701 until DVM reads zero ±0.1 mV.

612-19. LIST OF REPLACEABLE PARTS

612-20. Table 612-2 is a list of replaceable parts for the Full Remote Control Unit. Refer to Section 5 for an explanation of the column entries.

CAUTION

Indicated devices are subject to damage by static discharge.

Table 612-2. -12 Option, Full Remote Control Unit Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	FULL REMOTE CONTROL UNIT, OPTION 12 FIGURE 612-2						
A11	RCU 1 PCB ASSY 1	396242	89536	396242	1		
A12	RCU 2 PCB ASSY 1	396259	89536	396259	1		
A13	RCU 3 PCB ASSY	396150	89536	396150	1		
MP1	DECAL, REMOTE	408617	89536	408617	1		
MP2	COVER, CONNECTOR, PORT, OPTIONAL 2	398016	89536	398016	1		
MP3	CONNECTOR KIT (NOT SHOWN)	410241	89536	410241	1		
S121	SWITCH, TOGGLE DPDT (INSTALLED ON REAR PANEL)	327734	09353	7201LPZGI	1	1	

1 REPLACES INPUT PCB ASSY A1A3

2 REPLACES COVER CONNECTOR PORT P/N 398024

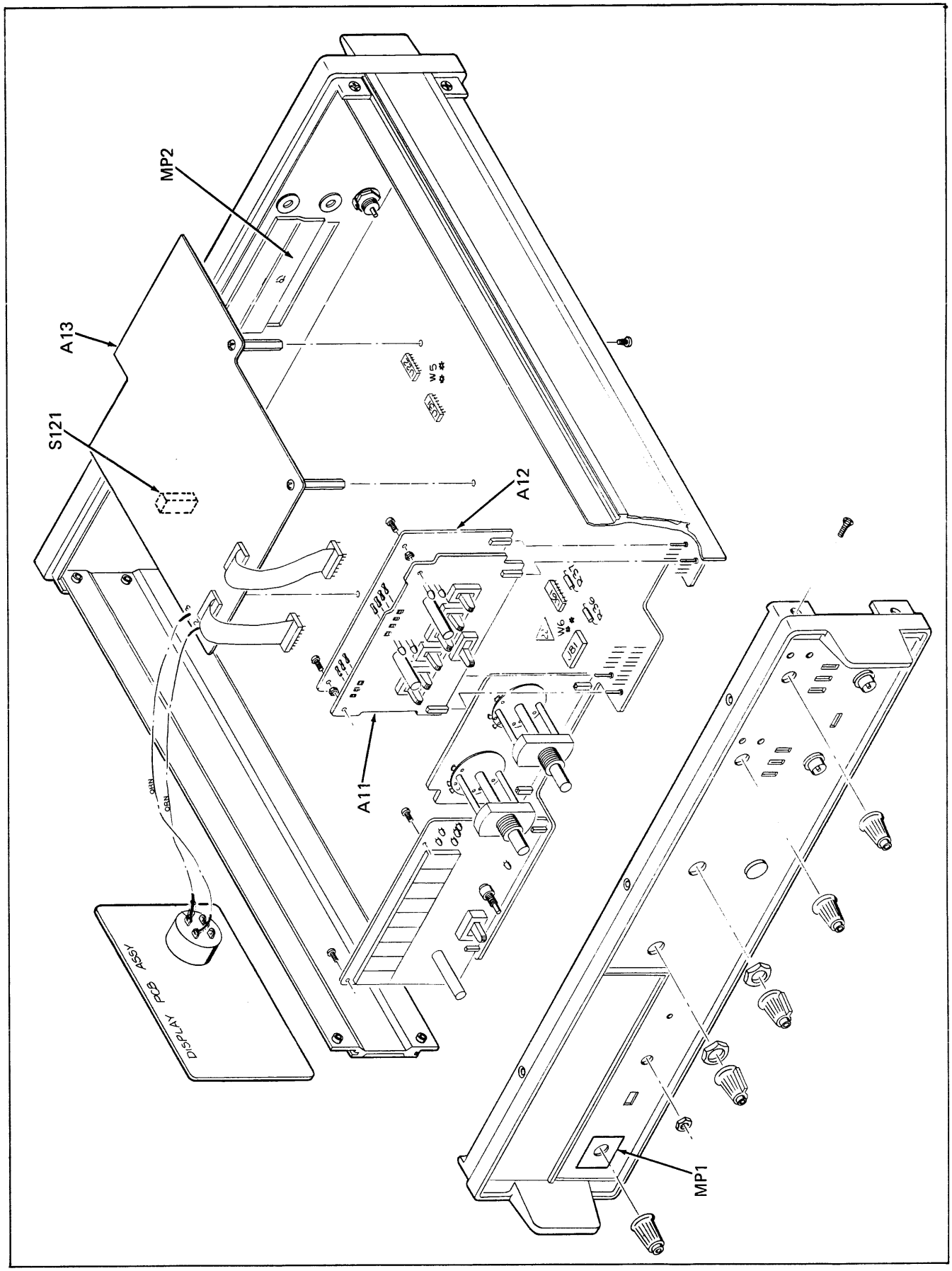


Figure 612-2. -12 Option, Full Remote Control Unit Assembly

Table 612-3. A11 RCU #1 PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A11	REMOTE CONTROL UNIT 1 (1953A-4021) FIGURE 612-3	396242	89536	396242	REF		
DS401	INDICATOR, LED	385898	28480	5082-4487	4	1	
DS402	INDICATOR, LED	385898	28480	5082-4487	REF		
DS403	INDICATOR, LED	385898	28480	5082-4487	REF		
DS404	INDICATOR, LED	385898	28480	5082-4487	REF		
J1	CONNECTOR						
	PIN, FEMALE, LARGE	149112	74970	105-0753	2		
	PIN, FEMALE, SMALL	375329	00779	85863-3	12		
P10	CONNECTOR PINS, MALE	376574	00779	5166-333-68	7		
R410	RES, COMP, 47 +/-5%, 1/4W	147892	01121	CB4705	4		
R411	RES, COMP, 47 +/-5%, 1/4W	147892	01121	CB4705	REF		
R412	RES, COMP, 47 +/-5%, 1/4W	147892	01121	CB4705	REF		
R413	RES, COMP, 47 +/-5%, 1/4W	147892	01121	CB4705	REF		
S108	SWITCH, SLIDE, SPDT	380113	79727	GF-124-SPDT	7	2	
S109	SWITCH, SLIDE, SPDT	380113	79727	GF-124-SPDT	REF		
S110	SWITCH, SLIDE, SPDT	380113	79727	GF-124-SPDT	REF		
S111	SWITCH, SLIDE, SPDT	380113	79727	GF-124-SPDT	REF		
S112	SWITCH, SLIDE, SPDT	380113	79727	GF-124-SPDT	REF		
S113	SWITCH, SLIDE, SPDT	380113	79727	GF-124-SPDT	REF		
S114	SWITCH, SLIDE, SPDT	380113	79727	GF-124-SPDT	REF		
U401	RES, NETWORK, SEVEN 10K +/-5%, 1.5W (OR 7 DISCRETE RESISTORS, P/N 148106)	364000	71450	760-1	1	1	
U402	IC, TTL, HEX INVERTER, OPEN COLLECTOR	379305	01295	SN7405N	1	1	

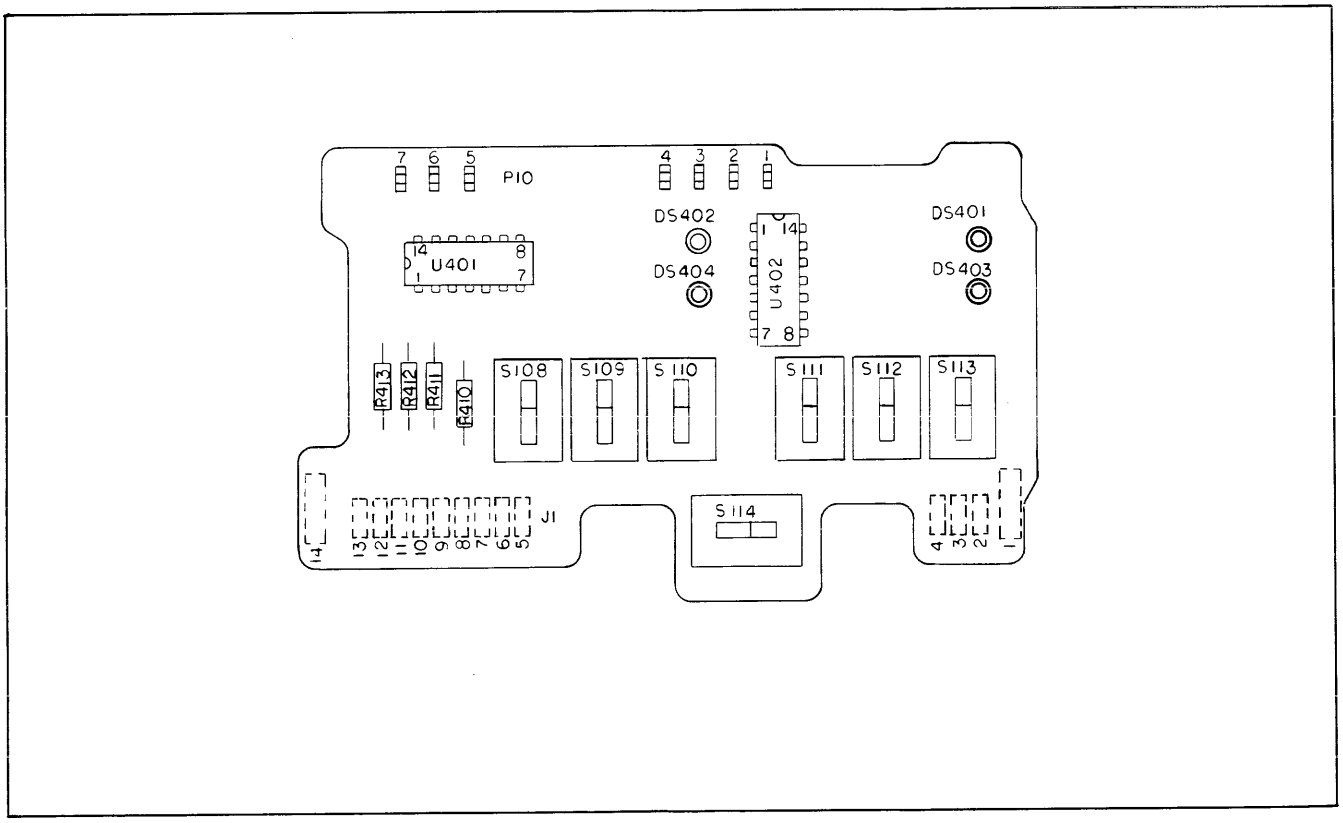


Figure 612-3. A11 RCU #1 PCB Assembly

Table 612-4. A12 RCU #2 PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A12	REMOTE CONTROL UNIT 2 (1953A-4022) FIGURE 612-4	396259	89536	396259	REF		
A12A10	RELAY, DRY REED, SPST	334920	24211	GB-831A-4E	REF		
A12A11	RELAY, DRY REED, SPST	334920	24211	GB-831A-4E	REF		
A12A4	RELAY, DRY REED, SPST	334920	24211	GB-831A-4E	8		
A12A5	RELAY, DRY REED, SPST	334920	24211	GB-831A-4E	REF		
A12A6	RELAY, DRY REED, SPST	334920	24211	GB-831A-4E	REF		
A12A7	RELAY, DRY REED, SPST	334920	24211	GB-831A-4E	REF		
A12A8	RELAY, DRY REED, SPST	334920	24211	GB-831A-4E	REF		
A12A9	RELAY, DRY REED, SPST	334920	24211	GB-831A-4E	REF		
C1	CAP, MYLAR, 0.1 UF +/-10%, 400V	447573	73445	C280MF/A100K	2		
C2	CAP, MYLAR, 0.1 UF +/-10%, 400V	447573	73445	C280MF/A100K	REF		
C3	CAP, CER, 1.5 PF +/-0.25 PF, 1 KV	178475	56289	10TCCV15-NPO	2		
C4	CAP, CER, 1.5 PF +/-0.25 PF, 1 KV	178475	56289	10TCCV15-NPO	REF		
J2	CONNECTOR						
	PIN, FEMALE, LARGE	149112	74970	105-0753	2		
	PIN, FEMALE, SMALL	375329	00779	85863-3	9		
R1	RES, COMP, 910K +/-5%, 1/4W	285338	01121	CB9145	2		
R2	RES, COMP, 910K +/-5%, 1/4W	285338	01121	CB9145	REF		
R3	RES, COMP, 100K +/-5%, 1/4W	148189	01121	CB1045	2		
R4	RES, COMP, 100K +/-5%, 1/4W	148189	01121	CB1045	REF		
R5	RES, VAR, 10K +/-30%, 1/2W	385880	89536	385880	2		
R6	RES, VAR, 10K +/-30%, 1/2W	385880	89536	385880	REF		
U3	IC, TTL, HEX INVERTER, OPEN COLLECTOR	379305	01295	SN7405N	1	1	

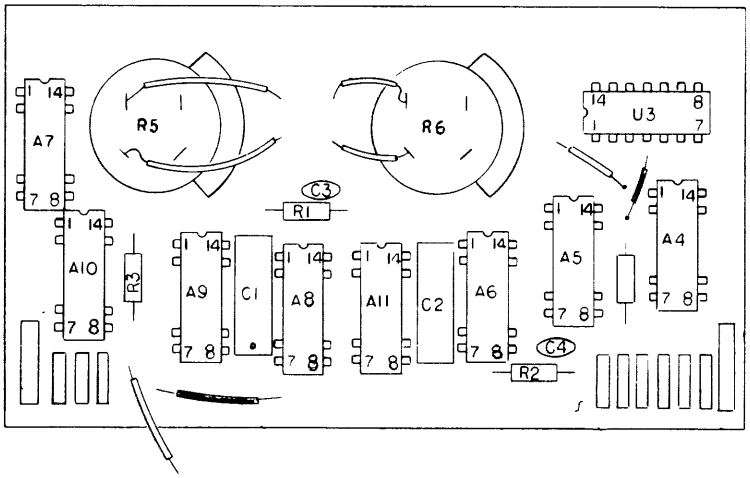


Figure 612-4. A12 RCU #2 PCB Assembly

Table 612-5. A13 RCU #3 PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A13	Ⓧ REMOTE CONTROL UNIT 3 PCB ASSEMBLY (1953A-4023) FIGURE 612-5	396150	89536	396150	REF		
C701	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015-5KA4	3		
C702	CAP, DISC, 100 PF +/-10%, 50V	105593	71590	DD101	4		
C703	CAP, DISC, 0.1 UF +/-20%, 50 VDC W	149146	56289	33C41B6	2		
C704	CAP, DISC, 100 PF +/-10%, 50V	105593	71590	DD101	REF		
C705	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015-5KA4	REF		
C706	CAP, DISC, 100 PF +/-10%, 50V	105593	71590	DD101	REF		
C708	CAP, DISC, 0.1 UF +/-20%, 50 VDC W	149146	56289	33C41B6	REF		
C709	CAP, DISC, 100 PF +/-10%, 50V	105593	71590	DD101	REF		
C711	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015-5KA4	REF		
C712	CAP, CER, 0.002 UF, GMV, 1 KV	105569	56289	DA140-139CB	1		
CR701	DIODE, ZENER, 12V, 400 MW	110726	07910	1N964B	3	1	
CR702	DIODE, SI	203323	07919	1N4448	4	1	
CR703	DIODE, SI	203323	07919	1N4448	REF		
CR704	DIODE, SI	203323	07919	1N4448	REF		
CR705	DIODE, SI	203323	07919	1N4448	REF		
CR706	DIODE, ZENER, 12V, 400 MW	110726	07910	1N964B	REF		
CR707	DIODE, ZENER, 12V, 400 MW	110726	07910	1N964B	REF		
J81	FLAT CABLE ASSEMBLY	393520	08261	5142-006	2		
J82	FLAT CABLE ASSEMBLY	393520	08261	5142-006	REF		
Q701	XSTR, FET, N-CHANNEL	404277	01295	TIS73	4		
Q702	XSTR, FET, N-CHANNEL	404277	01295	TIS73	REF		
Q703	XSTR, FET, N-CHANNEL	404277	01295	TIS73	REF		
Q704	XSTR, FET, N-CHANNEL	404277	01295	TIS73	REF		
R701	RES, VAR, 10K	369553	54869	PT10V-10K	4		
R702	RES, COMP, 2.2M +/-5%, 1/4W	198390	01121	CB2255	4		
R703	RES, COMP, 2.2M +/-5%, 1/4W	198390	01121	CB2255	REF		
R704	RES, VAR, 10K	369553	54869	PT10V-10K	REF		
R705	RES, VAR, 10K	369553	54869	PT10V-10K	REF		
R706	RES, COMP, 2.2M +/-5%, 1/4W	198390	01121	CB2255	REF		
R707	RES, COMP, 2.2M +/-5%, 1/4W	198390	01121	CB2255	REF		
R708	RES, VAR, 10K	369553	54869	PT10V-10K	REF		
R709	RES, MF, 95.3K +/-0.1%, 1/8W	346858	91637	MFF1-89532B	2		
R710	RES, MF, 4.32K +/-1%, 1/8W	294819	91637	MFF1-84321F	2		
R711	RES, MF, 47.5K +/-0.1%, 1/8W	344523	91637	MFF1-84752B	2		
R712	RES, MF, 2.32K +/-1%, 1/8W	260315	91637	MFF1-82321F	2		
R713	RES, MF, 10K +/-0.1%, 1/8W	343459	91637	MFF1-81002B	4		
R714	RES, MF, 10K +/-0.1%, 1/8W	343459	91637	MFF1-81002B	REF		
R715	RES, COMP, 27K +/-5%, 1/4W	148148	01121	CB2735	4		
R716	RES, COMP, 27K +/-5%, 1/4W	148148	01121	CB2735	REF		
R717	RES, COMP, 10K +/-5%, 1/4W	148106	01121	CB1035	2		
R718	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	7		
R719	RES, MF, 10K +/-0.1%, 1/8W	343459	91637	MFF1-81002B	REF		
R720	RES, COMP, 47K +/-5%, 1/4W	148163	01121	CB4735	3		
R721	RES, MF, 8.06K +/-1%, 1/8W	294942	91637	MFF1-8061F	2		
R722	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	4		
R723	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	REF		
R724	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	REF		

Table 612-5. A13 RCU #3 PCB Assembly (cont)

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R725	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	REF		
R726	RES, MF, 10K +/-0.1%, 1/8W	343459	91637	MFF1-81002B	REF		
R727	RES, COMP, 27K +/-5%, 1/4W	148148	01121	CB2735	REF		
R728	RES, COMP, 27K +/-5%, 1/4W	148148	01121	CB2735	REF		
R729	RES, COMP, 10K +/-5%, 1/4W	148106	01121	CB1035	REF		
R730	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	REF		
R731	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	REF		
R732	RES, COMP, 47K +/-5%, 1/4W	148163	01121	CB4735	REF		
R733	RES, COMP, 47K +/-5%, 1/4W	148163	01121	CB4735	REF		
R734	RES, MF, 8.06K +/-1%, 1/8W	294942	91637	MFF1-8061F	REF		
R735	RES, MF, 402K +/-1%, 1/8W	348391	91637	MFF1-84023F	2		
R736	RES, MF, 200K +/-1%, 1/8W	261701	91637	MFF1-82003F	2		
R737	RES, MF, 1M +/-1%, 1/8W	268797	91637	MFF1-81004F	2		
R738	RES, MF, 499K +/-1%, 1/8W	349191	91637	MFF1-84993F	2		
R739	RES, COMP, 2M +/-5%, 1/4W	268771	01121	CB2055	2		
R740	RES, COMP, 3.9M +/-%, 1/4W	188417	01121	CB3955	2		
R741	RES, MF, 47.5K +/-0.1%, 1/8W	344523	91637	MFF1-84752B	REF		
R743	RES, MF, 4.32K +/-1%, 1/8W	294819	91637	MFF1-84321F	REF		
R744	RES, MF, 499K +/-1%, 1/8W	349191	91637	MFF1-84993F	REF		
R745	RES, MF, 402K +/-1%, 1/8W	348391	91637	MFF1-84023F	REF		
R746	RES, MF, 200K +/-1%, 1/8W	261701	91637	MFF1-82003F	REF		
R747	RES, MF, 95.3K +/-0.1%, 1/8W	346858	91637	MFF1-89532B	REF		
R748	RES, MF, 1M +/-1%, 1/8W	268797	91637	MFF1-81004F	REF		
R749	RES, COMP, 2M +/-5%, 1/4W	268771	01121	CB2055	REF		
R750	RES, COMP, 3.9M +/-%, 1/4W	188417	01121	CB3955	REF		
R751	RES, COMP, 100 +/-5%, 1/4W	147926	01121	CB1015	2		
R752	RES, COMP, 82 +/-5%, 1/4W	149484	01121	CB8205	2		
R753	RES, COMP, 82 +/-5%, 1/4W	149484	01121	CB8205	REF		
R754	RES, COMP, 100K +/-5%, 1/4W	148189	01121	CB1045	3		
R756	RES, COMP, 100K +/-5%, 1/4W	148189	01121	CB1045	REF		
R757	RES, COMP, 100K +/-5%, 1/4W	148189	01121	CB1045	REF		
R758	RES, COMP, 390 +/-5%, 1/4W	147975	01121	CB3915	1		
R759	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	REF		
R760	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	REF		
R761	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	REF		
R762	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	REF		
R763	RES, COMP, 100 +/-5%, 1/4W	147926	01121	CB1015	REF		
R764	RES, COMP, 4.7M +/-5%, 1/4W	220046	01121	CB4755	4		
R765	RES, COMP, 4.7M +/-5%, 1/4W	220046	01121	CB4755	REF		
R766	RES, COMP, 4.7M +/-5%, 1/4W	220046	01121	CB4755	REF		
R767	RES, COMP, 4.7M +/-5%, 1/4W	220046	01121	CB4755	REF		
U701	IC, 5-XSTR, ARRAY, SI, NPN	248906	86684	CA3046	2	1	
U702	IC, LIN OP AMP	363515	07263	LM301AN	4	1	
U703	IC, LIN OP AMP	363515	07263	LM301AN	REF		
U704	⊗IC, CMOS, HEX BUFFER/INVERTER	381830	95303	CD4050AE	3	1	
U705	IC, 5-XSTR, SI, NPN	248906	86684	CA3046	REF		
U706	IC, LIN OP AMP	363515	07263	LM301AN	REF		
U707	IC, LIN OP AMP	363515	07263	LM301AN	REF		
U708	⊗IC, CMOS, HEX BUFFER/INVERTER	381830	95303	CD4050AE	REF		
U709	⊗IC, CMOS, HEX BUFFER/INVERTER	381830	95303	CD4050AE	REF		

Table 612-5. A13 RCU #3 PCB Assembly (cont)

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U710	RES, NETWORK, THIRTEEN 100K +/-5%, 1/4W	404624	89536	404624	1		
U711	IC, TTL, TRI-STATE HEX BUFFER	408146	07263	DM8095N	4		
U712	IC, TTL, TRI-STATE HEX BUFFER	408146	07263	DM8095N	REF		
U713	IC, TTL, TRI-STATE HEX BUFFER	408146	07263	DM8095N	REF		
U714	IC, TTL, TRI-STATE HEX BUFFER	408146	07263	DM8095N	REF		

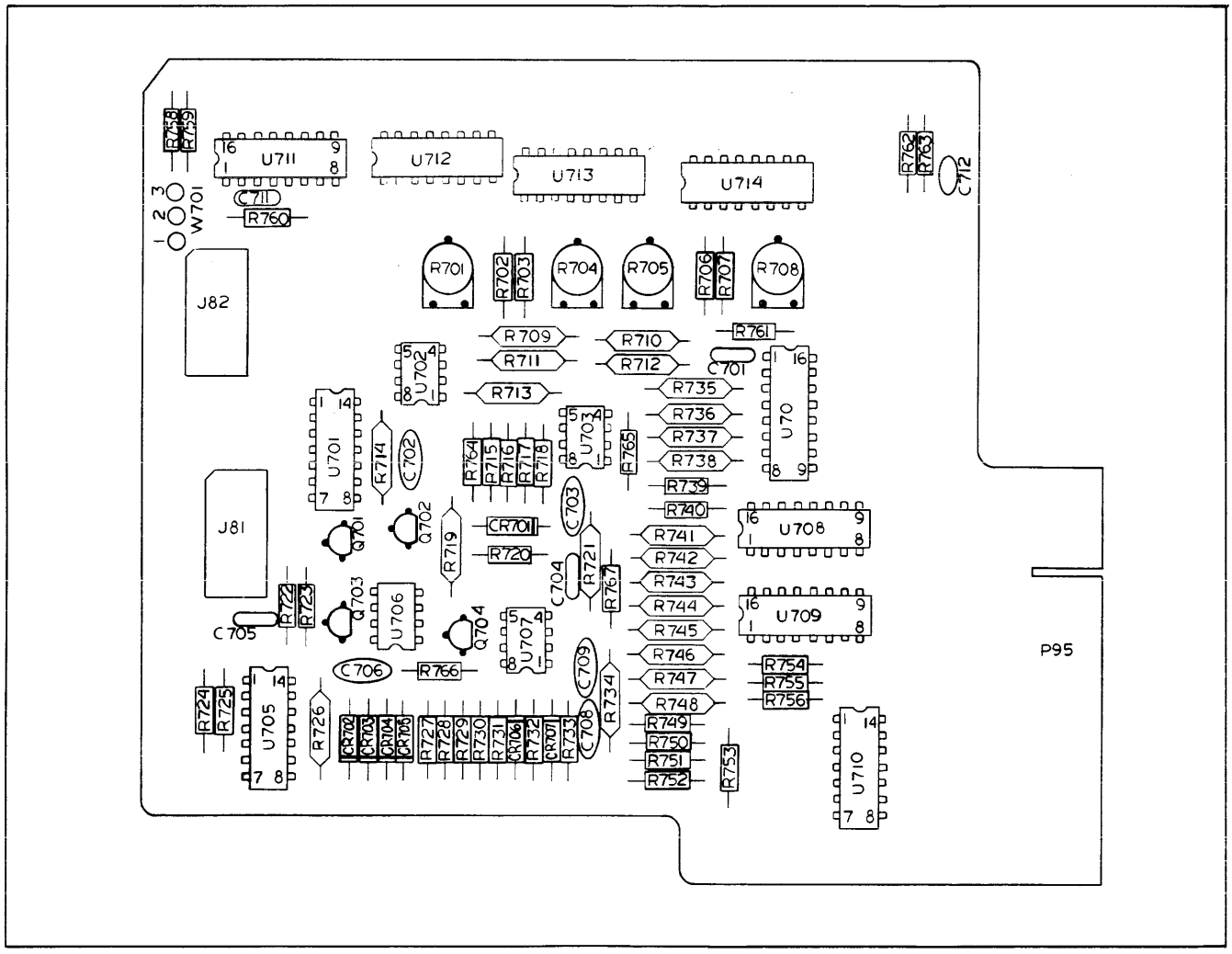


Figure 612-5. A13 RCU #3 PCB Assembly

Option -13
1000 MHz Prescaler

613-1. INTRODUCTION

613-2. The channel C input of the Model 1953A is intended for use with an optional frequency-prescaler. Option -13 is a prescaler which extends the operating range of the counter to 1000 MHz. This prescaler has a frequency range extending from 50 MHz to 1000 MHz with a specified sensitivity of 15 mV rms.

613-3. The option comprises a plug-in pcb assembly, a front panel mounted BNC connector, and the related components required both to adjust the power supply for correct operating voltages and to compensate the counter circuitry for the prescaling divisor. The option must be ordered factory-installed in the 1953A when the instrument is purchased, it is not field installable.

613-4. OPERATION

613-5. Operation of the 1953A in the prescaler mode is established by rotating the FUNCTION switch to the FREQ C position.

613-6. THEORY OF OPERATION

613-7. The main function of the prescaler is to reduce the frequency of the input signal to below 130 MHz for application to the main gate and decade counters The prescaler also provides the necessary conditioning of the input signal to provide sufficient gain and the proper waveshaping. The frequency division factor of the 1000 MHz prescaler is eight.

613-8. As shown in Figure 613-1, the input signal is fed through an input protection fuse, F1, to the input of the amplifier, which contains input limiting. The output of the amplifier, which is also internally limited, is applied to a divider circuit which divides by a factor of eight to reduce the input frequency to below 130 MHz. The prescaled signal, amplified by U1 and divided by U2 and U3 is fed to the Main PCB Assembly for application to the main gate and decade counters.

613-9. The output of the amplifier is sensed via CR1/U5, to detect signals whose level is too low to reliable clock the divider circuit. When a low signal level is detected, the divider output is disabled causing the display to read zero.

613-10. PERFORMANCE CHECKS

613-11. The performance check for the 1000 MHz Prescaler is actually a sensitivity check made at the upper and lower frequency limits. Proceed as follows:

a. Connect a 1000 MHz RF generator, terminated into 50 ohms, to a T-connector on the CHANNEL C input. Set the generator output for 25 MHz at approximately 15 mV rms.

b. Connect the RF millimvoltmeter (refer to Table 4-1) to the T-connector on the input of the prescaler.

c. Adjust the generator output for a reading of 15 mV rms on the RF millivoltmeter.

d. Confirm that the counter reads 25 MHz $\pm$ generator accuracy.

e. Change the generator output to 1000 MHz and adjust the output of 15 mV on the RF millivoltmeter.

613-12. CALIBRATION

613-13. Calibration of the prescaler amounts to adjustment of the low level sense control located on the top edge of the Prescaler PCB Assembly. Proceed as follows:

a. Remove the top dust cover from the instrument.

b. Energize the counter and connect the RF generator to the CHANNEL C input connector. Select an output of 100 MHz at approximately 15 mV rms.

c. On the counter, adjust the level control (R15) to a midpoint which produces a stable display.

d. Reduce the input signal level until the display becomes unstable.

e. Readjust the level control until the display is again stable.

f. Repeat steps d and e until no additional sensitivity, can be achieved.

613-14. LIST OF REPLACEABLE PARTS

613-15. Table 613-1 is a list of replaceable parts for the 1000 MHz Prescaler. Refer to Section 5 for an explanation of the column entries.

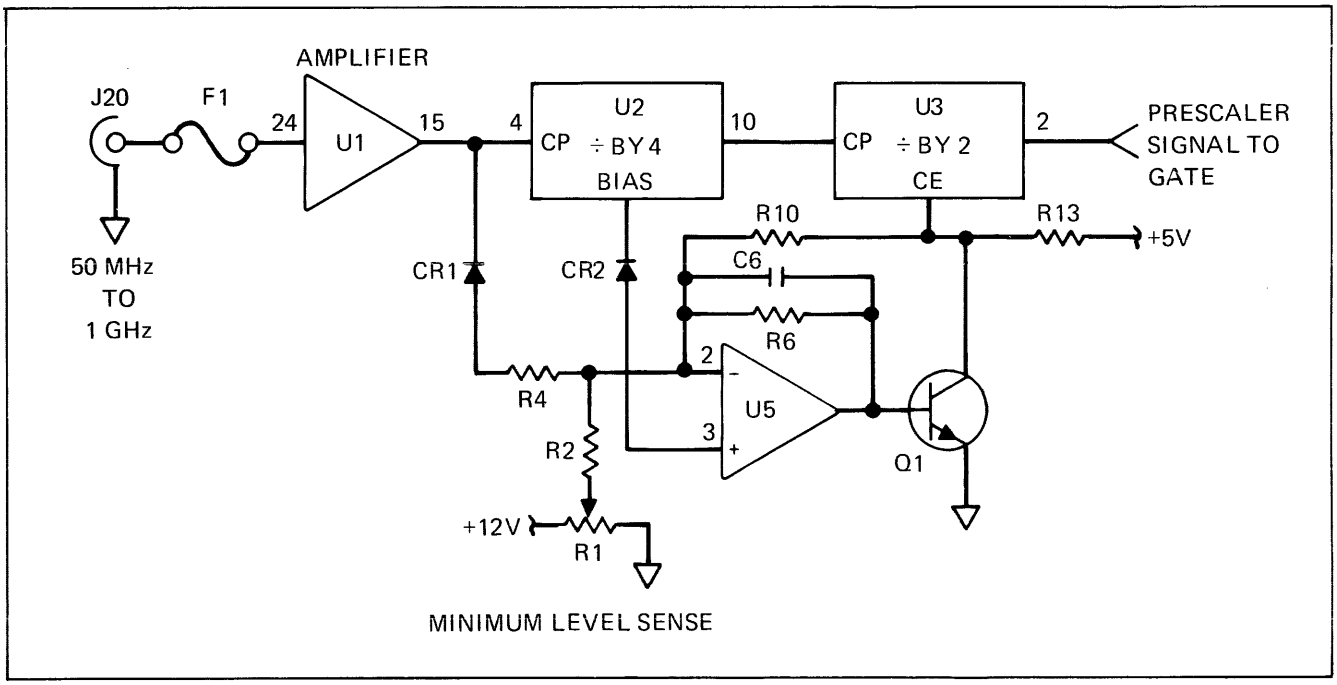


Figure 613-1. 1000 MHz Prescaler Block Diagram

Table 613-1. -13 Option, 1000 MHz Prescaler PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	1000 MHZ PRESCALER, OPTION -13 FIGURE 613-2						
A14	1000 MHZ PRESCALER PCB ASSEMBLY	396309	89536	3963909	1		
H1	GROUND CLIP	462101	89536	462101	1		
MP1	1000 MHZ DECAL	428037	89536	428037	1		
U13	IC, TTL, 4-BIT BINARY COUNTER	320739	01295	SN7493N	1	1	
W1	CABLE ASSY (FRONT PANEL TO PCB)	406942	89536	406942	1		

