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WARNING

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

Dwayne Baade
Tek. Serv. Al. Walker

308 DATA ANALYZER

SERVICE

INSTRUCTION MANUAL

Tektronix, Inc.
P.O. Box 500
Beaverton, Oregon 97077

1st Serial Number 300578

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WARRANTY

Tektronix warrants to the original purchaser that this product is free from defects in materials and workmanship, under normal use, for a period of one (1) year from the date of shipment. Tektronix will, at its option, repair or replace the product if Tektronix determines it is defective within the warranty period, and it is returned, freight prepaid, to a Tektronix Service Center.

There is no implied warranty of fitness for a particular purpose. Tektronix is not liable for consequential damages.

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NOTE

The following tables appear in the Diagrams foldout section.

OPERATORS SAFETY SUMMARY

The general safety information in this part of the summary is for both operating and servicing personnel. Specific warnings and cautions will be found throughout the manual where they apply and do not appear in this summary.

TERMS

In This Manual

CAUTION statements identify conditions or practices that could result in damage to the equipment or other property.

WARNING statements identify conditions or practices that could result in personal injury or loss of life.

As Marked on Equipment

CAUTION indicates a personal injury hazard not immediately accessible as one reads the marking, or a hazard to property including the equipment itself.

DANGER indicates a personal injury hazard immediately accessible as one reads the marking.

SYMBOLS

As Marked on Equipment

DANGER — High voltage.

Protective ground (earth) terminal.

Power Source

This product is intended to operate from a power source that will not apply more than 250 volts rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

Grounding the Product

This product is grounded through the grounding conductor of the power cord. To avoid electrical shock, plug the power cord into a properly wired receptacle before connecting to the product input or output terminals. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

Danger Arising From Loss of Ground

Upon loss of the protective-ground connection, all accessible conductive parts (including knobs and controls that may appear to be insulating) can render an electric shock.

Use the Proper Power Cord

Use only the power cord and connector specified for your product.

Use only a power cord that is in good condition.

For detailed information on power cords and connectors, see Section 2 of the manual.

Refer cord and connector changes to qualified service personnel.

Use the Proper Fuse

To avoid fire hazard, use only the fuse of correct type, voltage rating and current rating as specified in the parts list for your product.

Refer fuse replacement to qualified service personnel.

Do Not Operate in Explosive Atmospheres

To avoid explosion, do not operate this product in an explosive atmosphere unless it has been specifically certified for such operation.

Do Not Remove Covers or Panels

To avoid personal injury, do not remove the product covers or panels. Do not operate the product without the covers and panels properly installed.

SERVICING SAFETY SUMMARY

FOR QUALIFIED SERVICE PERSONNEL ONLY

Refer also to the preceding Operators Safety Summary.

Do Not Service Alone

Do not perform internal service or adjustment of this product unless another person capable of rendering first aid and resuscitation is present.

Use Care When Servicing With Power On

Dangerous voltages exist at several points in this product. To avoid personal injury, do not touch exposed connections and components while power is on.

Disconnect power before removing protective panels, soldering, or replacing components.

Power Source

This product is intended to operate from a power source that will not apply more than 250 volts rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

The 308 Data Analyzer.

2662-33

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INTRODUCTION AND SPECIFICATION

INTRODUCTION

DESCRIPTION

The Sony/Tektronix 308 is a keyboard-controlled, multifunctional, portable data analyzer, intended to meet the need for a portable and inexpensive service aid. The 308 can also be used as a digital design instrument and as a production-line checkout tool for in-circuit tests. Four modes of operation provide the user with a variety of data-analyzing methods. This instrument can be used for timing analysis of parallel signals, state analysis of parallel signals, state analysis of serial transmissions (including data communications), and signature analysis.

Parallel Timing Analyzer Function

When used as a Parallel Timing analyzer, the 308 provides an eight-channel input, a 20 MHz clock speed, and 252 bits/channel memory size. The eight-channel parallel word recognizer triggers upon recognition of a preset digital word. This word-recognition capability is expandable to 24 channels with an accessory word recognizer probe. If no preset data is specified, the 308 software immediately generates an internal trigger at the start of an acquisition. The digital delay counts up to 65,535 clocks. Data sampled before or after the delayed trigger can be stored either at sample intervals ranging from 50 ns to 200 ms or synchronously with an external clock. The latch input allows the 308 to capture glitches narrower than the sample interval. Stored data is displayed on the crt in digitized timing format representing the high and low levels of the stored data, but not the actual waveform.

Parallel State Analyzer Function

The Parallel State Analyzer function is identical to the Parallel Timing Analyzer function except for the display. Data is displayed in binary, octal, and hexadecimal formats.

Serial State Analyzer Function

When operated as a Serial State analyzer, the 308 receives serial data which conforms to EIA STD RS-232-C. Data of five, six, seven, or eight bits per character may be inputted using either synchronous or asynchronous timing. A two-character word recognizer provides internal triggering upon recognition of a preset digital word. The digital delay counts up to 65,535 words. Data sampled before or after the delayed trigger can be stored, using an internal clock, at baud rates of 50 Hz to 9.6 kHz or using an external clock. Stored data is displayed on the crt readout in binary, hexadecimal, and ASCII formats.

Signature Analyzer Function

The Signature Analyzer function provides data inputs, start-stop gating inputs, and a 20 MHz clock input. A sequence of data between the start and stop gates is converted to a four-digit word and displayed as a four-digit signature.

SPECIFICATION

Tables 1-1, 1-2, and 1-3 list the electrical, environmental, and physical characteristics of the 308. The electrical characteristics are valid for the 308 when the 308 has been adjusted as described in the Service Manual (Calibration) at an ambient temperature between +20° to +30° C (+68° to +86° F), is operating in an ambient temperature between 0° to +50° C (+32° to +122° F) and has warmed up for at least 15 minutes.

Table 1-1

Electrical Characteristics

Characteristics	Performance Requirements	Supplemental Information
PARALLEL TIMING ANALYZER FUNCTION		
Inputs to P6451 Data Acquisition Probe (Clock and data)		
Input R and C	1 MΩ ±5%.	Paralleled by ≈5 pF.
Threshold Voltage at the MONITOR Jack		
VAR	At least −12 V to +12 V.	
TTL	+1.4 V ±0.2 V.	
Logic Swing		
Minimum	500 mV p-p +2% of threshold voltage.	Centered on the threshold voltage.
Maximum	−40 V.	A threshold voltage of at least +10 V.
Nondestructive Input Voltage (Maximum)	At least −40 V to +40 V.	
Latch Mode		Any transition that occurs between two sample clocks is displayed as one clock-period-wide data during the next clock interval.
Width of Data Input (Minimum)		
400 mV Overdrive	10 ns.	
250 mV Overdrive		15 ns.
550 mV Overdrive		5 ns.
External Clock Mode		
Clock Period (Minimum)	50 ns.	
Clock Pulse Width (Minimum)		
High-Logic Level	24.5 ns.	
Low-Logic Level	24.5 ns.	
Data Setup Time (Minimum)	25 ns.	Data must precede clock transition by this amount of time.
Data Hold Time (Minimum)	0 ns.	

Table 1-1 (cont)

Electrical Characteristics

Characteristics	Performance Requirements	Supplemental Information
PARALLEL TIMING ANALYZER FUNCTION (cont)		
Internal Clock Mode		
Sample Interval (Minimum)	50 ns.	
Data Pulse Width to ensure sampling (Minimum)	1 sample interval plus 10 ns.	
Input Delay between Channels		
Channels 0—7		15 ns or less.
Frequency of Crystal Oscillator	100 MHz ±0.005 MHz.	0.0025% from 0° C to 50° C ambient, 0.0015% at 25° C ±3° C ambient. Aging: 5 ppm per year.
Sample Intervals	50 ns to 200 ms/sample in 1,2,5 sequence.	
Clock Qualifier	Function is enabled when Qualifier Input switch (S171) on side panel is set to C.	S171 set to position T (Trigger Qualifier function) at factory.
Input Threshold	+1.4 V ±0.2 V (TTL level).	
Input Impedance		10 kΩ or more for TTL signal.
Setup Time		0 ns or less with reference to selected (rising or falling) clock edge.
Hold Time		30 ns plus Clock pulse width or less.
Safe Peak Input Voltage	+10 V to −5 V.	
Memory Size		
Acquisition	8 x 252 (bits).	
Reference	8 x 252 (bits).	
Trigger		
Data Word Recognizer	Programmable to set 8 bits of recognition pattern.	
Input	8-channel data input from P6451 Data Acquisition Probe.	
Asynchronous Mode		Internal sample interval requires asynchronous word recognition.
Input Pulse Width (Minimum)	20 ns for any single channel. 35 ns for any combination of channels.	
Filter	Continuously variable to at least 300 ns.	Matching combinations of narrower width than filter setting are not recognized.

Table 1-1 (cont)

Electrical Characteristics

Characteristics	Performance Requirements	Supplemental Information
PARALLEL TIMING ANALYZER FUNCTION (cont)		
Trigger (cont)		
Synchronous Mode		External sample interval requires synchronous word recognition.
Setup Time	35 ns.	
Hold Time	0 ns.	With reference to selected (rising or falling) clock edge.
External Qualifier	Programmable to set 1-bit qualifier.	
Input Threshold	+1.4 V ±0.2 V (TTL level).	
Input Impedance		10 kΩ or more for TTL signal.
Asynchronous Mode		
Pulse Width (Minimum)	20 ns for qualifier input only.	
Synchronous Mode		
Setup Time	0 ns or less.	With reference to selected (rising or falling) clock edge.
Hold Time	40 ns or less.	
Safe Peak Input Voltage	+10 V to −5 V.	
External Word Recognizer (Optional P6406 Probe)	Programmable to set 16-bit recognition pattern.	
Input Channels	16 channels of input data from P6406.	
Input Threshold	+1.4 V ±0.2 V (TTL level).	
Input Current		
High-Logic Level	40 μA maximum at +2.7 V.	
Low-Logic Level	−400 μA maximum at 0.4 V.	
Safe Peak Input Voltage	+15 V to −1 V peak.	
Asynchronous Mode		
Pulse Width (Minimum)	20 ns for any single channel. 45 ns for any combination of the 24 channel inputs from P6451 and P6406.	
Synchronous Mode		
Setup Time	45 ns.	
Hold Time	0 ns.	With reference to selected (rising or falling) clock edge.

Table 1-1 (cont)

Electrical Characteristics

Characteristics	Performance Requirements	Supplemental Information
PARALLEL TIMING ANALYZER FUNCTION (cont)		
Trigger Output of Word Recognizer		
Output Level	TTL level.	0.5 V or less for low-level output; 2.4 V or more for high-level output.
Voltage (Maximum)	+6 V peak.	
Current (Maximum)		
High-Logic Level	−1 mA.	
Low-Logic Level	2 mA.	
Typical Propagation Delay (Probe tip to word recognizer output with filter set to minimum)		60 ns.
Trigger Delay	Programmable to set the delay count.	
Delay Count	Up to 65,535 count.	Delayed by clock.
Data Position		
PRE	Positions the Delayed Trigger at the 240th position in the 252-byte Data Memory.	
POST	Positions the Delayed Trigger at the 13th position in the 252-byte Data Memory.	
Full Valid Data Display/First Trigger Mode Selection	Selectable by internal jumper.	Instrument is shipped in Full Valid Data Mode. Under certain circumstances a fraction of display is indicated as invalid data to indicate unused storage location.
Full Valid Data Display	Produces a full valid data display.	
First Trigger Mode	Accepts first trigger after start of a data acquisition.	
START Control	Starts data acquisition when START key is pressed in.	
STOP Control	Stops data acquisition and switches to display mode when STOP key is pressed in.	
RE-START Control	Repeats acquisition if valid new Data Memory matches data in Reference Memory. If not equal, stops data acquisition and switches to display mode.	

Table 1-1 (cont)

Electrical Characteristics

Characteristics	Performance Requirements	Supplemental Information
PARALLEL TIMING ANALYZER FUNCTION (cont)		
Display		
Data Format	Timing Diagram.	
Window Size	42, 84, or 168 bits/channel.	
Display Mode		
MENU	Displays all setting information for acquisition.	
WINDOW	Window position and size are displayed on screen.	
CURSOR	Displays position of cursor line and word at cursor line.	

PARALLEL STATE ANALYZER FUNCTION

Characteristics, Performance Requirements and Supplemental Information for Parallel State Analyzer Function are identical to the Parallel Timing Function except for the Display format.