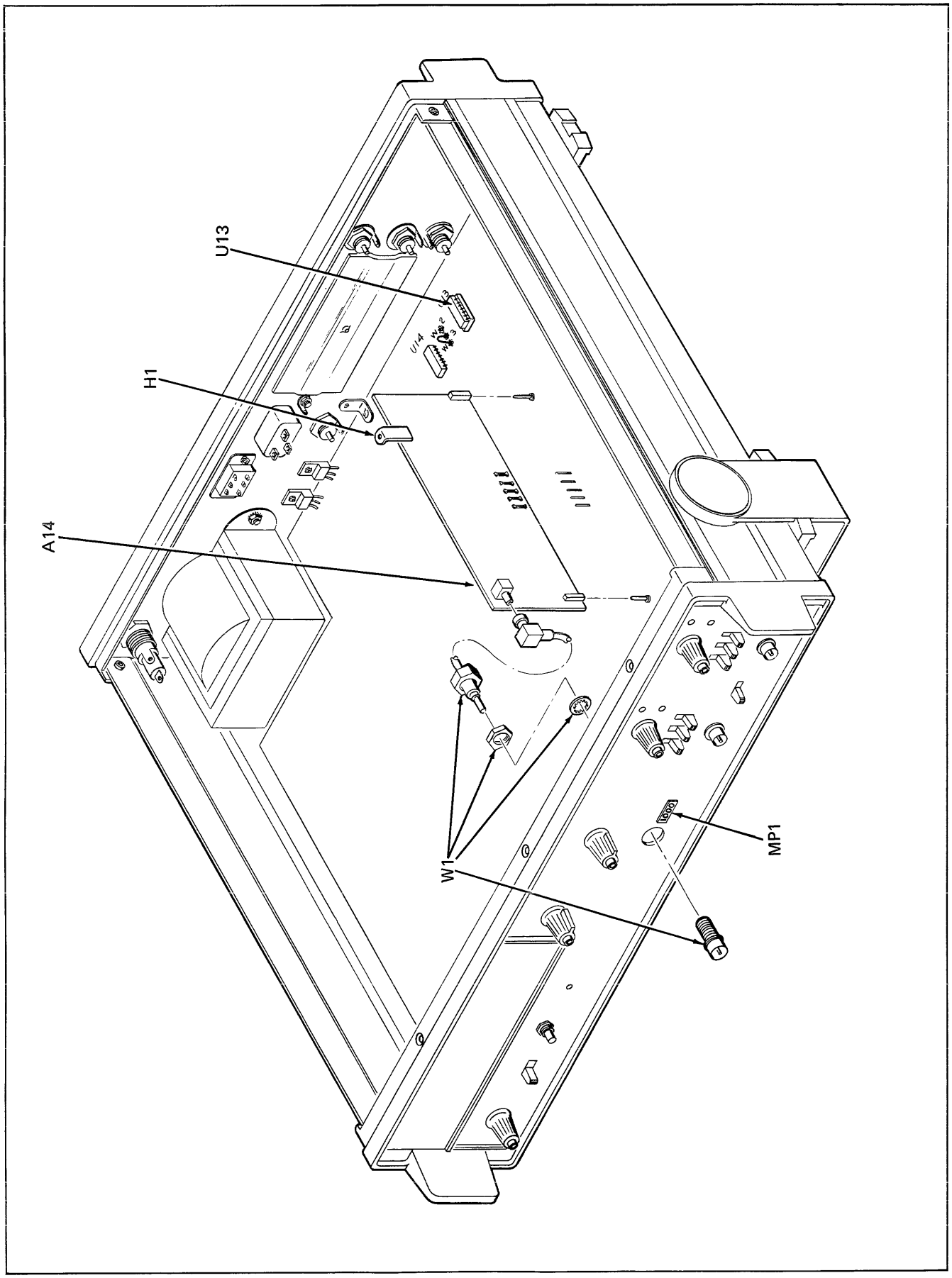


Figure 613-2. -13 Option, 1000 MHz Prescaler PCB Assembly

Table 613-2. A14 1000 MHz Prescaler PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A14	1000 MHZ PRESCALER PCB ASSEMBLY (1953A-4027T) FIGURE 613-3	396309	89536	396309	REF		
C1	CAP, CER, 0.001 UF	402966	71590	8121-A100-W5-R-102M	7		
C3	CAP, CER, 0.001 UF	402966	71590	8121-A100-W5-R-102M	REF		
C4	CAP, CER, 0.001 UF	402966	71590	8121-A100-W5-R-102M	REF		
C5	CAP, CER, 0.001 UF	402966	71590	8121-A100-W5-R-102M	REF		
C6	CAP, CER, 0.001 UF	402966	71590	8121-A100-W5-R-102M	REF		
C7	CAP, CER, 0.001 UF +/-10%, 500V	357806	71590	CB102	2		
C8	CAP, CER, 0.001 UF	402966	71590	8121-A100-W5-R-102M	REF		
C9	CAP, CER, 0.001 UF	402966	71590	8121-A100-W5-R-102M	REF		
C10	CAP, CER, 0.001 UF +/-10%, 500V	357806	71590	CB102	REF		
C11	CAP, TA, 10 UF +/-20%, 16V	193623	56289	196D106X00015KA1	1		
CR1	DIODE, HOT CARRIER	369595	07263	GH1100	2	1	
CR2	DIODE, HOT CARRIER	369595	07263	GH1100	REF		
F1	FUSE, 0.2A	370577	75915	273.200	2		
F2	FUSE, 0.2A	370577	75915	273.200	REF		
J5	CONNECTOR						
	PIN, FEMALE, LARGE	149112	74970	105-0753	2		
	PIN, FEMALE, SMALL	375329	00779	85863-3	6		
J20	CONNECTOR, COAX	353243	98291	51.053.000	1		
L1	FERRITE BEAD	321182	02114	56-590-65-4B	1		
Q1	XSTR, SI, NPN	218396	04713	2N3904	2	1	
Q2	XSTR, SI, PNP	352369	07263	2N4403	1	1	
Q3	XSTR, SI, NPN	218396	04713	2N3904	REF		
R1	RES, VAR, 10K +/-20%	385393	54869	PT-10H-10K	1		
R2	RES, COMP, 330K +/-5%, 1/4W	192948	01121	CB3345	2		
R3	RES, COMP 2.7K +/-5%, 1/4W	170720	01121	CB2725	4		
R4	RES, COMP 10K +/-5%, 1/4W	148106	01121	CB1035	2		
R5	RES, COMP 2.7K +/-5%, 1/4W	170720	01121	CB2725	REF		
R6	RES, COMP, 330K +/-5%, 1/4W	192948	01121	CB3345	REF		
R7	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	1		
R8	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R9	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	1		
R10	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	3		
R11	RES, COMP 10K +/-5%, 1/4W	148106	01121	CB1035	REF		
R13	RES, COMP 2.7K +/-5%, 1/4W	170720	01121	CB2725	REF		
R14	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	REF		
R15	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R17	RES, COMP 2.7K +/-5%, 1/4W	170720	01121	CB2725	REF		
R18	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	REF		
R19	RES, DEP. CAR, 1.5M +/-5%, 1/4W	349001	80031	CR251-4-5P1M5	1		
U1	IC, LINEAR, BROAD BAND AMPL	428797	31091	CA1044	1	1	
U2	IC, ECL, SELECTED	444034	89536	444034	1	1	
U3	IC, TTL, D-TYPE FLIP-FLOP	404574	07263	F11C06DC	1	1	
U4	IC, OP AMP	402750	07263	LM741CN	1	1	
XU2	SOCKET, IC, 14-PIN, DIP	291542	00779	583527-1	1		
XU3	SOCKET, IC, 16-PIN, DIP	370312	01295	C931602	1		
ZZ	SOCKET, PIN (FOR XU1, XF1, XF2)	403642	00779	50863-B	28		

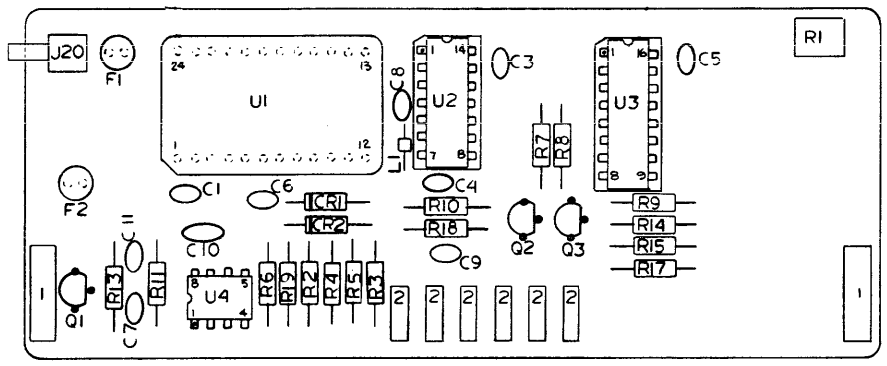


Figure 613-3. A14 1000 MHz Prescaler PCB Assembly

Option -14
1250 MHz Prescaler

614-1. INTRODUCTION

614-2. The channel C input of the Model 1953A is intended for use with an optional frequency prescaler. Option -14 is a prescaler which extends the operating range of the counter to 1250 MHz. This prescaler has a frequency range extending from 50 MHz to 1250 MHz with a specified sensitivity of 15 mV rms, from 50 MHz to 1000 MHz decreasing to 30 mV rms between 1000 MHz and 1250 MHz.

614-3. The option comprises a plug-in pcb assembly, a front panel mounted BNC connector, and the related components required both to adjust the power supply for correct operating voltages and to compensate the counter circuitry for the prescaling divisor. The option must be ordered factory-installed in the 1953A when the instrument is purchased, it in not field installable.

614-4. OPERATION

614-5. Operation of the 1953A in the prescaler mode is established by rotating the FUNCTION switch to the FREQ C position.

614-6. THEORY OF OPERATION

614-7. The main function of the prescaler is to reduce the frequency of the input signal to below 165 MHz for application to the main gate and decade counters. The prescaler also provides the necessary conditioning of the input signal to provide sufficient gain and the proper waveshaping. The frequency division factor for the 1250 MHz Prescaler is eight.

614-8. As shown in Figure 614-1, the input signal is fed through an input protection fuse, F1, to the input of the amplifier. The output of the amplifier, which is internally limited, is applied to a divider circuit which divides by a factor of eight to reduce the input frequency to below 165 MHz. The prescaled signal, amplified by U1 and divided by U2 and U3 is fed to the Main PCB Assembly for application to the main gate and decade counters.

614-9. The output of the amplifier is sensed via CR1 and U5, to detect signals whose level is too low to reliably clock the divider circuit. When a low signal level is detected, the divider output is disabled causing the display to read zero.

614-10. PERFORMANCE CHECKS

614-11. The performance check for the 1250 MHz Prescaler is actually a sensitivity check made at the upper and lower frequency limits. Proceed as follows:

a. Connect a 1.3 GHz RF generator, terminated into 50 ohms, to a T-connector on the CHANNEL C input. Set the generator output for 50 MHz at approximately 15 mV rms.

b. Connect the RF millivoltmeter (refer to Table 4-1) to the T-connector on the input of the prescaler.

c. Adjust the generator output for a reading of 15 mV rms on the RF millivoltmeter.

d. Confirm that the counter reads 50 MHz ± generator accuracy.

e. Change the generator output to 1250 MHz and adjust the output for 30 mV rms on the RF millivoltmeter.

f. Confirm that the counter reads 1250 MHz ± generator accuracy.

614-12. CALIBRATION

614-13. Calibration of the prescaler amounts to adjustment of the sense control located on the top edge of the Prescaler PCB Assembly. Proceed as follows:

a. Remove the the top dust cover from the instrument.

b. Energize the counter and connect the RF generator to the CHANNEL C input connector. Select an output of 100 MHz approximately 15 mV rms.

c. On the counter, adjust the level control (R15) to a midpoint which produces a stable display.

d. Reduce the input signal level until the display becomes unstable.

e. Readjust the level control until the display is again stable.

f. Repeat steps d and e until no additional sensitivity can be achieved.

614-14. LIST OF REPLACEABLE PARTS

614-15. Table 614-1 is a list of replaceable parts for the 1250 MHz Prescaler. Refer to Section 5 for an explanation of the column entries.

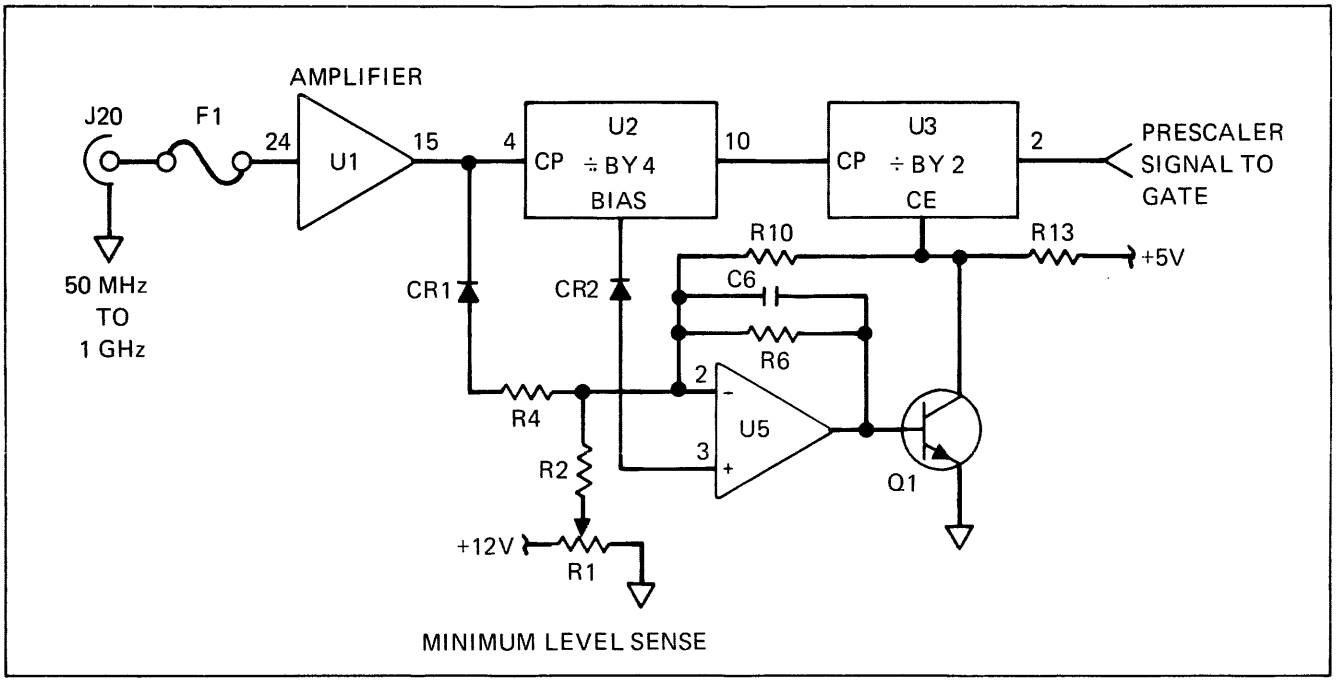


Figure 614-1. 1250 MHz Prescaler Block Diagram

Table 614-1. -14 Option, 1250 MHz Prescaler Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	1250 MHZ PRESCALER, OPTION -14 FIGURE 614-2						
A15	1250 MHZ PRESCALER PCB ASSY	405597	89536	405597	1		
H1	GROUND CLIP	462101	89536	462101	1		
MP1	1250 MHZ DECAL	428045	89536	428045	1		
U13	IC, TTL, 4-BIT BINARY COUNTER (INSTALLED ON COUNTER MAIN PCB)	320739	01295	SN7493N	1	1	
W1	CABLE ASSY (FRONT PANEL TO PCB)	406942	89536	406942	1		

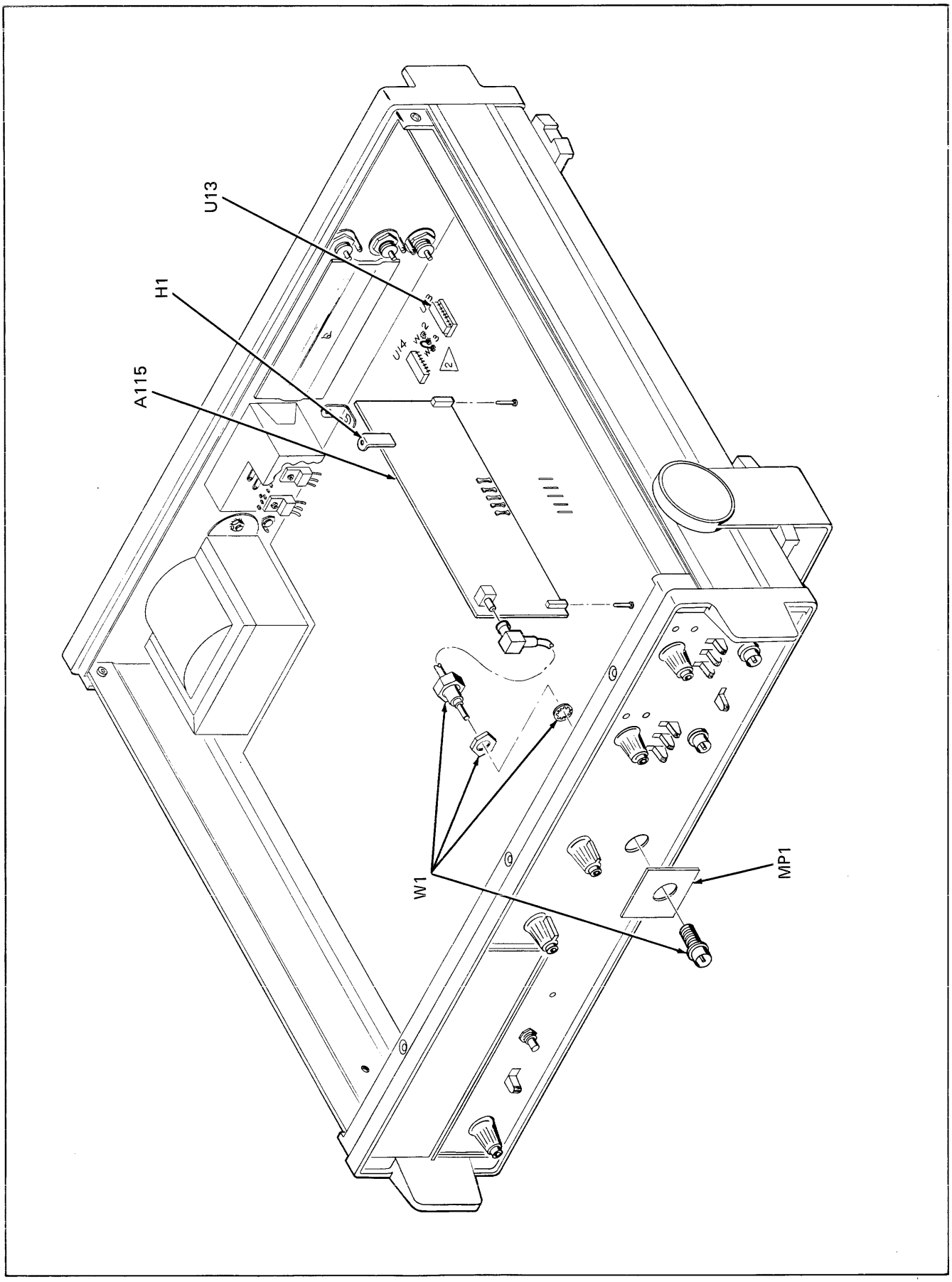


Figure 614-2. -14 Option, 1250 MHz Prescaler Assembly

Table 614-2. A15 1250 MHz Prescaler PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A15	1250 MHZ PRESCALER PCB ASSY (1953A-4028T) FIGURE 614-3	405589	89536	405589	REF		
C1	CAP, CER, 0.001 UF	402966	71590	8121-A100-W5R-102M	7		
C3	CAP, CER, 0.001 UF	402966	71590	8121-A100-W5R-102M	REF		
C4	CAP, CER, 0.001 UF	402966	71590	8121-A100-W5R-102M	REF		
C5	CAP, CER, 0.001 UF	402966	71590	8121-A100-W5R-102M	REF		
C6	CAP, CER, 0.001 UF	402966	71590	8121-A100-W5R-102M	REF		
C7	CAP, CER, 0.001 UF +/-10%, 500V	357806	71590	CB102	2		
C8	CAP, CER, 0.001 UF	402966	71590	8121-A100-W5R-102M	REF		
C9	CAP, CER, 0.001 UF	402966	71590	8121-A100-W5R-102M	REF		
C10	CAP, CER, 0.001 UF +/-10%, 500V	357806	71590	CB102	REF		
C11	CAP, TA, 10 UF +/-20%, 16V	193623	56289	196D106X00015KA1	1		
CR1	DIODE, HOT CARRIER	369595	07263	DH1100	2	1	
CR2	DIODE, HOT CARRIER	369595	07263	DH1100	REF		
F1	FUSE, 0.2A	370577	75915	273.200	2		
F2	FUSE, 0.2A	370577	75915	273.200	REF		
J5	CONNECTOR						
	PIN, FEMALE, LARGE	149112	74970	105-0753	2		
	PIN, FEMALE, SMALL	375329	00779	85863-3	6		
J20	CONNECTOR, COAX	353243	98291	51-053-000	1		
L1	FERRITE BEAD	321182	02114	56-590-65-4B	1		
Q1	XSTR, SI, NPN	218396	04713	2N3904	2	1	
Q2	XSTR, SI, PNP	352369	07263	2N4403	1	1	
Q3	XSTR, SI, NPN	218396	04713	2N3904	REF		
R1	RES, VAR, 10K +/-20%	385393	54869	PT-10H-10K	1		
R2	RES, COMP, 330K +/-5%, 1/4W	192948	01121	CB3345	2		
R3	RES, COMP, 2.7K +/-5%, 1/4W	170720	01121	CB2725	4		
R4	RES, COMP, 10K +/-5%, 1/4W	148106	01121	CB1035	2		
R5	RES, COMP, 2.7K +/-5%, 1/4W	170720	01121	CB2725	REF		
R6	RES, COMP, 330K +/-5%, 1/4W	192948	01121	CB3345	REF		
R7	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	3		
R8	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R9	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	1		
R10	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	3		
R11	RES, COMP, 10K +/-5%, 1/4W	148106	01121	CB1035	REF		
R13	RES, COMP, 2.7K +/-5%, 1/4W	170720	01121	CB2725	REF		
R14	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	REF		
R15	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R17	RES, COMP, 2.7K +/-5%, 1/4W	170720	01121	CB2725	REF		
R18	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	REF		
R19	RES, COMP, 1.5M +/-5%, 1/4W	349001	01121	CB1555	1		
U1	IC, LINEAR, BROAD BAND AMPL	428797	31091	CA1044	1		
U2	IC, ECL, SELECTED	418186	89536	418186	1	1	
U3	IC, TTL, D-TYPE FLIP-FLOP	404574	07263	F11C06DC	1	1	
U4	IC, OP AMP	402750	07263	LM741CN	1	1	
XU2	SOCKET, IC, 14-PIN DIP	291542	00779	582527-1	1		
XU3	SOCKET, IC, 16-PIN DIP	370312	01295	C931602	1		
ZZ	SOCKET, PIN (FOR XU1, XF1, XF2)	403642	00779	50863-B	28		

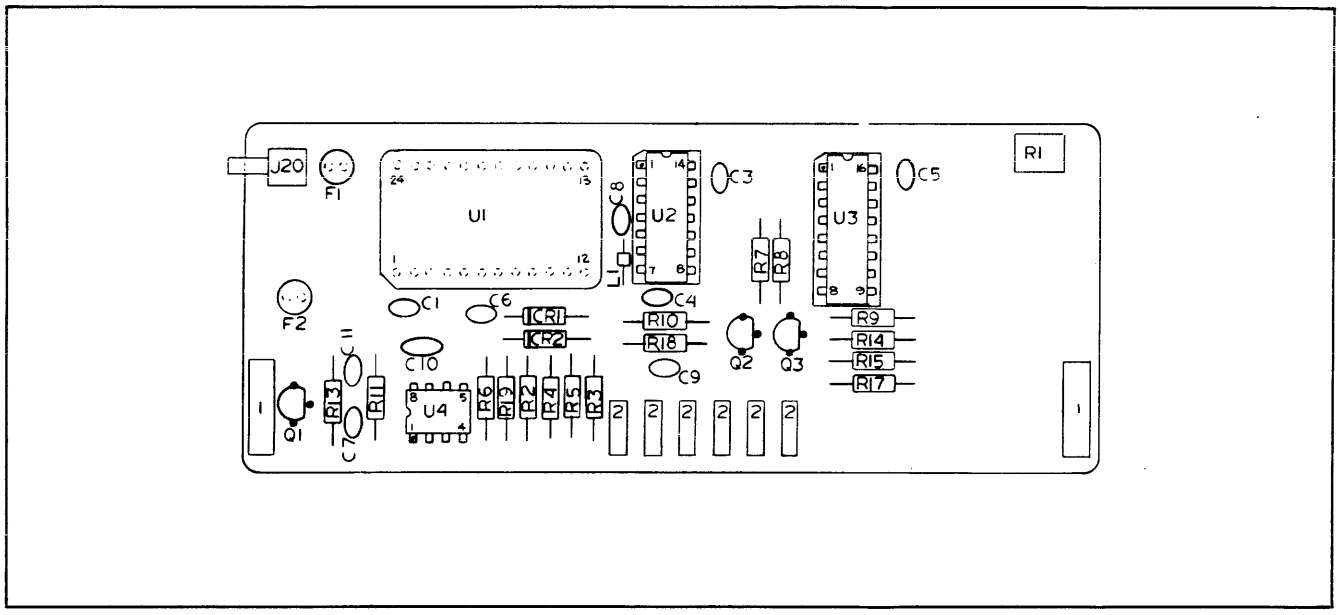


Figure 614-3. A15 1250 MHz Prescaler PCB Assembly

Option -15
IEEE-488 Standard Interface

615-1. INTRODUCTION

615-2. Option -15 is an IEEE-488 Standard Interface. All programming of the counter is based on a character-serial, seven bit ASCII code, using 26 characters of the character set. All other characters are ignored by the interface.

615-3. By entering commands from a control device a measurement response can be obtained, either continuously or on command. The measurement response includes nine digits of data, with an embedded decimal point and an exponent. An overflow indication is included when the response exceeds the numeric display of the instrument. The status of the counter can be obtained by requesting a Status Response Message from the interface. The reply is a single character, in an alpha-numeric code.

615-4. SPECIFICATIONS

615-5. The specifications for the IEEE Interface are: full remote programming of function, range, and all signal conditioning controls including trigger levels, directly compatible with IEEE Interface Standard. Data output includes nine digits of display information, decimal point and exponent for time or frequency units. Front panel lockout is provided. An application bulletin covering the programming of this option is available upon request.

615-6. INSTALLATION

615-7. If the IEEE-488 Standard Interface, Option -15 is desired, it must be installed at the factory. The option is not field installable.

615-8. OPERATING FEATURES

615-9. Installation of Option -15 in the instrument adds the operator switches shown in Figure 615-1. A1 through A5 are used to control the local address of the counter. They may be set to the binary equivalent of the any number, 0 through 30. The number 31 (11111) is not a legal address setting. The A1 through A5 switches are placed toward the top for a binary 1. Set the address of the counter using the codes in Table 615-1.

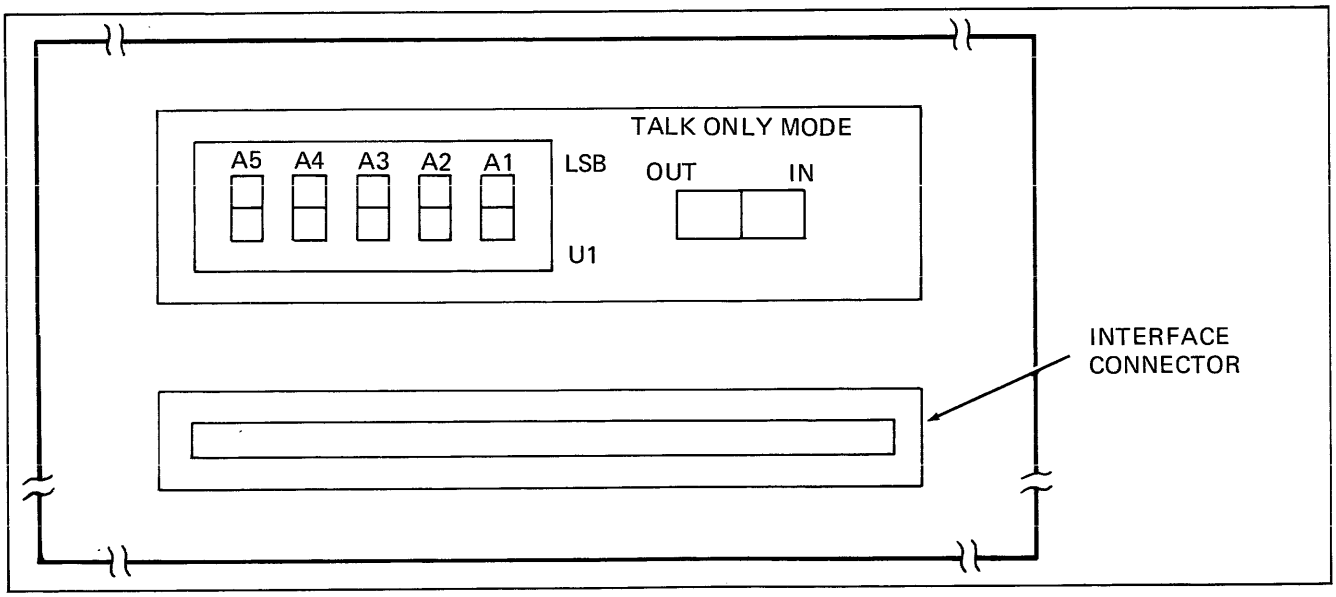


Figure 615-1. IEEE Address Switches

615-10. The TALK ONLY MODE switch controls whether the counter will operate as a "talker" only or as both a "talker" and "listener". With the switch to the right (IN), the counter only "talks".

615-11. Differentiation on the bus between "talk", "listen" and commands is made by the controller as it manipulates the two high order bits of the seven data lines.

Table 612-2. Listen and Talk Addresses

DECIMAL	5 4 3 2 1 BINARY	ASCII CHARACTER	
		LISTEN	TALK
0	0 0 0 0 0	SP	@
1	0 0 0 0 1	!	A
2	0 0 0 1 0	"	B
3	0 0 0 1 1	#	C
4	0 0 1 0 0	$	D
5	0 0 1 0 1	%	E
6	0 0 1 1 0	&	F
7	0 0 1 1 1	'	G
8	0 1 0 1 0	*	H
9	0 1 0 0 1	(	I
10	0 1 0 1 0	)	J
11	0 1 0 1 1	+	K
12	0 1 1 0 0	,	L
13	0 1 1 0 1	–	M
14	0 1 1 1 0	.	N
15	0 1 1 1 1	/	O
16	1 0 0 0 0	0	P
17	1 0 0 0 1	1	Q
18	1 0 0 1 0	2	R
19	1 0 0 1 1	3	S
20	1 0 1 0 0	4	T
21	1 0 1 0 1	5	U
22	1 0 1 1 0	6	V
23	1 0 1 1 1	7	W
24	1 1 0 0 0	8	X
25	1 1 0 0 1	9	Y
26	1 1 0 1 0	:	Z
27	1 1 0 1 1	;	[
28	1 1 1 0 1	<	\
29	1 1 1 0 1	=	]
30	1 1 1 1 0	>	

615-12. OPERATING NOTES

615-13. Commands

615-14. The commands can be subdivided into Operating Functions, Range, Trigger Instructions, Coupling, Output Functions, Sampling, Status and Clear. An explanation and breakdown of these commands and their respective codes are given in the following sub-paragraphs.

615-15. Operating Function Commands

615-16. This group of commands provide for the selection of the operating function. The commands correspond to the positions of the FUNCTION switch on the front panel. The commands and their applicable codes are listed in Table 615-2.

Table 615-2. Operating Features

CODE	FUNCTION
F0	FREQ A
F1	FREQ C
F2	FREQ (A/B)
F3	Period A
F4	T.I. A-B
F5	A GTD by B
F6	Self-Check

615-17. Range Commands

615-18. The Range Commands are listed in Table 615-3. Each code corresponds to a switch position on the front panel RANGE switch.

Table 615-3. Range Commands

CODE	RANGE		
	GATE T.	PER AVGD	T.I. RES
R0	0.1 ms	10^0	0.1 μs
R1	1.0 ms	10^1	1.0 μs
R2	10 ms	10^2	10 μs
R3	0.1s	10^3	0.1 ms
R4	1.0s	10^4	1.0 ms
R5	10s	10^5	10 ms

615-19. Trigger Instructions

615-20. The trigger for channel A and channel B can be programmed for both level and function. The function includes positive or negative slope and AC or DC coupling. The trigger levels are variable with either a positive or negative reference between 0.01 and 0.99 volts with 0.01 volt resolution and between 0.1 and 9.9 volts with 0.1 resolution. The commands correspond to the switches in the applicable channel Trigger controls and Signal conditioners. Table 615-4 contains the Trigger Codes and their instructions.

Table 615-4. Trigger Instructions

CODE		
CHANNEL A	CHANNEL B	INSTRUCTION
A+	B+	Positive Slope
A–	B–	Negative Slope
A0	B0	AC Coupled
A1	B1	DC Coupled
A+0	B+0	Positive Slope and AC Coupled
A+1	B+1	Positive Slope and DC Coupled
A–0	B–0	Negative Slope and AC Coupled
A–1	B–1	Negative Slope and DC Coupled
LA+X.X	LB+X.X	Trigger Level of +X.X Volts
LA–X.X	LB–X.X	Trigger Level of –X.X Volts
LA+.XX	LB+.XX	Trigger Level of +.XX Volts
LA–.XX	LB–.XX	Trigger Level of –.XX Volts

X = numeric digit 0 through 9. If only the first digit is substituted for the "X" character, the second must be replaced with a termination character.

615-21. Coupling

615-22. To couple channel A and channel B, program the instruction S1. Programming the instruction S0 separates channel A and B. The front panel equivalent is the SEP-COM switch between the two channel areas.

615-23. Sampling Instructions

615-24. The sample rate can be programmed with either the H0 or H1 code. The data is sampled continuously with H0 programmed; while with H1 it is sampled only on request. The code required to trigger a sample with H1 programmed is the character T.

615-25. Output Functions

615-26. The Output Modes are programmed using a code of M0 or M1. When programmed with an M0 code, the 1953A outputs the last frequency measured when it is addressed and then resumes taking measurements at the rate set by the Sampling Instructions, either H0 or H1. For the M1 code, the 1953A outputs a service request (SRQ) on the bus after it has taken a measurement, then waits until it is addressed to transmit that measurement. After transmission of the measurement, the 1953A resumes sampling at the rate programmed by the Sampling Instruction.

615-27. When both the H1 and M1 codes are programmed, the code X causes the retransmission of the last reading.

615-28. Status Instruction

615-29. With the code character G programmed and the Interface addressed as a "Talker", the 1953A outputs a status response. the format of the responses is detailed in a later paragraph.

615-30. Clear Command

615-31. Programming the code character C initializes the instrument to the following:

F0 R0 A+0 B+0 LA.00 S0 M0 H0.

This is the equivalent of: Frequency A at the 0.1 ms range; channel A positive slope, ac coupled; channel A trigger level of +.00 Volts; channel B trigger level of +.00 Volts; channel A and B separated; output when addressed; and sample continuously.

615-32. Programming Example

615-33. A typical command and an explanation of each section is given in Table 615-5.

Table 615-5. Programming Example

Example: F4 R1 LA-2.7 LB.85 A-1 B1 S0	
CODE	INSTRUCTION
F4	Time Interval Function
R1	1 μsec Resolution
LA–2.7	A Trigger Level at –2.7 Volts
LB.85	B Trigger Level at .85 Volts
A–1	Channel A, Negative Slope, Direct Coupling
B1	Channel B, Positive Slope, Direct Coupling
S0	Channels A and B Separate

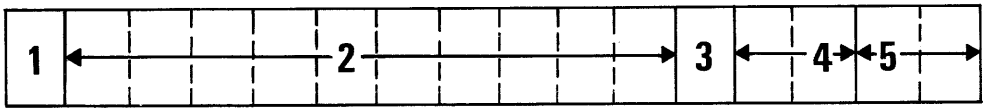
615-34. INTERFACE RESPONSES

615-35. Measurement Response

615-36. The format of the measurement response is shown in Figure 615-2. The response is transmitted when the interface is addressed while in the proper mode.

615-37. Status Response

615-38. A request for status brings a response of a one-digit status message, followed by the carriage return and line feed termination characters. Refer to the applicable columns of Table 615-6 for the status of the Gate, Overflow and Busy Signals.



LOCATION	NO. OF CHARACTERS	EXPLANATION
1	1	Overflow indication
2	10	Nine digits of data with embedded decimal
3	1	Character E to mark exponent
4	2	Exponent with sign
5	2	Termination character - carriage return followed by a line feed

Figure 615-2. Measurement Response Format

Table 615-6. Response Codes

These Columns Are Applicable To Status Response.					
STATUS	GATE OPEN	OVERFLOW	COUNTER BUSY	SERVICE REQUEST	SERIAL-POLL STATUS
0	NO	NO	NO	NO	!
0	NO	NO	NO	YES	a
1	NO	NO	YES	NO	#
1	NO	NO	YES	YES	c
2	NO	YES	NO	NO	%
2	NO	YES	NO	NO	e
3	NO	YES	YES	NO	,
3	NO	YES	YES	YES	g
4	YES	NO	NO	NO	)
4	YES	NO	NO	YES	i
5	YES	NO	YES	NO	+
5	YES	NO	YES	YES	k
6	YES	YES	NO	NO	–
6	YES	YES	NO	YES	m
7	YES	YES	YES	NO	/
7	YES	YES	YES	YES	0
	These Columns Are Applicable To Status Response in Serial Poll Mode.				

615-39. Status Response In Serial Poll Mode

615-40. A request for a status response in the Serial Poll mode results in a single character reply without any termination characters. Refer to the applicable columns to Table 615-6 for the status of the Gate, Overflow, Busy and Service Request Signals.

615-41. The Serial Poll status request instruction is dependent upon the controlling device and the IEEE bus. Refer to the standard and the sub-set used for this information.

615-42. THEORY OF OPERATION

615-43. The theory of operation for the IEEE-488 Interface is given in the following paragraphs on a block diagram level. The description includes an explanation of the operation of the interface in both the listen and talk modes since the counter is capable of both listening (accepting commands to change range, status, function, etc.) and talking (transmitting measurement or status information) to the bus. The counter is assigned a binary address code on the Interface PCB. The address is set on five switches which determine the five low-order bits of an ASCII character. The two high-order bits determine whether it is to be a talk or listen address. Refer to Table 615-6 for the addresses available. The address 11111 is reserved for the "unlisten" and "untalk" commands which prevent the counter from misunderstanding the information on the bus and talking or listening to itself. The block diagram of the interface used in the discussion is found in Figure 615-3.

615-44. Listen Mode

615-45. To operate in the Listen Mode, the pre-selected address must be on the Data Lines and the REN and ATN command lines active. This action, followed by active DAV and RFD signals, sets control flip-flops in the Data Decoders and Control Storage, preparing the interface microprocessor to accept instructions from the controller. After the data has been accepted, the DAC lines becomes active, inactivating ATN and DAV. The last action results in the DAC signal returning to inactive so that the interface is now ready to accept instructions.

615-46. Starting an instruction requires the ASCII code for the desired instruction on the data lines with ATN inactive and RFD active. The Controller drives DAV active to start the Handshake sequence. Once the data has been accepted in the microprocessor, the DAC signal goes active to complete the Handshake sequence. The microprocessor acts on the instruction, transforms it into the digital format required and outputs the instruction to the counter.

615-47. Talk Mode

615-48. The Talk Mode requires the ATN signal active and the correct address, just as the Listen Mode, to differentiate between it and an instruction. The start of the Handshake sequence latches the command into the Data Decoders and Control Storage for transfer to the microprocessor. Once the Handshake sequence is complete, the interface is in the Talk Mode and can begin transmitting data to the Controller.

615-49. After the addressing has been completed, the microprocessor accepts the data on the lines from the counter and outputs it through Data Storage to the Date I/F Transceivers and Controller. After completion, depending upon the mode selected, the microprocessor will either continue to transmit the outputs from the counter or, after the single sample, be reset by the controller to hold until addressed again.

615-50. Talk Only Mode

615-51. The I/F Switchboard assembly has a switch that allows the operator to place the instrument in the Talk Only Mode. In this configuration, the interface outputs the data from the counter, either measurement or status, as determined by a previous mode instruction or by the default configurations.

615-52. TROUBLESHOOTING

615-53. The use of microprocessor control in the IEEE-488 Option increases the speed and efficiency of the interface but at the same time increases the complexity and difficulty of troubleshooting. The two significant pcbs in the interface are layered parallel to the counter main pcb. As a result, if any checks are required on the Interface PCB, the I/F Processor PCB must be removed from the counter and reconnected back into the circuit using the extender cables available in the optional extender cable accessory kit 1953A-7020K. For this reason check point locations are given on the I/F Processor PCB, whenever feasible, to preclude removal of the pcb until required.

615-54. Troubleshooting for the 1953A Option -15 IEEE Interface consists of the Tabular Flow Chart in Table 615-7. When a step on the flow chart is completed, check for a decision transfer. If no decision is required, perform the next step of the table in sequence.

615-55. LIST OF REPLACEABLE PARTS

615-56. Table 615-9 is a list of replaceable parts for the IEEE-488 Interface Option. Refer to Section 5 for an explanation of the column entries.

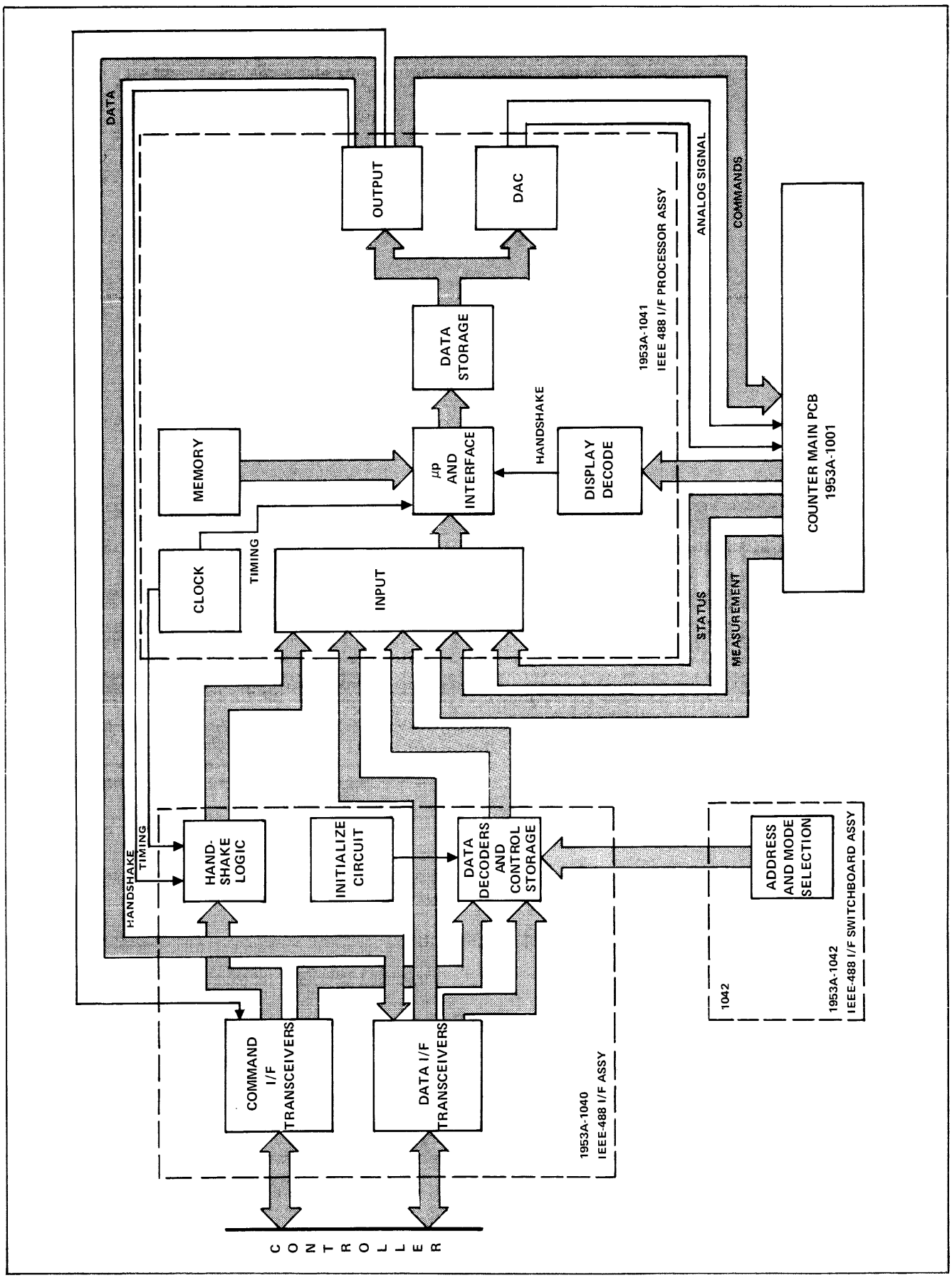


Figure 615-3. IEEE Interface Block Diagram

CAUTION

Indicated devices are subject to damage by static discharge.

The 1953A can be ordered with three factory-installed BNC connectors on the rear panel which serve as inputs to channels A, B, and C. When this option is ordered, no front panel connector is installed for the channel C input. The channels A and B inputs are in parallel with the corresponding front panel inputs. The addition of the rear panel input terminals for channels A and B increases the input capacity of these channels to 85 pF.

Table 615-7. IEEE-488 Troubleshooting

STEP NO.	INSTRUCTION	YES	NO	GO TO
	NOTE *The Microprocessor group called out in this procedure consists of the Clock U28, the 404 Microprocessor U22, the ROM U23, the Memory Interface U17 and the Multiplexers U8, U13, U18 and U24. Due to the speed and complexity of these components, the recommended solution for troubleshooting is substitution.*			
1	Address the counter with the assigned Listen address.			
2	Check MLA at U18-1 with a Scope (Logic Tester).			
3	Is the signal HIGH?	5	4	
4	Check the circuits on the IRterface PCB. Verify that the ATN is low at the input, then check the handshake circuits and the listen flip-flop. Repair as required; then restart at step 1.			
5	If the controller will allow it, alter the listen address to ensure the data transceivers will respond to both signal levels, e.g., if the normal listen address as shown in Table 615-1 is "/" for a binary code of 0111, change the address to "0" for a binary code of 10000, forcing the transceivers to go both high and low. Repeat steps 1 through 4 with the new address, then return to the normal address and proceed to step 6. If the address is not alterable, proceed to step 6.			
6	Perform the test in Table 615-8, checking for the applicable logic level with a scope.			
7	Were all readings satisfactory?	9	8	
8	If the output of either U25 or U26 is incorrect, decode and check the signal input from U9, U10, U14 and U15. The data for U32 should be latched into U9, U10, U14 and U15 also. Check the appicable latch and controls if only the signals from that latch are affected. If these areas are satisfactory, check the microporcessor group. Repair as required, then repeat the applicable portions in step 6.			
9	Enter the instruction LA9.9 LB9.9.			
10	With a DVM or scope check at U12-4 (channel A) and U11-4 (channel B) for a voltage approaching 1V dc.			
11	Enter the instruction LA.00 LB.00.			
12	Check U12-4 and U11-4 for a voltage approaching 0V dc.			
13	Are the readings in steps 10 and 12 correct?	15	14	
14	If the problem is in channel A, check the binary coded input to U3 from U14-9, U15-9, U9-9, U10-9 (first four bits) and U14-10, U15-10, U9-10, U10-10 (last four bits). For channel B, check the binary coded input to U5 from pins 11 and 12 of U14, U15, U9 and U10 for the first and last four bits, respectively. U14-9 and U14-11 are high for positive entries and low for negative. The remaining seven bits will start with all low for positive entries and increment for each count. Negative numbers will start with all high except the MSB at zero and decrement one bit for each negative count. If these areas are satisfactory, check the microprocessor group. Repair as required, then repeat the test starting at step 9.			
15	Enter the instruction H0 M0.			

Table 615-7. IEEE-488 Troubleshooting (cont)

STEP NO.	INSTRUCTION	YES	NO	GO TO
16	Observe U20-13 with a scope for a pulse train.			
17	Leave the scope connected to U20-13 and observe the display while entering the instruction H1.			
18	The pulse train should cease with the completion of the entry.			
19	Enter the instruction T.			
20	One pulse should occur concurrent with the entry.			
21	Enter the instruction H0.			
22	The pulse train should resume with the completion of the instruction.			
23	Are the indications in steps 16 through 22 correct?	25	24	
24	Verify the operation of U20 and the microprocessor group. Repair as required, then restart the test at step 16.			
25	Enter the talk address.			
26	Does the ocunter respond with measurement data to the controller?	31	27	
27	Monitor U21-10/U29-13 with a scope while entering the talk address.			
28	Does the point pulse to a logic level?	30	29	
29	Check at U18-1 for a High MTA. If MTA is not correct, check the circuits on the Interface PCB; ATN, the transceivers, addressing gates, handshake circuitry and the talk flip-flop. Repair as required, then repeat starting at step 25.			
30	Check the microprocessor group and U21/U29 with their associated circuitry. Repair as required, then repeat starting at step 25.			
31	Enter the Listen address and the instruction H1 M1.			
32	Address the instrument as a talker.			
33	Record the transmitted measurement, if not done automatically by the controller.			
34	Enter the Listen address and the instruction X.			
35	Address the instrument as a talker.			
36	Is the response the same as obtained in step 33?	38	37	
37	Check the microprocessor group. The remaining circuits have been verified by previous tests. Repair as required, then restart at step 31.			
38	Enter the Listen address and the instruciton G.			
39	Address the instrument as a talker.			
40	Is the one-digit status response correct?	42	41	
41	Check the microprocessor group and the gate and overflow inputs from the Main PCB. The remaining circuits have been verified by previous tests. Repair as required, then restart at step 39.			
42	Troubleshooting of the IEEE-488 Interface is complete.			

Table 615-8. Instruction Logic Levels

INSTRUCTION MNEMONIC		LOGIC LEVEL HIGH AT	LOGIC LEVEL LOW AT	COMMENTS
Clear (C)	F0	U26 Group	U26-2	A high logic level for the U26 group infers that from the designated pins U26-2 through U26-7 and U26-9, all are high except the one specifically designated low. The same hold true for the U25 group which are pins U25-2 through U25-7.
	R0	U25 Group	U25-2	
	$\overline{SC}$		U32-11	
	$\overline{SA}$		U32-13	
	$\overline{DA}$		U32-3	
	$\overline{SB}$		U32-15	
	$\overline{DB}$		U32-7	
	$\overline{TA}$		U35-5	
	$\overline{TB}$		U32-9	
Freq C (F1)	$\overline{C}$	U26 Group	U26-3	
Freq A/B (F2)	$\overline{A/B}$	"	U26-4	
Period A (F3)	$\overline{PA}$	"	U26-5	
Time Interval (F4)	$\overline{TI}$	"	U26-6	
A Gated By B (F5)	$\overline{AXB}$	"	U26-7	
Self-Check (F6)	$\overline{CH}$	"	U26-9	
Freq A (F0)	$\overline{A}$	"	U26-2	
1.0 ms (R1)	$\overline{2}$	U25 Group	U25-3	
10.0 ms (R2)	$\overline{3}$	"	U25-4	
0.1s (R3)	$\overline{4}$	"	U25-5	
1.0s	$\overline{5}$	"	U25-6	
10.0s (R5)	$\overline{6}$	"	U25-7	
0.1 ms (R0)	$\overline{1}$	"	U25-2	
Com (S1)	$\overline{SC}$	U32-11		
Sep (S0)	$\overline{SC}$		U32-11	
Slope A(A-1)	$\overline{SA}$		U32-13	
Neg DC Coupled				
	$\overline{DA}$		U32-3	
Slope A Pos AC Coupled (A+0)	$\overline{SA}$	U32-13		
	$\overline{DA}$	U32-3		
Slope B Neg DC Coupled (B-1)	$\overline{SB}$		U32-15	
	$\overline{DB}$			
Slope B Pos AC Coupled (A+0)	$\overline{SB}$	U32-15		
	$\overline{DB}$	U32-7		
Ch AX10 (LA 0.0).	$\overline{TA}$		U32-5	
Ch AX1 (LA.00)	$\overline{TA}$	U32-5		
Ch BX10 (LB0.0)	$\overline{TB}$		U32-9	
Ch BX1 (LB.00)	$\overline{TB}$	U32-9		

Table 615-9. -15 Option, IEEE-488 Interface Assembly

ITEM NO.	DESCRIPTION		FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	⊘IEEE-488 INTERFACE, OPTION -15 FIGURE 615-4							
A11	RCU 1 PCB ASSY	1	396242	89536	396242	1		
A12	RCU 2 PCB ASSY	1	396259	89536	396259	1		
A16	BUS INTERFACE PCB ASSY		440214	89536	440214	1		
A17	PROCESSOR PCB ASSY		440222	89536	440222	1		
A18	SWITCH PCB ASSY		440230	89536	440230	1		
H1	SCREW, CONNECTOR MOUNTING		423472	89536	423472	2		
MP1	SUPPORT, CONNECTOR		439190	89536	439190	1		
U17	⊘IC, MOS, STANDARD MEMORY INTERFACE		404434	34649	P4289	1		
U22	⊘IC, MOS, CENTRAL PROCESSOR UNIT		404418	34649	C4040	1		
U23	⊘IC, MOS, ROM		486506	89536	486506	1		

1 REPLACES A1A3 INPUT PCB ASSY P/N 396127

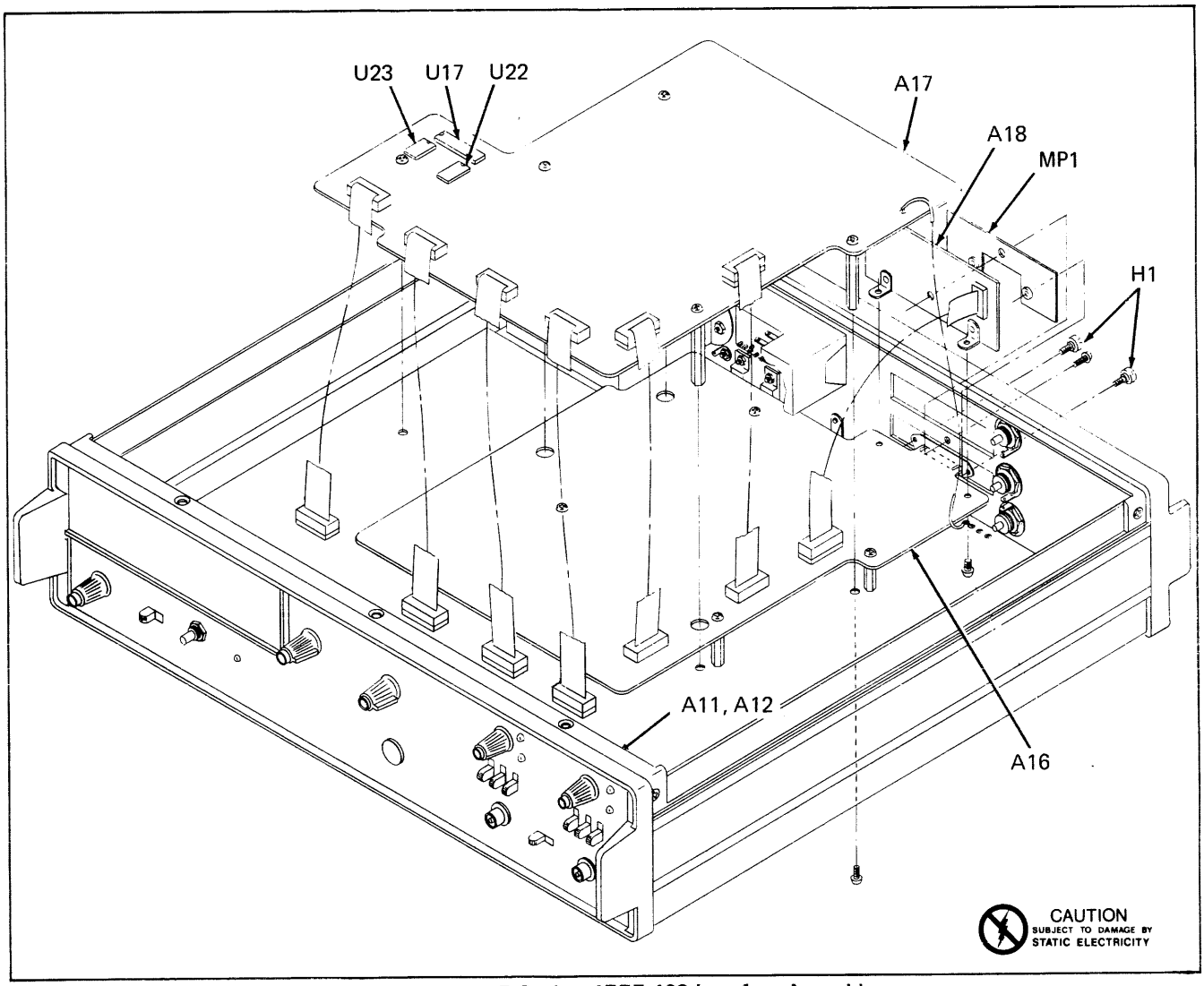


Figure 615-4. -15 Option, IEEE-488 Interface Assembly

Table 615-10. A11 Remote Control Unit #1 PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A11	REMOTE CONTROL UNIT 1 PCB ASSY (1953A-4021) FIGURE 615-5	396242	89536	396242	REF		
DS401	INDICATOR, LED	385898	28480	5082-4487	4	1	
DS402	INDICATOR, LED	385898	28480	5082-4487	REF		
DS403	INDICATOR, LED	385898	28480	5082-4487	REF		
DS404	INDICATOR, LED	385898	28480	5082-4487	REF		
J1	CONNECTOR						
	PIN, FEMALE, LARGE	149112	74970	105-0753	2		
	PIN, FEMALE, SMALL	375329	00779	85863-3	12		
P10	CONNECTOR POST UNINSULATED	376574	00779	5166-333-68	7		
R410	RES, COMP, 47 +/-5%, 1/4W	147892	01121	CB4705	4		
R411	RES, COMP, 47 +/-5%, 1/4W	147892	01121	CB4705	REF		
R412	RES, COMP, 47 +/-5%, 1/4W	147892	01121	CB4705	REF		
R413	RES, COMP, 47 +/-5%, 1/4W	147892	01121	CB4705	REF		
S108	SWITCH, SLIDE, SPDT	380113	79727	GF-124-SPDT	7	2	
S109	SWITCH, SLIDE, SPDT	380113	79727	GF-124-SPDT	REF		
S110	SWITCH, SLIDE, SPDT	380113	79727	GF-124-SPDT	REF		
S111	SWITCH, SLIDE, SPDT	380113	79727	GF-124-SPDT	REF		
S112	SWITCH, SLIDE, SPDT	380113	79727	GF-124-SPDT	REF		
S113	SWITCH, SLIDE, SPDT	380113	79727	GF-124-SPDT	REF		
S114	SWITCH, SLIDE, SPDT	380113	79727	GF-124-SPDT	REF		
U401	RES, NETWORK, SEVEN 10K +/-5%, 1.5W (OR 7 DISCRETE RESISTORS, P/N 148106)	364000	71450	760-1	1	1	
U402	IC, TTL, HEX INVERTER, OPEN COLLECTOR	379305	01295	SN7405N	1	1	

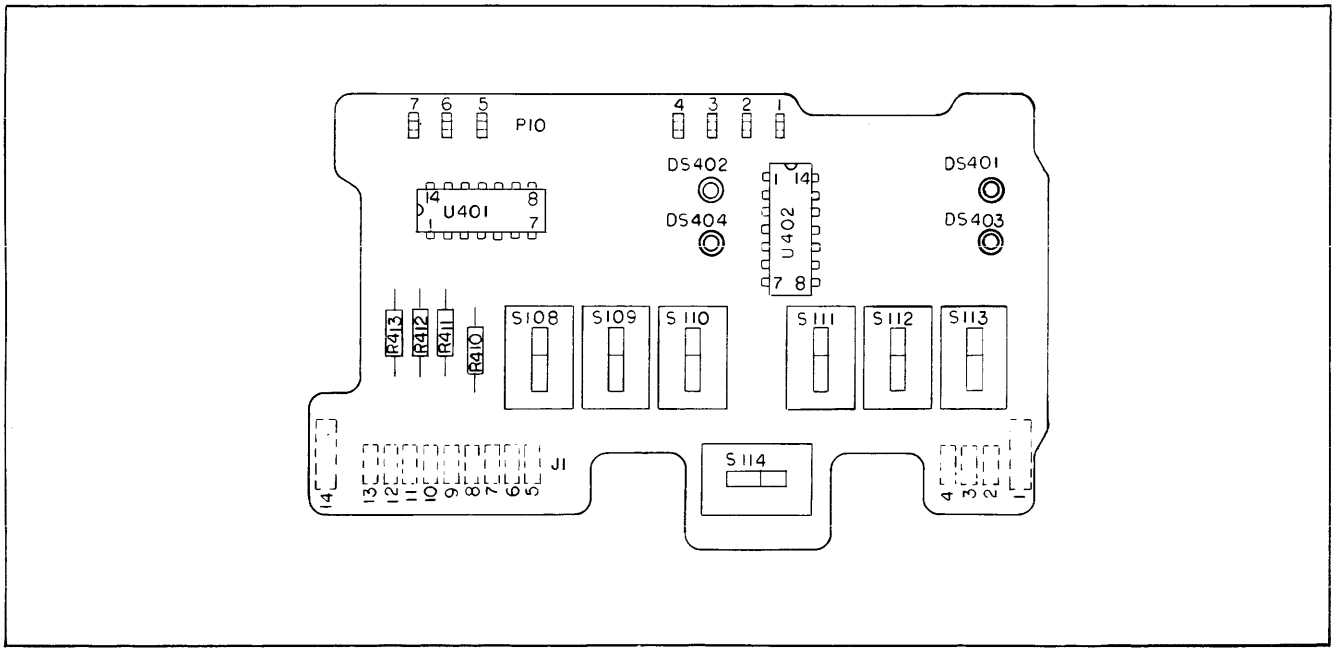


Figure 615-5. A11 Remote Control Unit #1 PCB Assembly

Table 615-11. A12 Remote Control Unit #2 PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A12	REMOTE CONTROL UNIT 2 PCB ASSEMBLY (1953A-4022) FIGURE 615-6	396259	89536	396259	REF		
C1	CAP, MYLAR, 0.1 UF +/-10%, 400V	447573	73445	C280MF/A100K	2		
C2	CAP, MYLAR, 0.1 UF +/-10%, 400V	447573	73445	C280MF/A100K	REF		
C3	CAP, CER, 1.5 PF +/-0.25 PF, 1 KV	178475	56289	10TCCV15-NPO	2		
C4	CAP, CER, 1.5 PF +/-0.25 PF, 1 KV	178475	56289	10TCCV15-NPO	REF		
J2	CONNECTOR						
	PIN, FEMALE, LARGE	149112	74970	105-0753	2		
	PIN, FEMALE, SMALL	375329	00779	85863-3	9		
R1	RES, COMP, 910K +/-5%, 1/4W	285338	01121	CB9145	2		
R2	RES, COMP, 910K +/-5%, 1/4W	285338	01121	CB9145	REF		
R3	RES, COMP, 100K +/-5%, 1/4W	148189	01121	CB1045	2		
R4	RES, COMP, 100K +/-5%, 1/4W	148189	01121	CB1045	REF		
R5	RES, VAR, 10K +/-30%, 1/2W	385880	89536	385880	2		
R6	RES, VAR, 10K +/-30%, 1/2W	385880	89536	385880	REF		
U3	IC, TTL, HEX INVERTER, OPEN COLLECTOR	379305	01295	SN7405N	1	1	

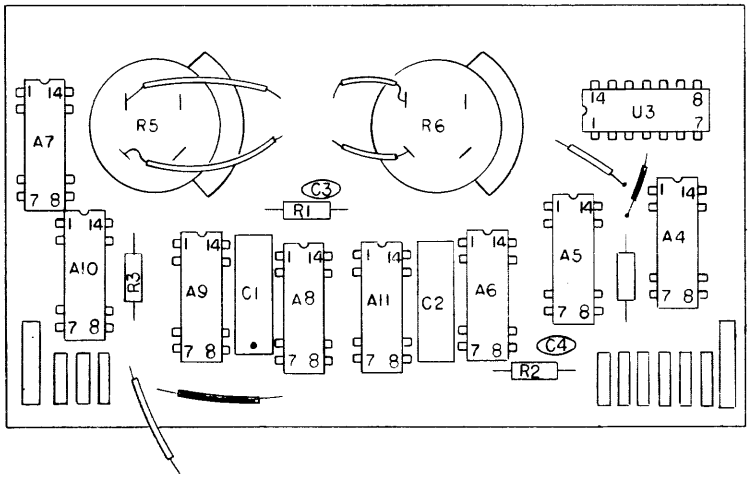


Figure 615-6. A12 Remote Control Unit #2 PCB Assembly

Table 615-12. A16 IEEE-488 1975 Interface PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A16	IEEE-488-1975 BUS INTERFACE PCB ASSY (1953A-4040) FIGURE 615-7						
C1	CAP, TA, 0.22 UF +/-20%, 35V	161331	56289	196D224X0035HA1	4		
C2	CAP, TA, 0.22 UF +/-20%, 35V	161331	56289	196D224X0035HA1	REF		
C3	CAP, TA, 0.22 UF +/-20%, 35V	161331	56289	196D224X0035HA1	REF		
C4	CAP, TA, 0.22 UF +/-20%, 35V	161331	56289	196D224X0035HA1	REF		
C5	CAP, ELECT, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA1	1	1	
J1	CONNECTOR, FEMALE, 24-PIN	408898	13511	57-20240-2 (323)	1		
J2	CABLE ASSEMBLY	380576	89536	380576	2		
J3	CABLE ASSEMBLY	380576	89536	380576	REF		
J6	SOCKET, IC, 16-PIN	370312	01295	C931602	1		
R1	RES, FXD, COMP, 390 +/-5%, 1/4W	147975	01121	CB3905	1		
R2	RES, COMP, 3K +/-5%, 1/4W	193508	01121	CB3025	1		
U1	IC, QUAD INTERFACE BUS TRANSCEIVER	428649	04713	MC3446P	4	1	
U2	IC, QUAD INTERFACE BUS TRANSCEIVER	428649	04713	MC3446P	REF		
U3	IC, QUAD INTERFACE BUS TRANSCEIVER	428649	04713	MC3446P	REF		
U4	IC, QUAD INTERFACE BUS TRANSCEIVER	428649	04713	MC3446P	REF		
U5	IC, TTL, HEX INVERTER	393058	01295	SN74LS04N	2	1	
U6	IC, TTL, HEX INVERTER	393058	01295	SN74LS04N	REF		
U7	IC, TTL, DUAL J-K FLIP-FLOP	393157	01295	SN74LS107N	3	1	
U8	IC, TTL, DUAL J-K FLIP-FLOP	393157	01295	SN74LS107N	REF		
U9	IC, TTL, 8-INPUT NAND GATE	404889	01295	SN74LS30N	4	1	
U10	IC, TTL, 8-INPUT NAND GATE	404889	01295	SN74LS30N	REF		
U11	IC, TTL, QUAD 2-INPUT NOR GATE	393041	01295	SN74SL02N	3	1	
U12	IC, TTL, QUAD 2-INPUT AND GATE	393066	01295	SN74LS08N	1	1	
U13	IC, TTL, DUAL J-K FLIP-FLOP	393157	01295	SN74LS107N	REF		
U14	IC, TTL, QUAD 2-INPUT NOR GATE	393041	01295	SN74SL02N	REF		
U15	IC, TTL, 8-INPUT NAND GATE	404889	01295	SN74LS30N	REF		
U16	IC, TTL, DUAL J-K FLIP-FLOP	414029	01295	SN74LS112N	1	1	
U17	IC, TTL, QUAD 2-INPUT NOR GATE	393041	01295	SN74SL02N	REF		
U18	IC, TTL, DUAL D-TYPE FLIP-FLOP	393124	01295	SN74LS74N	1	1	
U19	IC, TTL, 8-INPUT NAND GATE	404889	01295	SN74LS30N	REF		
U20	IC, TTL, QUAD 2-INPUT NAND GATE	393033	01295	SN74LS00N	1		
U21	IC, TTL, QUAD 2-INPUT OR GATE	393108	01295	SN74LS32N	1	1	