Characteristics	Performance Requirements	Supplemental Information
Display		
Data Format	Binary, octal, and hexadecimal.	
Data Table Size	12 rows.	
Display Mode		
MENU	Displays all setting information for acquisition.	
CURSOR	Displays the cursor position and 12 bytes of data beginning at the cursor point and the cursor position.	
SEARCH	Displays data which matches search word setting. Data is displayed on top of the table in inverse video. Programmable to set a search word pattern.	
COMPARE	Highlights data different from data in Reference Memory. Data is displayed in inverse video.	

Table 1-1 (cont)

Electrical Characteristics

Characteristics	Performance Requirements	Supplemental Information
	SERIAL STATE ANALYZER FUNCTION	
Data Input (via P6107 Probe)		
Input R and C	10 MΩ ±3%, paralleled by approximately 13 pF at probe tip. 1 MΩ paralleled by 40 pF ±1 pF at bnc input connector.	
Threshold Voltage at MONITOR Jack		
VAR	−12 V to +12 V.	
TTL	+1.4 V ±0.2 V.	
Logic Swing		
Minimum	500 mV p-p +2% of threshold voltage.	Centered on the threshold voltage.
Maximum	±30 V peak.	
Nondestructive Peak Input Voltage	±500 V at probe tip. ±250 V at bnc input connector.	
External Clock and Trigger Input (via P6451 Probe)		
Clock Input	Clock input from P6451.	
Trigger Input	CH 0 input from P6451.	
Input R and C	1 MΩ ±5%, paralleled by about 5 pF.	
Threshold Voltage at MONITOR Jack		
VAR	−12 V to +12 V.	Sets threshold voltage at 0 V for measurement of RS-232-C Interface signal.
TTL	+1.4 V ±0.2 V.	
Logic Swing		
Minimum	500 mV p-p +2% of threshold voltage.	Centered on the threshold voltage.
Maximum Peak Input Voltage	±30 V.	
Nondestructive Input Voltage (Maximum)	At least −40 V to +40 V.	
Data Sampling Timing	Synchronous and asynchronous.	
Bits per Character	5, 6, 7, or 8.	Includes parity bit if parity is active.

Table 1-1 (cont)

Electrical Characteristics

Characteristics	Performance Requirements	Supplemental Information
SERIAL STATE ANALYZER FUNCTION (cont)		
Data Sampling Rates		
Internal Clock for Asynchronous Mode	50, 75, 110, 134.5, 150, 200, 300, 600, 1200, 1800, 2400, 4800, and 9600 bits per second.	
Accuracy of Internal Clock	±0.02%.	
External Clock for Asynchronous Mode	Up to 9600 bits per second.	
External Clock for Synchronous Mode	Up to 9600 bits per second.	
Input Logic	Negative or positive.	
Parity	Odd, even, or none.	
Synchronizing Word (Synchronous Mode Only)	Programmable to require two equal words. If not programmed, defaults to ASCII SYN word.	The ASCII SYN word is binary 00010110.
Hunt Word (Synchronous Mode Only)	Programmable to require one word. If not programmed, defaults to xxxxxxxx.	In this particular case, xxxxxxxx means *not used* (normally x equals *don't care*).
Setup and Hold Time for Synchronous Mode		
Setup Time	3 μs maximum with respect to external clock edge.	
Hold Time	3 μs maximum with respect to external clock edge.	
Stop Bits (Asynchronous Mode Only)	Responds to one or more stop bits.	Not adjustable.
Trigger		
Data Word Recognizer	Programmable to require a sequence of two words (characters).	
External Trigger	Programmable to require one bit.	
Trigger Delay	Programmable to set delay count.	
Delay Count	Up to 65,635.	Count delayed by word.
Data Position		
PRE	Positions the Delayed Trigger at the 240th position in the 252-byte Data Memory.	
POST	Positions the Delayed Trigger at the 13th position in the 252-byte Data Memory.	

Table 1-1 (cont)

Electrical Characteristics

Characteristics	Performance Requirements	Supplemental Information
SERIAL STATE ANALYZER FUNCTION (cont)		
START Control	Switches to acquisition mode and prepares to recognize acquisition start signal when START key is pressed.	
Acquisition Start Signal		
Asynchronous Mode	Recognition of start bit.	
Synchronous Mode	Recognition of two equal SYNC characters.	
STOP Control	Stops data acquisition and switches to display mode when STOP key is pressed.	
RE-START Control	Repeats acquisition if valid data in Data Memory matches data in Reference Memory. If there is no match, stops acquisition and display mode is enabled.	
Framing Error Detection	When a valid stop bit is not detected, data acquisition is stopped and switched to display mode, unless fewer than 9 bytes have been received. In that case, acquisition is restarted.	This allows acquiring data from a continuous data stream in asynchronous protocol.
Display		
Data Format	Binary, hexadecimal, and ASCII.	
Data Table Size	12 rows.	
Parity Error	Parity error is indicated beside ASCII character.	If parity is programmed.
Framing Error (Asynchronous Mode Only)	Framing error point is marked with $\boxed{\text{FEST}}$.	
Mode		
MENU	Identical to Parallel State Function.	
EXTENDED MENU	Identical to Parallel State Function.	Additional programming capabilities are provided through the Extended Menu.
CURSOR	Identical to Parallel State Function.	
SEARCH	Identical to Parallel State Function.	
COMPARE	Identical to Parallel State Function.	

Table 1-1 (cont)

Electrical Characteristics

Characteristics	Performance Requirements	Supplemental Information
SIGNATURE ANALYZER FUNCTION		
Data Input (via P6107 Probe)		
Setup Time	15 ns maximum.	Data to be valid at least 15 ns before selected clock edge.
Hold Time	0 ns.	With reference to selected (rising or falling) clock edge.
Input R and C	10 MΩ ±3%, paralleled by approximately 13 pF at probe tip. 1 MΩ paralleled by 40 pF ±1 pF at bnc input connector.	
Threshold Voltage at MONITOR Jack		
VAR	−12 V to +12 V.	
TTL	+1.4 V to ±0.2 V.	
Logic Swing		
Minimum	500 mV p-p +2% of threshold voltage.	Centered on the threshold voltage.
Maximum	±30 V peak.	
Nondestructive Peak Input Voltage	±500 V at probe tip. ±250 V at bnc input connector.	
Clock Input (via Clock Input of P6451 Probe)	Input performance requirements are same as data input requirements for Parallel Timing Analyzer Function.	
Clock Period (Minimum)	50 ns.	
Clock Pulse Width (Minimum)		
High-Logic Level	24.5 ns.	
Low-Logic Level	24.5 ns.	

Table 1-1 (cont)

Electrical Characteristics

Characteristics	Performance Requirements	Supplemental Information
SIGNATURE ANALYZER FUNCTION (cont)		
Start and Stop Gate		
Start Input (via CH 0 Input of P6451 Probe)	Input performance requirements are same as data input requirements for Parallel Timing Analyzer Function.	
Stop Input (via CH 1 Input of P6451 Probe)	Input performance requirements are same as data input requirements for Parallel Timing Analyzer Function.	
Setup Time	25 ns.	Start or Stop to be valid at least 25 ns before selected clock edge.
Hold Time	0 ns.	With respect to the selected (rising or falling) clock edge.
Gate Length (Minimum)	One clock cycle.	
Timing between Gates (Maximum)	2.5 ms or 1 clock cycle, whichever is longer.	
Probability of Classifying Correct Data Stream as Correct	100%.	
Probability of Classifying Faulty Data Stream as Faulty	99.998%.	
Display		
Data Format	4-digit signature.	
Characters	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, C, F, H, P, U.	
Mode	Hold or Repeat.	
Indication of Faulty Signature	< symbol displayed in Hold Mode. FAULT displayed in Repeat Mode.	
CRT DISPLAY SYSTEM		
CRT		
Display Area		6.8 cm (W) x 5.4 cm (H).
Phosphor		P4.
Accelerating Voltage		Approximately 6.7 kV.

Table 1-1 (cont)

Electrical Characteristics

Characteristics	Performance Requirements	Supplemental Information	
POWER SUPPLY			
Range of Line Voltages	90 V to 132 V ac or 180 V to 250 V ac, 48 Hz to 440 Hz.		
Power Consumption	38 W maximum.		
DC Supply Voltages	**Accuracy**	**Temperature Drift**	**Ripple**
+5 V	+5 V ±0.15 V.	0.1 V	<100 mV p-p
−5 V	−5 V ±0.15 V.	0.1 V	<50 mV p-p
+15 V	+15 V ±0.75 V.		
−15 V	−15 V ±0.75 V.		

Table 1-2

Environmental Characteristics

Characteristics	Description
Temperature	
Operating	0° C to +50° C.
Storage	−55° C to +75° C.
Altitude	
Operating	To 15,000 ft (4,500 m). Maximum allowable ambient temperature decreased by 1° C/1,000 ft (300 m) from 5,000 ft (1,500 m) to 15,000 ft (4,500 m).
Storage	To 50,000 ft (15,000 m).
Humidity (Operating and Storage)	Five cycles (120 hr. total) with equipment tested at 90% to 95% Relative Humidity. Tested non-operating at 60° C and operating to MIL-STD-810C Method 507.1 Procedure IV, modified as specified in MIL-T-28800B paragraph 4.5.5.1.1.2.
Vibration (Operating)	With instrument operating, vibration frequency swept from 10 to 55 to 10 Hz in 1-minute sweeps in each of three major axes at total displacement of 0.025 inch. Held 3 minutes at 55 Hz. All major resonances must be above 55 Hz.
Shock (Operating and Storage)	30 g, half-sine, 11 ms duration, 2 guillotine-type shocks per axis each direction, for a total of 12 shocks.
Electromagnetic Interference (EMI)	Reference MIL STD 461A-462. Radiated emission as specified. Conducted emission, relax 20 dB below 150 kHz. Omit susceptability.

Table 1-3

Physical Characteristics

Characteristics	Description
Weight	
Net, Without Accessories	3.7 kg (8.157 lb).
Shipping, Domestic	8.8 kg (19.4 lb).
Dimensions	See Figure 1-1.
Width, With Handle	23.7 cm (9.3 in).
Depth, Handle Not Extended	35.4 cm (14 in).
Depth, Handle Extended	45.4 cm (17.9 in).
Heights	
Without Accessory Pouch	11.7 cm (4.6 in).
With Accessory Pouch	17.0 cm (6.7 in).

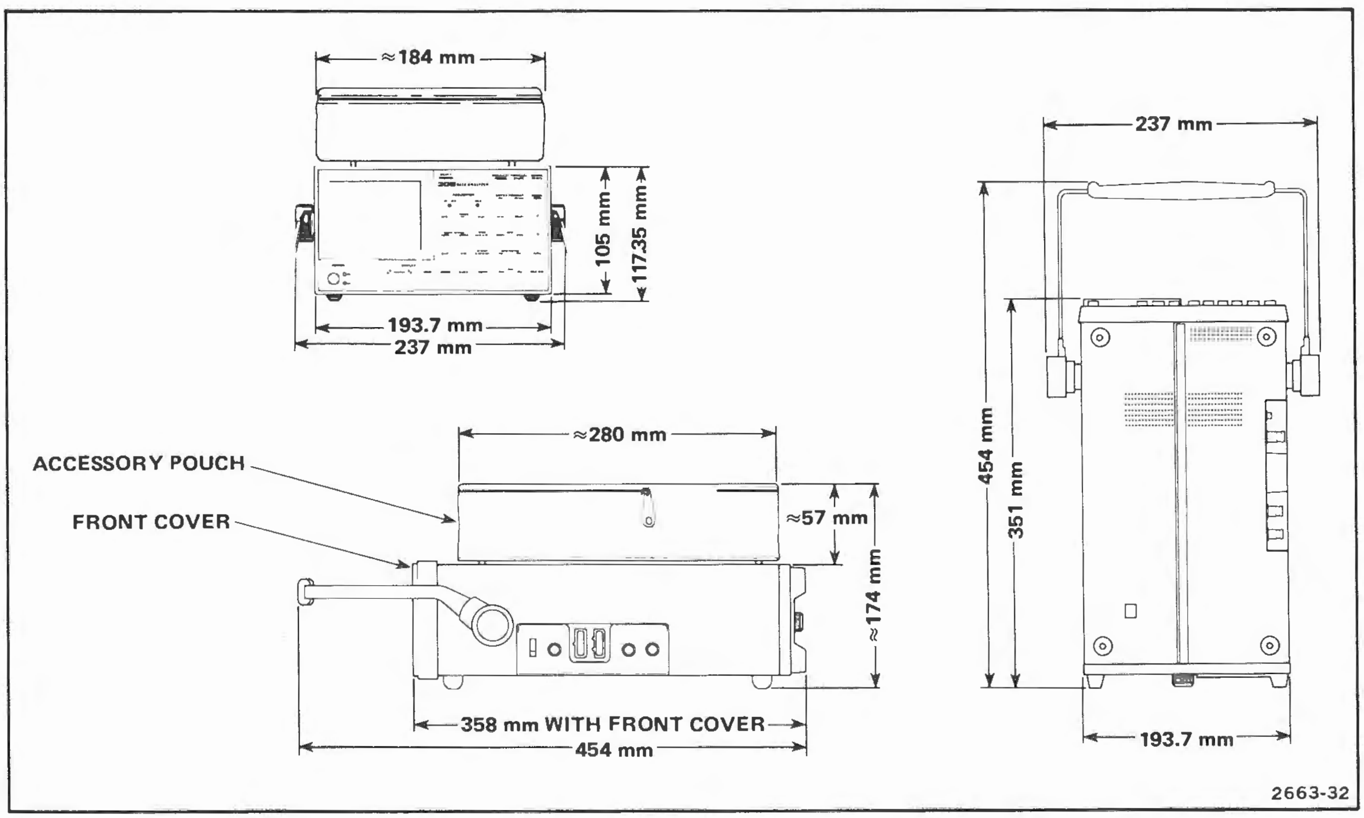

Figure 1-1. 308 dimensional drawing.