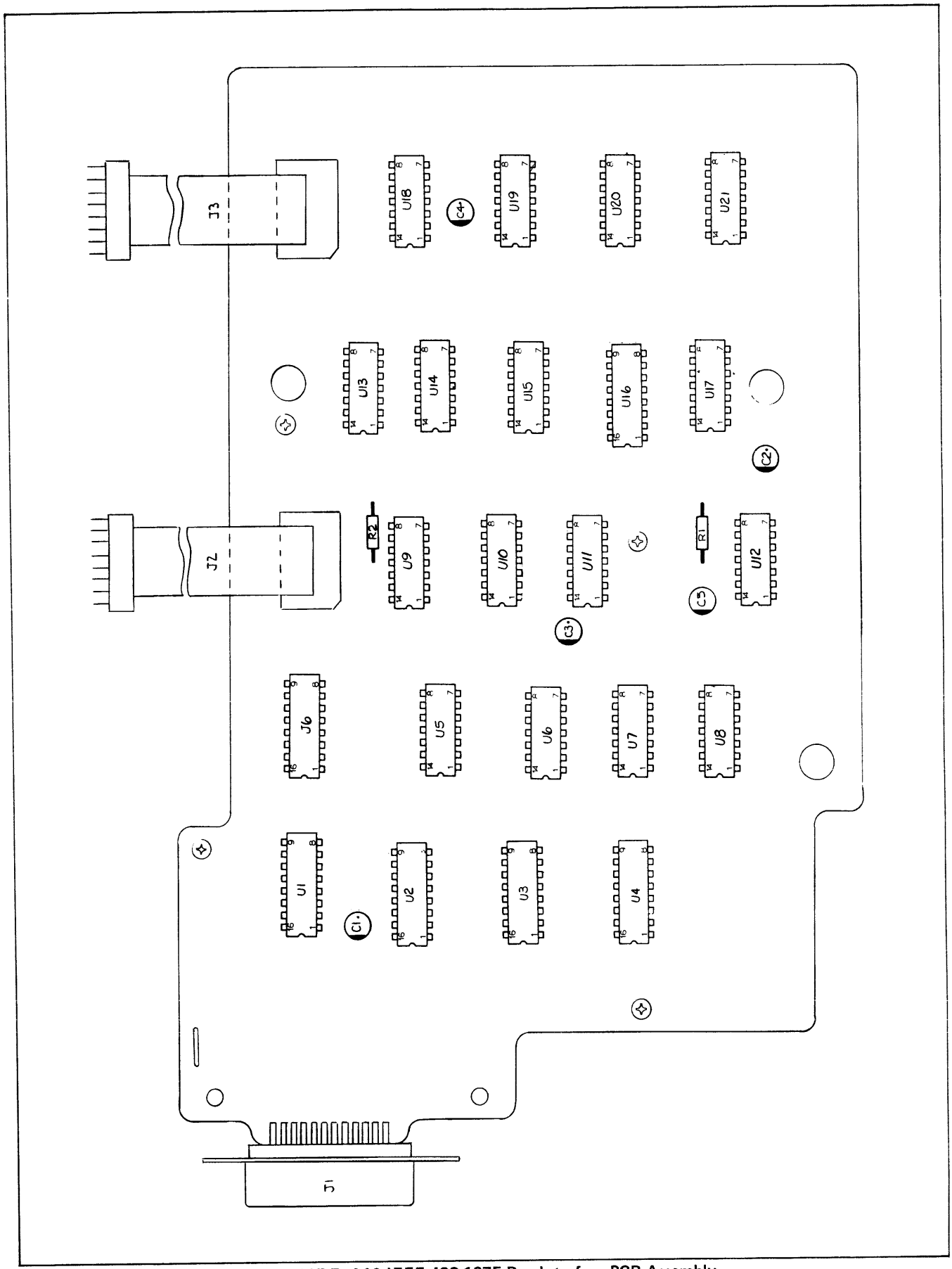


Figure 615-7. A16 IEEE-488-1975 Bus Interface PCB Assembly

Table 615-13. A17 Processor PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A17	⊗IEEE-488-1975 PROCESSOR PCB ASSEMBLY (1953A-4041) (FIGURE 615-8)						
C1	CAP, ELECT, 10 UF +50/-10%, 25V	170266	73445	ET100X25A2	4	1	
C2	CAP, ELECT, 10 UF +50/-10%, 25V	170266	73445	ET100X25A2	REF		
C3	CAP, ELECT, 10 UF +50/-10%, 25V	170266	73445	ET100X25A2	REF		
C4	CAP, ELECT, 10 UF +50/-10%, 25V	170266	73445	ET100X25A2	REF		
C5	CAP, TA, 0.47 UF +/-20%, 250V	161349	56289	196D474X0035HA1	1		
C6	CAP, MICA, 22 PF +/-5%, 500V	148551	72136	DM15C220J	2		
C7	CAP, MICA, 22 PF +/-5%, 500V	148551	72136	DM15C220J	REF		
C8	CAP, TA, 1 UF +/-20%, 35V	161919	56289	196D105X0035JA1	2		
C9	CAP, TA, 1 UF +/-20%, 35V	161919	56289	196D105X0035JA1	REF		
C10	CAP, MICA, 100 PF +/-5%, 500V	148494	72136	DM15F101J	2		
C11	CAP, MICA, 100 PF +/-5%, 500V	148494	72136	DM15F101J	REF		
C12	CAP, POLYESTER, 0.01 UF +/-10%, 250V	325548	73445	C280MAEA10K	2		
C13	CAP, POLYESTER, 0.01 UF +/-10%, 250V	325548	73445	C280MAEA10K	REF		
C14	CAP, TA, 0.22 UF +/-20%, 35V	161331	56289	196D224X0035HA1	5		
C15	CAP, TA, 0.22 UF +/-20%, 35V	161331	56289	196D224X0035HA1	REF		
C16	CAP, TA, 0.22 UF +/-20%, 35V	161331	56289	196D224X0035HA1	REF		
C17	CAP, TA, 0.22 UF +/-20%, 35V	161331	56289	196D224X0035HA1	REF		
C18	CAP, TA, 0.22 UF +/-20%, 35V	161331	56289	196D224X0035HA1	REF		
C19	CAP, TA, 5.6 UF +/-20%, 25V	368969	56289	196D565X0025KA1	3		
C20	CAP, TA, 10 UF +/-20%, 35V	417683	56289	196D106X0035PE4	2		
C21	CAP, TA, 10 UF +/-20%, 35V	417683	56289	196D106X0035PE4	REF		
C24	CAP, TA, 5.6 UF +/-20%, 25V	368969	56289	196D565X0025KA1	REF		
C25	CAP, TA, 5.6 UF +/-20%, 25V	368969	56289	196D565X0025KA1	REF		
CR1	DIODE, SI	203323	07910	1N4448	3		
CR2	DIODE, SI	203323	07910	1N4448	REF		
CR3	DIODE, SI	203323	07910	1N4448	REF		
CR4	DIODE, ZENER, 7V	260695	07910	1N754A	1	1	
J1	CABLE	380576	08261	5122-003.5	4		
J2	CABLE	380576	08261	5122-003.5	REF		
J3	CABLE	380576	08261	5122-003.5	REF		
J4	SOCKET, IC, 16-PIN	387324	71765	133-59-02-062	3		
J5	CABLE	380576	08261	5122-003.5	REF		
J6	SOCKET, IC, 16-PIN	387324	71765	133-59-02-062	REF		
L1	CHOKE, 6 TURN	320911	89536	320911	3		
L2	CHOKE, 6 TURN	320911	89536	320911	REF		
L3	CHOKE, 6 TURN	320911	89536	320911	REF		
R1	RES, COMP, 51 +/-5%, 1/4W	221879	01121	CB5105	1		
R2	RES, COMP, 680K +/-5%, 1/4W	188433	01121	CB6845	1		
R3	RES, COMP, 100 +/-5%, 1/4W	147926	01121	CB1015	1		
R4	RES, COMP, 20K +/-5%, 1/4W	221614	01121	CB2035	1		
R5	RES, COMP, 3K +/-5%, 1/4W	193508	01121	CB3025	1		
R6	RES, NETWORK, 10K	414003	89536	414003	1		
R7	RES, COMP, 5.6K +/-5%, 1/4W	148080	01121	CB5625	4		
R8	RES, COMP, 5.6K +/-5%, 1/4W	148080	01121	CB5625	REF		
R9	RES, COMP, 5.6K +/-5%, 1/4W	148080	01121	CB5625	REF		
R10	RES, COMP, 5.6K +/-5%, 1/4W	148080	01121	CB5625	REF		
R11	RES, MF, 5.11K +/-1%, 1/8W	294868	91637	MFF1-85111F	4		

Table 615-13. A17 Processor PCB Assembly (cont)

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R12	RES, MF, 5.11K +/-1%, 1/8W	294868	91637	MFF1-85111F	REF		
R13	RES, MF, 562 +/-1%, 1/8W	340828	91637	MFF1-85620F	2		
R14	RES, MF, 66.5 +/-1%, 1/8W	289082	91637	MFF1-86652F	2		
R15	RES, MF, 549 +/-1%, 1/8W	436469	91637	MFF1-85490F	2		
R16	RES, VA, 10K +/-10%, 1/2W	309674	89536	309674	2		
R17	RES, MF, 5.11K +/-1%, 1/8W	294868	91637	MFF1-85111F	REF		
R18	RES, MF, 549 +/-1%, 1/8W	436469	91637	MFF1-85490F	REF		
R19	RES, MF, 5.11K +/-1%, 1/8W	294868	91637	MFF1-85111F	REF		
R20	RES, MF, 562 +/-1%, 1/8W	340828	91637	MFF1-85620F	REF		
R21	RES, MF, 66.5 +/-1%, 1/8W	289082	91637	MFF1-86652F	REF		
R22	RES, VA, 10K +/-10%, 1/2W	309674	89536	309674	REF		
R23	RES, COMP, 10K +/-5%, 1/4W	148106	01121	CB1035	1		
U1	IC, TTL, 8-BIT BISTABLE LATCH	408377	01295	SN74LS75N	2		
U2	IC, TTL, HEX INVERTER	393058	01295	SN74LS04N	1		
U3	IC, 8-BIT D/A CONVERTER	419226	06665	DAC08CZ	2		
U4	IC, OP AMP	363515	12040	LM301AN	2	1	
U5	IC, 8-BIT D/A CONVERTER	419226	06665	DAC08CZ	REF		
U6	IC, OP AMP	363515	12040	LM301AN	REF		
U7	IC, TTL, 8-BIT BISTABLE LATCH	408377	01295	SN74LS75N	REF		
U8	IC, TTL, 8-BIT DATA SELECTOR/MULTIPLEXER	407577	01295	SN74LS251	4	1	
U9	IC, TTL, 8-BIT ADDRESSABLE LATCH	419242	01295	SN74LS259N	4	1	
U10	IC, TTL, 8-BIT ADDRESSABLE LATCH	419242	01295	SN74LS259N	REF		
U11	⊗IC, CMOS, TRIPLE 2-CHANNEL MULTIPLEXER	375808	95303	CD4053AE	2	1	
U12	⊗IC, CMOS, TRIPLE 2-CHANNEL MULTIPLEXER	375808	95303	CD4053AE	REF		
U13	IC, TTL, 8-BIT DATA SELECTOR/MULTIPLEXER	407577	01295	SN74LS251	REF		
U14	IC, TTL, 8-BIT ADDRESSABLE LATCH	419242	01295	SN74LS259N	REF		
U15	IC, TTL, 8-BIT ADDRESSABLE LATCH	419242	01295	SN74LS259N	REF		
U16	IC, TTL, QUAD 2-INPUT OR GATE	393108	01285	SN74LS32N	1		
U17	SEE OPTION -15 FINAL ASSEMBLY						
U18	IC, TTL, 8-BIT DATA SELECTOR/MULTIPLEXER	407577	01295	SN74LS251	REF		
U19	IC, TTL, QUAD 2-INPUT NAND GATE	393033	01295	SN74LS00N	1	1	
U20	IC, TTL, 3-TO-8 LINE DECODER	407585	01295	SN74LS138N	1	1	
U21	IC, TTL, DUAL J-K FLIP-FLOP	393157	01295	SN74LS107N	2	1	
U22	SEE OPTION -15 FINAL ASSEMBLY				REF		
U23	SEE OPTION -15 FINAL ASSEMBLY				REF		
U24	IC, TTL, 8-BIT DATA SELECTOR/MULTIPLIER	407577	01295	SN74LS251	REF		
U25	IC, TTL, BCD-TO-DECIMAL DECODER/DRIVER	419192	01295	SN74LS145N	2	1	
U26	IC, TTL, BCD-TO-DECIMAL DECODER/DRIVER	419192	01295	SN74LS145N	REF		
U27	IC, TTL, TRIPLE, 3-INPUT NOR GATE	393090	01295	SN74LS27N	1	1	
U28	IC, CLOCK GENERATOR, MICRO-COMPUTER SET	404459	34649	C4201	1	1	
U29	IC, TTL, DUAL J-K FLIP-FLOP	393157	01295	SN74LS107N	REF		
U30	⊗IC, CMOS, QUAD 2-INPUT NAND GATE	355198	04713	MC14011CP	1	1	
U31	⊗IC, CMOS, 8-INPUT NOR GATE	408781	95303	CD4078B	1	1	
U32	IC, TTL, TRI-STATE BUFFER	429902	12040	DM81LS95N	1	1	
XU17	SOCKET, IC, 40-PIN DIP	376244	01295	C934002	1		
XU22	SOCKET, IC, 24-PIN DIP	376236	01295	C932402	2		
XU23	SOCKET, IC, 24-PIN DIP	376236	01295	C932402	REF		
XU28	SOCKET, IC, 16-PIN	387324	71765	133-59-02-062	REF		
Y1	CRYSTAL, 5.185 MHZ	408518	89536	408518	1		

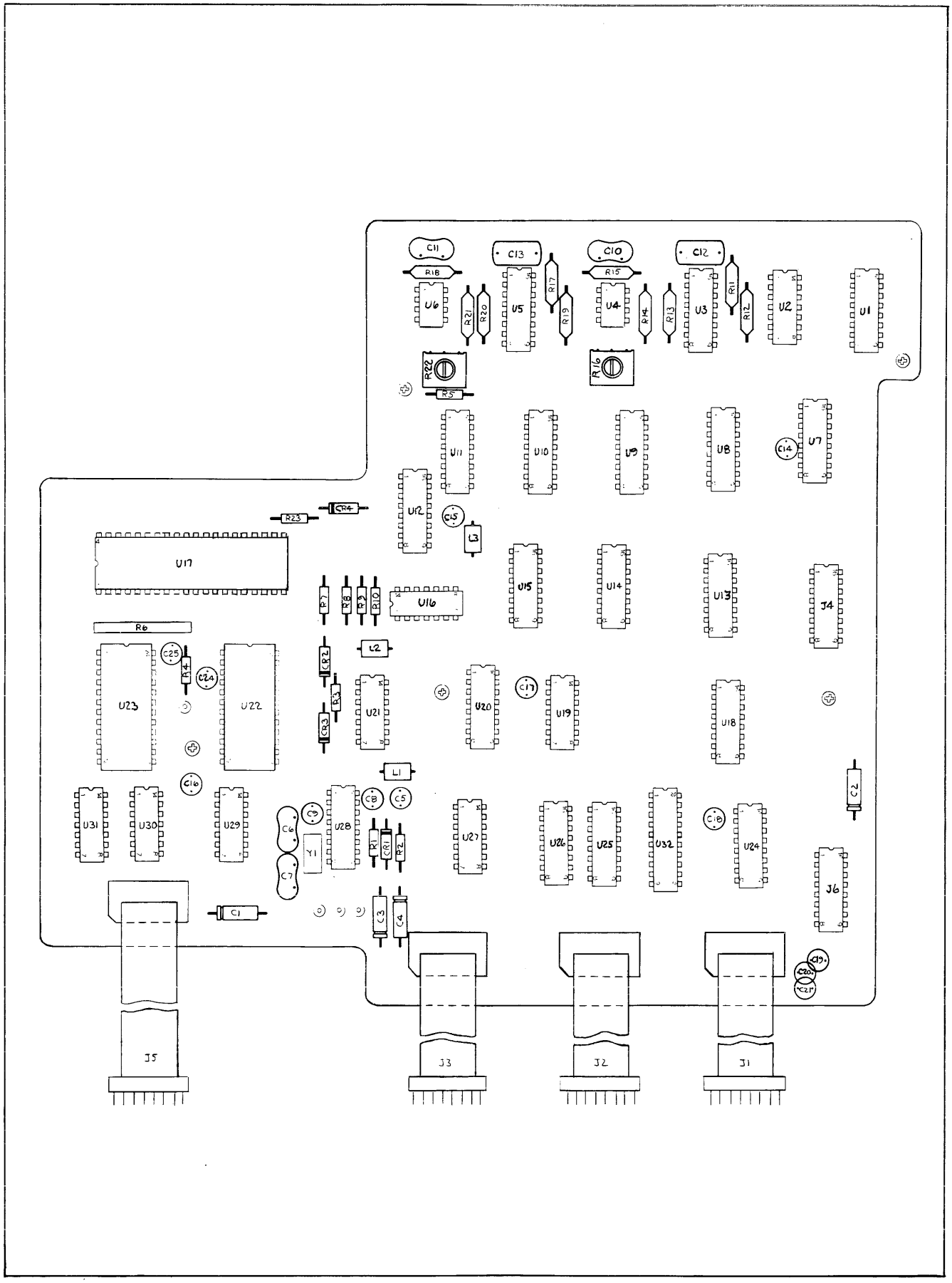


Figure 615-8. A17 Processor PCB Assembly

Table 615-14. A18 IEEE-488-1975 Switch PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A18	IEEE-488-1975 SWITCH PCB ASSEMBLY (1953A-4042) FIGURE 615-9						
H1	BRACKET, ANGLE	306225	73734	36-515	2		
J1	CABLE	393520	08261	5142-006	1		
S1	SWITCH	393629	10389	23-021-114	1	1	
U1	SWITCH, DIP, 5 SPDT	477414	11236	206-125MOD	1	1	

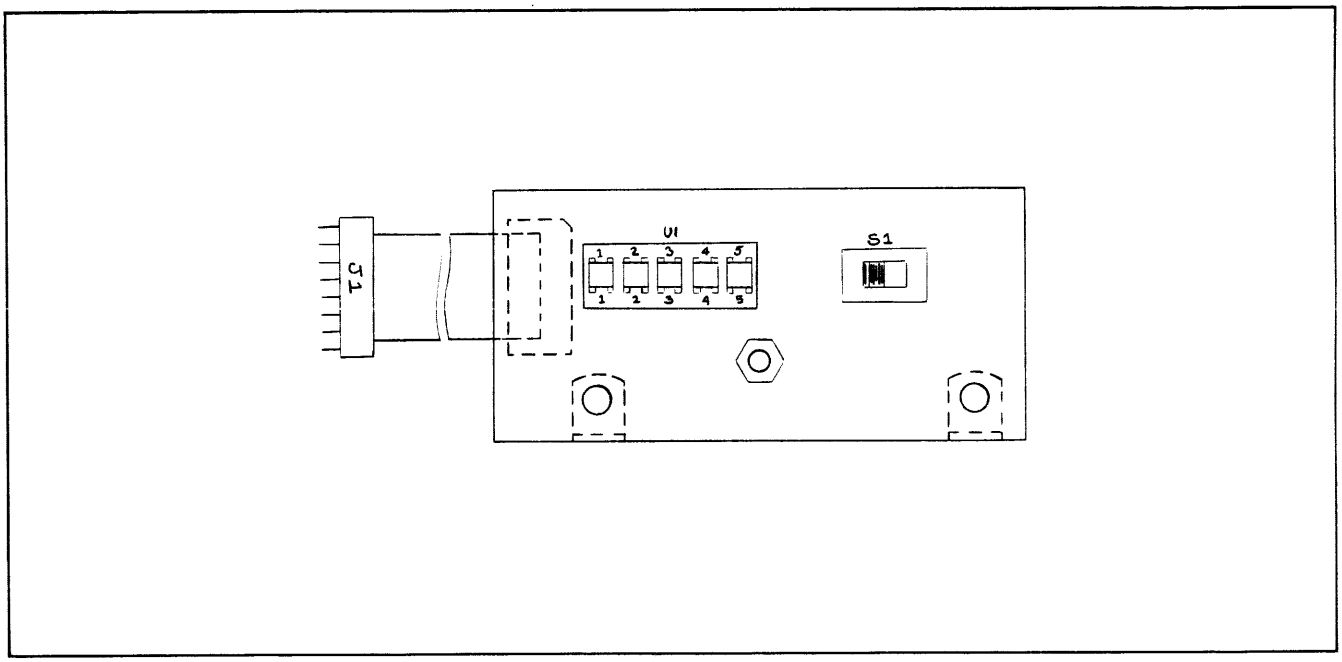


Figure 615-9. A18 IEEE-488-1975 Switch PCB Assembly

Option -16
Rear Panel Inputs

The 1953A can be ordered with three factory-installed BNC connectors on the rear panel which serve as inputs to channels A, B and C. When this option is ordered, no front panel connector is installed for the channel C input. The channels A and B inputs are in parallel with the corresponding front panel inputs. The addition of the rear panel input terminals for channels A and B increases the input capacity of these channels to 85 pF.

NOTE

Sensitivity on the A channel is reduced to 75 mV at 100 MHz, decreasing to 150 mV at 125 MHz, as measured from the rear connector. When using the rear "A" connector at frequencies above 75 MHz a 50 ohm termination is recommended at the front "A" connector to reduce effects of standing waves. See measurement error discussion in Section 2 of this manual.

Table 616-1. -16 Option, Rear Panel Inputs

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	REAR PANEL INPUTS OPTION -16 FIGURE 616-1						
H1	SOLDER LUG	167015	73734	118100	2		
J122	CONNECTOR, BNC	152033	95712	30355-1	2		
J123	CONNECTOR, BNC	152033	95712	30355-1	REF		
W1	COAX CABLE ASSY (CHANNEL A & B)	433391	89536	433391	2		
W2	CABLE ASSY (CHANNEL C)	406934	89536	406934	1		

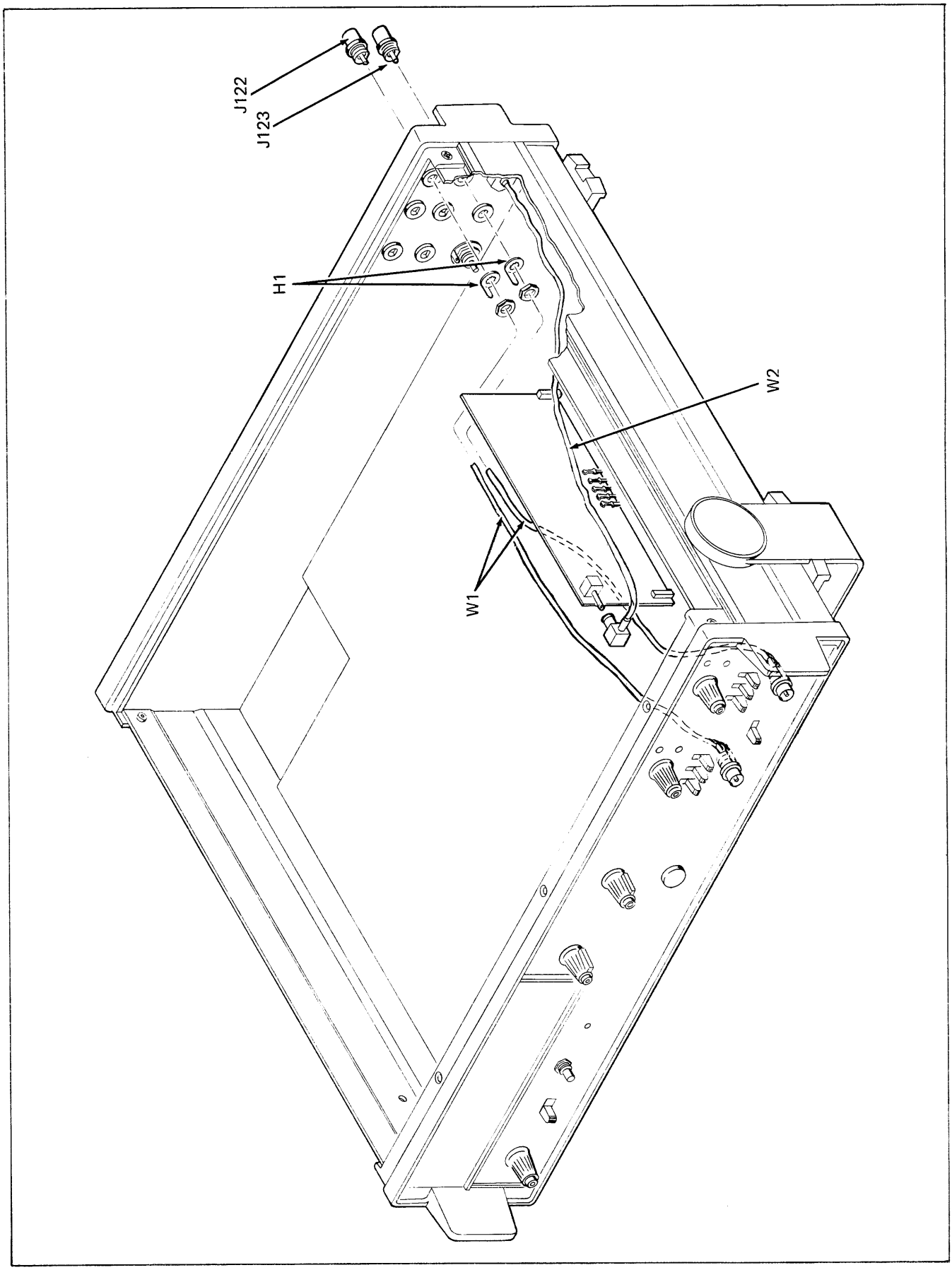


Figure 616-1. -16 Option, Rear Panel Inputs Assembly

Option -20
Superior Oven-Stabilized Time Base

620-1. INTRODUCTION

620-2. The Superior Oven-Stabilized Time Base affords the highest degree of time base available to the Model 1953A. The specifications for Option -20 are given in Section 1. The unit is installed on the inside of the 1953A, and requires re-arrangement of the instrument's power switching. A switch installed on the rear panel of the 1953A is used to activate the oven independently of the power switch for the instrument itself. The option must be ordered factory installed in the 1953A when the instrument is purchased, it is not field installable.

620-3. CALIBRATION

620-4. Calibration of the Ovenized Oscillator is similar to that of the other time bases. Proceed as follows:

a. Connect 1953A to ac line power.

b. Turn CYCLE RATE control cw, off the OFF detent.

c. Set FUNCTION switch to FREQ A.

d. Set CONT/TRIG switch to TRIG.

e. Connect 10 MHz frequency standard to CHANNEL A connector.

f. Adjust Channel A TRIGGER LEVEL control to establish proper input signal triggering.

g. Set RANGE switch to 10s (GATE 4).

h. Momentarily press RESET button. After 10 seconds 1953A display should indicate: 100000.0000 kHz.

i. If display is incorrect, locate the adjustment screw access hole on the rear panel. Using an insulated tuning tool, turn the adjustment slightly.

j. Momentarily press RESET button. Observe the display for a change in the readout.

k. Repeat steps h, i and j until the display reads 10000.00 kHz.

Table 620-1. -20 Option, Superior Oven-Stabilized Time Base

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	SUPERIOR OVEN-STABILIZED TIME BASE OPTION -20 FIGURE 620-1						
C91	CAP, ELECT, 2100 UF, -10/+100%, 35V	370742	80031	3050JJ212U035	1	1	
C122	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA1	1		
C123	CAP, TA, 10 UF +/-20%, 35V	417683	56289	196D106X0035PE4	1		
K1	RELAY, REED	352658	71707	UF-40063	1		
MP1	DECAL	428052	89536	428052	1		
R121	RES, VAR, CER, 10K +/-20%, 1/2W	267880	11236	190PC103B	1	1	
S121	SWITCH, TOGGLE	327734	09353	7201LHPZG1	1		
U7	OSCILLATOR	416826	12020	48-65B	1		
U91	RECT, BRIDGE	296509	09423	FB200	1		
U101	REG ASSY +18V	443713	89536	443713	1		
W1	CABLE ASSY	443721	89536	443721	1		

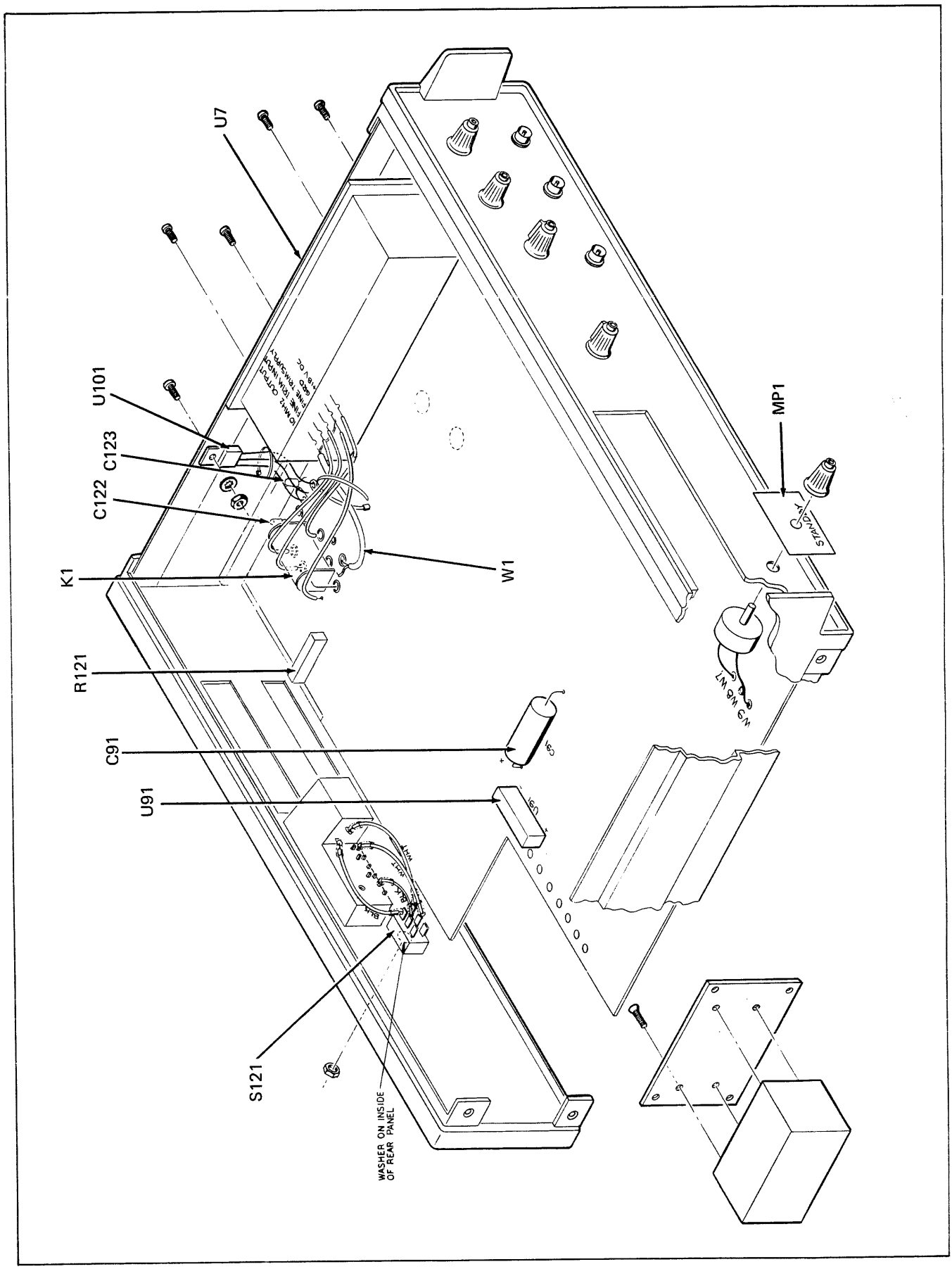


Figure 620-1. -20 Option, Superior Oven-Stabilized Time Base

Section 7

General Information

7-1. This section of the manual contains generalized user information as well as supplemental information to the List of Replaceable parts contained in Section 5. The following information is presented in this section:

List of Abbreviations

Federal Supply Codes for Manufacturers

Fluke Technical Service Centers — U.S. and Canada

Sales and Service Locations — International

Sales Representatives — U.S. and Canada

List of Abbreviations and Symbols

A or amp	ampere
ac	alternating current
af	audio frequency
a/d	analog-to-digital
assy	assembly
AWG	american wire gauge
B	bel
bcd	binary coded decimal
^{o}C	Celsius
cap	capacitor
ccw	counterclockwise
cer	ceramic
cermet	ceramic to metal(seal)
ckt	circuit
cm	centimeter
cmrr	common mode rejection ratio
comp	composition
cont	continue
crt	cathode-ray tube
cw	clockwise
d/a	digital-to-analog
dac	digital-to-analog converter
dB	decibel
dc	direct current
dmm	digital multimeter
dvm	digital voltmeter
elect	electrolytic
ext	external
F	farad
^{o}F	Fahrenheit
FET	Field-effect transistor
ff	flip-flop
freq	frequency
FSN	federal stock number
g	gram
G	giga (10^{9})
gd	guard
Ge	germanium
GHz	gigahertz
gmv	guaranteed minimum value
gnd	ground
H	henry
hd	heavy duty
hf	high frequency
Hz	hertz
IC	integrated circuit
if	intermediate frequency
in	inch(es)
intl	internal
I/O	input/output
k	kilo (10^{3})
kHz	kilohertz
kΩ	kilohm(s)
kV	kilovolt(s)
lf	low frequency
LED	light-emitting diode
LSB	least significant bit
LSD	least significant digit
M	mega (10^{6})
m	milli (10^{-3})
mA	milliampere(s)
max	maximum
mf	metal film
MHz	megahertz
min	minimum
mm	millimeter
ms	millisecond
MSB	most significant bit
MSD	most significant digit
MTBF	mean time between failures
MTTR	mean time to repair
mV	millivolt(s)
mv	multivibrator
MΩ	megohm(s)
n	nano (10^{-9})
na	not applicable
NC	normally closed
(–) or neg	negative
NO	normally open
ns	nanosecond
opnl ampl	operational amplifier
p	pico (10^{-12})
para	paragraph
pcb	printed circuit board
pF	picofarad
pn	part number
(+) or pos	positive
pot	potentiometer
p-p	peak-to-peak
ppm	parts per million
PROM	programmable read-only memory
psi	pound-force per square inch
RAM	random-access memory
rf	radio frequency
rms	root mean square
ROM	read-only memory
s or sec	second (time)
scope	oscilloscope
SH	shield
Si	silicon
serno	serial number
sr	shift register
Ta	tantalum
tb	terminal board
tc	temperature coefficient or temperature compensating
tcxo	temperature compensated crystal oscillator
tp	test point
u or μ	micro (10^{-6})
uhf	ultra high frequency
us or μs	microsecond(s) (10^{-6})
uut	unit under test
V	volt
v	voltage
var	variable
vco	voltage controlled oscillator
vhf	very high frequency
vlf	very low frequency
W	watt(s)
ww	wire wound
xfmr	transformer
xstr	transistor
xtal	crystal
xtlo	crystal oscillator
Ω	ohm(s)
μ	micro (10^{-6})

Federal Supply Codes for Manufacturers

00213
Nytronics Comp. Group Inc.
Subsidiary of Nytronics Inc.
Formerly Sage Electronics
Rochester, New York

00327
Welwyn International, Inc.
Westlake, Ohio

00656
Aerovox Corp.
New Bedford, Massachusetts

00686
Film Capacitors, Inc.
Passaic, New Jersey

00779
AMP Inc.
Harrisburg, Pennsylvania

01121
Allen-Bradley Co.
Milwaukee, Wisconsin

01281
TRW Electronic Comp.
Semiconductor Operations
Lawndale, California

01295
Texas Instruments, Inc.
Semiconductor Group
Dallas, Texas

01537
Motorola Communications &
Electronics Inc.
Franklin Park, Illinois

01686
RCL Electronics Inc.
Manchester, New Hampshire

01730
Replaced by 73586

01884
Use 56289
Sprague Electric Co.
Dearborn Electronic Div.
Lockwood, Florida

02114
Ferroxcube Corp.
Saugerties, New York

02131
General Instrument Corp.
Harris ASW Div.
Westwood, Maine

02395
Rason Mfg. Co.
Brooklyn, New York

02533
Snelgrove, C.R. Co., Ltd.
Don Mills, Ontario, Canada
M3B 1M2

02606
Fenwal Labs
Div. of Travenal Labs.
Morton Grove, Illinois

02660
Bunker Ramo Corp., Conn Div.
Formerly Amphenol-Borg
Electric Corp.
Broadview, Illinois

02799
Areo Capacitors, Inc.
Chatsworth, California

03508
General Electric Co.
Semiconductor Products
Syracuse, New York

03614
Replaced by 71400

03651
Replaced by 44655

03797
Eldema Div.
Genisco Technology Corp.
Compton, California

03877
Transistron Electronic Corp.
Wakefield, Massachusetts

03888
KDI Pyrofilm Corp.
Whippany, New Jersey

03911
Clairex Electronics Div.
Clairex Corp.
Mt. Vernon, New York

03980
Muirhead Inc.
Mountainside, New Jersey

04009
Arrow Hart Inc.
Hartford, Connecticut

04062
Replaced by 72136

04202
Replaced by 81312

04217
Essex International Inc.
Wire & Cable Div.
Anaheim, California

04221
Aemco, Div. of
Midtex Inc.
Mankato, Minnesota

04222
AVX Ceramics Div.
AVX Corp.
Myrtle Beach, Florida

04423
Telonic Industries
Laguna Beach, California

04645
Replaced by 75376

04713
Motorola Inc. Semiconductor
Products
Phoenix, Arizona

04946
Standard Wire & Cable
Los Angeles, California

05082
Replaced by 94988

05236
Jonathan Mfg. Co.
Fullerton, California

05245
Components Corp. now
Corcom, Inc.
Chicago, Illinois

05277
Westinghouse Electric Corp.
Semiconductor Div.
Youngwood, Pennsylvania

05278
Replaced by 43543

05279
Southwest Machine &
Plastic Co.
Glendora, California

05397
Union Carbide Corp.
Materials Systems Div.
New York, New York

05571
Use 56289
Sprague Electric Co.
Pacific Div.
Los Angeles, California

05574
Viking Industries
Chatsworth, California

05704
Replaced by 16258

05820
Wakefield Engineering Inc.
Wakefield, Massachusetts

06001
General Electric Co.
Electronic Capacitor &
Battery Products Dept.
Columbia, South Carolina

06136
Replaced by 63743

06383
Panduit Corp.
Tinley Park, Illinois

06473
Bunker Ramo Corp.
Amphenol SAMS Div.
Chatsworth, California

06555
Beede Electrical Instrument Co.
Penacook, New Hampshire

06739
Electron Corp.
Littleton, Colorado

06743
Clevite Corp.
Cleveland, Ohio

06751
Components, Inc. Semcor Div.
Phoenix, Arizona

06860
Gould Automotive Div.
City of Industry, California

06961
Vernitron Corp., Piezo
Electric Div.
Formerly Clevite Corp., Piezo
Electric Div.
Bedford, Ohio

06980
Eimac Div.
Varian Associates
San Carlos, California

07047
The Ross Milton Co.
South Hampton, Pennsylvania

07115
Replaced by 14674

07138
Westinghouse Electric Corp.,
Electronic Tube Div.
Horsehead, New York

07233
TRW Electronic Components
Cinch Graphic
City of Industry, California

07256
Silicon Transistor Corp.
Div. of BBF Group Inc.
Chelmsford, Massachusetts

07261
Aumet Corp.
Culver City, California

07263
Fairchild Semiconductor
Div. of Fairchild Camera
& Instrument Corp.
Mountain View, California

07344
Bircher Co., Inc.
Rochester, New York

07597
Burndy Corp.
Tape/Cable Div.
Rochester, New York

07792
Lerma Engineering Corp.
Northampton, Massachusetts

07910
Teledyne Semiconductor
Formerly Continental Device
Hawthorne, California

07933
Use 49956
Raytheon Co.
Semiconductor Div. HQ
Mountain View, California

08225
Industro Transistor Corp.
Long Island City, New York

Federal Supply Codes for Manufacturers (cont)

08261
Spectra Strip Corp.
Garden Grove, California

08530
Reliance Mica Corp.
Brooklyn, New York

08806
General Electric Co.
Miniature Lamp Products Dept
Cleveland, Ohio

08863
Nylomatic Corp.
Norrisville, Pennsylvania

08988
Use 53085
Skottie Electronics Inc.
Archbald, Pennsylvania

09214
G.E. Co. Semi-Conductor
Products Dept.
Power Semi-Conductor
Products OPN Sec.
Auburn, New York

09353
C and K Components
Watertown, Massachusetts

09423
Scientific Components, Inc.
Santa Barbara, California

09922
Burndy Corp.
Norwalk, Connecticut

09969
Dale Electronics Inc.
Yankton, S. Dakota

10059
Barker Engineering Corp.
Formerly Amerace, Amerace
ESNA Corp.
Kenilworth, New Jersey

11236
CTS of Berne
Berne, Indiana

11237
CTS Keene Inc.
Paso Robles, California

11358
CBS Electronic Div.
Columbia Broadcasting System
Newburyport, Minnesota

11403
Best Products Co.
Chicago, Illinois

11503
Keystone Columbia Inc.
Warren, Michigan

11532
Teledyne Relays
Hawthorne, California

11711
General Instrument Corp.
Rectifier Division
Hicksville, New York

11726
Qualidyne Corp.
Santa Clara, California

12014
Chicago Rivet & Machine Co.
Bellwood, Illinois

12040
National Semiconductor Corp.
Danburry, Connecticut

12060
Diodes, Inc.
Chatsworth, California

12136
Philadelphia Handle Co.
Camden, New Jersey

12300
Potter-Brumfield Div.
AMF Canada LTD.
Guelph, Ontario, Canada

12323
Presin Co., Inc.
Shelton, Connecticut

12327
Freeway Corp. formerly
Freeway Washer & Stamping Co.
Cleveland, Ohio

12443
The Budd Co. Polychem Products
Plastic Products Div.
Bridgeport, Pennsylvania

12615
U.S. Terminals Inc.
Cincinnati, Ohio

12617
Hamlin Inc.
Lake Mills, Wisconsin

12697
Clarostat Mfg. Co.
Dover, New Hampshire

12749
James Electronics
Chicago, Illinois

12856
Micrometals
Sierra Madre, California

12954
Dickson Electronics Corp.
Scottsdale, Arizona

12969
Unitrode Corp.
Watertown, Massachusetts

13103
Thermalloy Co., Inc.
Dallas, Texas

13327
Solitron Devices Inc.
Tappan, New York

13511
Amphenol Cadre Div.
Bunker-Ramo Corp.
Los Gatos, California

13606
Use 56289
Sprague Electric Co.
Transistor Div.
Concord, New Hampshire

13839
Replaced by 23732

14099
Semtech Corp.
Newbury Park, California

14140
Edison Electronic Div.
Mc Gray-Edison Co.
Manchester, New Hampshire

14193
Cal-R-Inc. formerly
California Resistor, Corp.
Santa Monica, California

14298
American Components, Inc.
an Insilco Co.
Conshohocken, Pennsylvania

14655
Cornell-Dublier Electronics
Division of Federal Pacific
Electric Co. Govt. Control Dept.
Newark, New Jersey

14752
Electro Cube Inc.
San Gabriel, California

14869
Replaced by 96853

14936
General Instrument Corp.
Semi Conductor Products Group
Hicksville, New York

15636
Elec-Trol Inc.
Saugus, California

15801
Fenwal Electronics Inc.
Div. of Kidde Walter and Co., Inc.
Framingham, Massachusetts

15818
Teledyne Semiconductors,
formerly Amelco Semiconductor
Mountain View, California

15849
Litton Systems Inc. Useco Div.
formerly Useco Inc.
Van Nuys, California

15898
International Business
Machines Corp.
Essex Junction, Vermont

15909
Replaced by 14140

16258
Space-Lok Inc.
Burbank, California

16299
Corning Glass
Electronic Components Div.
Raleigh, North Carolina

16332
Replaced by 28478

16473
Cambridge Scientific Ind.
Div. of Chemed Corporation
Cambridge, Maryland

16742
Paramount Plastics
Fabricators, Inc.
Downey, California

16758
Delco Electronics
Div. of General Motors Corp.
Kokomo, Indiana

17001
Replaced by 71468

17069
Circuit Structures Lab.
Burbank, California

17338
High Pressure Eng. Co., Inc.
Oklahoma City, Oklahoma

17545
Atlantic Semiconductors, Inc.
Asbury Park, New Jersey

17856
Siliconix, Inc.
Santa Clara, California

17870
Replaced by 14140

18178
Vactec Inc.
Maryland Heights, Missouri

18324
Signetics Corp.
Sunnyvale, California

18612
Vishay Resistor Products Div.
Vishay Intertechnology Inc.
Malvern, Pennsylvania

18736
Voltronics Corp.
Hanover, New Jersey

18927
GTE Sylvania Inc.
Precision Material Group
Parts Division
Titusville, Pennsylvania

19451
Perine Machinery & Supply Co.
Seattle, Washington

19701
Electro-Midland Corp.
Mepco-Electra Inc.
Mineral Wells, Texas

20584
Enochs Mfg. Inc.
Indianapolis, Indiana

Federal Supply Codes for Manufacturers (Continued)

34333
Silicon General
Westminister, California

34335
Advanced Micro Devices
Sunnyvale, California

34802
Electromotive Inc.
Kenilworth, New Jersey

37942
Mallory, P.R. & Co., Inc.
Indianapolis, Indiana

42498
National Radio
Melrose, Massachusetts

43543
Nytronics Inc.
Transformer Co. Div.
Geneva, New York

44655
Ohmite Mfg. Co.
Skokie, Illinois

49671
RCA Corp.
New York, New York

49956
Raytheon Company
Lexington, Massachusetts

50088
Mostek Corp.
Carrollton, Texas

50579
Litronix Inc.
Cupertino, California

51605
Scientific Components Inc.
Linden, New Jersey

53021
Sangamo Electric Co.
Springfield, Illinois

54294
Cutler-Hammer Inc. formerly
Shallcross, A Cutter-Hammer Co.
Selma, North Carolina

55026
Simpson Electric Co.
Div. of Am. Gage and Mach. Co.
Elgin, Illinois

56289
Sprague Electric Co.
North Adams, Massachusetts

58474
Superior Electric Co.
Bristol, Connecticut

60399
Torin Corp, formerly
Torrington Mfg. Co.
Torrington, Connecticut

63743
Ward Leonard Electric Co., Inc.
Mount Vernon, New York

64834
West Mfg. Co.
San Francisco, Californai

65092
Weston Instruments Inc.
Newark, New Jersey

66150
Winslow Tele-Tronics Inc.
Eaton Town, New Jersey

70485
Atlantic India Rubber Works
Chicago, Illinois

70563
Amperite Company
Union City, New Jersey

70903
Belden Corp.
Geneva, Illinois

71002
Birnbach Radio Co., Inc.
Freeport, LI New York

71400
Bussmann Mfg.
Div. of McGraw-Edison Co.
Saint Louis, Missouri

71450
CTS Corp.
Elkhart, Indiana

71468
ITT Cannon Electric Inc.
Santa Ana, California

71482
Clare, C.P. & Co.
Chicago, Illinois

71590
Centrelab Electronics
Div. of Globe Union Inc.
Milwaukee, Wisconsin

71707
Coto Coil Co., Inc.
Providence, Rhode Island

71744
Chicago Miniature Lamp Works
Chicago, Illinois

71785
TRW Electronics Components
Cinch Connector Operations Div.
Elk Grove Village, Chicago, Illinois

72005
Driver, Wilber B., Co.
Newark, New Jersey

72092
Replaced by 06980

72136
Electro Motive Mfg. Co.
Williamantic, Connecticut

72259
Nytronics Inc.
Pelham Manor, New Jersey

72619
Dialight Div.
Amperex Electronic Corp.
Brooklyn, New York

72653
G.C. Electronics
Div. of Hydrometals, Inc.
Brooklyn, New York

72665
Replaced by 90303

72794
Dzus Fastener Co., Inc.
West Islip, New York

72928
Gulton Ind. Inc.
Gudeman Div.
Chicago, Illinois

72982
Erie Tech. Products Inc.
Erie, Pennsylvania

73138
Beckman Instruments Inc.
Helipot Division
Fullerton, California

73293
Hughes Aircraft Co.
Electron Dynamics Div.
Torrence, California

73445
Amperex Electronic Corp.
Hicksville, LI, New York

73559
Carling Electric Inc.
West Hartford, Connecticut

73586
Circle F Industries
Trenton, New Jersey

73734
Federal Screw Products, Inc.
Chicago, Illinois

73743
Fischer Special Mfg. Co.
Cincinnati, Ohio

73899
JFD Electronics Co.
Components Corp
Brooklyn, New York

73949
Guardian Electric Mfg. Co.
Chicago, Illinois

74199
Quan Nichols Co.
Chicago, Illinois

74217
Radio Switch Corp.
Marlboro, New Jersey

74276
Signalite Div.
General Instrument Corp.
Neptune, New Jersey

74306
Piezo Crystal Co.
Carlisle, Pennsylvania

74542
Hoyt Elect. Instr. Works
Penacook, New Hampshire

74970
Johnson E.F., Co.
Waseca, Minnesota

75042
TRW Electronics Components
IRC Fixed Resistors
Philadelphia, Pennsylvania

75376
Kurz-Kasch Inc.
Dayton, Ohio

75378
CTS Knights Inc.
Sandwich, Illinois

75382
Kulka Electric Corp.
Mount Vernon, New York

75915
Littlefuse Inc.
Des Plaines, Illinois

76854
Oak Industries Inc.
Switch Div.
Crystal Lake, Illinois

77342
AMF Inc.
Potter & Brumfield Div.
Princeton, Indiana

77638
General Instrument Corp.
Rectifier Division
Brooklyn, New York

77969
Rubbercraft Corp. of CA. LTD.
Torrance, California

78189
Shakeproof
Div. of Illinois Tool Works Inc.
Elgin, Illinois

78277
Sigma Instruments, Inc.
South Braintree, Massachusetts

78488
Stackpole Carbon Co.
Saint Marys, Pennsylvania

78553
Eaton Corp. Engineered
Fastener Div.
Tinnerman Plant
Cleveland, Ohio

79136
Waldes Kohinoor Inc.
Long Island City, New York

79497
Western Rubber Company
Goshen, Indiana

79963
Zierick Mfg. Corp.
Mt. Kisko, New York

80031
Electro-Midland Corp., Mepco Div.
A North American Phillips Co.
Morristown, New Jersey

80145
LFE Corp., Process Control Div.
formerly API Instrument Co.
Chesterland, Ohio

80183 - use 56289
Sprague Products
North Adams, Massachusetts

80294
Bourns Inc., Instrument Div.
Riverside, California

80583
Hammarlund Mfg. Co., Inc.
Red Bank, New Jersey

80640
Stevens, Arnold Inc.
South Boston, Massachusetts

81073
Grayhill, Inc.
La Grange, Illinois

81312
Winchester Electronics
Div. of Litton Industries Inc.
Oakville, Connecticut

81439
Therm-O-Disc Inc.
Mansfield, Ohio

81483
International Rectifier Corp.
Los Angeles, California

81590
Korry Mfg. Co.
Seattle, Washington

81741
Chicago Lock Co.
Chicago, Illinois

82305
Palmer Electronics Corp.
South Gate, California

82389
Switchcraft Inc.
Chicago, Illinois

Federal Supply Codes for Manufacturers (Concluded)

82415
North American Phillips
Controls Corp.
Frederick, Maryland

82872
Roanwell Corp.
New York, New York

82877
Rotron Inc.
Woodstock, New York

82879
ITT Royal Electric Div.
Pawtucket, Rhode Island

83003
Varo Inc.
Garland, Texas

83058
Carr Co., The United Can Div.
of TRW
Cambridge, Massachusetts

83298
Bendix Corp.
Electric Power Division
Eatontown, New Jersey

83330
Smith, Herman H., Inc.
Brooklyn, New York

83478
Rubbercraft Corp. of America, Inc.
West Haven, Connecticut

83594
Burroughs Corp.
Electronic Components Div.
Plainfield, New Jersey

83740
Union Carbide Corp.
Battery Products Div.
formerly Consumer Products Div.
New York, New York

84171
Arco Electronics
Great Neck, New York

84411
TRW Electronic Components
TRW Capacitors
Ogallala, Nebraska

84613
Fuse Indicator Corp.
Rockville, Maryland

84682
Essex International Inc.
Industrial Wire Div.
Peabody, Massachusetts

86577
Precision Metal Products,
of Malden Inc.
Stoneham, Massachusetts

86684
Radio Corp. of America
Electronic Components Div.
Harrison, New Jersey

86928
Seastrom Mfg. Co., Inc.
Glendale, California

87034
Illuminated Products Inc.
Subsidiary of Oak Industries Inc.
Anahiem, California

88219
Gould Inc.
Industrial Div.
Trenton, New Jersey

88245
Litton Systems Inc.
Useco Div.
Van Nuys, California

88419
Cornell-Dubilier Electronic Div.
Federal Pacific Co.
Fuquay-Varian, North Carolina

88486
Plastic Wire & Cable
Jewitt City, Connecticut

88690
Replaced by 04217

89536
Fluke, John Mfg. Co., Inc.
Seattle, Washington

89730
G.E. Co., Newark Lamp Works
Newark, New Jersey

90201
Mallory Capacitor Co. Div of
P.R. Mallory Co., Inc.
Indianapolis, Indiana

90211 - use 56365
Square D Co.
Chicago, Illinois

90215
Best Stamp & Mfg. Co.
Kansas City, Missouri

90303
Mallory Battery Co.
Div. of Mallory Co., Inc.
Tarrytown, New York

91094
Essex International Inc.
Suglex/IWP Div.
Newmarket, New Hampshire

91293
Johanson Mfg. Co.
Boonton, New Jersey

91407
Replaced by 58474

91502
Associated Machine
Santa Clara, California

91506
Augat Inc.
Attleboro, Massachusetts

91637
Dale Electronics Inc.
Columbus, Nebraska

91662
Elco Corp.
Willow Grove, Pennsylvania

91737 - use 71468
Gremar Mfg. Co., Inc.
ITT Cannon/Gremar
Santa Ana, California

91802
Industrial Devices, Inc.
Edgewater, New Jersey

91833
Keystone Electronics Corp.
New York, New York

91836
King's Electronics Co., Inc.
Tuckahoe, New York

91929
Honeywell Inc.
Micro Switch Div.
Freeport, Illinois

91934
Miller Electric Co., Inc.
Div of Aunet
Woonsocket, Rhode Island

92194
Alpha Wire Corp.
Elizabeth, New Jersey

93332
Sylvania Electric Products
Semiconductor Products Div.
Woburn, Massachusetts

94145
Replaced by 49956

94154 - use 94988
Wagner Electric Corp.
Tung-Sol Div.
Newark, New Jersey

94222
Southco Inc. formerly
South Chester Corp.
Lester, Pennsylvania

95146
Alco Electronic Products Inc.
Lawrence, Massachusetts

95263
Leecraft Mfg. Co.
Long Island City, New York

95264
Replaced by 98278

95275
Vitramon Inc.
Bridgeport, Connecticut

95303
RCA Corp.
Receiving Tube Div.
Cincinnati, Ohio

95348
Gordo's Corp.
Bloomfield, New Jersey

95354
Methode Mfg. Corp.
Rolling Meadows, Illinois

95712
Bendix Corp.
Electrical Components Div.
Microwave Devices Plant
Franklin, Indiana

95987
Weckesser Co. Inc.
Chicago, Illinois

96733
San Fernando Electric Mfg. Co.
San Fernando, California

96853
Gulton Industries Inc.
Measurement and Controls Div.
formerly Rustrak Instruments Co.
Manchester, New Hampshire

96881
Thomson Industries, Inc.
Manhasset, New York

97540
Master Mobile Mounts
Div. of Whitehall Electronics Corp.
Ft. Meyers, Florida

97913
Industrial Electronic Hdware Corp.
New York, New York

97945
Penwalt Corp.
SS White Industrial Products Div.
Piscataway, New Jersey

97966
Replaced by 11358

98094
Replaced by 49956

98159
Rubber-Teck, Inc.
Gardena, California

98278
Malco A Microdot Co., Inc.
Connector & Cable Div.
Pasadena, California

98291
Sealectro Corp.
Mamaroneck, New York

98388
Royal Industries
Products Div.
San Diego, California

98743
Replaced by 12749

98925
Replaced by 14433

99120
Plastic Capacitors, Inc.
Chicago, Illinois

99217
Bell Industries Elect. Comp. Div.
formerly Southern Elect. Div.
Burbank, California

99392
STM
Oakland, California

99515
ITT Jennings Monrovia Plant
Div. of ITT Jennings formerly
Marshall Industries Capacitor Div.
Monrovia, California

99779 - use 29587
Bunker-Ramo Corp.
Barnes Div.
Landsdowne, Pennsylvania

99800
American Precision Industries Inc.
Delevan Division
East Aurora, New York

99942
Centrelab Semiconductor
Centrelab Electronics Div. of
Globe-Union Inc.
El Monte, California

Toyo Electronics
(R-Ohm Corp.)
Irvine, California

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Minneapolis, Minnesota

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Elmeasco Instruments Pty. Ltd.
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Australia
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Dacca-12, Bangladesh
Tel. 303104

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Coasin Bolivia S.R.L.
Casilla 7295
La Paz, Bolivia
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Grupo 1309
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Tel. 365344

*Hinditron Services Pvt. Ltd.
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Midori-ku
Yokohama 226, Japan
Tel. (045) 473-5425
Tlx: 3823-666 FLUKJP J

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Nairobi, Kenya
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Tel. 331955

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Appendix 7A
Manual Change Information

INTRODUCTION

This appendix contains information necessary to backdate the manual to conform with earlier pcb configurations. To identify the configuration of the pcb's used in your instrument, refer to the revision letter (marked in ink) on the component side of each pcb assembly. Table 7A-1 defines the assembly revision levels documented in this manual.

NEWER INSTRUMENTS

As changes and improvements are made to the instrument, they are identified by incrementing the revision letter marked on the affected pcb assembly. These changes are documented on a supplemental change/errata sheet which, when applicable, is inserted at the front of the manual.

OLDER INSTRUMENTS

To backdate this manual to conform with earlier assembly revision levels, perform the changes indicated in Table 7A-1.

CHANGES

There are no backdating changes at this printing. All pcb assemblies are documented at their original revision level.

Table 7A-1. Manual Status and Backdating Information

Ref Or Option No.	Assembly Name	Fluke Part No.	* To adapt manual to earlier rev configurations perform changes in desending order (by no.), ending with change under desired rev letter																			
			–	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Y						
A1A1	Main PCB Assembly	396200	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	X						
A1A3	Input PCB Assembly	396234	●	●	●	●	●	●	●	●	X													
A3	Display PCB Assembly	396218	●	●	●	●	●	●	X															
A4	Switch PCB Assembly	396226	●	X																				
A6	Digital Output Unit PCB Assy	396283	●	●	●	●	X																	
A7	Multiplier PCB Assy #1	467639	X																					

* X = The PCB revision levels documented in this manual.
● = These revision letters were never used in the instrument.
–= No revision letter on the PCB.

Table 7A-1. Manual Status and Backdating Information (cont)

Ref Or Option No.	Assembly Name	Fluke Part No.	* To adapt manual to earlier rev configurations perform changes in desending order (by no.), ending with change under desired rev letter																				
			—	A	B	C	D	E	F	G	H	J	K	L	M	N	P							
A8	Multiplier PCB Assy #2	467803	X																				
A9	520 MHz Prescler PCB Assy	396291	●	●	●	●	●	●	●	●	X												
A10	Remote Control Unit PCB Assy	396627	●	●	●	X																	
A11	Remote Control Unit 1PCB Assy	396242	●	●	●	●	X																
A12	Remote Control Unit 2PCB Assy	396259	●	●	●	●	●	●	●	●	X												
A13	Remote Control Unit3 PCB Assy	396627		●	●	●	●	●	●	X													
A14	1000 MHz Prescaler PCB Assy	396309		●	●	●	●	●	●	●	●	●	●	X									
A15	1250 MHz Prescaler PCB Assy	396309	●	●	●	●	●	●	●	●	●	●	●	X									
A16	Bus Interface PCB Assy	433870	●	●	X																		
A17	Processor PCB Assy	433912	●	●	●	●	●	X															
A18	IEEE-488 Switch PCB Assy	433904	X																				

* X = The PCB revision levels documented in this manual.
● = These revision letters were never used in the instrument.
—= No revision letter on the PCB.

Section 8
Schematic Diagrams

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8-2	A1A1 Main PCB Assembly	8-4
8-3	A3 Display Switch PCB Assembly	8-14
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8-15	A13 Remote Control Unit 3 PCB Assembly, Options -12 and -15	8-38

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SHT 2 A CHANNEL AMPLIER
A INPUT
DC-75MHz 30mv
75-125MHz 50mv
AMP Q5,U2
ECL U4,22 POLARITY SELECTION
LEVEL TRANSLATOR Q11,12,15
SHT 3 TTL U22 POLARITY SELECTION
* XSTR SWITCH
SLOPE A
A+A|B+AxB
ACCUMULATOR INPUT SELECTOR U1, U4
MAIN GATE ÷ BY 2 U6
XA
GATE PULSE
TP 31

C CHANNEL PRESCALER
C INPUT
50-520 MHZ 15mV
(OPTION - 07, 13 OR 14)
C
PA+TI+CH

SHT 2 B CHANNEL AMPLIFIER
B INPUT
DC -25MHZ-30mV
AMP Q1,U1
LEVEL TRANSLATOR Q9, 10
U22 TTL POLARITY SELECTION
SHT 3
SLOPE B
XB

SHT 2 REFERENCE OSCILLATOR AMPLIFIER
EXT CLOCK
10MHZ-100mV (REAR PANEL)
EXT INTO
S91 (REAR PANEL)
AMP Q21,22 U21
U7 TCXO
FOR-10&-20 TIMEBASE SEE SHEET 8
CLOCK OUTPUT (REAR PANEL)
U16
GATE TIME (REAR PANEL)

115/230V 50-400HZ 25W
POWER SUPPLY
SHT 1
+18V U93,Q93,94 REGULATOR OPTION-07
TP 91 +18V 100mA
+12V U96,Q92 REGULATOR
TP 94 +12V 300mA
+5V U91,Q91,92,93 (TRACKING +12V)
TP 95 +5V 2 AMPS
-12V U93,Q95,96 (TRACKING +12V)
TP 92 -12V 100mA

DIGIT 1 SHT 3
U31,32,35 ÷ BY 5
DIGIT 2 SHT 3
U57 74196
COUNTER SELECTION
DIGIT 3 4 5 6 7 8 9 OVERFLOW
2.5MHZ
LS 1 CHIP # 1801 SHT 6
U65 9 DIGIT MEMORY + MULTIPLEXER
RESET
STROBE OSCILLATOR
BLANKING LOGIC
UPDATE
TP 65
STROBE AMPS U73,74 Q73-90 SHT 7
1002 9 DIGIT DISPLAY
U71,72 7 SEGMENT DECODER DRIVERS SHT 7
BL
DP

SHT 6 DECIMAL POINT LOGIC U43,44,45,46,47 54, 55, 56
FUNCTION
RANGE

SHT 3 U23 SELECT GATE 1 CLOCK INPUT ACCUMULATOR SELECTION LOGIC
(CH+PA) 10MHZ
10MHZ / 10^N
(TI)
FUNCTION

SHT 4 SELECT REFERENCE COUNTER OUTPUT U26, 27, 28
RANGE
U17 ÷10 1mS
U18 ÷10 10mS
U19 ÷10 0.1S
U37 ÷10 1S
U36 ÷10 10S
REFERENCE (TIME BASE) COUNTER SHT 4

SHT 4 U24 SELECT GATE 2 REF COUNTER CLOCK INPUT SELECTION LOGIC
(PA) (A/B) (TI) 10MHZ (A+C+CH)
10KHz/2.5KHz OR 1.25KHz
FUNCTION

SHT 4 C GATE TIME FF U25
INHIBIT LINE
TP 15

SHT 3
U11 1MHZ
U12 100KHZ
U15 10KHZ
U13,14 2.5KHz OR 1.25KHz IF C MODE
CLOCK DOWN COUNTER
FUNCTION C

SHT 4 U42 SELECT GATE 3 GATE FUNCTION SELECTION LOGIC
(AxB) MARKER (TI) GATE TIME FF
10 MHz
FUNCTION
(A+C+A/B+PA+CH)

SHT 5 U59 NOT BUSY FF
TP 59
RESET = START MEASUREMENT
CYCLE RATE RESET LOGIC U59,67,69
CONT/TRIG

SHT 5 RESET LOGIC U68 U69 U56
CK
PUSH BUTTON RESET
EXT RESET

SHT 5
COUNTER RESET LOGIC
MEMORY UPDATE LOGIC
SYSTEM READY LOGIC
SYSTEM READY
FUNCTION AXB

SHT 3 U34 TI MARKER GENERATION U44 U16 U34
MARKER (REAR PANEL)
RESET IF NEW MEASURMENT IS PREPARED

MHZ KHZ mS uS S
SHT 6 ANNUNCIATOR LOGIC U52, 62, 63
FUNCTION RANGE

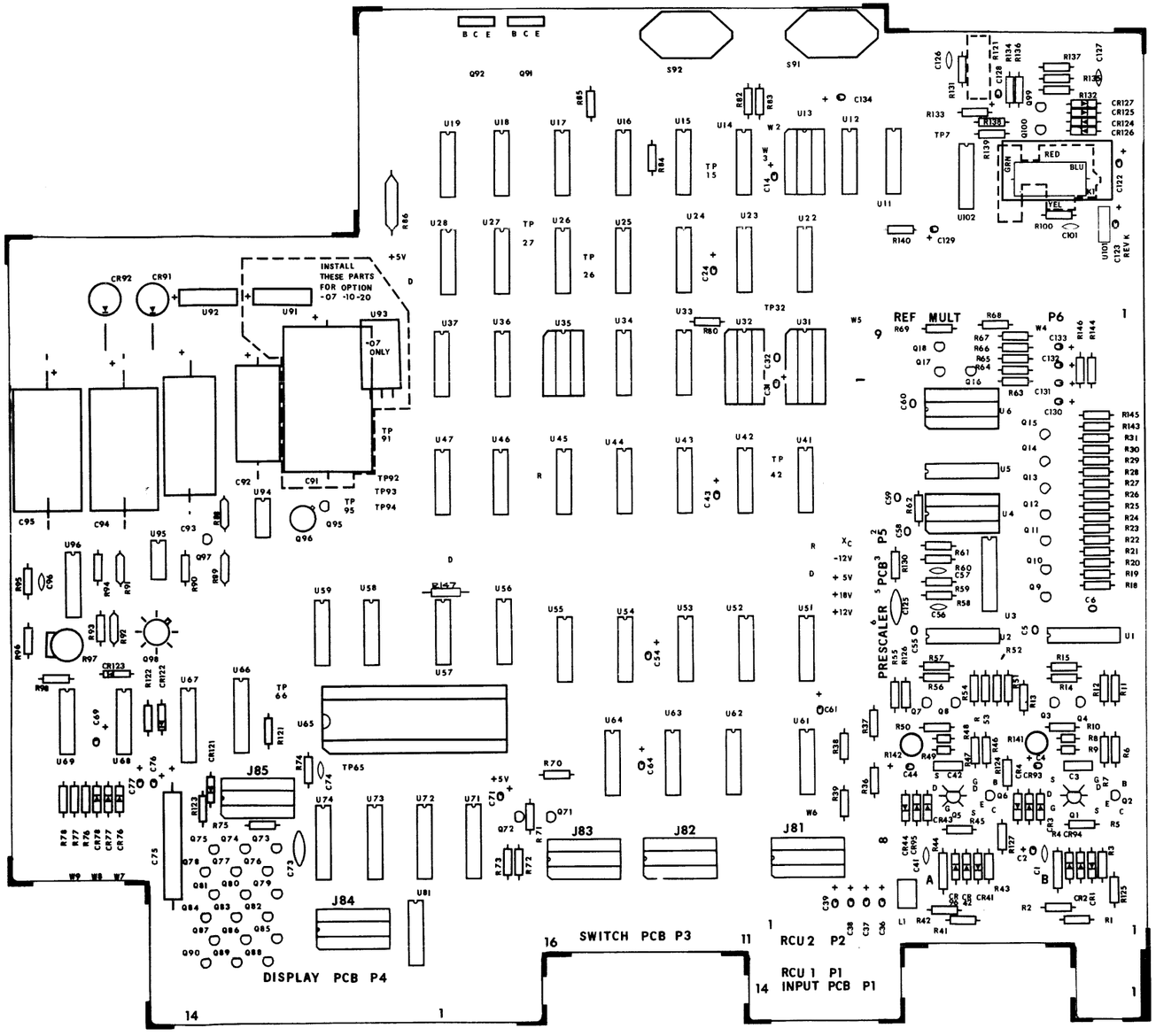
NOTES: FUNCTION INFORMATION LABELS ARE:
A : FREQUENCY A FUNCTION
C : FREQUENCY C FUNCTION
A/B : FREQUENCY RATIO A/B FUNCTION
PA : PERIOD A FUNCTION
TI : TIME INTERVAL A→B FUNCTION
AXB : A GATED BY B FUNCTION
CH : SELF CHECK FUNCTION

RANGE INFORMATION LABELS ARE
1 : 0.1mS — 10^-4 — 0.1 uS RANGE
2 : 1.0mS — 10^-3 — 1.0 uS RANGE
3 : 10mS — 10^-2 — 10 uS RANGE
4 : 0.1 S — 10^-1 — 0.1 mS RANGE
5 : 1.0 S — 10^0 — 1.0 mS RANGE
6 : 10 S — 10^1 — 10 mS RANGE

SIGNAL DESIGNATION
XA : OUTPUT A CHANNEL AFTER POLARITY SELECTION
XB : OUTPUT B CHANNEL AFTER POLARITY SELECTION

1953A-1000

Figure 8-1. 1953A Block Diagram



1953A-1201

Figure 8-2. A1A1 Main PCB Assembly

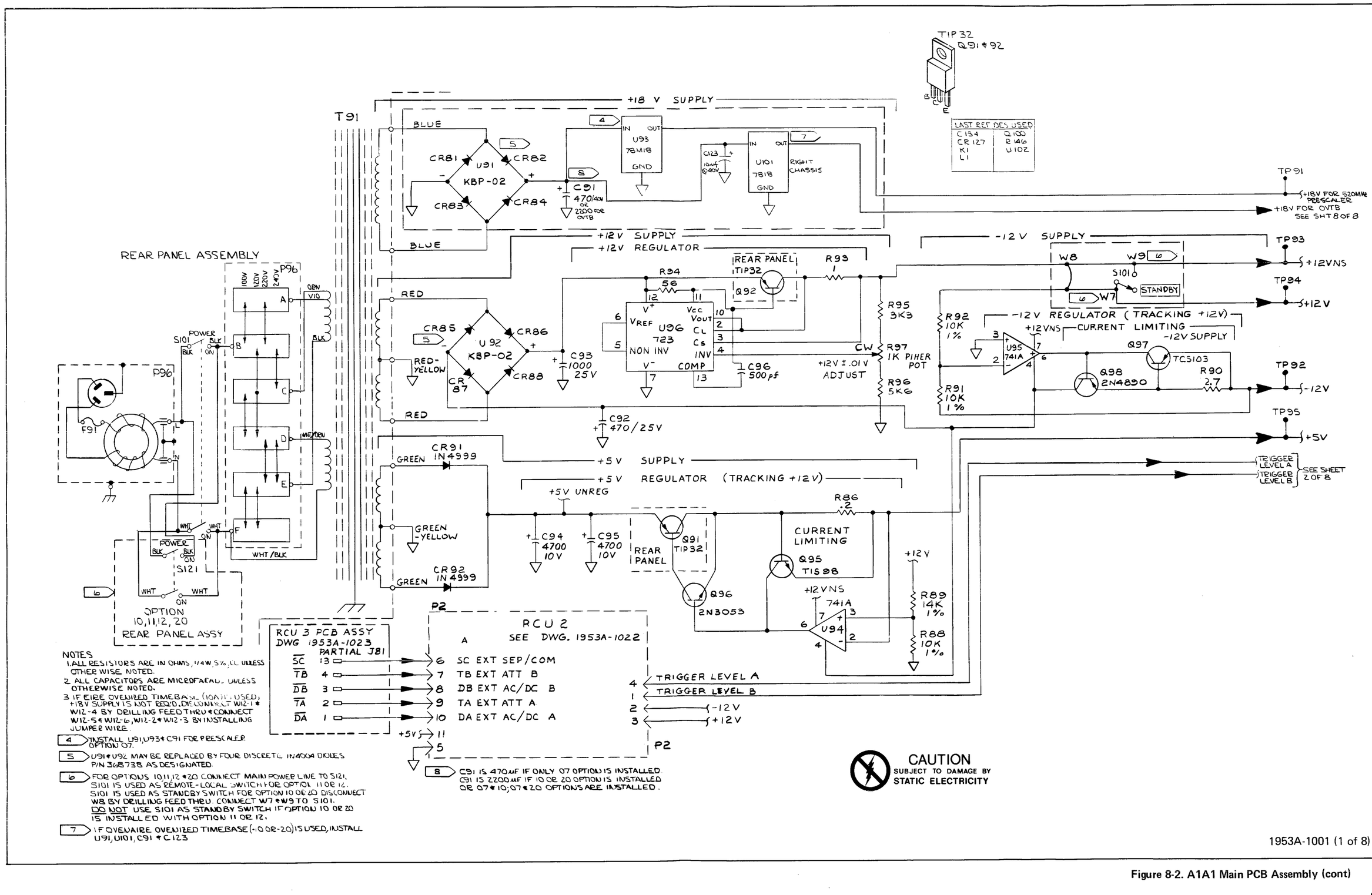
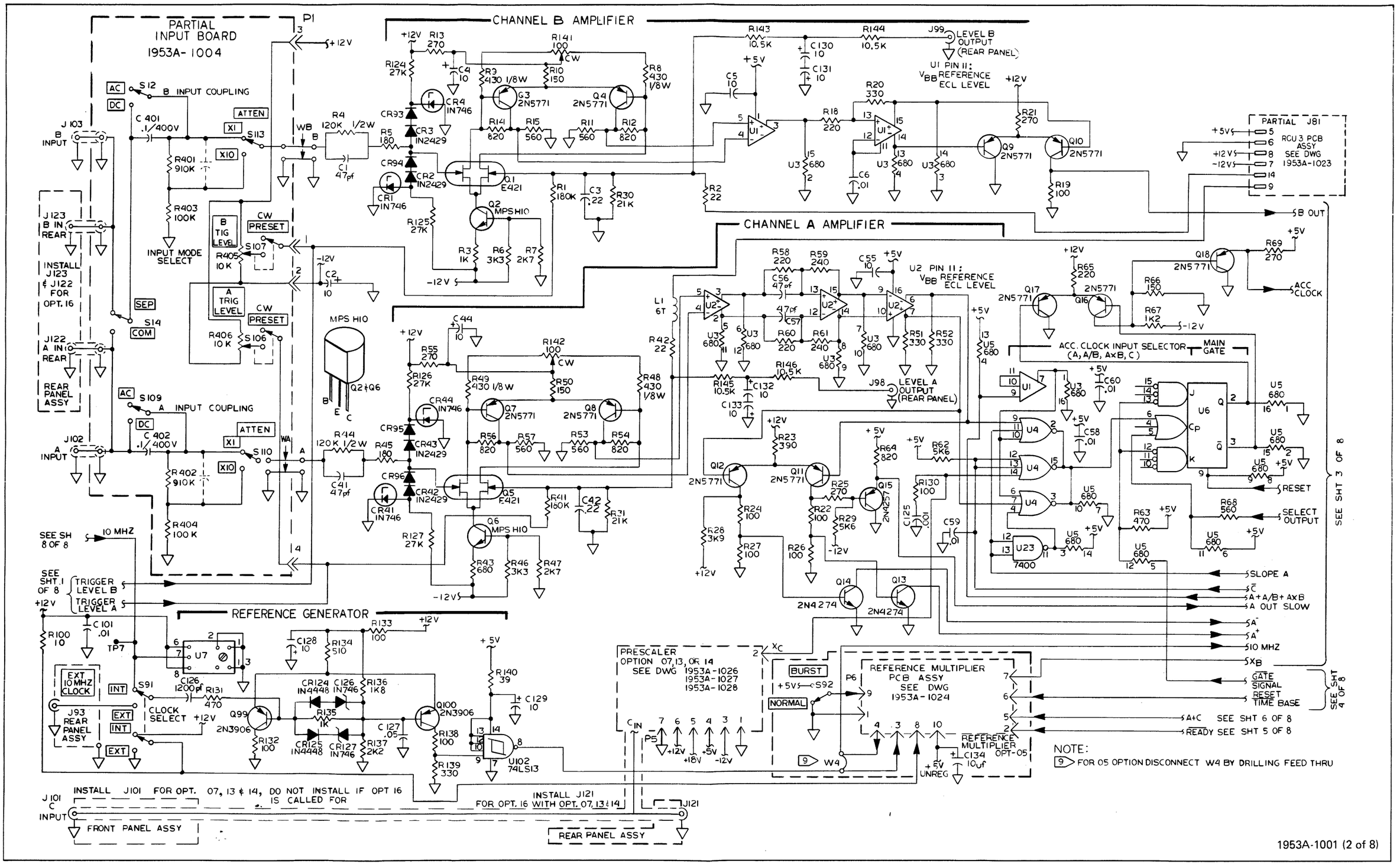