OPERATING INSTRUCTIONS

INSTALLATION

Installation consists of selecting the appropriate operating voltage, connecting the 308 to a power input source, and connecting the probe (or probes) as required between the 308 and the circuit under test.

POWER REQUIREMENTS

The 308 operates from a nominal 115 or 230 V, 48 to 440 Hz, single-phase power input source. Before connecting the instrument to a power source, verify that the line-voltage indicator on the bottom of the instrument is displaying the correct nominal voltage for the power input source to be used (refer to Figure 2-1).

POWER CORD

This equipment has a 3-wire power cord with a 3-contact plug for connection to the power source and to protective ground. The plug protective-ground contact connects (through the power cord protective-grounding conductor) to the accessible metal parts of the equipment. For electrical-shock protection, insert this plug into a power input source socket that has a securely grounded protective-ground contact.

The power cord is detachable (refer to Figure 2-2). When not in use it should be stored in the accessory pouch.

Instruments are usually factory equipped with a 115 V power cord unless otherwise ordered. Other cords that can be used with the tester are shown in Figure 2-3. For more information on power cords, contact your Tektronix representative or your local Tektronix Field Office.

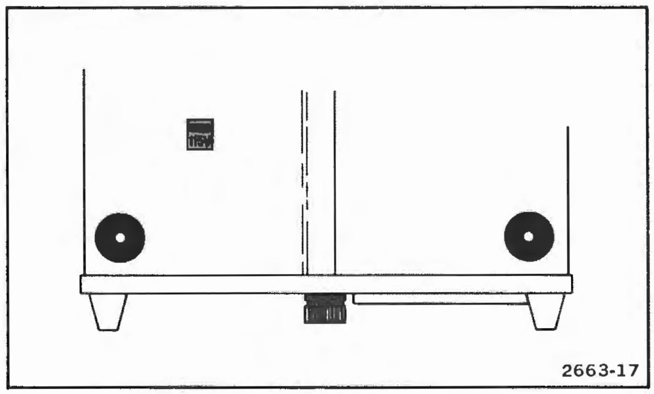

Figure 2-1. Location of the line-voltage indicator.

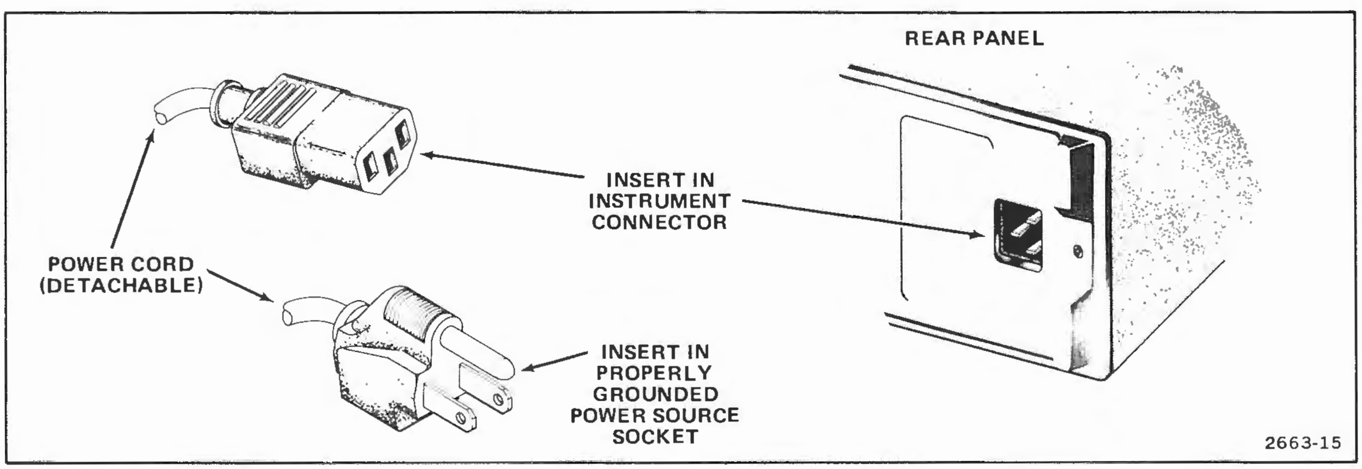

Figure 2-2. Connecting the power cord.

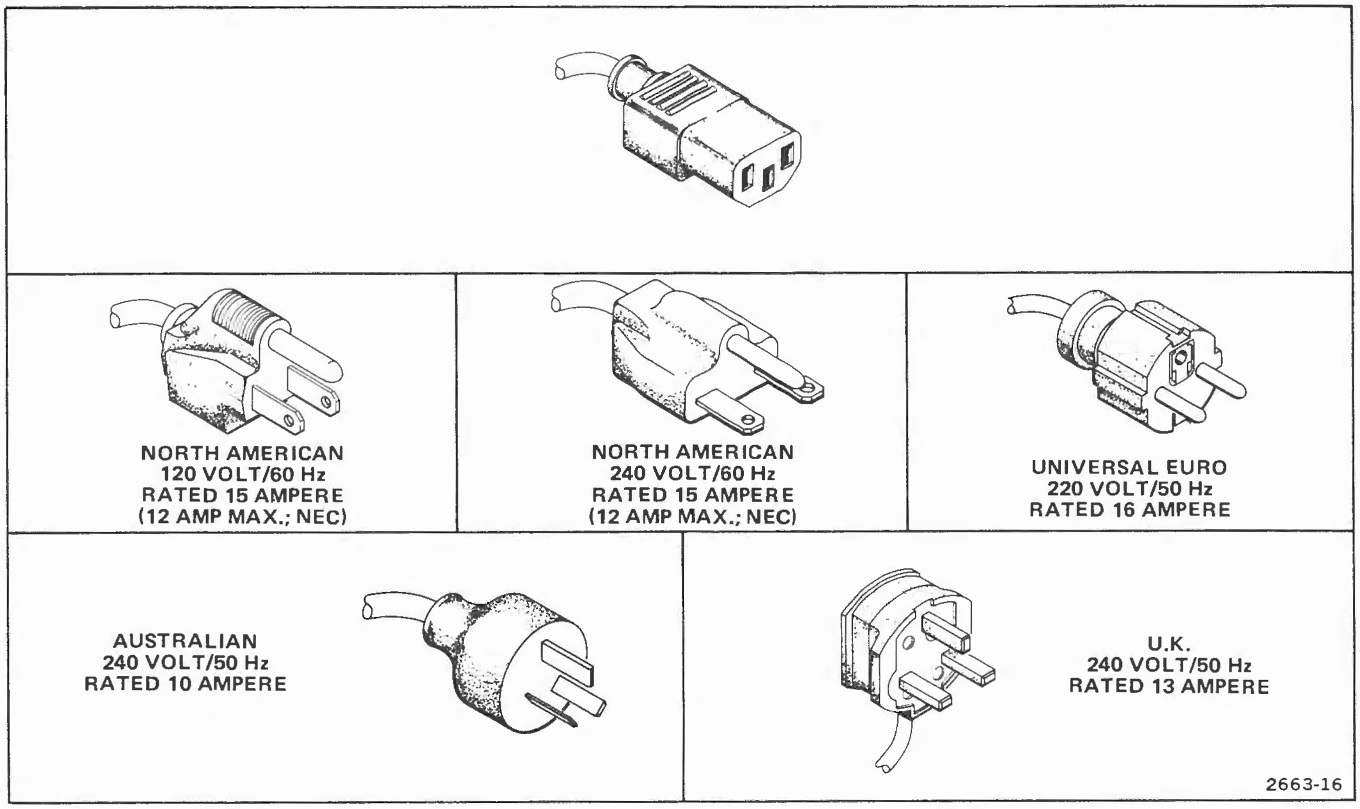

Figure 2-3. Optional power cords for the 308.

CONTROLS, CONNECTORS, AND INDICATORS

The following descriptions and illustrations explain the Acquisition Controls, Instrument and Display Mode Controls, Entry Controls, Signature Controls, and Input Controls and Connectors. The four major functions of the 308 and uses of its keyboard controls are also explained. Keyboard controls are grouped in the sequence that they would normally be used by the operator to effect acquisition of data, display of that data, how parameters are entered to affect acquisition of that data, and how controls permit using the 308 as a signature analyzer.

ACQUISITION CONTROLS

The acquisition controls and indicators illustrated in Figure 2-4 determine the manner in which the 308 acquires the information for application to the Data Memory.

1 **EXT CLOCK Light**—Light stays on when clock input remains at high level. Light stays off when clock input remains at low level. Light blinks when signal is present at the clock input.

2 **TRIG'D Light**—Light is illuminated when trigger word is recognized.

3 **TRIGGER DATA=**—Programs instrument to receive Data Trigger.

4 **TRIGGER EXT=**—Programs instrument to receive External trigger word.

5 **TRIGGER DELAY=**—Programs instrument to receive Clock Delay Setting.

6 7 **SAMPLE INTERVAL FASTER and SAMPLE INTERVAL SLOWER**—These controls select the sample interval of internal clock and clock edge of external clock. Sample interval is sequenced through 23 positions in Parallel mode and 17 positions in Serial State mode.

(8) **STORE DATA→REF**—Causes Data Memory contents to be duplicated in the Reference Memory.

(9) **START**—Starts acquisition process.

(10) **STOP**—Stops acquisition process with manual stop trigger.

(11) **RE-START IF DATA=REF**—Starts and re-starts acquisition process if valid portion of new Data Memory contents are equal to the valid portion of the Reference Memory content.

(12) **DATA POSITION PRE**—Positions the Delayed Trigger at the 240th position in the 252-byte Data Memory.

(13) **DATA POSITION POST**—Positions the Delayed Trigger at the 13th position in the 252-byte Data Memory.

(14) **INPUT SAMPLE**—Input is sampled according to clock edges.

(15) **INPUT LATCH**—Latch mode can only be used for parallel acquisitions. Input data is affected only between clock edges as explained later in Information Gathering.

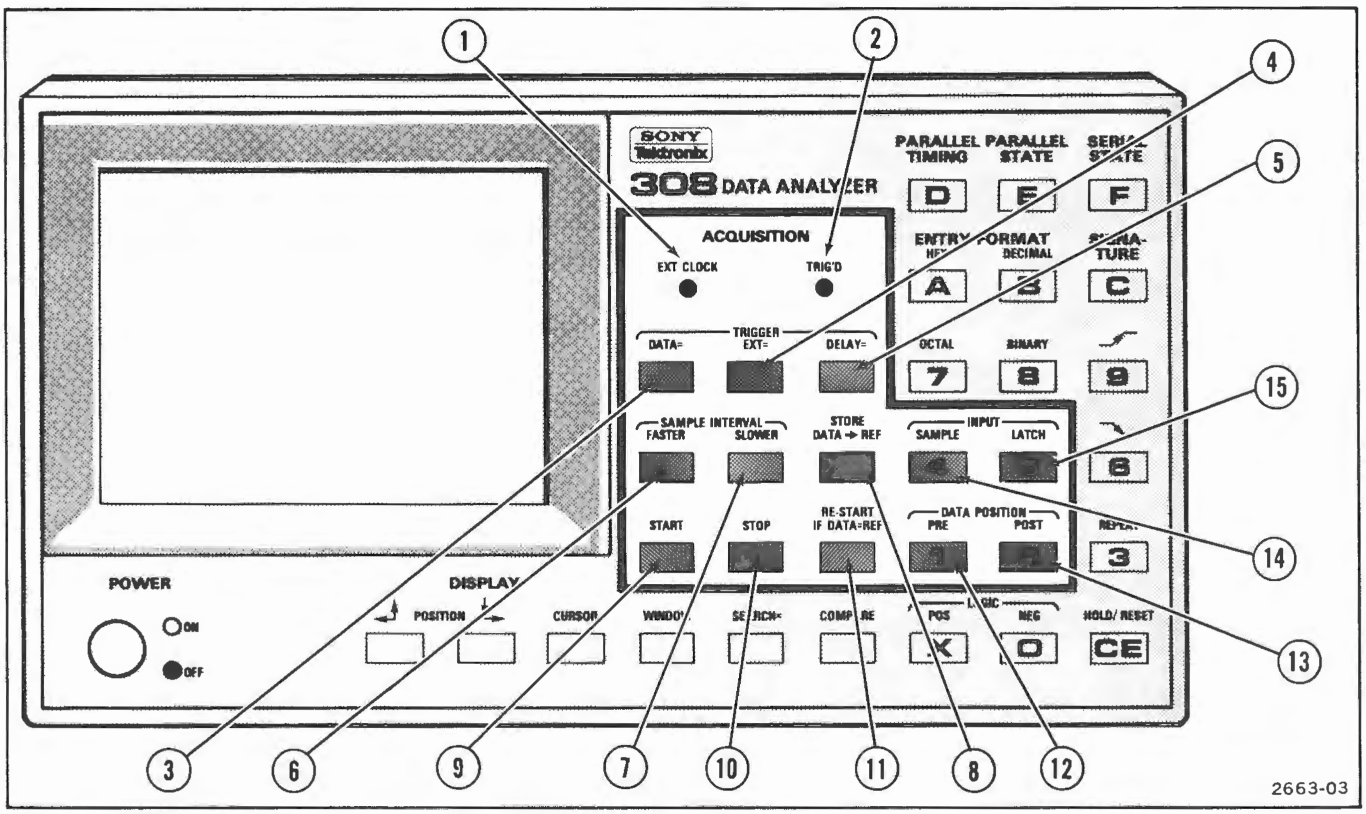

Figure 2-4. Acquisition controls and indicators.

INSTRUMENT AND DISPLAY MODE CONTROLS

All of the Instrument and Display Mode controls shown in Figure 2-5 affect the 308's display of information from the Data Memory. The first four controls also affect the choice of instrument acquisition system (Parallel Timing, Parallel State, Serial State, and Signature.

(1) **PARALLEL TIMING**—Selects eight-channel parallel input signal to be stored and displayed in timing format.

(2) **PARALLEL STATE**—Selects eight-channel parallel input signal to be stored and displayed in hexadecimal, binary, and octal formats.

(3) **SERIAL STATE**—Selects a serial-input signal to be stored and displayed in hexadecimal, binary, and ASCII formats.

(4) **SIGNATURE**—Selects a serial-input signal to be decoded and displayed in signature format.

(5) **POSITION** —Moves Window or Cursor to earlier position. If key is pressed and held, position steps automatically.

(6) **POSITION** —Moves Window or Cursor to later position. If key is pressed and held, position steps automatically.

(7) **CURSOR**—Chooses Cursor display in Parallel Timing, Parallel State, and Serial State modes.

(8) **WINDOW**—Chooses Window display in Parallel Timing mode.

(9) **SEARCH=**—Chooses Search display in Parallel and Serial State modes.

(10) **COMPARE**—Chooses Compare display in Parallel and Serial State modes. Highlights the data which differs from data in the Reference Memory in inverse video.

(11) **LOGIC POS**—Selects positive-true data from Data Memory for display.

(12) **LOGIC NEG**—Selects negative-true data from Data Memory for display.

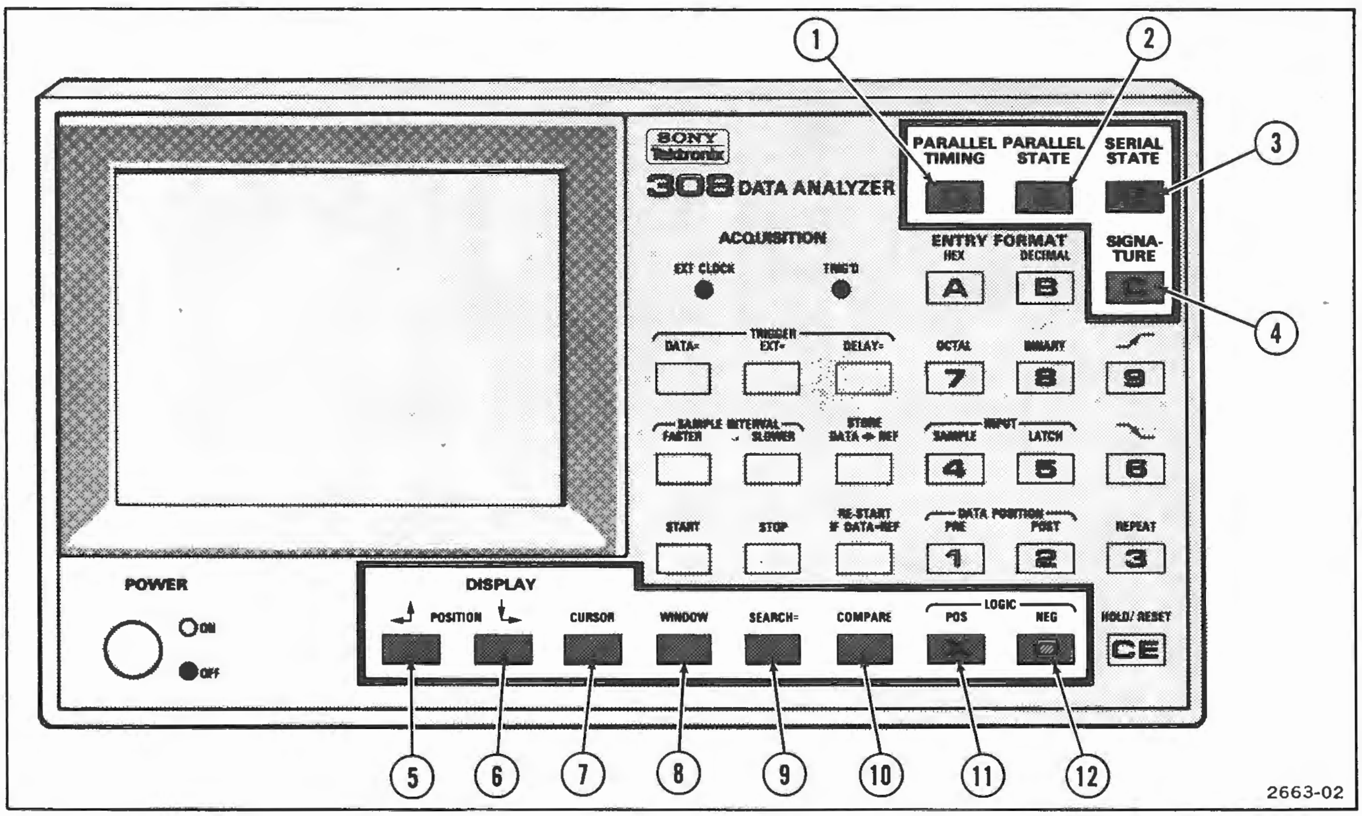

Figure 2-5. Instrument and display mode controls.

ENTRY CONTROLS

Entry controls shown in Figure 2-6 allow the user to change instrument parameters by creating inverse video blanks and allowing the operator to fill the blanks in hexadecimal, decimal, binary, or octal format.

(1) **TRIGGER DATA=**

(2) **EXT=**

(3) **DELAY=**

(4) **SEARCH=**

These four controls cause inverse video prompting. Inverse video area may be filled by using data entry keys (labeled **0** through **F**,**X**, and **CE**) in data-entry sequence. See Triggering, Delayed Triggering, and the Data Memory paragraphs for more information.

(5) **X**—In some data-entry sequences, pressing the **X** (don't care) key causes the 308 to ignore that bit. See Parallel and Serial Acquisition Parameter paragraph for more information.

(6) **CE**—The **CE** (Clear Entry) key may be used to cancel a single data entry or sequence of entries. Canceling a sequence of entries restores the previous setting.

(7) **HEX**

(8) **DECIMAL**

(9) **OCTAL**

(10) **BINARY**

These four controls determine the entry format (hexadecimal, etc.) of data to be entered by the operator, such as **DELAY=**, **DATA=**, or **SEARCH=**. The Entry Format is operator-selected to meet testing requirements.

Keys 0—9 and **A—F** are used to enter the actual information when required (for entries such as **DATA=**, **DELAY=**, and **SEARCH=**, etc.). The size of the area on the screen where information is entered changes as the selected Entry Format is changed and will blink on and off if an illegal character is used. For example, if the entry format is changed from hexadecimal to binary, the entry area increases in size and blinks if any character other than a zero or one (or in some cases, **X**) is entered.

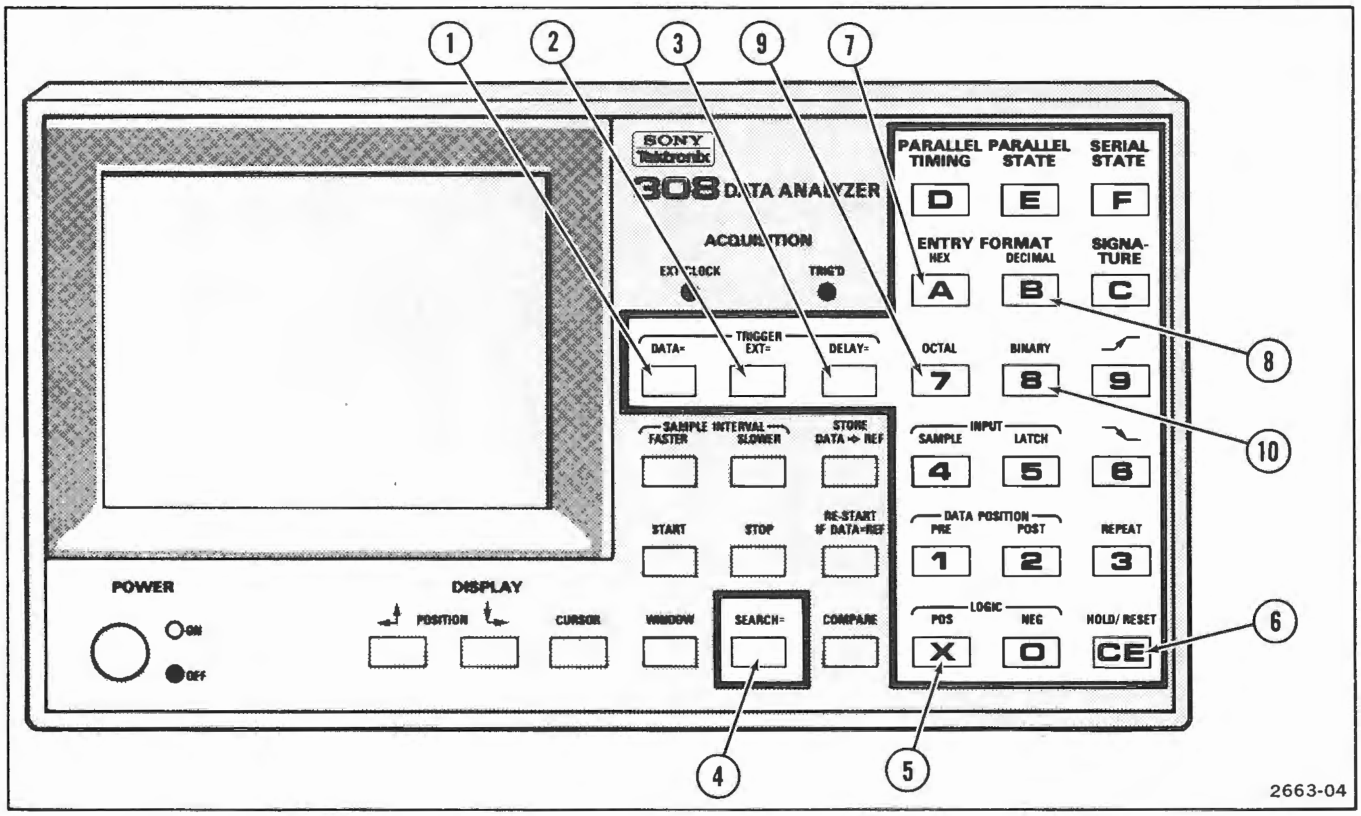

Figure 2-6. Entry controls.