Figure 8-2. A1A1 Main PCB Assembly (cont)



1953A-1001 (2 of 8)

Figure 8-2. A1A1 Main PCB Assembly (cont)

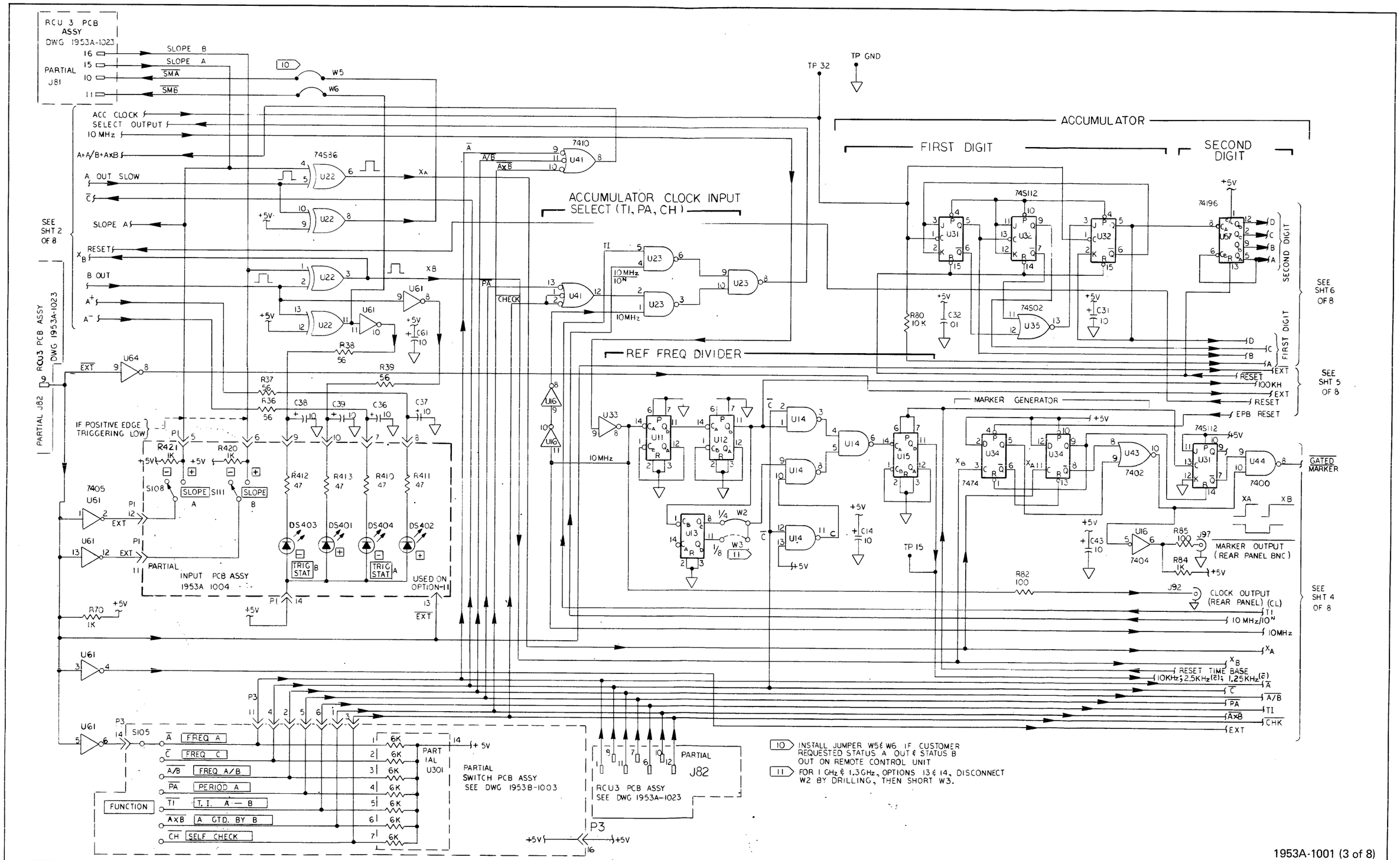
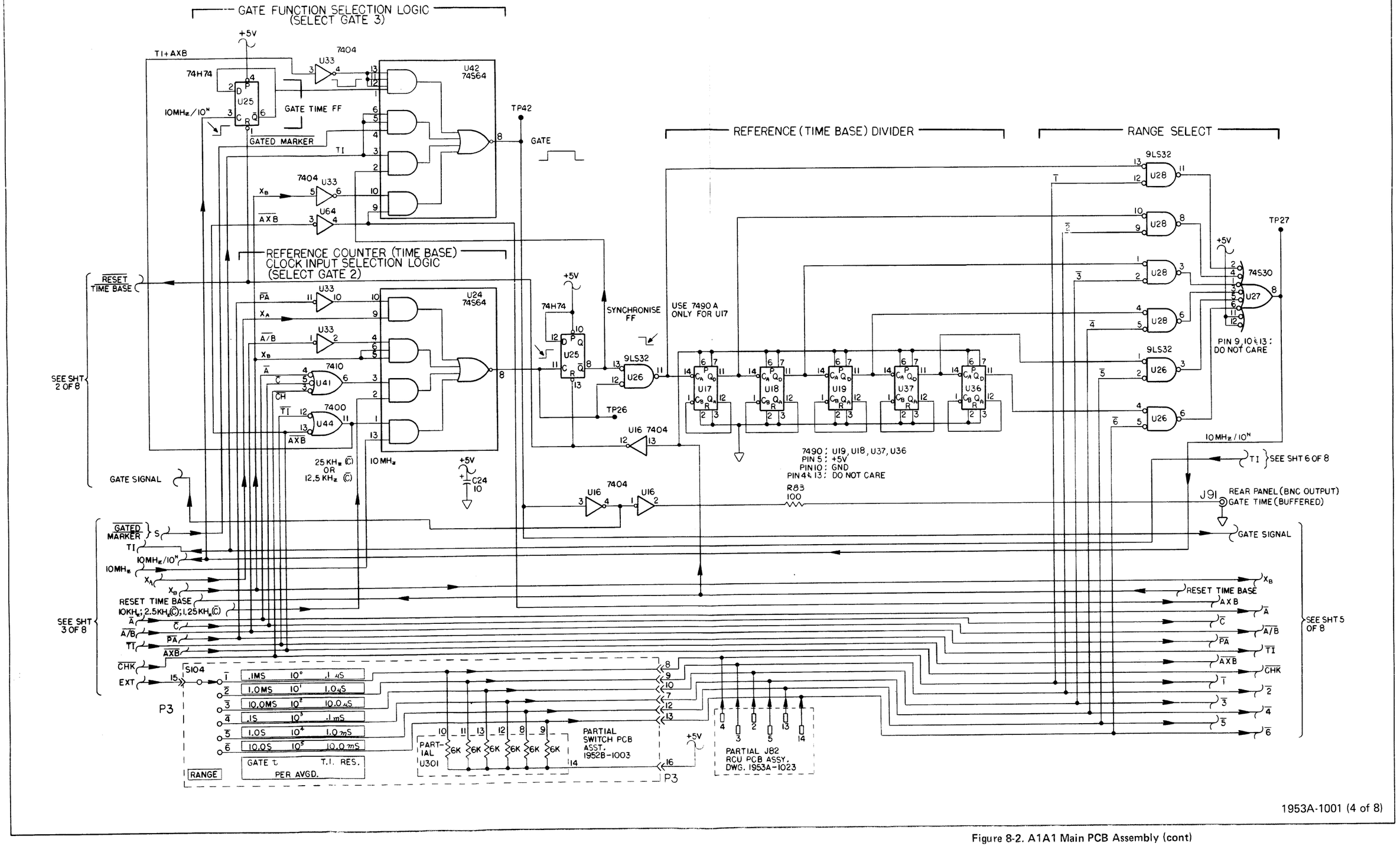
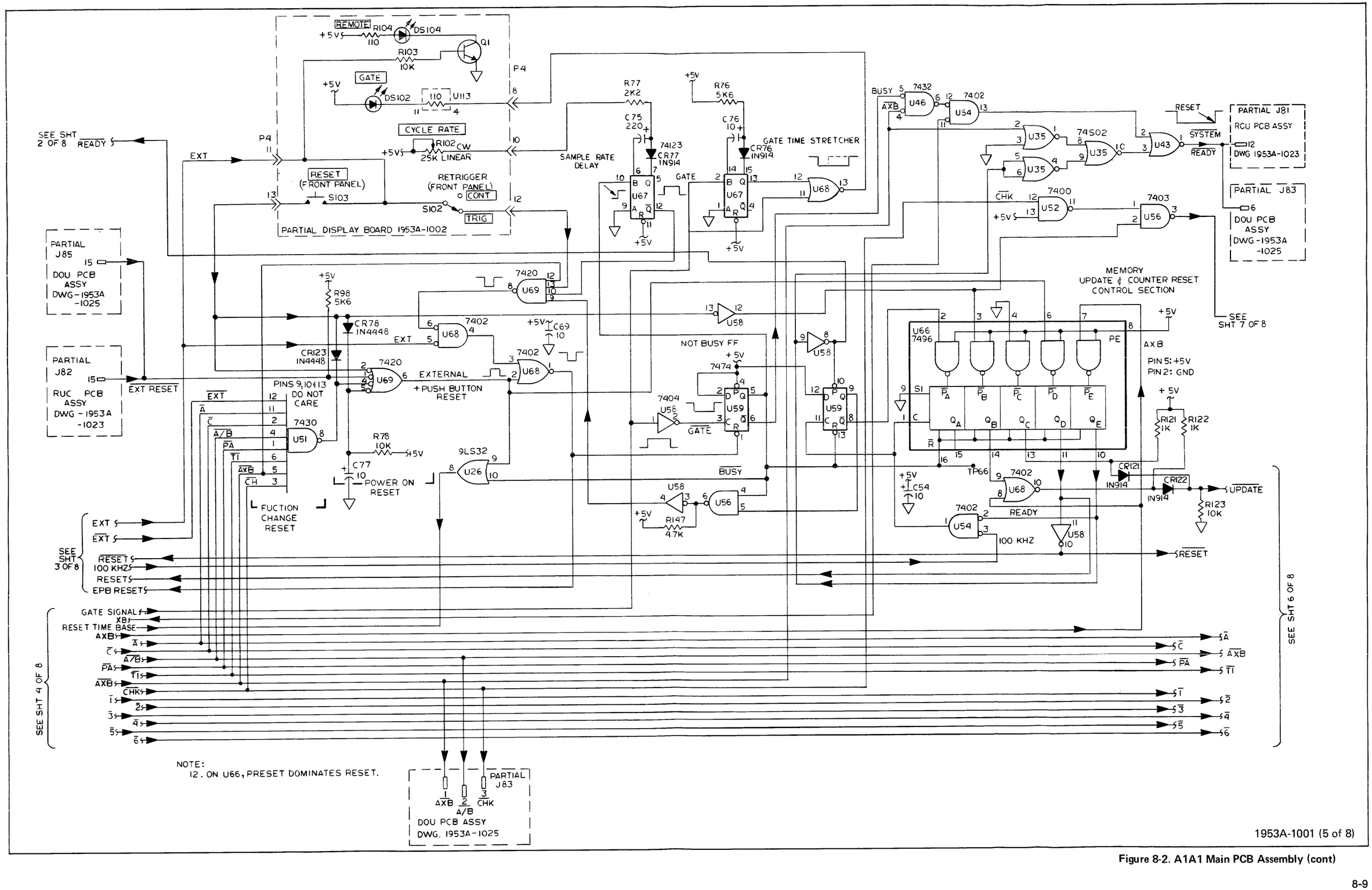


Figure 8-2. A1A1 Main PCB Assembly (cont)



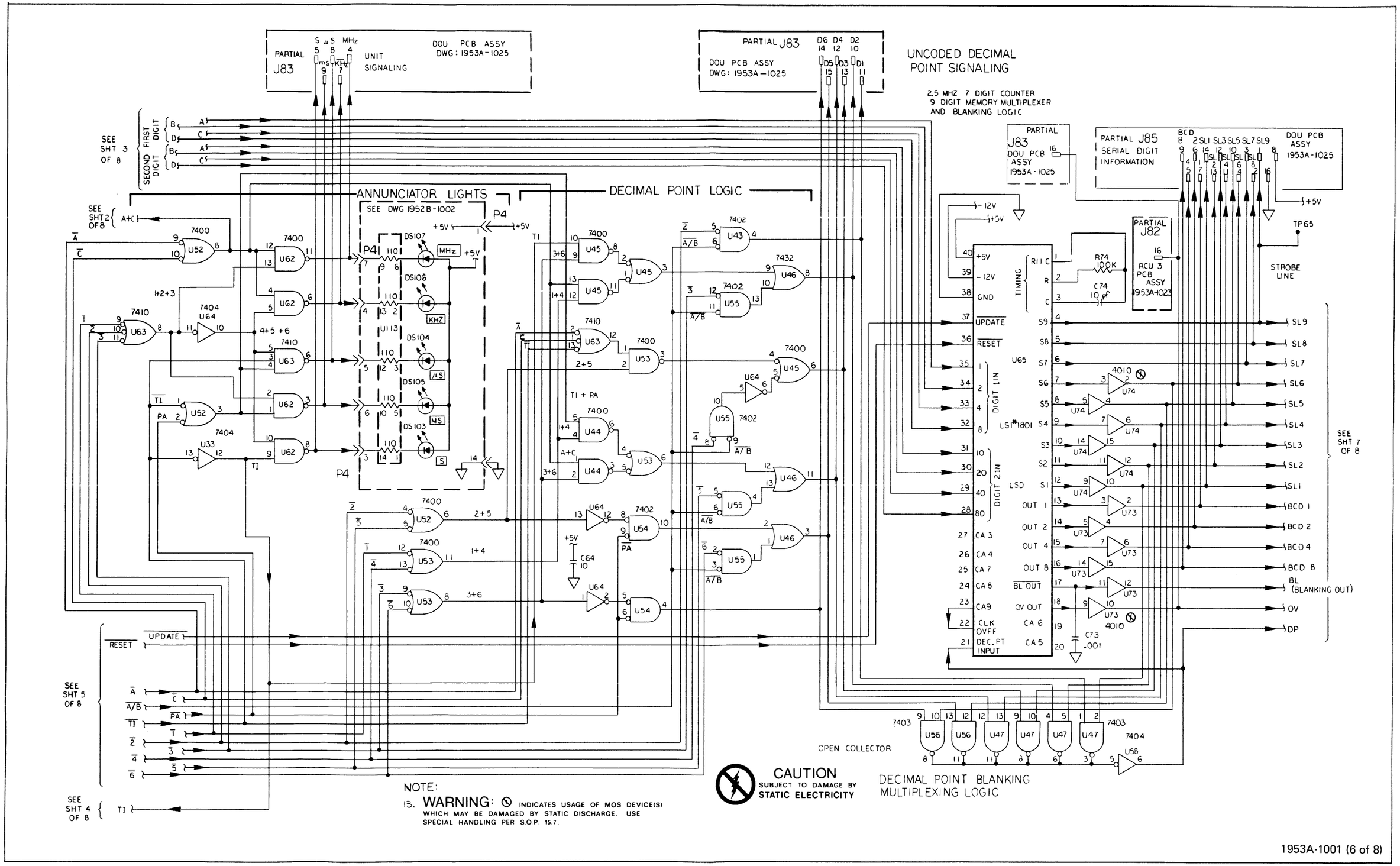
1953A-1001 (4 of 8)

Figure 8-2. A1A1 Main PCB Assembly (cont)



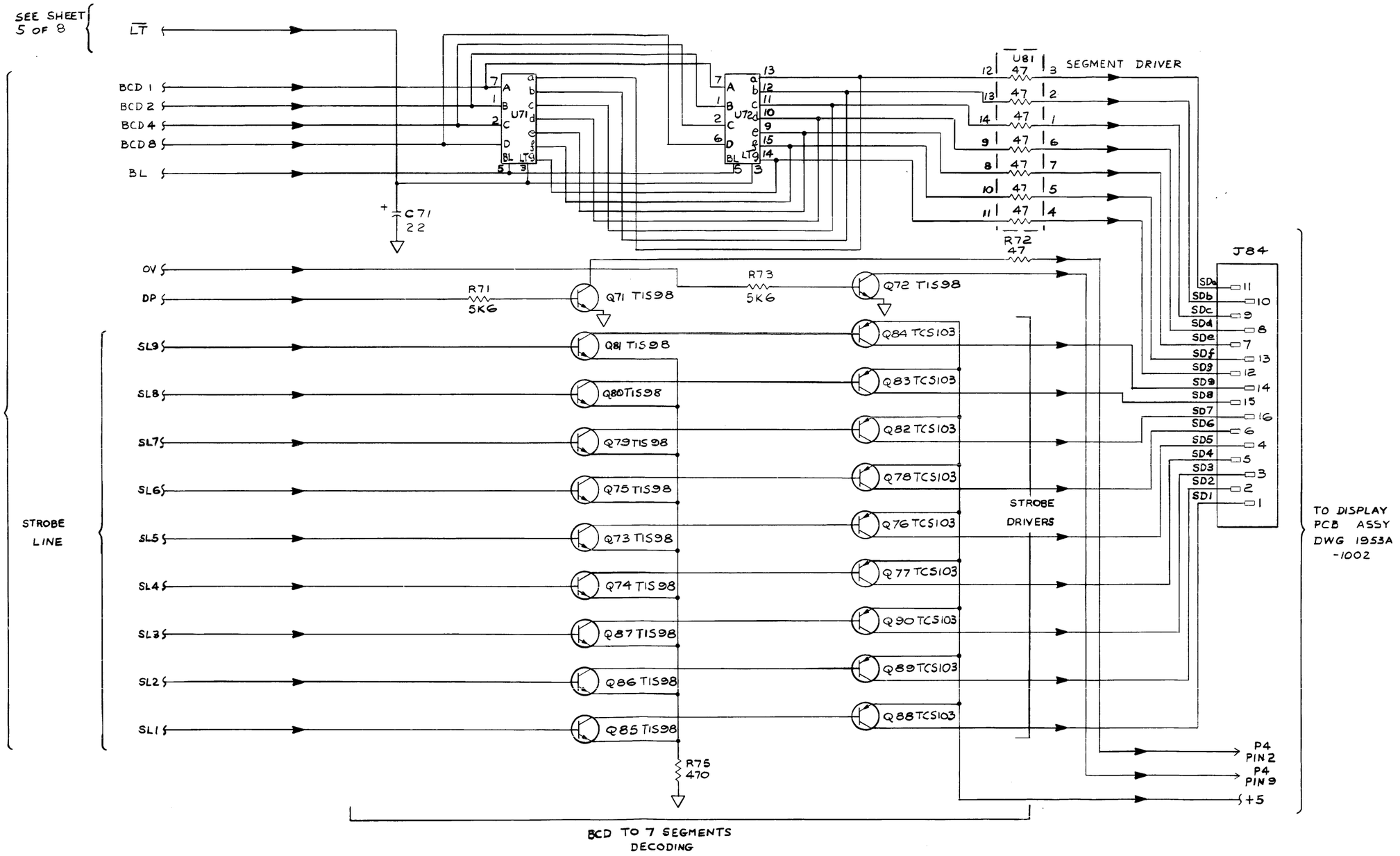
1953A-1001 (5 of 8)

Figure 8-2. A1A1 Main PCB Assembly (cont)



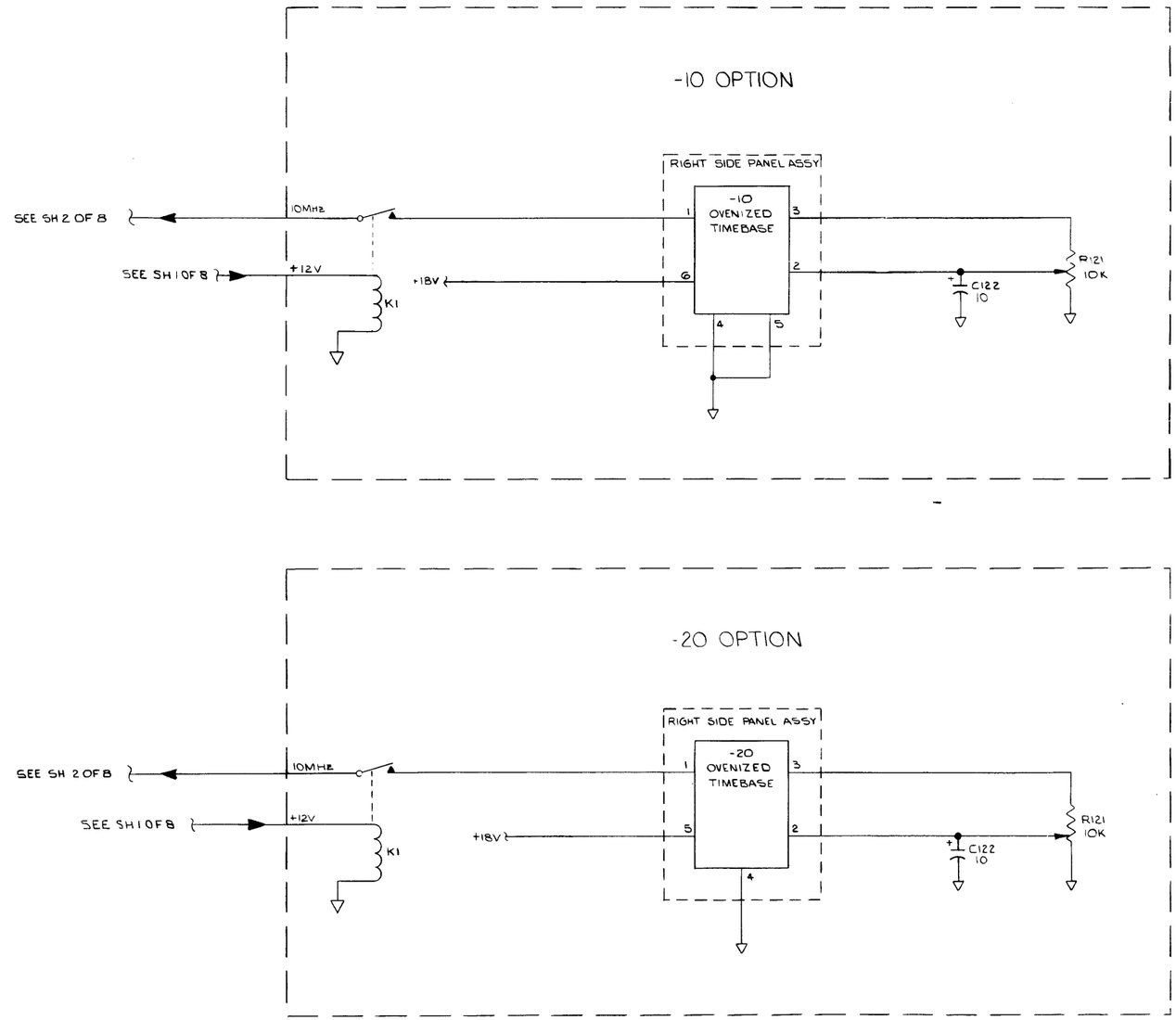
1953A-1001 (6 of 8)

Figure 8-2. A1A1 Main PCB Assembly (cont)



1953A-1001 (7 of 8)

Figure 8-2. A1A1 Main PCB Assembly (cont)

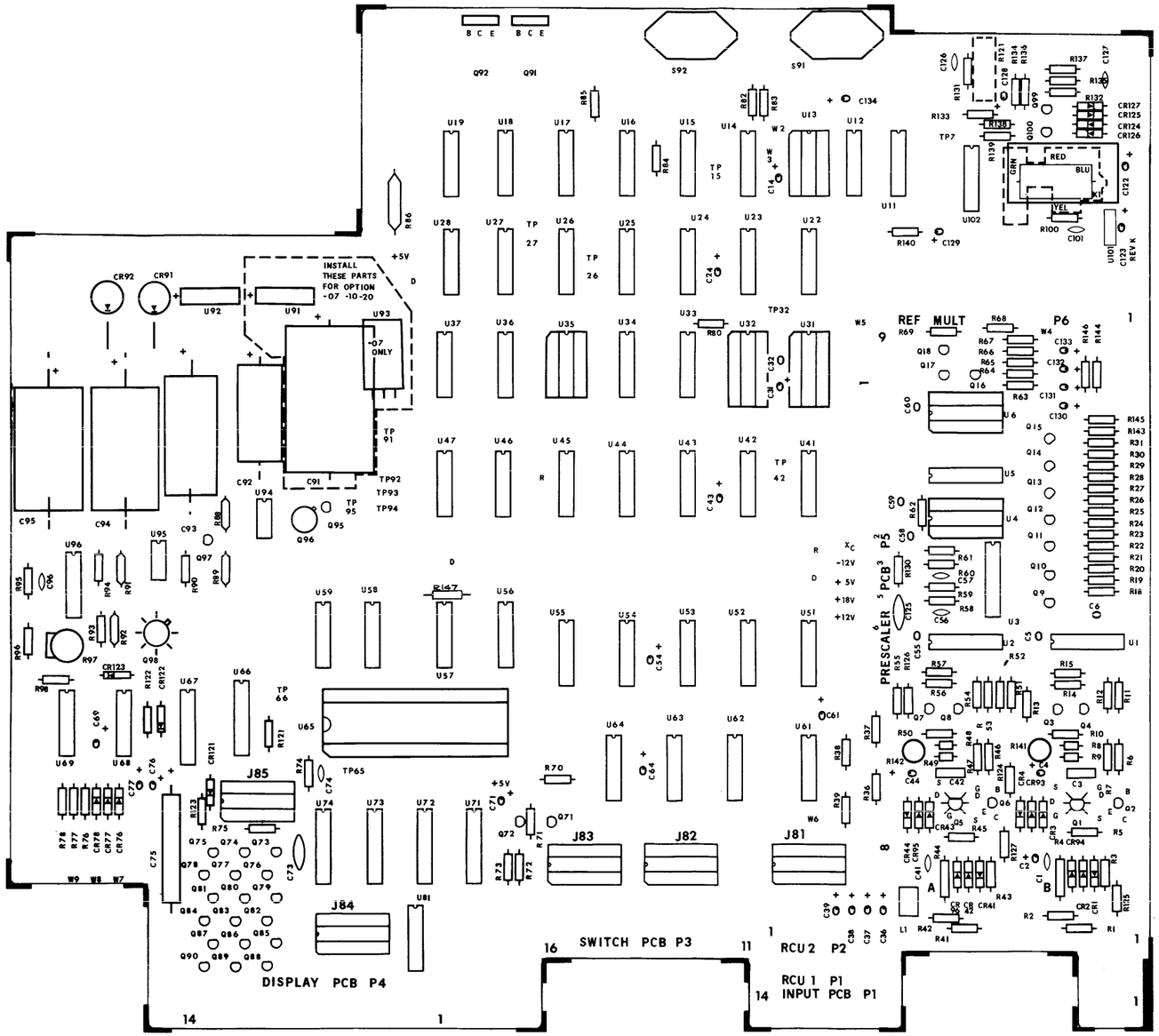


NOTES

1. FOR OPTION 10 OR 20 INSTALL R121 K1 & C122 ON MAIN BOARD

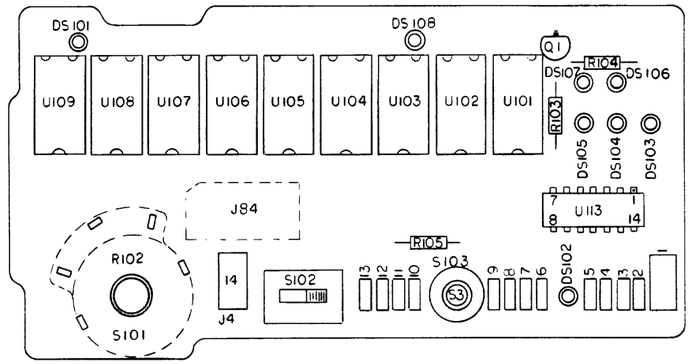
1953A-1001 (8 of 8)

Figure 8-2. A1A1 Main PCB Assembly (cont)



1953A-1201

Figure 8-2. A1A1 Main PCB Assembly (cont)



1953A-1202

Figure 8-3. A3 Display PCB Assembly

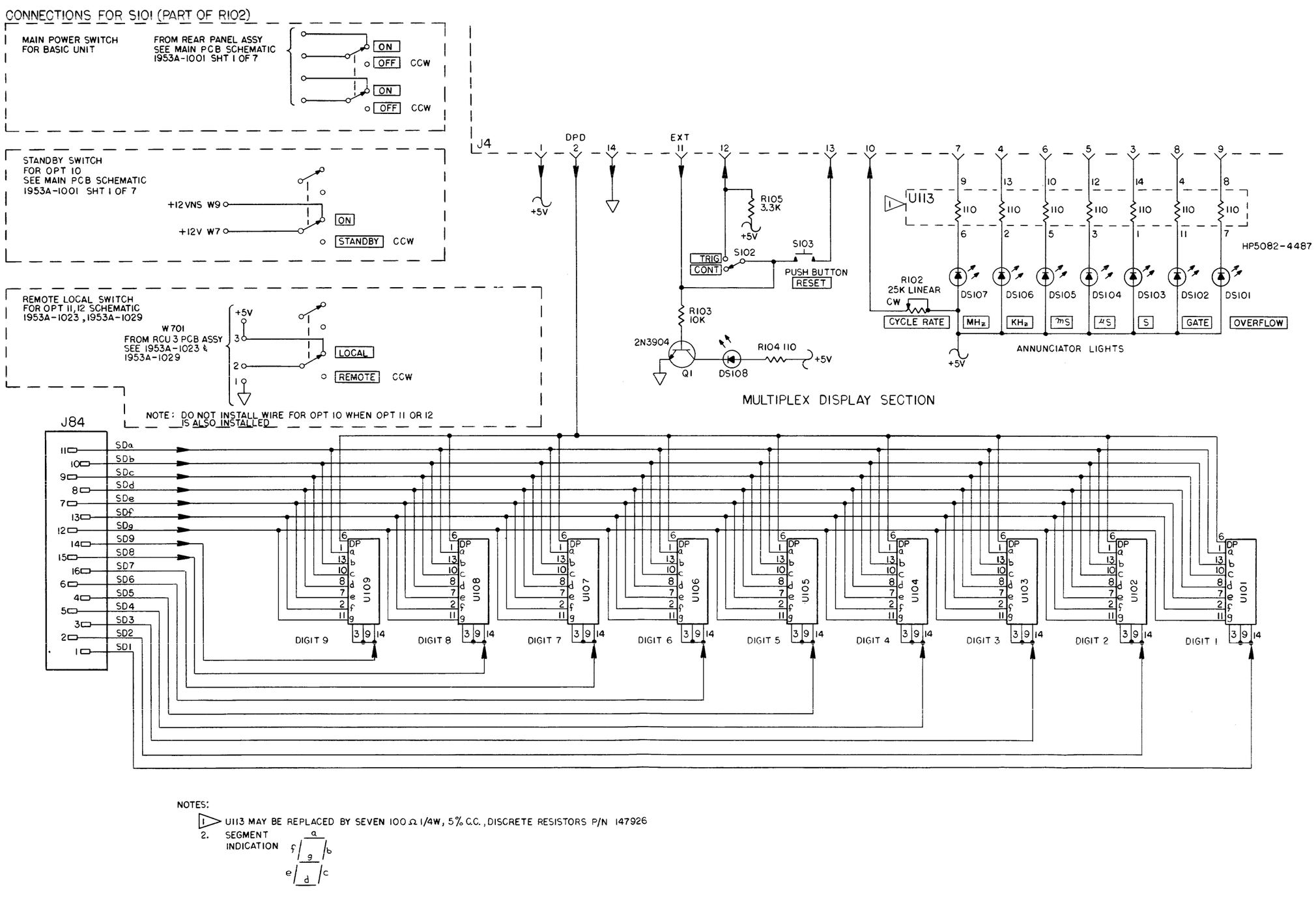
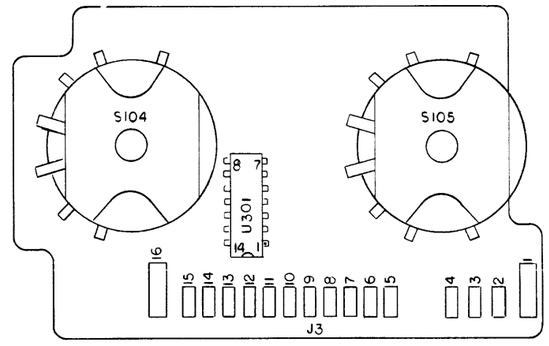