SIGNATURE CONTROLS

Controls shown in Figure 2-7 are for signature acquisition only. The operator may return to and use previously acquired data in the Data Memory.

(1) **SIGNATURE**—Enters Signature mode for new setup.

(2) _/¯—Chooses rising transition for Start and Clock, and a zero-one sequence for Stop.

(3) ¯_—Chooses falling transition for Start and Clock, and a one-zero sequence for Stop.

(4) **REPEAT**—Causes a repeat of any acquisition of input data and displays the most recent data in signature format, losing the old signature. If new signature is different from the old one, FAULT is displayed on the screen for about one second.

(5) **HOLD/RESET**—Causes storage of the signature each time this key is pressed. Up to eight signatures can be displayed on the screen. New signature is displayed on top of signature table. If new signature is different from old signature, < is displayed on the screen beside the new signature.

INPUT CONTROLS AND CONNECTORS

As shown in Figure 2-8, all the input controls and connectors, along with the only output connector (**WORD RECOG TRIGGER OUTPUT**) are located on the right side panel of the 308.

(1) **VAR/TTL**—When placed in the TTL position, the **VAR/TTL** switch sets the input thresholds for nominal TTL levels of 1.4 ±0.2 V. When placed in the VAR position, the input thresholds are continuously variable from +12 V to −12 V. The **VAR/TTL** positions and adjustments affect all the signal inputs to the 308. Word Recognizer probe inputs accept only TTL levels.

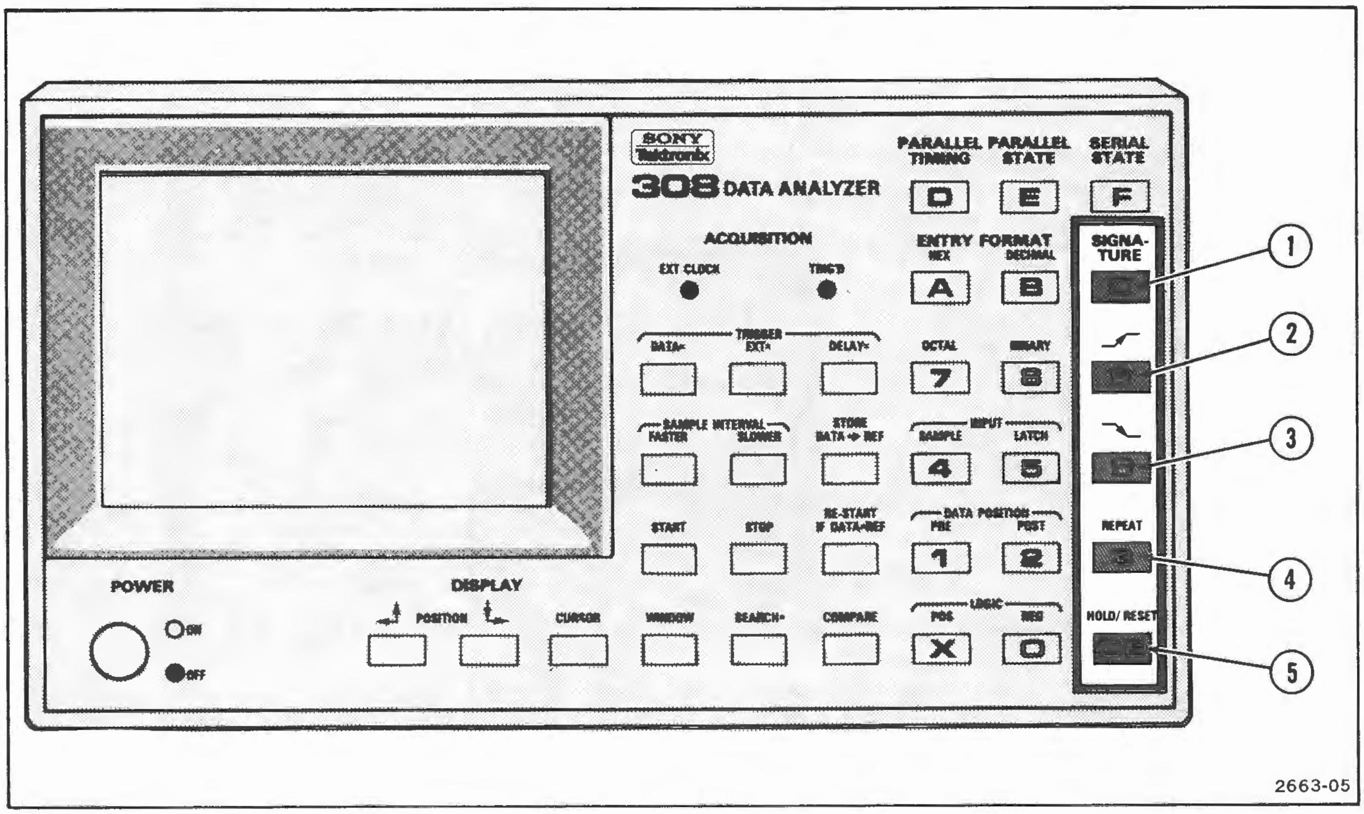

Figure 2-7. Signature controls.

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(2) **THRESHOLD VOLTAGE**—A screwdriver adjustment for varying the input thresholds when the **VAR/TTL** switch is in the VAR position.

(3) **MONITOR**—Actual threshold voltage may be checked with a meter at the MONITOR jack.

(4) **SERIAL/SIGNATURE DATA INPUT**—This input must have the proper data probe connected to it for serial or signature applications. Data applied to the serial data input is processed according to EIA STD RS-232-C protocol prior to being stored in the Data Memory and is displayed in the same manner as parallel data. The same probe and connector are used for signature applications, but the operator-selected input signal requirements and the display are different.

(5) **P6451 INPUT ONLY**—The Data Acquisition probe can only be connected to this connector. The eight parallel bits of data acquired by the Data Acquisition probe are processed differently than the serial data; however, the data is stored in the Data Memory and displayed in the same manner.

(6) **P6406 INPUT ONLY**—The Word Recognizer probe can only be connected to this connector and can be used to expand the 308 trigger capabilities. Keep in mind only the eight data bits acquired by the Data Acquisition probe will be stored and displayed.

(7) (8) **EXTERNAL TRIGGER QUALIFIER INPUT and T/C**—This input can be used in several manners depending on the position of the **T/C** (Trigger/Clock) switch. With the **T/C** switch set to T, word recognition capabilities are extended.

(9) **ASYNC FILTER**—This screwdriver adjustment can be set to prevent false triggering on word recognition patterns of shorter duration than provided for by the filter setting, when operating in the asynchronous mode. Figure 2-9 (Data Transitions, Filter Adjustment, and Triggering) illustrates how a false trigger can occur, giving the operator erroneous data indications.

(10) **WORD RECOG TRIGGER OUTPUT**—This output goes to a TTL logic HI whenever the input data matches data programmed by the operator.

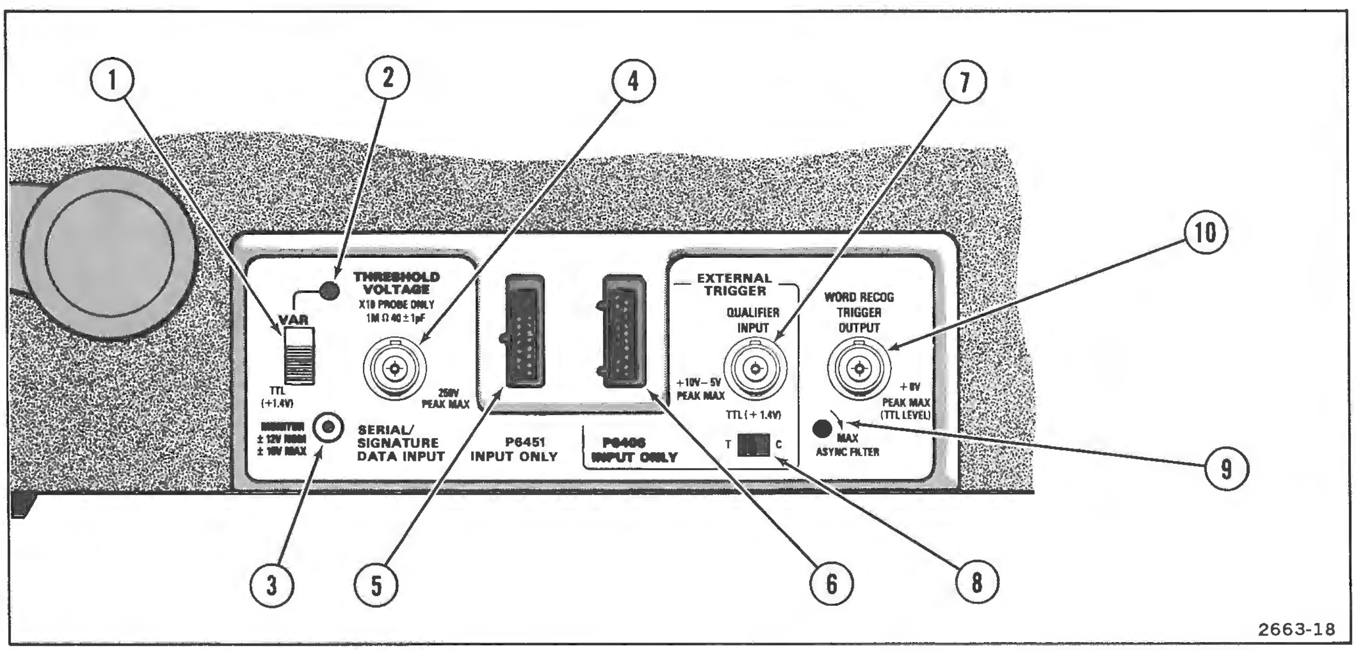
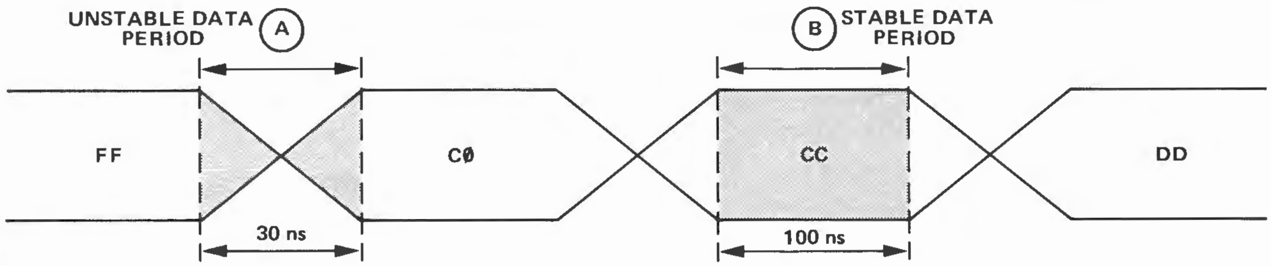


Figure 2-8. Right side panel controls and connectors.

ASYNCHRONOUS PARALLEL DATA STREAM INTO WORD RECOGNIZER



SETUP TRIGGER CONDITIONS: DATA $\boxed{H}$ = CC; EXT $\boxed{H}$ = XXXX-X (DON'T CARE)

SLOW TRANSITION MAY SEEM TO CONTAIN THE TRIGGER WORD

FILTER SHOULD BE ADJUSTED TO PREVENT TRIGGERING AT POINT (A) AND ALLOW TRIGGERING AT POINT (B)

ADJUSTMENT METHOD WITH DELAY =ØØØØ:
1) ADJUST THE FILTER TO THE DESIRED POINT
2) ACQUIRE THE DATA
3) CHECK THE DISPLAY AGAINST THE LISTING BELOW
4) REPEAT STEPS 1-3 AS NEEDED

TOO LITTLE FILTER DELAY	CORRECT DELAY	TOO MUCH FILTER DELAY
FF	FF	FF
DT=***CO***	CO	CO
CC	DT=***CC***	CC
DD	DD	DT=***DD***

NOTE: THIS CONDITION OR NO TRIGGER MAY BE RECOGNIZED.

2663-46

Figure 2-9. Data transitions, filter adjustment, and triggering.

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OPERATORS CHECKOUT PROCEDURE

INTRODUCTION

The 308 has internal diagnostics to help verify that the instrument is performing properly. Some of the diagnostics occur automatically whenever the 308 is powered on. Other diagnostics require that probes be properly attached to test points or that operator input to the keyboard is needed. Any error found during correct operation of the diagnostics means that an instrument failure has occurred, has been detected, and that service is required.

By executing the power-on diagnostics and user-initiated diagnostics Ø through 5, the operator can quickly verify that signal paths of the 308 are operating properly. User-initiated diagnostic 6 is provided to enable the chip-selects for troubleshooting only.

DIAGNOSTICS

Power Up

When the operator presses the **POWER** switch, the 308 automatically performs a self-diagnostic procedure and will display SELF TEST-IN PROGRESS. If no errors are found, the IN PROGRESS display will change to OK in inverse video in about 10 seconds or less. Then the Parallel Timing Menu will be displayed. However, if an error occurs, the operator may determine the nature of the error from the list in Table 2-1. Some errors may allow the operator to use the instrument if the portion that is defective does not affect the test to be performed.

User-Initiated

For information on performing user-initiated diagnostics Ø through 5, refer to the Performance Check portion of the Calibration section of this manual.

Table 2-1

Power-up Error Codes

Error Codes	Failure
1—6	RAM or ROM—Instrument will not function.
7—23	Parallel acquisition functions improperly.
(16—19)	While parallel acquisition may take place, the delay selected will not be correct.
(20—23)	While parallel acquisition may take place, the sample rate will not select properly.
24	Serial acquisition functions improperly.
25	Shows that a keyboard key was pressed in during power up.
26—28	Signature acquisition functions improperly.

OPERATORS FAMILIARIZATION

THE CONTROL FUNCTION ACCESS CHART

The Control Function Access Chart (foldout page in the Diagrams section) will aid the operator in learning how to access (or move) from one function and its subfunctions to another function.

Organization of the Control Function Access Chart

This chart emphasizes the major analyzing modes of the 308. These modes are: Parallel Timing, Parallel State, Serial State, and Signature. Each major mode and its subfunctions are grouped in separate vertical columns for ease of understanding. The fourth column shows the extended Serial State Menu and the user-initiated Diagnostic Menu. Reading the chart horizontally, you will see four menus in the first row, three cursor displays in the second row, two search word displays in the third row, and two compare displays in the fourth row.

Each display is numbered and titled, and lines connect the various displays. Usually pressing a single key will allow the operator to change from one display to another. The key that must be pressed to change a display is shown next to the line along with an arrow indicating the direction of change.

Extended Serial Menu Addition

Usually one or two keys are pressed to obtain the required display. An exception to this is the extended Serial Menu Addition. If the operator selects another function, such as Signature (display 13), by pressing the **SIGNATURE** key, and then needs to change to the extended Serial Menu Addition, pressing the **SERIAL STATE** key will obtain the Serial State Menu (display 8) again. Next, press the **SERIAL STATE** key a second time to obtain the extended Serial Menu Addition (display 12).

NOTE

Items 4 and 5 on the extended Serial Menu Addition will only be displayed when the SYNC=EXT baud rate is selected.

Pressing the **SERIAL STATE** key again obtains the Serial State Menu (display 8). Therefore, the only way to get into or out of the extended Serial Menu Addition is to pass through the Serial State Menu display.

THE NEXT STATE TABLE

The information contained in the Next State Table, Figure 2-10, is similar (with a few differences) to the information contained in the Control Function Access Chart. In the Next State Table the Signature modes are broken down into the Setup, Hold, and Repeat modes. The effect of using keys to enter instrument variables is also included. The following example illustrates how the table works. Assuming the instrument is in the State Cursor state (5) and the **DATA=** key is pressed, the next state the instrument would automatically enter is the State Menu (3). This is indicated in the table by the *3 at the intersection of the lines between State Cursor and Data=. The asterisk shows that in addition to going into the State Menu state, an instrument variable has been set, and a data entry sequence must be completed by using the data entry keys (see Figure 2-6, Entry Controls).

BASIC OPERATING INFORMATION

The 308 gathers information from a device under test, stores it, and displays it in several forms to allow easy interpretation by the user. All information for display is stored in the Data Memory and may also be stored indefinitely in a Reference Memory for later comparison with data in the Data Memory. Figure 2-11, Baisc 308 Acquisition and Display System, illustrates this process.

Using the 308 is a three-step process. The first step is gathering data via the probe(s) and processing it according to the operator-determined parameters. The second step is storing the data in the Data Memory and later in the Reference Memory, if needed. The data gathering and storing processes together are referred to as a data acquisition.

Pressing the **START** key initiates an acquisition. This does not always cause automatic storage of incoming data since various triggering, clocking and/or word recognition requirements programmed by the operator may delay or prevent storage. Once all of the proper conditions have been met, the data is stored in the Data Memory to allow the third step, displaying the data. Data acquisitions are identical for certain classes of instrument modes. All Parallel Timing and Parallel State modes have identical acquisitions, and all Serial modes have identical acquisitions. Stored data from either a Parallel or a Serial acquisition is placed in the same (and only) Data Memory. Thus, all of the serial and parallel display formats can be used to examine the data acquired, regardless of whether the acquisition took place in a Serial or a Parallel mode. After a data acquisition has been made, the operator can place this same data into the Reference Memory for a later comparison with other data that is acquired.

KEY ENTERED ↓ / PRESENT STATE →	TIMING MENU Ø	TIMING CURSOR 1	TIMING WINDOW 2	STATE MENU 3	STATE SEARCH 4	STATE CURSOR 5	STATE COMPARE 6	SERIAL MENU 7	SERIAL SEARCH 8	SERIAL CURSOR 9	SERIAL COMPARE A	SIGNATURE SETUP B	HOLD C	REPEAT D	EXTENDED SERIAL MENU E
DATA=	*Ø	*Ø	*Ø	*3	*3	*3	*3	*7	*7	*7	*7				
FAST	Ø	Ø	Ø	3	3	3	3	7	7	7	7				
WINDOW	2	2	2												
EXT=	*Ø	*Ø	*Ø	*3	*3	*3	*3	*7	*7	*7	*7				
SLOW	Ø	Ø	Ø	3	3	3	3	7	7	7	7				
SEARCH=				*4	*4	*4	*4	*8	*8	*8	*8				
CURSOR	1	1	1	5	5	5	5	9	9	9	9				
DELAY=	*Ø	*Ø	*Ø	*3	*3	*3	*3	*7	*7	*7	*7				
STORE DATA	Ø	1	2	3	4	5	6	7	8	9	A				
RESTART	Ø	1	2	3	4	5	6	7	8	9	A				
COMPARE				6	6	6	6	A	A	A	A				
PRL TIMING	Ø	Ø	Ø	Ø	Ø	1	Ø	Ø	Ø	1	Ø	Ø	Ø	Ø	
PRL STATE	3	5	3	3	3	3	3	3	4	5	6	3	3	3	
SERIAL	7	9	7	7	8	9	A	E	7	7	7	7	7	7	7
SIGNATURE	*B	*B	*B	*B	*B	*B	*B	*B	*B	*B	*B	*B	*B	*B	
RISING EDGE												B			
FALLING EDGE												B			
REPEAT												D	D	D	
HOLD/RESET												C	C		
START	Ø	1	2	3	4	5	6	7	8	9	A				

* ACCEPTS DATA ENTRY SEQUENCE AFTER GOING TO NEXT STATE

2663-06

Figure 2-10. Next state table.

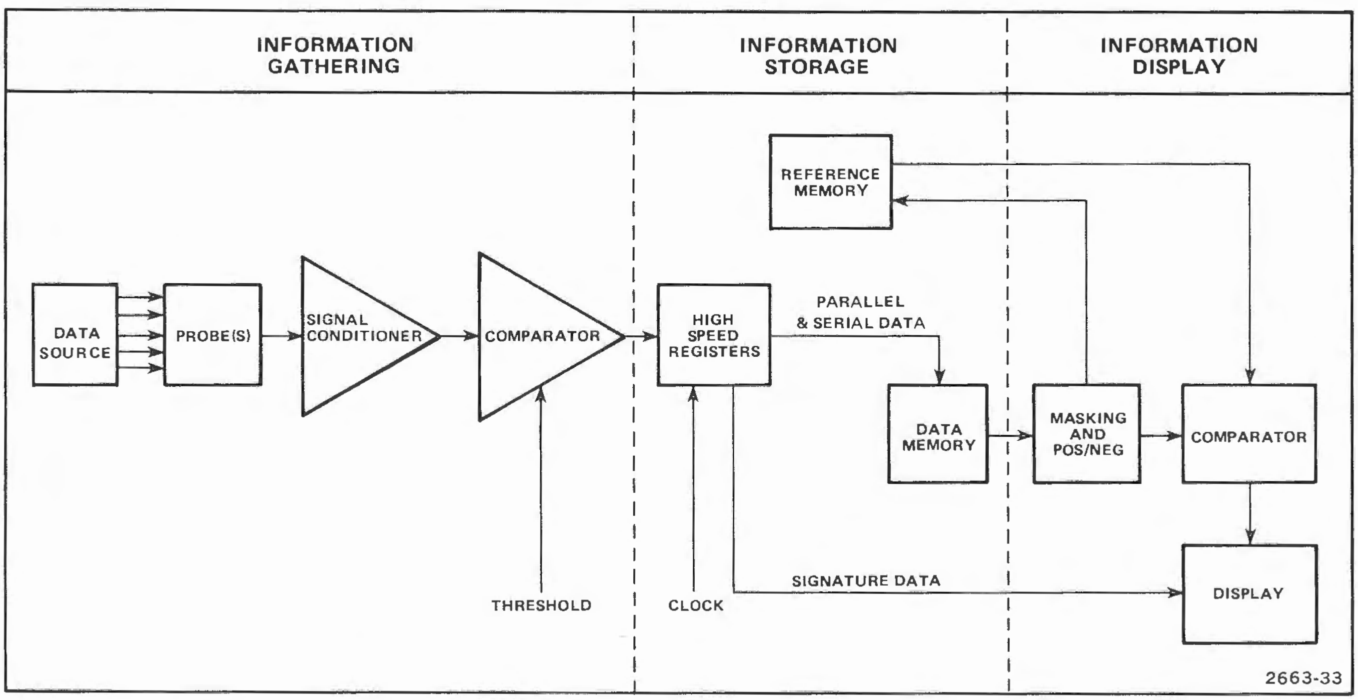


Figure 2-11. Basic 308 acquistion and display system.

Information Gathering

The 308 gathers digital information that is recorded as a sequence of numbers, not as voltages. Figure 2-12, Positive Logic with Number Assignments to Voltage Inputs, illustrates how the number assignments are determined. The digital equivalent of the input voltage is either a one or a zero, depending on whether the voltage level is above or below the preset threshold voltage.

Information Storage

There are three ways in which digital data is stored by the 308 for presentation to the user.

In the Parallel Timing and Parallel State modes, data is acquired simultaneously on eight separate lines. The eight bits of each sample point are stored in the Data Memory that can hold up to 252 eight-bit samples (bytes).

In the Serial State mode, incoming data on one line is interpreted according to EIA STD RS-232-C rules into bytes of data that may be from five to eight bits in length. Each resulting byte is stored in the 252-byte Data Memory. This is the same 252-byte Data Memory that is used for storing parallel data. The methods of triggering and storing are similar for serial and parallel modes.

Within the Data Memory there are two sample-point positions that can be chosen as a reference point. The one eight-bit point chosen will contain the byte associated with the delayed trigger condition. The two conditions are selectable to allow more data to be retained from before (PRE) or after (POST) the delayed trigger condition.

In the Signature mode, the data is transformed into a 16-bit, 4-digit alphanumeric code. If the trigger conditions always allow the same sequence of samples to be obtained, a valid signature will be generated.