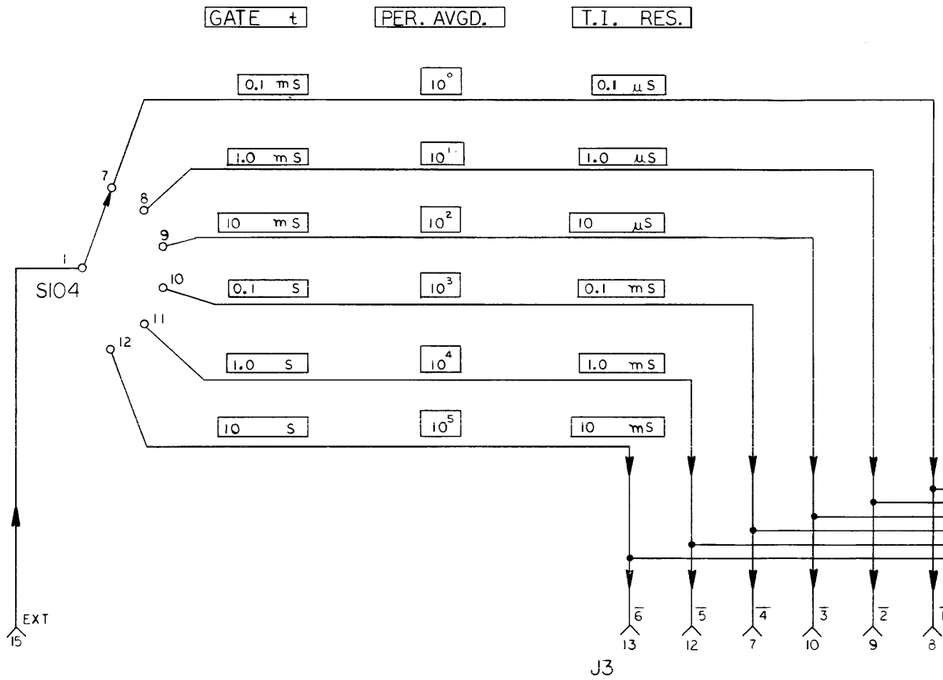
Figure 8-3. A3 Display PCB Assembly (cont)



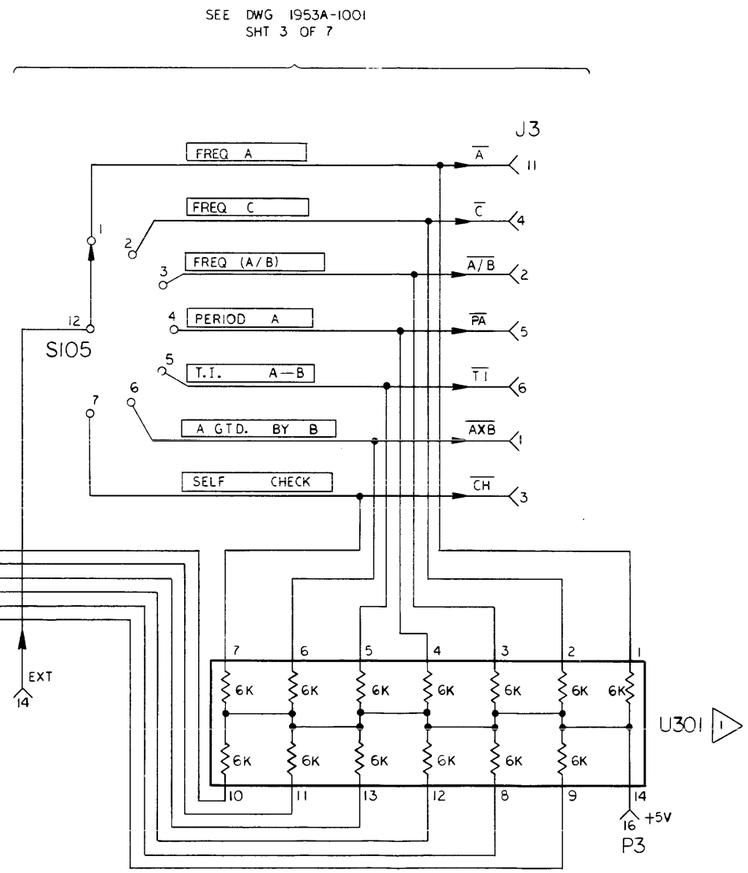
1953A-1203

Figure 8-4. A4 Switch PCB Assembly

RANGE SWITCH



FUNCTION SWITCH

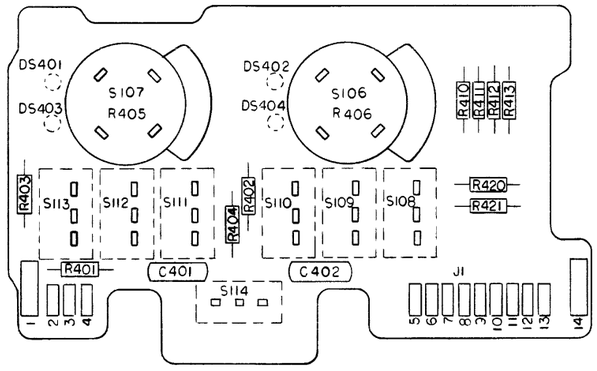


NOTE

1 U301 MAY BE REPLACED BY 13 5K6 DISCRETE RESISTORS

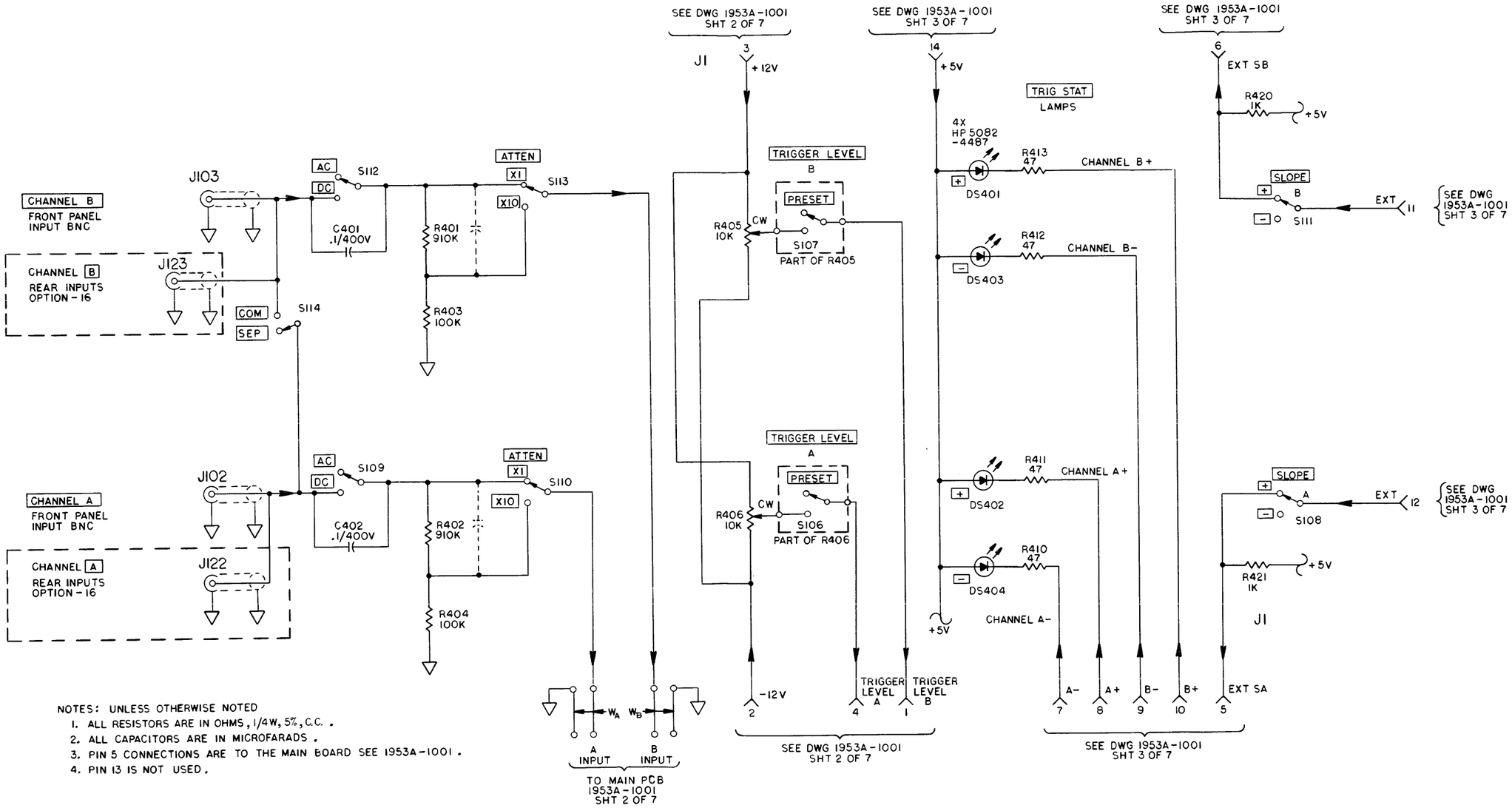
1953A-1003

Figure 8-4. A4 Switch PCB Assembly (cont)



1953A-1204

Figure 8-5. A1A3 Input PCB Assembly

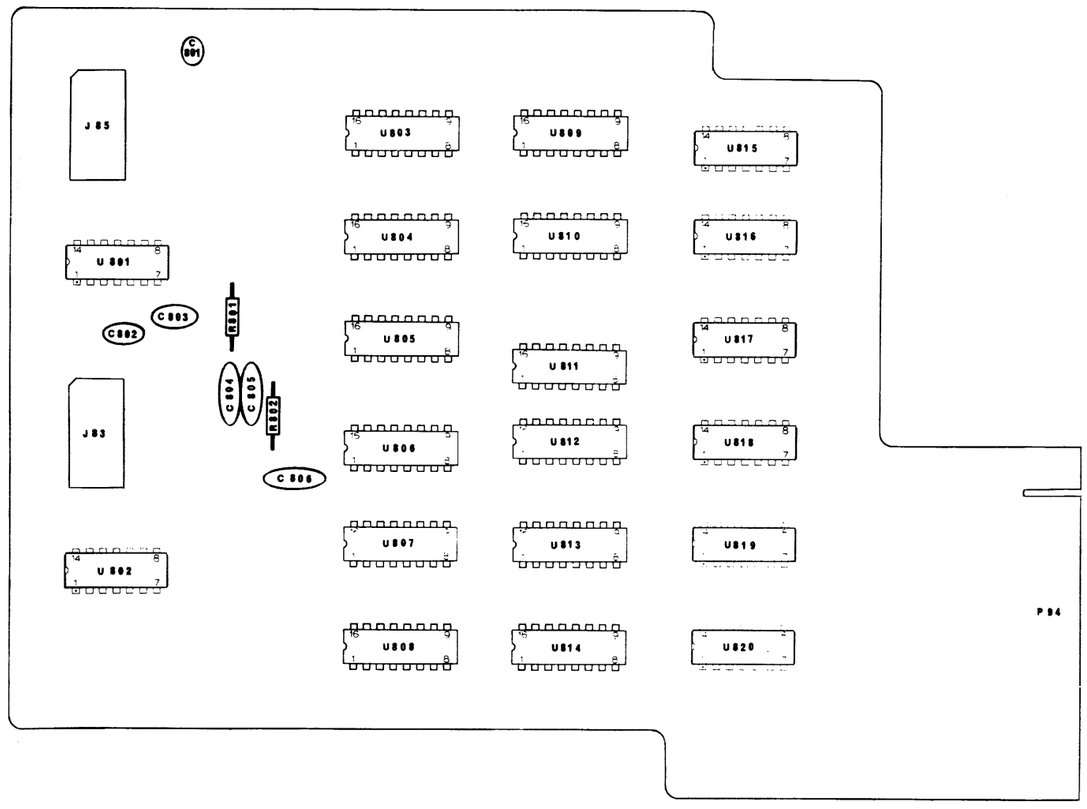


NOTES: UNLESS OTHERWISE NOTED

1. ALL RESISTORS ARE IN OHMS, 1/4W, 5%, C.C. .
2. ALL CAPACITORS ARE IN MICROFARADS .
3. PIN 5 CONNECTIONS ARE TO THE MAIN BOARD SEE 1953A-1001 .
4. PIN 13 IS NOT USED .

1953A-1004

Figure 8-5. A1A3 Input PCB Assembly (cont)



1953A-1225

Figure 8-6. A6 Data Output Unit PCB Assembly , –02 Option

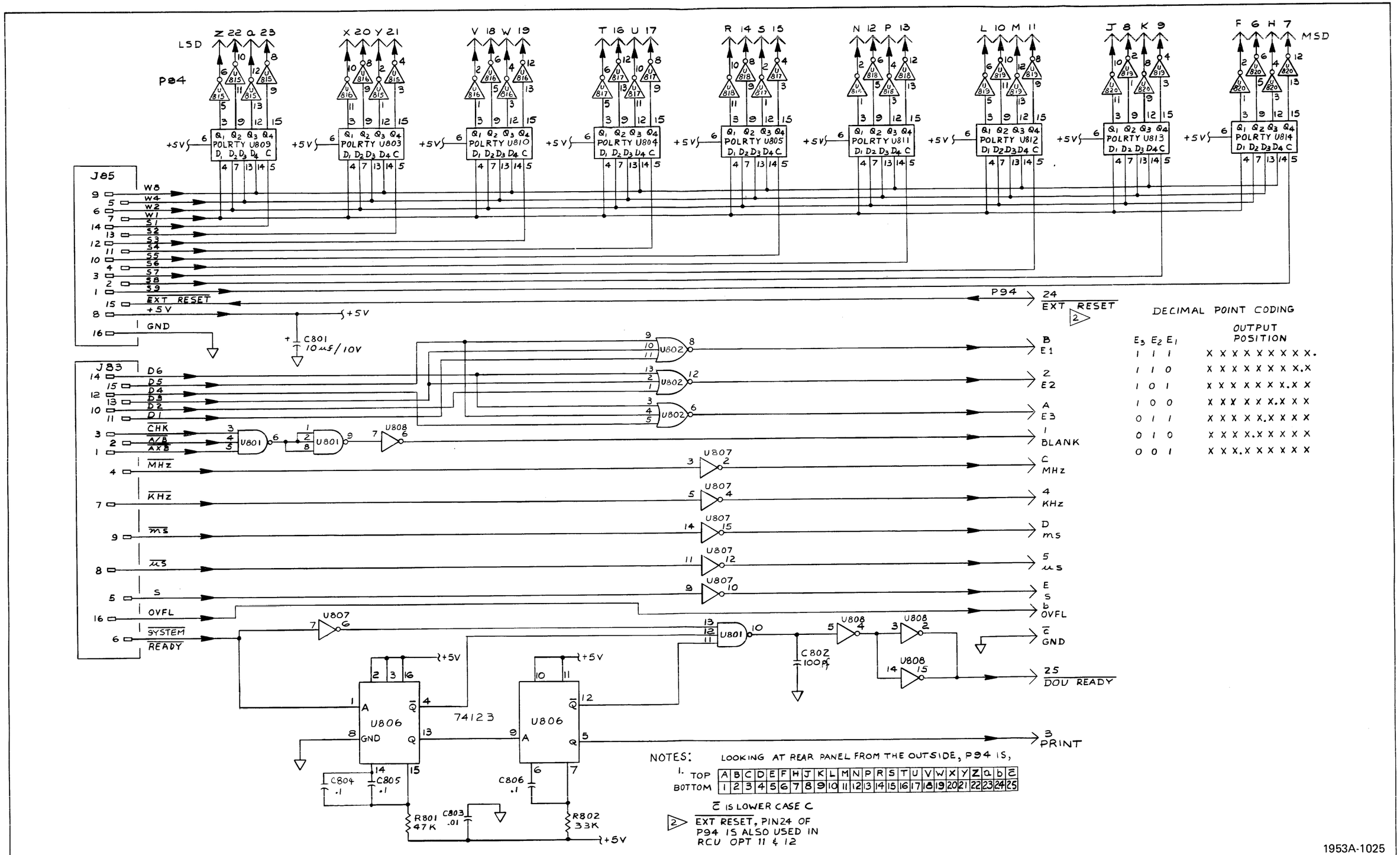
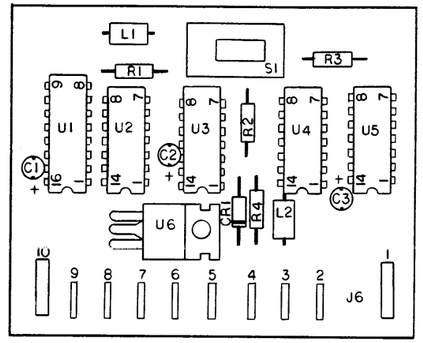
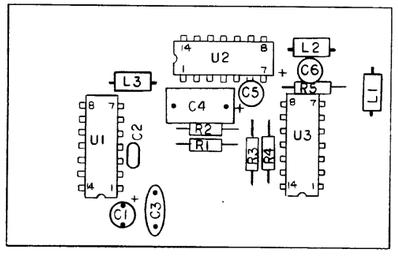


Figure 8-6. Data Output Unit PCB Assembly, -02 Option (cont)

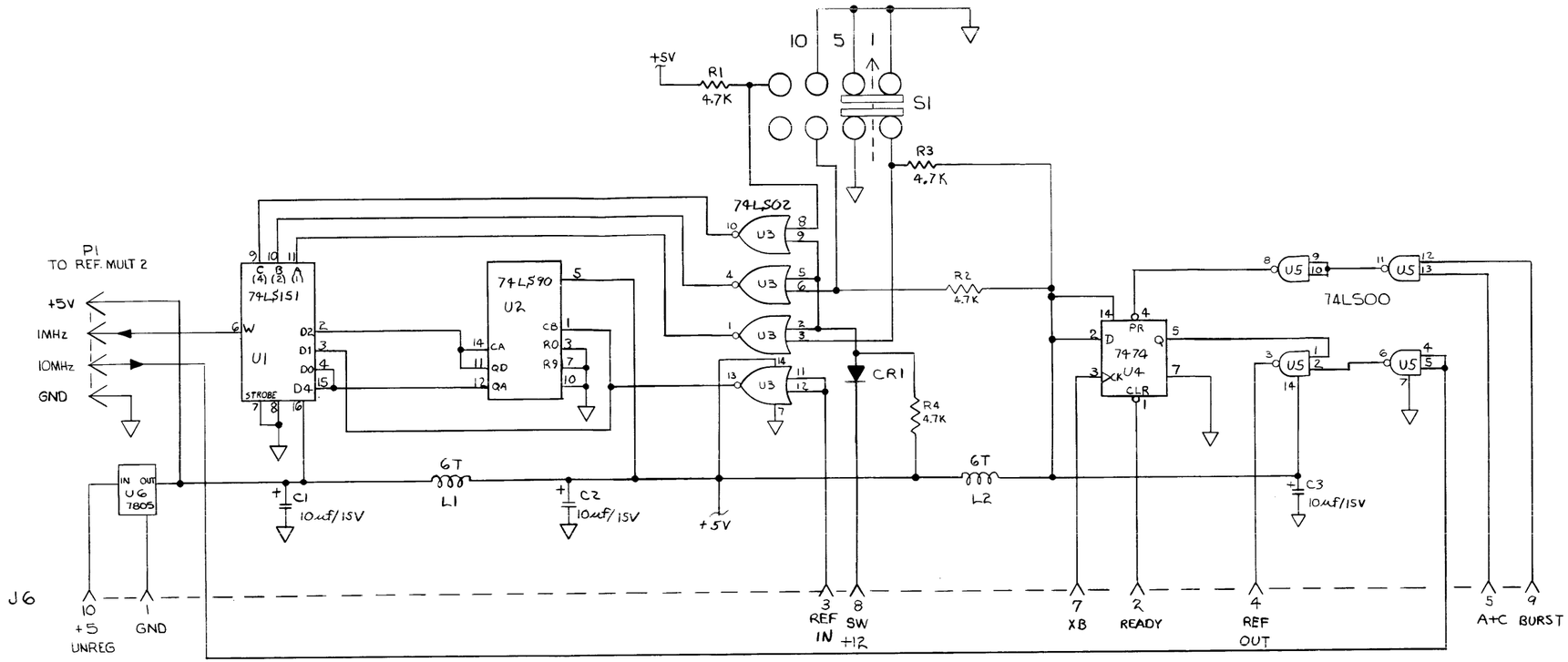


A7 External Time Base Multiplier 1
1953A-1234

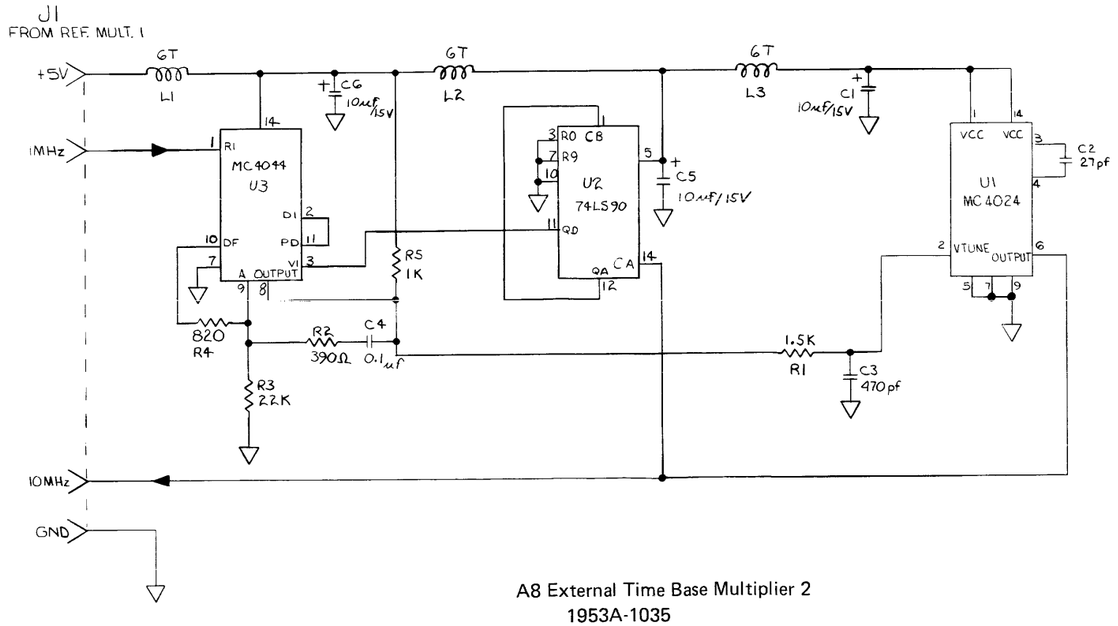


A8 External Time Base Multiplier 2
1953A-1235

Figure 8-7. A7/A8 External Time Base Multiplier PCB Assemblies, –05 Option

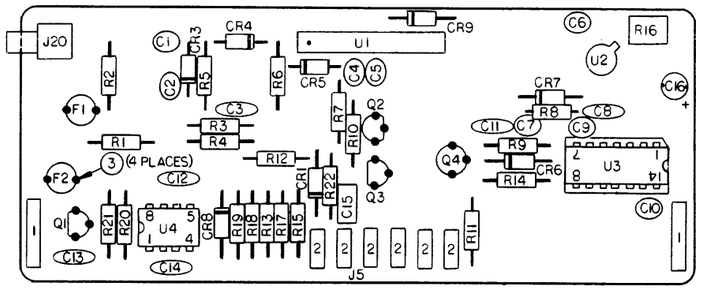


A7 External Time Base Multiplier 1
1953A-1034



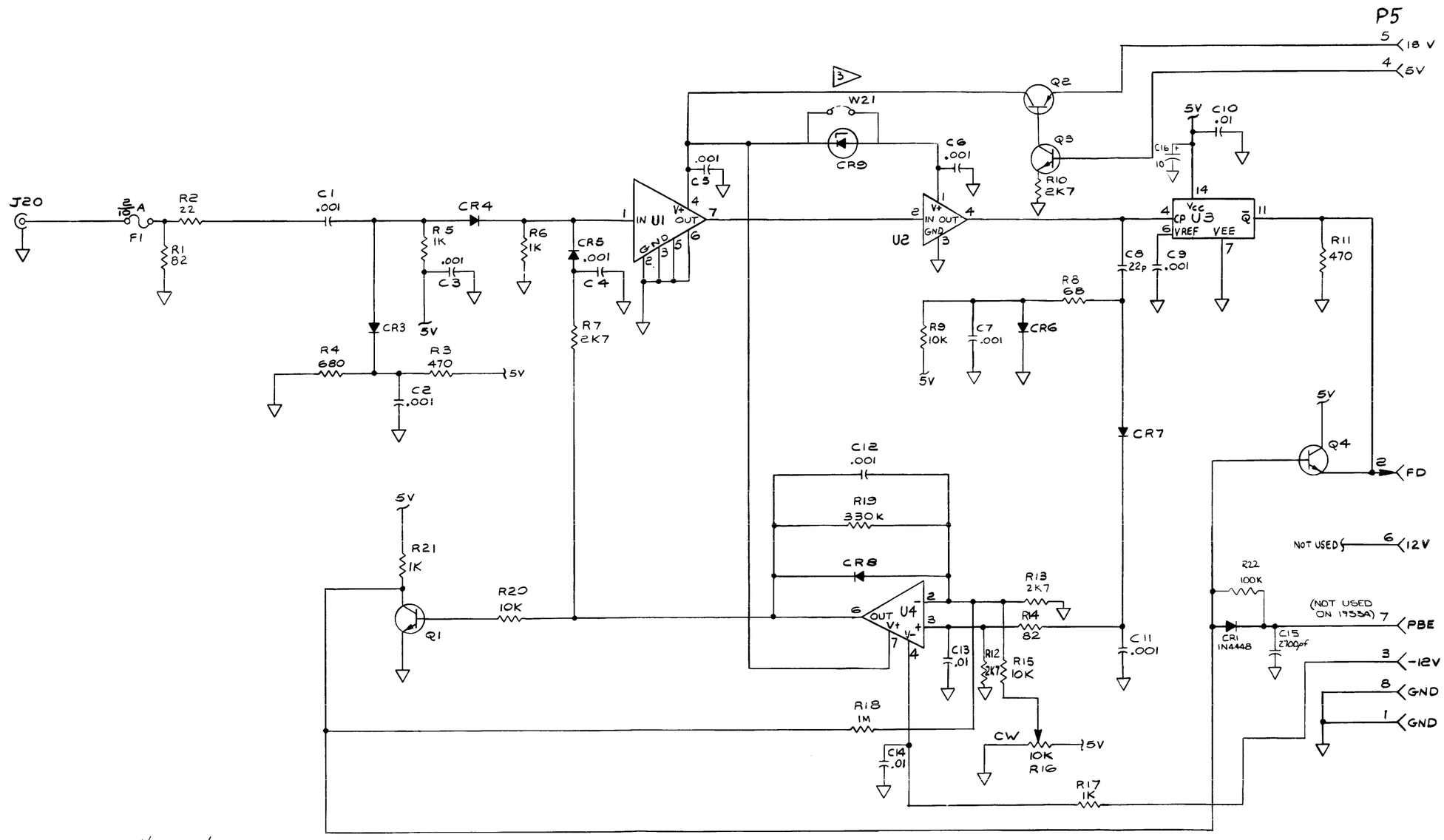
A8 External Time Base Multiplier 2
1953A-1035

Figure 8-7. A7/A8 External Time Base Multiplier PCB Assemblies, -05 Option (cont)



1953A-1226

Figure 8-8. A9 520 MHz Prescaler PCB Assembly , –07 Option

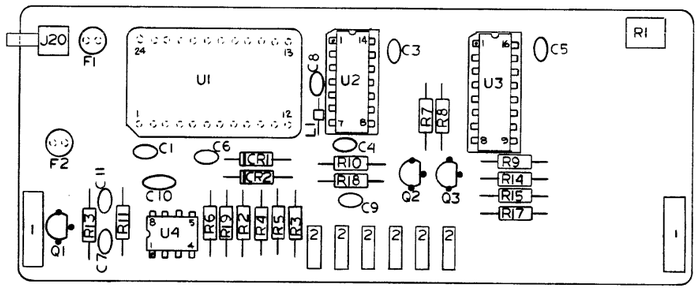


NOTES:

1. ALL RESISTORS ARE IN OHMS, 1/4 W, 5% C.C. UNLESS OTHERWISE NOTED.
2. ALL CAPACITORS ARE IN MICROFARADS, UNLESS OTHERWISE NOTED.
3. NORMAL U2 IS GPD 402, IF GPD 603 IS USED INSTALL JUMPER WIRE ACROSS W21

1953A-1026

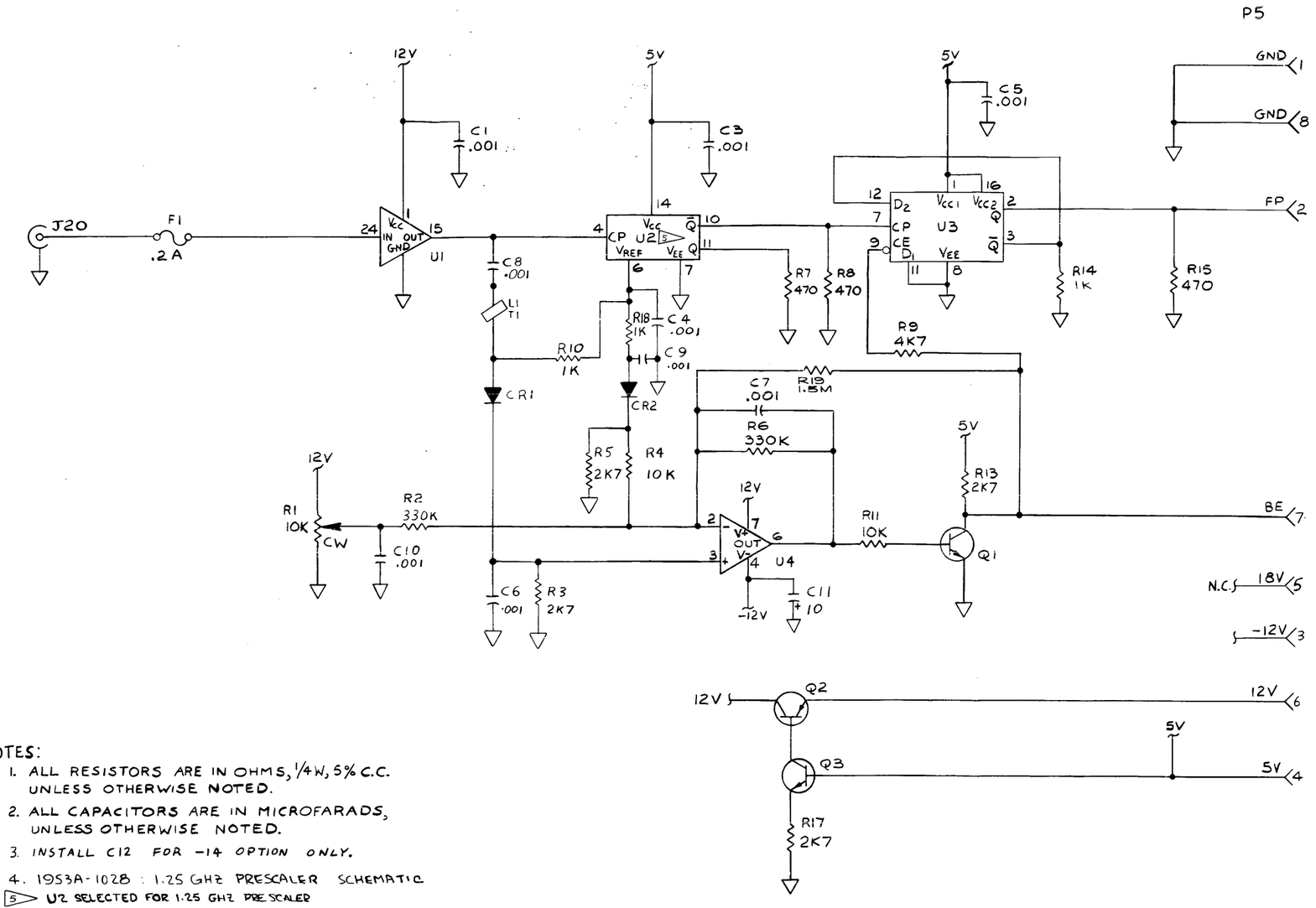
Figure 8-8. A9 520 MHz Prescaler PCB Assembly, -07 Option (cont)



NOTES
1. 1953A-1227 IS 1000 MHZ PRESCALER
2. 1953A 1228 IS 1250 MHZ PRESCALER
3. U2 IS SELECTED FOR 1250 MHZ PRESCALER

1953A-1227
1953A-1228

Figure 8-9. A14/A15 Prescaler PCB Assemblies , –13 & –14 Options



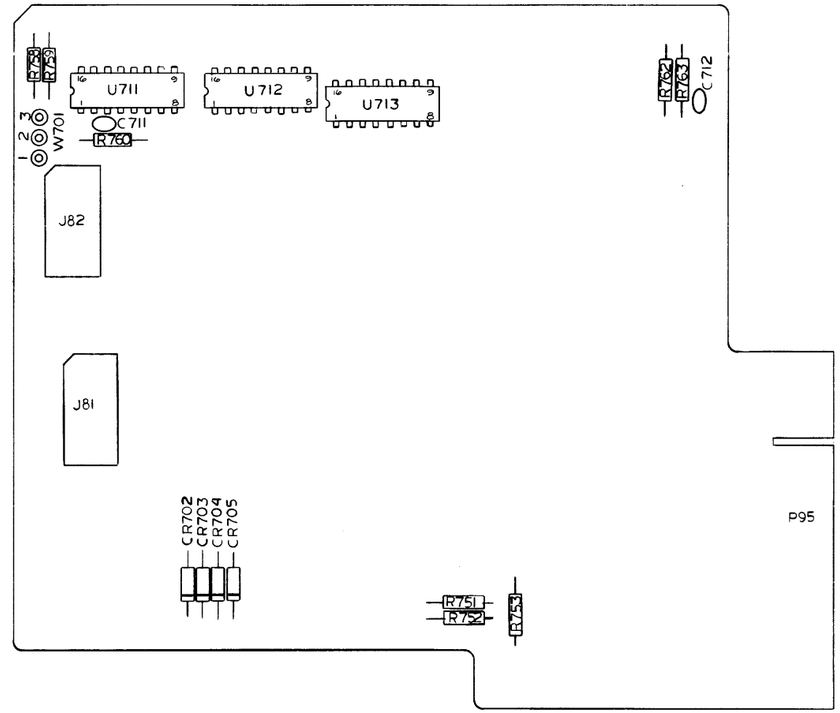
NOTES:

1. ALL RESISTORS ARE IN OHMS, 1/4W, 5% C.C. UNLESS OTHERWISE NOTED.
2. ALL CAPACITORS ARE IN MICROFARADS, UNLESS OTHERWISE NOTED.
3. INSTALL C12 FOR -14 OPTION ONLY.
4. 1953A-1028 : 1.25 GHz PRESCALER SCHEMATIC