PARALLEL AND SERIAL ACQUISITION PARAMETERS. The Parallel Timing and Parallel State menus have identical menu information; therefore, any selection made in either mode will have the same effect, and only the display will change. The Serial State menu has a great deal of commonality with the Parallel State menu, and they will be discussed together. Table 2-2 is keyed to Figures 2-13 and 2-14 and describes the acquisition parameters for Parallel State and Serial State menus.

STARTING THE ACQUISITION. An acquisition is started when the following conditions have been met:

1. All of the parameters are correctly set, as discussed in previous paragraphs.

2. The probes have been properly connected.

3. The threshold has been set or adjusted properly.

4. The correct timing information is available for the sampling inputs.

5. The **START** key is pressed.

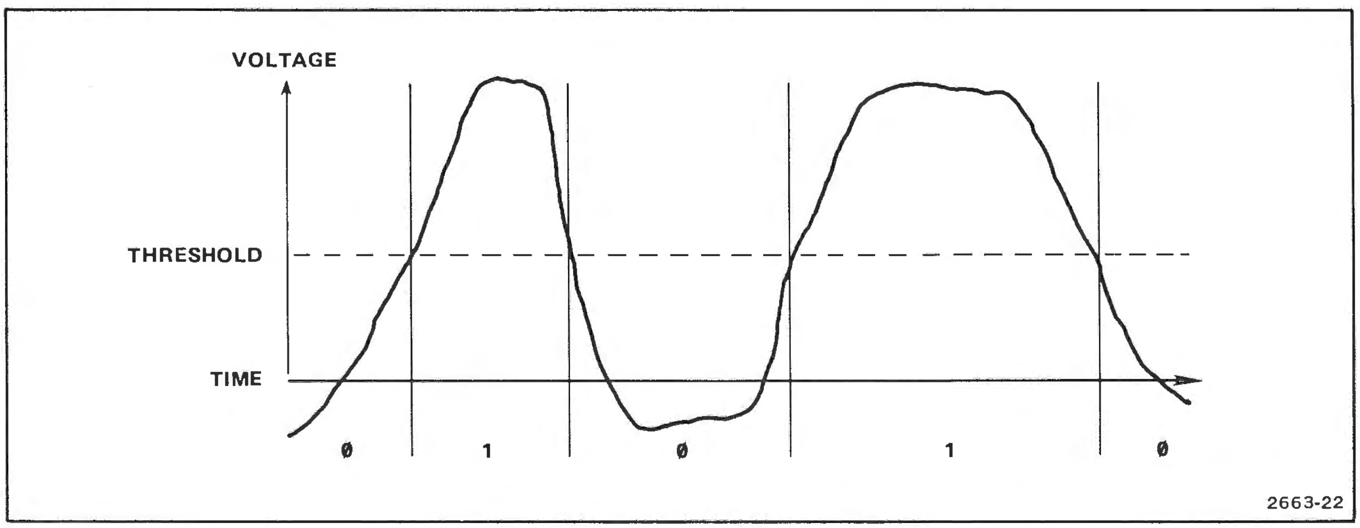


Figure 2-12. Positive logic with number assignments to voltage inputs.

Table 2-2

Parallel and Serial Acquisition Parameters

Item	Applicable Menu	Description
1.	PARALLEL AND SERIAL	Shows main instrument mode: Parallel Timing, Parallel State, Serial State, or Signature. Inverse video shows that data was acquired in another mode.
2	PARALLEL AND SERIAL	Data entry mode: Hexadecimal, Decimal, Octal, or Binary. Controlled by the Entry Format keys described in Figure 2-6 and affects only the data entered in the acquisition parameter information blocks. Does not affect the data format of the display.
3	PARALLEL	Sample or Latch: Affects the method of gathering data.
	PARALLEL AND SERIAL	When in Sample mode, the data is clocked-in using specified setup and hold times.
4	PARALLEL AND SERIAL	PRE Trigger Data or POST Trigger Data: Controls location of Delayed Trigger to be in the 13th or 240th byte acquired in the Data Memory. For general concept information refer to the discussion on Data Storage and the Data Memory under Basic Operational Information.
5	PARALLEL AND SERIAL	**POS**itive or **NEG**ative: These are not acquisition variables. They control the sens by which the Data Memory displays information. **POS** means that voltages above the threshold appear as 1's. **NEG** means that voltages below the threshold appear as 1's.
6	PARALLEL AND SERIAL	DLY=: Sets the number of sample intervals between the Start Trigger and the Delayed Trigger. The inverse video character that appears between DLY and = indicates the number system in use, as follows: H means Hexadecimal and O means Octal. For decimal values no character is inserted. The value cannot be set in binary.
7	PARALLEL	SMPL=: Selected by the **SAMPLE INTERVAL/FASTER/SLOWER** keys. Internally-generated periods have a range of 50 ns to 200 ms in a 1-2-5 sequence. Externally generated sample periods controlled by either the rising or falling edge of the Clock input may be selected.
	SERIAL	SYNC= or ASYNC=: Selected by the **SAMPLE INTERVAL/FASTER/SLOWER** keys. ASYNChronous baud rates from 50 Hz to 9600 Hz may be selected. Externally generated sample periods controlled by either the rising or falling edge of the Clock input may be selected.
	PARALLEL	DATA=: Displays the data portion of the trigger specification. Selecting the data format (information block 2) will cause an O, H, or B to be inserted in inverse video between DATA and = if the values are in a non-decimal format. Pressing the **DATA=** key will cause the display to light up an inverse video block of the appropriate length for the data format selected; then the data entry keys can be used to fill the block. Errors may be corrected with the **CE** (Clear Entry) key.
	PARALLEL	EXT=: An expansion of the Trigger specification for inputs other than data inputs. Pressing the **EXT=** key will cause the display to light up an inverse video block of the appropriate length for the data format selected; then the data entry keys can be used to fill the block. Errors may be corrected with the **CE** (Clear Entry) key. If the Word Recognizer Probe is connected, pressing the **EXT=** key allows the operator to specify its word. In that case, the external/clock qualifier entry block will be moved to the right of the word recognizer entry block, and separated by a hyphen.
8	SERIAL	DATA 1= and DATA 2=: Pressing the **DATA=** key will cause both of these blocks to light up in inverse video. These blocks specify a two-byte sequence for triggering serial acquisition. More information is contained in Serial Protocol Variables.

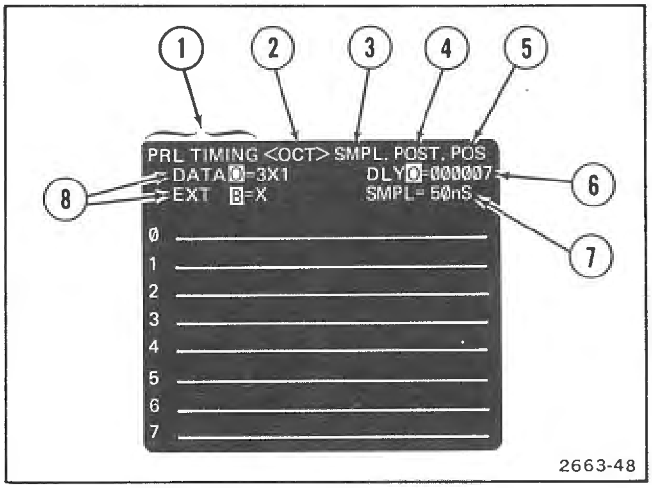


Figure 2-13. Parallel acquisition menu.

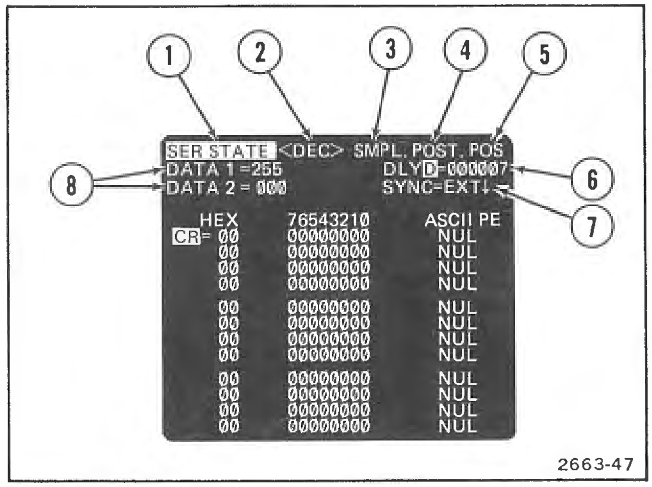


Figure 2-14. Serial acquisition menu.

NOTE

PARALLEL: No data is received if the sample rate is set to an external clock which is not crossing the threshold level.

SERIAL: No data is received if the sample rate (baud rate) clock is set for an external clock which is not crossing the threshold, or if protocol timing information is not present to cause synchronization of the receiver. See the portion on Serial Protocol Variables for more information.

6. Either the **START** key or the **RE-START IF DATA = REF** key is pressed. Starting may be done repeatedly by using the Reference Memory to pre-qualify an automatic restart using the **RE-START IF DATA = REF** key.

The data portion of the display will disappear during the acquisition and does not return until the acquisition is completed and new data is available for display in the Data Memory.

STOPPING THE ACQUISITION. An acquisition is stopped when any one of the following conditions is met:

1. The preset trigger condition is met (indicated when the **TRIG'D** indicator is illuminated.

2. The programmed delay has been completed.

3. The Data Memory is filled as needed for the PRE or POST modes.

4. The **STOP** key is pressed, generating a Stop Trigger.

5. The Data Memory is completely filled.

When a Stop Trigger is provided by pressing the **STOP** key, the following actions occur:

The most recently acquired byte becomes the Stop Trigger and up to 239 previously acquired bytes will be available in the Data Memory. The Stop Trigger byte is placed in location 240 in the Data Memory. The last 12 bytes of the Data Memory are unfilled (and shown as invalid data). Data from the Data Memory immediately appears on the screen.

TRIGGER CONDITIONS. The flexibility of the 308 is increased by the large variety of trigger conditions that it can be programmed to accept. These conditions differ considerably between Parallel and Serial acquisitions and are described as follows:

PARALLEL

1. The trigger can be based on up to 25 different inputs at the same time.

2. The Data Acquisition probe provides eight inputs (any byte of input data) to the Trigger. Inputs can be specified by the DATA= block of the menu. Any input may be required to be HI, LO, or X (don't care). For example, if the operator set the screen display to DATA $\boxed{B}$ = 011XXXXX, then bits zero through four are set to Don't Care (X), bits five and six are set to a HI, and bit seven is set to a LO.

3. With a Word Recognizer probe attached, EXT= can be expanded by an additional sixteen bits, with the **EXTERNAL TRIGGER QUALIFIER INPUT** always being the 17th bit. These bits can be set like the ones for the data acquisition probe. Don't Care (X) bits are available only in the HEX entry format. The external Word Recognizer probe accepts X's as equivalent to a four-bit group. An example with the Binary format selected would be:

EXT $\boxed{B}$ = 11110000
00001111—1

4. With the **T/C** switch set to the T and with no Word Recognizer probe installed, this bit is always a part of the trigger qualifier. An example of the screen display is EXT = X. If the **T/C** switch is set to C, that bit must be HI in order for a data byte to be acquired and recorded in the Data Memory. Therefore, not every byte will be accepted (only those with the EXT = 1). Special timing requirements on this clock-qualifying function are described in the Specification portion of this manual.

SERIAL

1. The data stream into the Serial/Signature probe can be used for a trigger source if the **DATA** = key is pressed. This requires the operator to fill in two information blocks that define exactly what two *consecutive* data bytes will be used to trigger the 308. An example of the screen display in this case would be:

DATA 1 $\boxed{B}$ = 00001111
DATA 2 $\boxed{B}$ = 11110011

2. The second way of triggering the serial data stream is to press the **EXT** = key; then the trigger will be a single bit coming in through channel zero of the Data Acquisition probe. The screen display will change (e.g., EXT $\boxed{B}$ = 1).

FULL VALID DATA MEMORY AND FIRST TRIGGER MODES. Usually when acquiring parallel data, the first few triggers may not be accepted by the 308. In the Full Valid Data Memory mode the 308 can refuse to accept triggers until enough data to fill the Data Memory has been received.

Occasionally, the operator has a requirement to observe data early in an acquisition sequence and should use the First Trigger mode. To do this, move jumper P224 from pins 1 and 2 (Full Valid Data Memory mode) to pins 2 and 3 (First Trigger mode).