(5) U2 SELECTED FOR 1.25 GHz PRESCALER

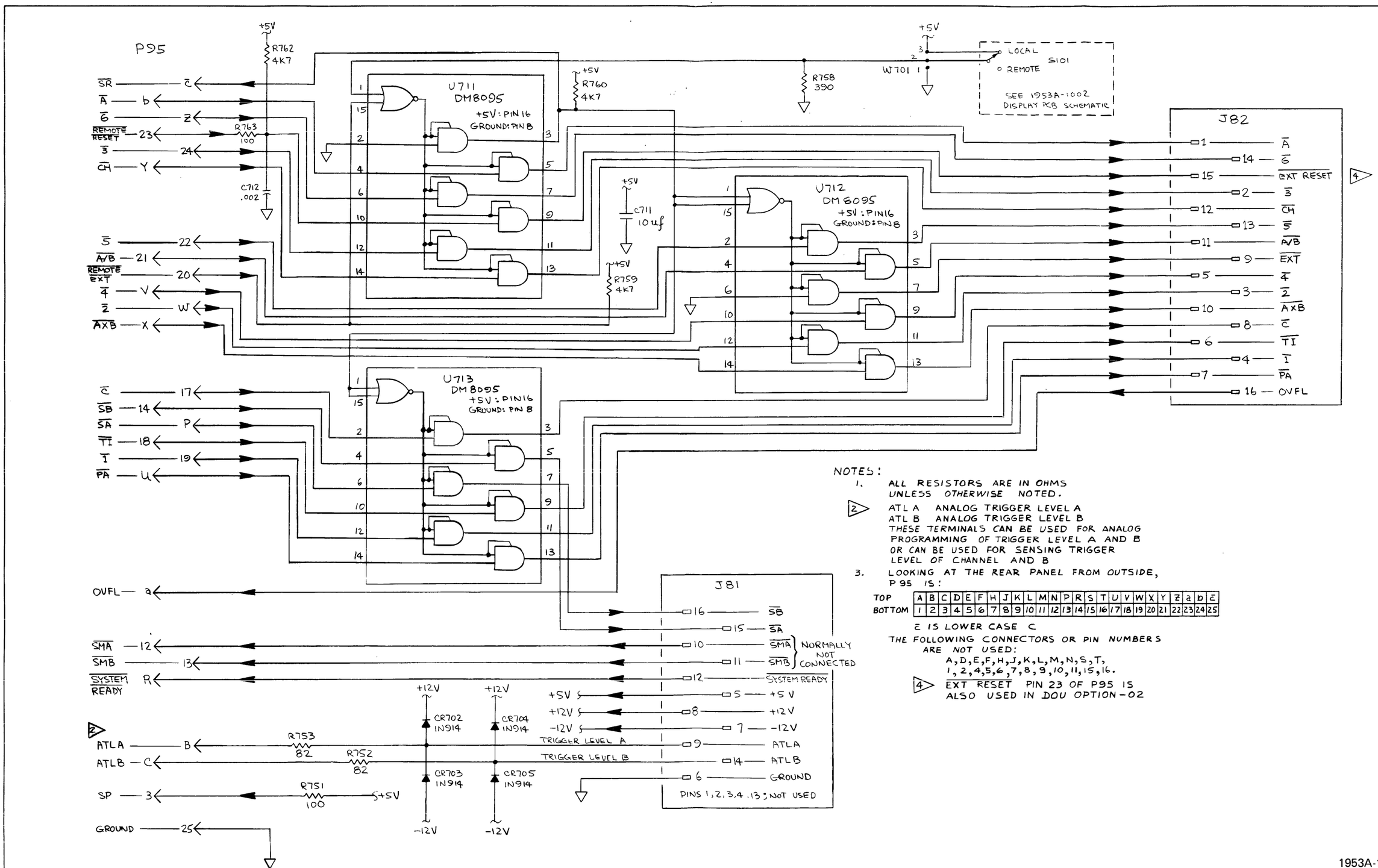
1953A-1027
1953A-1028

Figure 8-9. A14/A15 Prescaler PCB Assemblies, -13 & -14 Options (cont)



1953A-1229

Figure 8-10. A10 Basic Remote Control Unit PCB Assembly , –11 Option



NOTES:

1. ALL RESISTORS ARE IN OHMS UNLESS OTHERWISE NOTED.
2. ATL A ANALOG TRIGGER LEVEL A
   ATL B ANALOG TRIGGER LEVEL B
   THESE TERMINALS CAN BE USED FOR ANALOG PROGRAMMING OF TRIGGER LEVEL A AND B OR CAN BE USED FOR SENSING TRIGGER LEVEL OF CHANNEL AND B
3. LOOKING AT THE REAR PANEL FROM OUTSIDE, P95 IS:

TOP	A	B	C	D	E	F	H	J	K	L	M	N	P	R	S	T	U	V	W	X	Y	Z	a	b	c
BOTTOM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25

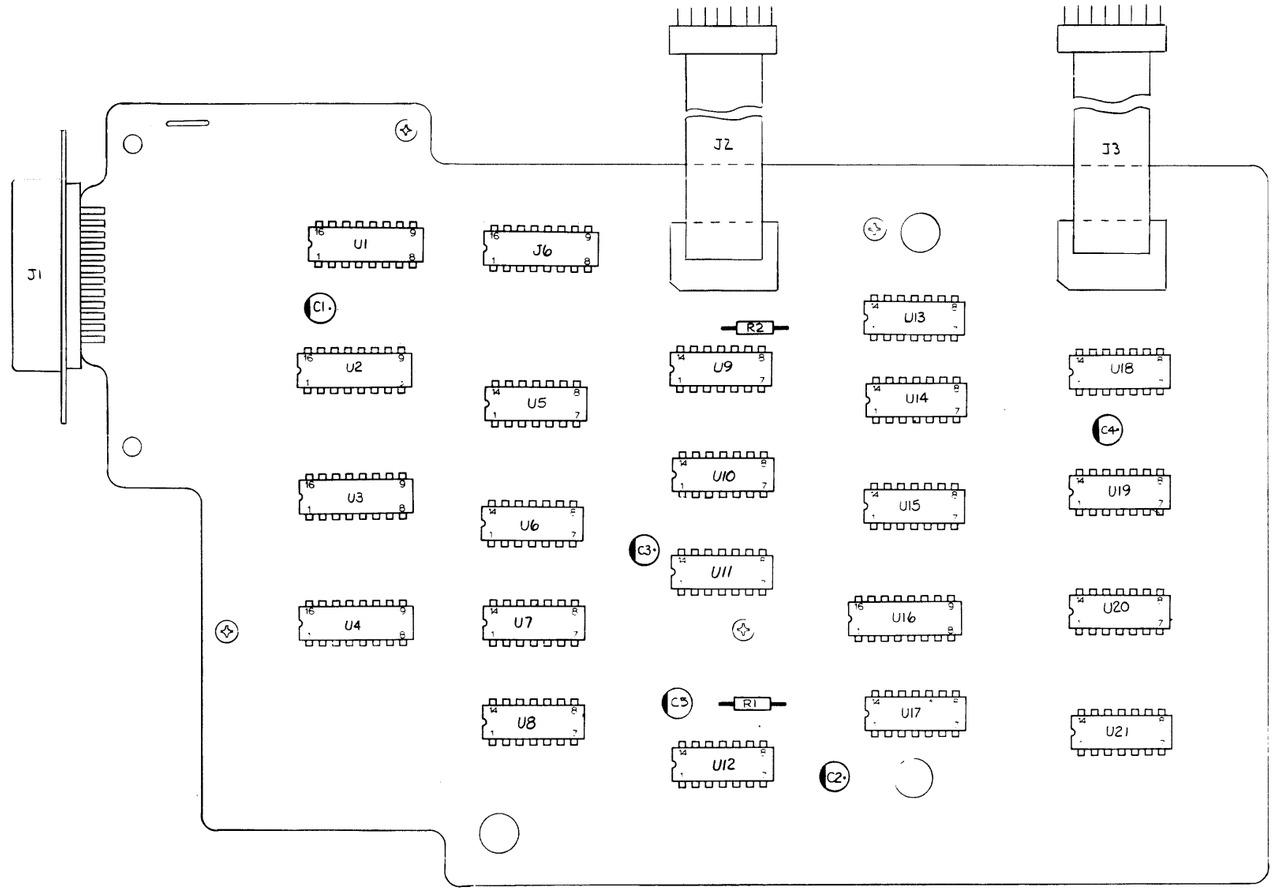
c IS LOWER CASE C

THE FOLLOWING CONNECTORS OR PIN NUMBERS ARE NOT USED:
A, D, E, F, H, J, K, L, M, N, S, T,
1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 15, 16.

4. EXT RESET PIN 23 OF P95 IS ALSO USED IN DOU OPTION-02

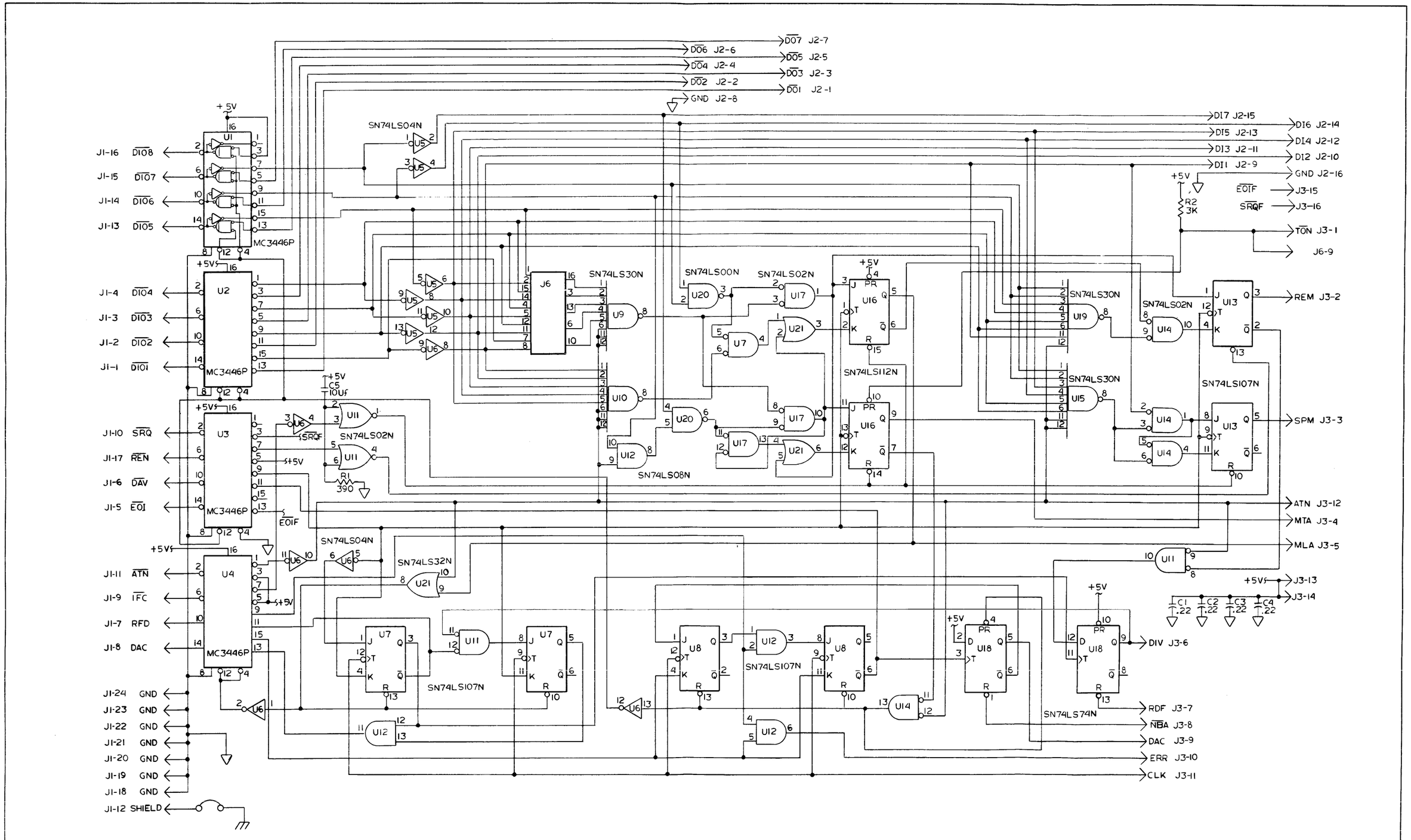
1953A-1029

Figure 8-10. A10 Basic Remote Control Unit PCB Assembly, -11 Option (cont)



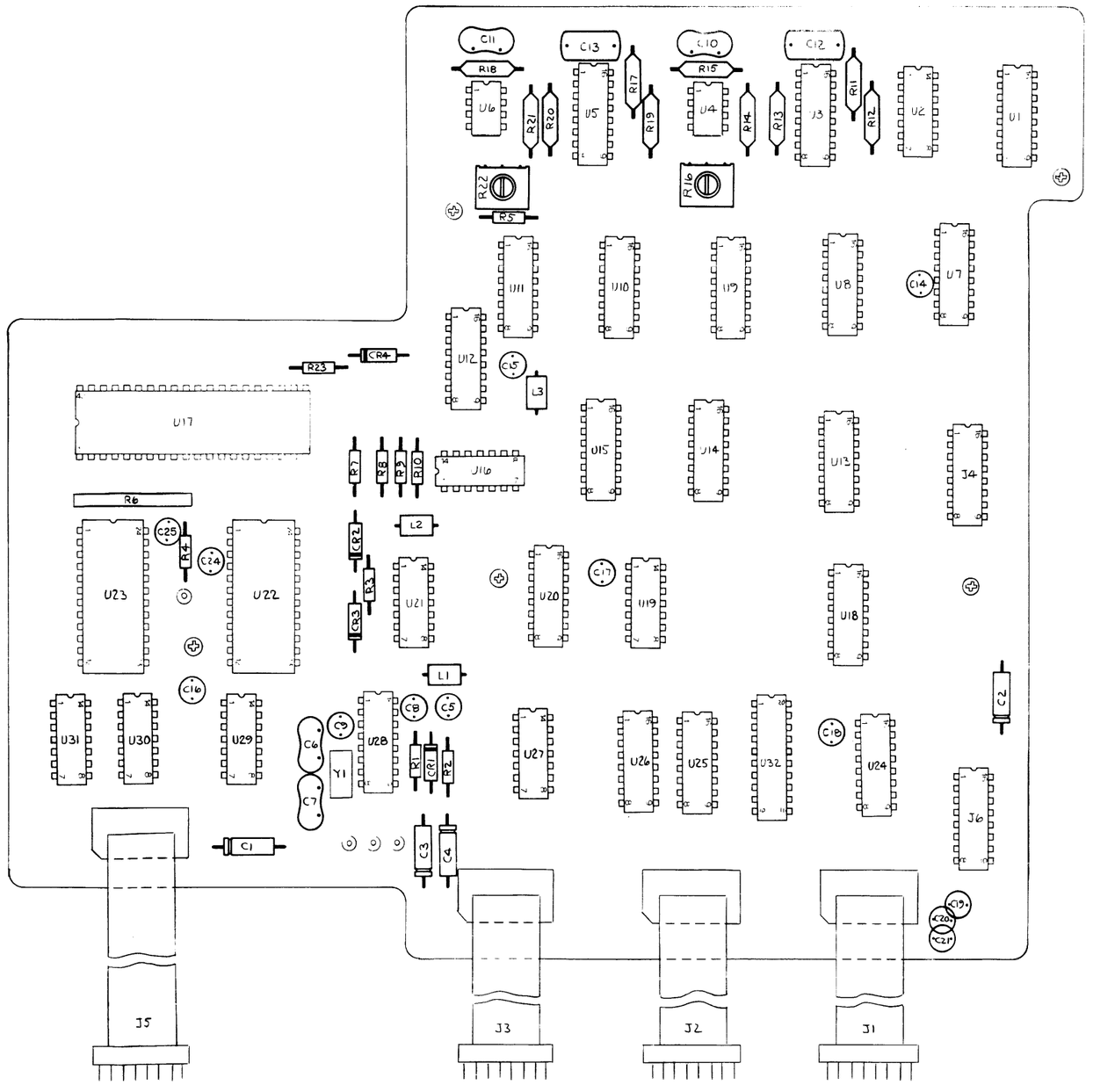
1953A-1240

Figure 8-11. A16 IEEE-488 Bus Interface PCB Assembly , –15 Option



1953A-1040

Figure 8-11. A16 IEEE-488 Bus Interface PCB Assembly, -15 Option (cont)



1953A-1241

Figure 8-12. A17 IEEE-488-1975 Processor PCB Assembly, –15 Option

1953A-1041 (1 of 2)

Figure 8-12. A17 IEEE-488 p1975 Processor PCB Assembly, –15 Option (cont)

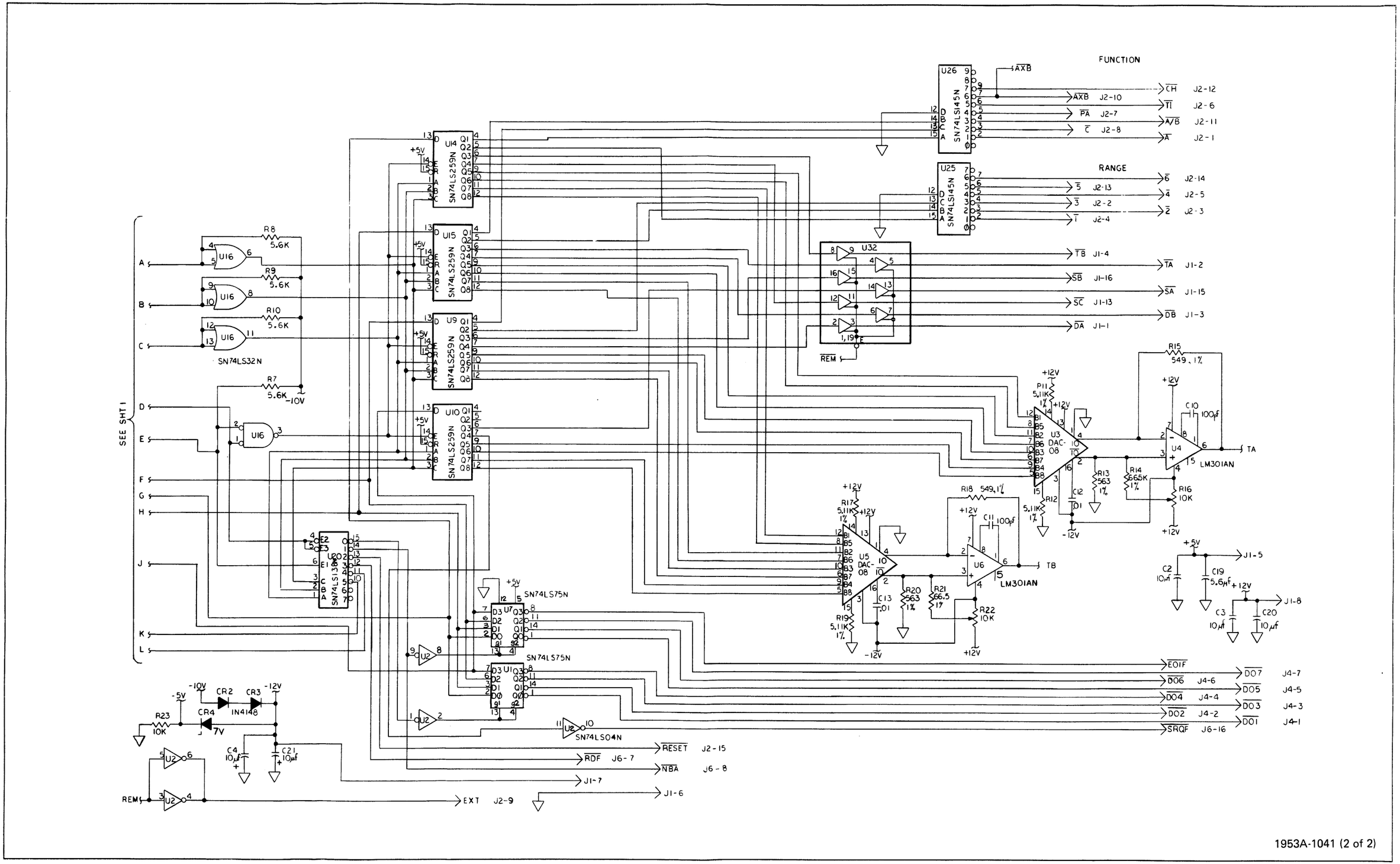
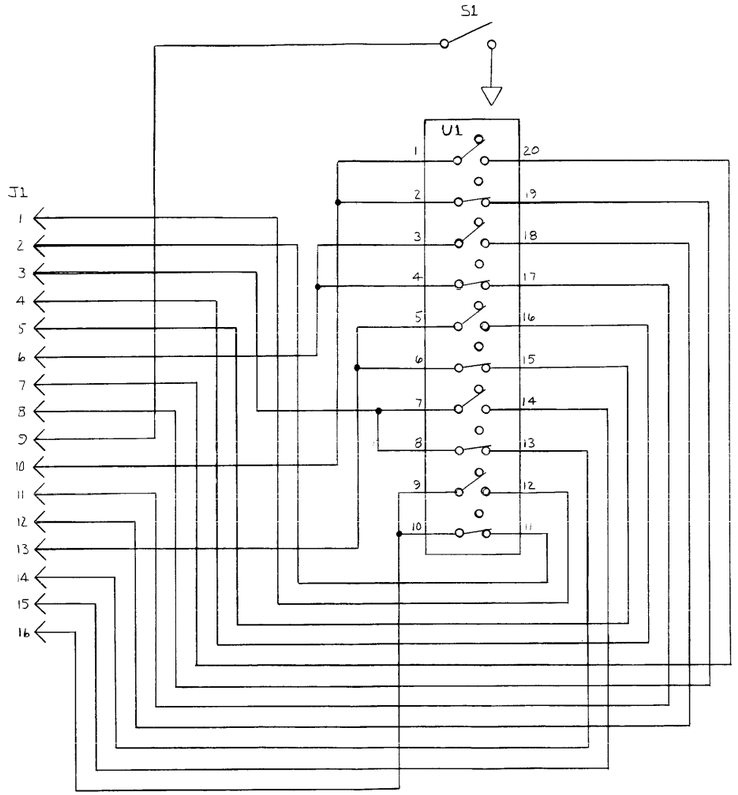


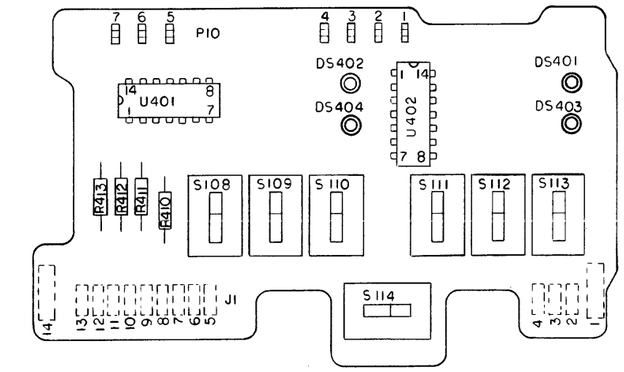
Figure 8-12. A17 IEEE-488-1975 Processor PCB Assembly, –15 Option (cont)

1953A-1242



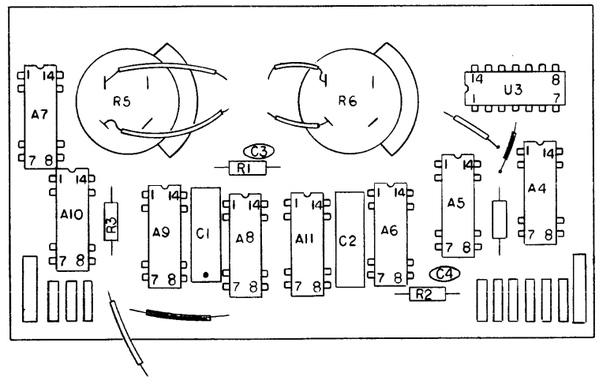
1953A-1042

Figure 8-13. A18 IEEE-488-1975 Switch PCB Assembly, -15 Option



A11 (RCU 1)

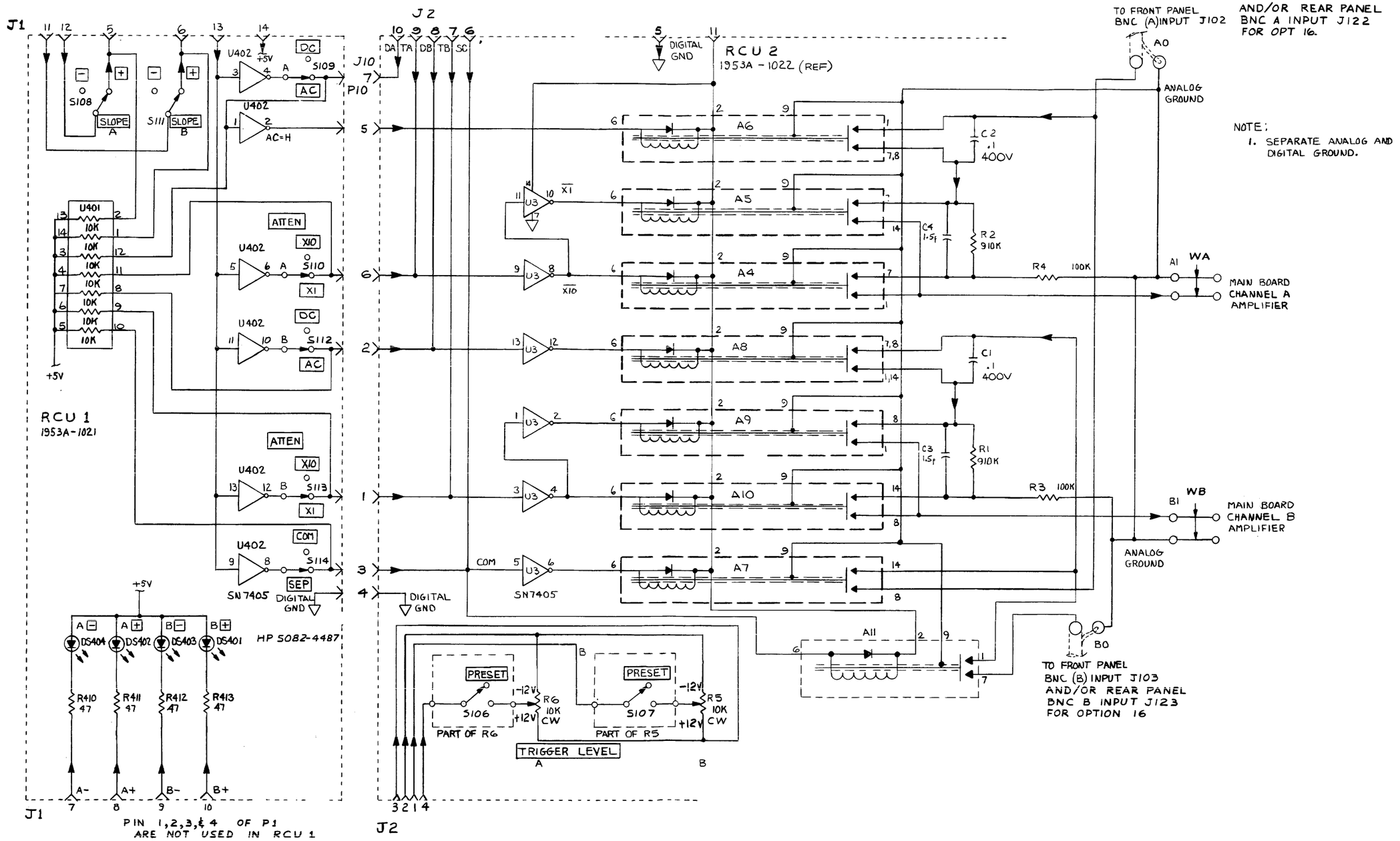
1953A-1221



A12 (RCU 2)

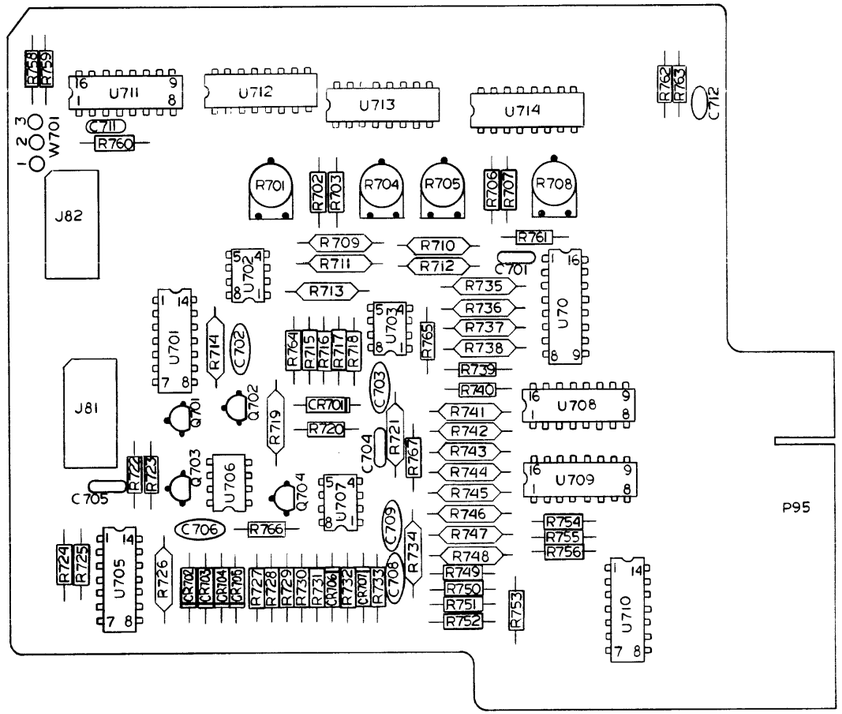
1953A-1222

Figure 8-14. A11/A12 Remote Control Unit PCB Assemblies 1 and 2, -12 & -15 Options



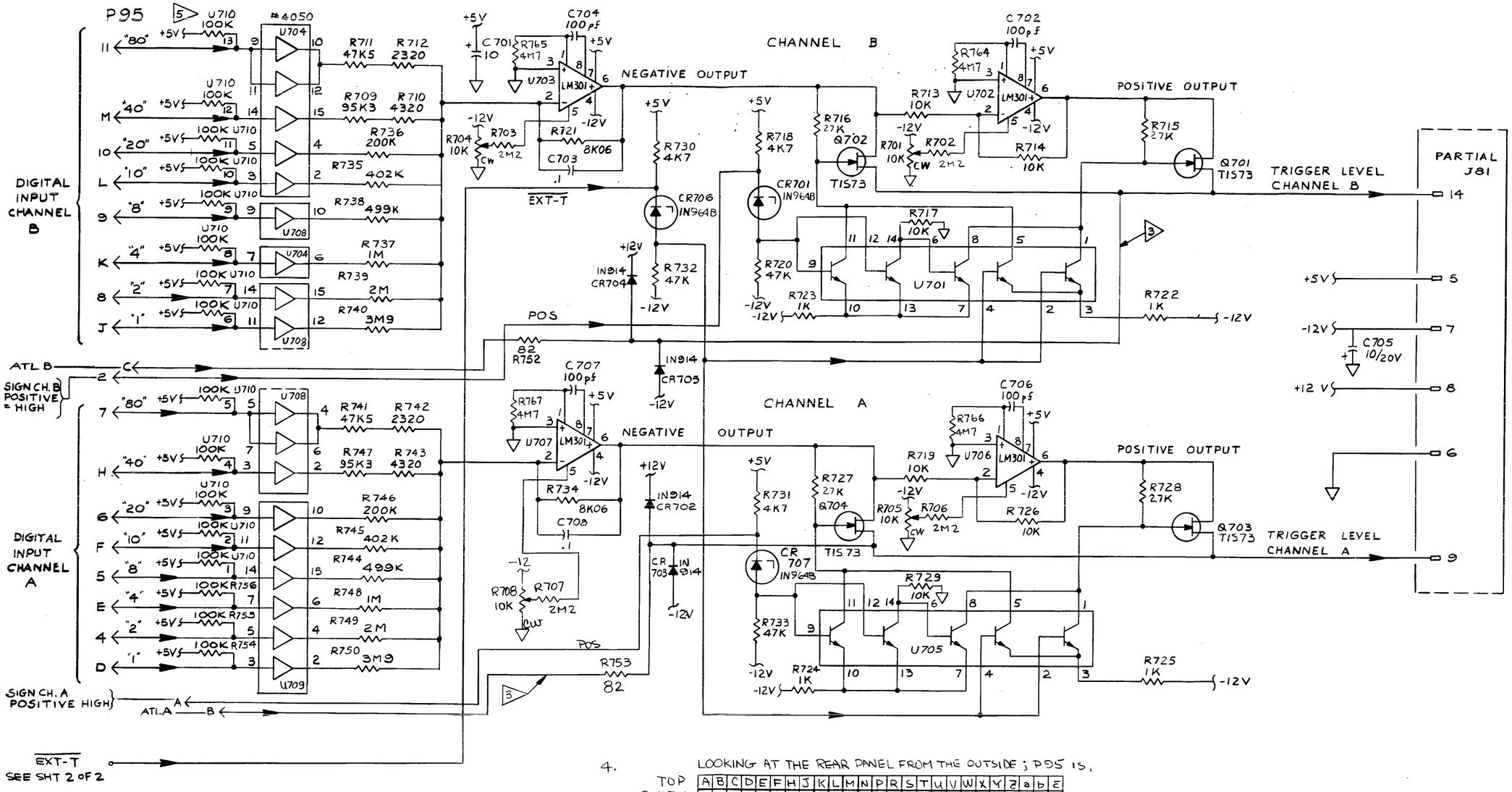
1953A-1021

Figure 8-14. A11/A12 Remote Control Unit PCB Assemblies 1 and 2, -12 & -15 Options (cont)



1953A-1223

Figure 8-15. A13 Remote Control Unit PCB Assembly 3, -12 & -15 Options



NOTES:

1. ALL RESISTORS ARE IN OHMS UNLESS OTHERWISE NOTED.
2. ALL CAPACITORS ARE IN MICROFARADS UNLESS OTHERWISE NOTED.
3. ATLA (ANALOG TRIGGER LEVEL A) ATLB (ANALOG TRIGGER LEVEL B) THESE TERMINALS CAN BE USED FOR ANALOG PROGRAMMING OF TRIGGER LEVEL A AND B OR CAN BE USED FOR SENSING TRIGGER LEVEL OF CHANNELS A AND B.
4. LOOKING AT THE REAR PANEL FROM THE OUTSIDE; P95 IS,

TOP	A	B	C	D	E	F	H	J	K	L	M	N	P	R	S	T	U	V	W	X	Y	Z	a	b	c
BOTTOM	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25

c IS LOWER CASE C

5. U710 CAN BE SUBSTITUTED BY 13 DISCRETE 100K 1/4W 5% RESISTORS.
6. EXT RESET PIN 23 OF P95 IS ALSO USED IN DOU OPTION-02. (SEE SHT 2 OF 2)

1953A-1023 (1 of 2)

Figure 8-15. A13 Remote Control Unit PCB Assembly 3, -12 & -15 Options (cont)

P95

SR — C
A — b
B — a
REMOTE RESET — 23 — R763 100
S — 24
CH — Y
S — 22
A/B — 21
REMOTE EXT — 20
4 — V
2 — W
AXB — X
C — 17
SB — 14
SA — P
TI — 18
1 — 19
PA — U
DB — S
SC — N
EXT-T — 1
TA — 16
TB — 15
DA — T
SP — 3
OVFL — a
SMA — 12
SMB — 13
SYSTEM READY — R
GROUND — 25

+5V R762 4K7
C712 .002
+5V R759 4K7
+5V R760 4K7
R758 390
+5V W701 1
LOCAL S101 REMOTE
SEE 1953A-1002 DISPLAY PCB SCHEMATIC

U711 DM8095 +5V: PIN 16 GROUND: PIN 8
U712 DM8095 +5V: PIN 16 GROUND: PIN 8
U713 DM8095 +5V: PIN 16 GROUND: PIN 8
U714 DM8095 +5V. PIN 16 GROUND: PIN 8

+5V C711 10
+5V R761 4K7
R751 100 +5V

J82
1 — A
14 — B
15 — EXT RESET
2 — S
12 — CH
13 — S
11 — A/B
9 — EXT
5 — 4
3 — 2
10 — AXB
8 — C
6 — TI
4 — 1
7 — PA
16 — OVFL

PARTIAL J81
16 — SB
15 — SA
3 — DB
13 — SC
2 — TA
4 — TB
1 — DA
10 — SMA (NORMALLY NOT CONNECTED)
11 — SMB (NORMALLY NOT CONNECTED)
12 — SYTEM READY

EXT-T SEE SHT 1 OF 2

1953A-1023 (2 of 2)

Figure 8-15. A13 Remote Control Unit PCB Assembly 3, -12 & -15 Options (cont)