Information Display

PARALLEL AND SERIAL DISPLAYS. Data the 308 has acquired and stored in its Data Memory can be displayed in several ways. Data Memory can contain up to 252 bytes. The manner in which data is displayed is determined by pressing the **PRE** or **POST** key, unless the **STOP** key was pressed to end the acquisition. This applies to all modes except Signature. For normal displays, the Delayed Trigger is put into either the PRE or POST trigger data position. When the **STOP** key is pressed, a special display is automatically selected. When the operator presses the **STOP** key, the 308 will display up to 239 bytes of data (from the Data Memory) that occurred before the **STOP** key was pressed.

The displays never show the entire Data Memory at once. They may show as few as 12 bytes (in a state mode) or as many as 168 bytes (in the Timing mode). Each display has a different purpose.

Data can be acquired in either a parallel or serial mode and displayed in either mode. The words on the display screen indicate that the mode of operation will be in inverse video if the data being displayed was acquired in another mode. If the data was acquired in the Parallel mode and the display was changed to the Serial mode, the words SER STATE will appear in inverse video in the upper left corner of the screen to indicate that the data being displayed was acquired in another mode.

CURSOR DISPLAYS. There are three cursor displays that refer to the same cursor. The Parallel Timing Cursor (display 2 in the Control Function Access Chart) is used to inspect the Data Memory in a timing-diagram format. The cursor may be moved onto the screen with the **POSITION** controls. The cursor word will be displayed in hexadecimal, octal, decimal, or binary depending on the operator-selected format. A numeral indicates the relative position of the cursor and the Delayed Trigger. The numeral indicates the number of spaces between the cursor and the Delayed Trigger, and the sign (+ or −) indicates whether the cursor precedes (−) or follows (+) the Delayed Trigger.

The Parallel State Cursor display (display 5 in the Control Function Access Chart) shows twelve bytes from the Data Memory, starting with the Cursor byte. The Cursor position, after Delayed Trigger, is shown at the top of the data listing. The listing shows the data in hexadecimal in the first column, binary in the second column, and octal in the third column. The **POSITION** controls move the cursor to any position in the Data Memory. These controls may be held down for continuous motion of the cursor.

The Serial State Cursor display (display 9 in the Control Function Access Chart) is similar to the Parallel State Cursor display. The difference is that the third data display column has the ASCII equivalent of the data instead of the octal equivalent.

Everything that has been mentioned so far concerns getting data into the 308 Data Memory. The next areas to be discussed evolve around displaying the memory contents, the controls for displaying the data, the methods of displaying the data, and finally, how data acquired in one mode may be intermixed and displayed in another mode. Particular details of the masking and inversion that occur in certain cases will also be explained along with the general usage of the Reference Memory.

The number of bytes displayed on the screen and the position of this segment in the Data Memory are controlled through the Parallel Timing window display which is discussed next.

PARALLEL WINDOW DISPLAY. The Parallel Window display (display 3 in the Control Function Access Chart) is used to control the portion of the display that is shown in the timing displays and the magnification factor. In this display, the window size will change from 168 to 84 to 42 bytes and back around as the **WINDOW** button is pressed repeatedly. The position of the window within the Data Memory is controlled by the **POSITION** keys while in this display. The cursor position will not change, relative to the data, when using the **POSITION** controls in this display. It will continue pointing at the same data byte as that byte is moved to different places in the display. The window size is displayed at the top of the screen.

The bar at the top of the data display is a representation of the Data Memory. The dark area indicates the part of the Data Memory showing in the display. The Ø indicates where the Delayed Trigger is positioned in the Data Memory. It will be either in the PRE Trigger data or POST Trigger data position. Usually, the Parallel Timing and Parallel Cursor displays would be used together to position the window into the memory and then to inspect the memory with the cursor. The next step could be to use the Parallel State display to further increase the detail available from a portion of the memory.

SEARCH WORD DISPLAYS. The two Search Word displays (displays 6 and 10 in the Control Function Access Chart) work identically, except that the Parallel State Search Word display shows an octal listing and the Serial State Search Word display shows an ASCII listing.

The purpose of this display is to allow the user to quickly locate a byte in the Data Memory or to determine whether it is in the Data Memory. To use the Search Word displays, press the **SEARCH=** key, then press the appropriate data entry keys to fill in the word to be found. Any data entry format can be used to make this entry. The display will return a message showing the location of the first occurrence of the word in the Data Memory, and the word will appear in the cursor location. If the word is not found, the cursor will not move, and the display will read SRCH POS = SW NOT FOUND. The **POSITION** keys can be used to find successive occurrences of the Search Word. Each time a **POSITION** key is pressed, the display will move the next occurrence of the search word to the top of the display and update the rest of the display. If the only part of the display that changes is the SRCH POS = section, then the whole pattern repeats. This might occur when the data is acquired from a data bus during execution of a program loop.

COMPARE DISPLAYS. The Compare displays are used in conjunction with the Reference Memory. The Reference Memory is filled with a copy of the Data Memory when the **STORE DATA → REF** key is pressed. The Compare displays would then show differences between the Reference Memory contents and any later Data Memory contents. The display is highlighted in inverse video for data which differs between the Data Memory and Reference Memory. This display is often used with the Restart mode described in the paragraph on the Reference Memory.

INTERMIXING PARALLEL AND SERIAL DISPLAYS. There are two major areas of special consideration for intermixing serial and parallel display modes. These are of concern when data acquired in Parallel mode acquisitions are displayed in Serial mode displays or vice versa. The important points concern bits-per-character masking and data inversion by using the **POS** and **NEG** keys.

There is one general rule for use of the Reference Memory. The Reference Memory will always store data when the **STORE DATA → REF** key is pressed. That data will have the same form as the data being displayed when the key is pushed. The effects of this will be discussed later.

PARALLEL ACQUISITIONS AND SERIAL DISPLAYS. Any time the serial displays are being used to view parallel-sourced data, the data will be affected by the current bits-per-character setting in the extended Serial Menu. This means that if eight bits of parallel data were acquired but the display is Serial State Cursor, there might be some bits displayed as zero (even though the same bits would not be zero in a Parallel State Cursor display). If the bits-per-character variable is set to 5, then bit 7, bit 6, and bit 5 will always be shown as zero in this situation. This is true for both POSITIVE and NEGATIVE logic selections.

This behavior allows the operator to make direct comparisons of serial and parallel data with the Reference Memory. If a byte of parallel data is 11111111_2 and it is being observed in a serial display with bits-per-character set to 5, then it will appear as 00011111_2. If the display is one of the serial displays and the **STORE DATA → REF** key is pressed, then that byte will be stored as 00011111_2. If the display were parallel, then 11111111_2 would be stored.

In this example, if data was obtained from the parallel side of a serial-to-parallel conversion process (or a parallel-to-serial process), the data would be shown and stored in the Reference Memory in the same form as if it had been acquired from the serial side of the converter.

This behavior can be seen by first acquiring all ones, 11111111_2 in parallel (initialize the instrument by turning it on and pressing the **NEG** key). Then select the extended Serial Menu and set bits-per-character to 5. Then select the serial menu display. The data will now appear as 00011111_2. To further emphasize this effect, press the **STORE DATA → REF** key. Now select the Parallel State Compare display. The first three bits of the state listing will be highlighted as $\boxed{111}$ 11111_2. This is because the Reference Memory contains 00011111_2 while the Display Memory is being shown as 11111111_2.

SERIAL ACQUISITIONS AND PARALLEL DISPLAYS. When using the Serial Acquisition system, the bits-per-character variable takes effect with the next acquisitions. To allow the 308 to correctly interpret serial data, the bits-per-character setting must agree with the data being received. See Serial Protocol Variables for more information. When fewer than eight bits are being received, they are stored in the least significant bit locations in the Data Memory. The most significant bits which are not used are set to zero. For example, if the data 11111_2 was being sent on the serial line under test, the bits-per-character setting should be set to 5. The data will be stored in the Data Memory as 00011111_2.

There is a noticeable difference between the behavior of serial and parallel acquired data. If the data has a serial acquisition source, the display masking will not change when the bits-per-character is changed until a new acquisition is done. For parallel acqired data, the change is immediate.

The contents of the Data Memory filled from serial acquisitions can be compared against parallel acquisition data stored in the Reference Memory. If data acquired from a parallel source is later stored into the Reference Memory while the display is set to SERIAL STATE, the data acquired in a new serial acquisition can match it exactly and the Compare displays can be used to find errors. The Re-start If Data = Ref mode can be used by the 308 to continuously monitor and record (babysitting mode) a serial line with a reference from a parallel acquisition.

MASKING AND INVERSION. Refer to Figure 2-11, Basic 308 Acquisition and Display System, as Masking and Inversion are discussed. Any data bits that are not filled by a serial acquisition are displayed as zeroes. If parallel data is being shown in a serial display mode, it is treated exactly as serial data with the same number of bits per character. The parallel acquisition is an eight-bit byte and, if displayed serially with a six-bit byte selected, bits 6 and 7 will appear as zeroes.

The masking (setting of data bits to zero) happens after the data sense is determined and after an acquisition has been made, if the data was acquired in a parallel mode. This is true for both the negative and positive logic sense. All unused bits are set to zero to show that they are unused.

Signature Analysis

The 308's signature analyzer is accessed by pressing the key labeled **SIGNATURE.** The Signature mode is entered in a way that allows the operator to specify the signal transition of the signature the operator is looking for. This is done by using the _/‾ and the ‾_ keys to select the required signal transition for Clock, Start, and Stop signals.

There are two ways of acquiring signatures and displaying them. To obtain one signature and display it, press the **HOLD/RESET** key. This will obtain one signature, display it, and stop. Another signature can be obtained and displayed by pressing the **HOLD/RESET** key again. The new signature will be put on the top of the list, with the old signature under it. If the new signature is different from the old signature, there will be a < sign placed to its right. Up to eight signatures can be displayed at one time using this Hold mode.

When there is no Start signal present, the **TRIG'D** indicator will not be illuminated. When a Start signal is present, but there is no Stop signal, the **TRIG'D** indicator will be illuminated continuously and no signature will be displayed on the screen. In the latter case, press the **STOP** key to terminate the search for a signature. This causes an invalid signature to be generated and displayed. Control settings may then be changed, if necessary.

To repeatedly obtain signatures and update the screen, press the **REPEAT** key. In this mode the signature-acquisition circuit starts seeking for a new signature while an old signature is being displayed: Whenever the new signature differs from the next most recently acquired signature, the new signature will be displayed and the message FAULT will be displayed for about one second. If the signature is continually changing (unstable) the FAULT message will blink continuously.

Signatures are four-character alphanumeric codes that are characteristic of certain repeating data streams. To obtain a signature, there must be a Clock signal, a Start signal, and a Stop signal in addition to the Data signal. The Start and Stop signals are used to open and close a gate for the Data signal. During the open gate, the Data signal is fed into a shift register with feedback paths. At the close of the gate, the contents of the 16-bit shift register is turned into a display. The **TRIG'D** light on the front panel is turned on when the gate is opened by the Start signal and is turned off when the gate is closed by the Stop signal.

Figure 2-15, Typical Signature Data Sequences, shows how Start and Stop signals gate the signature data sequence. Figure 2-16, Data to Signature Sequence, shows how the gated data is formed into a signature by a shift register circuit. Before the gate is opened, the shift register is reset to all zeroes. As each bit of data is passed by the gate, it is exclusive-ORed with shift register bits 7, 9, 12, and 16. The output is shifted into the register. The contents of the shift register, after the gate is closed by the Stop signal, is the signature in binary form. The display is formed by showing one character for each four bits of the shift register. The display codes are a special set of numbers and letters that correspond to the hexadecimal digits shown in the figure.

To use the Signature Analyzer in the 308, the start, stop, and clock leads on the Parallel Data Acquisition probe must be connected to appropriate test points. Then the Serial/Signature probe must be attached to the Data test point. The threshold must be adjusted for these probes by selecting either TTL or VAR and setting **THRESHOLD VOLTAGE** to the appropriate value.

The input to the 308 Serial/Signature Data probe is 10 MΩ at approximately 13 pF. This input is voltage-sensing and furnishes no current to the test node (the test point for signature data input). The Start, Stop, and Clock inputs are also high-impedance, voltage-sensing inputs (but at about 1 MΩ). The voltage is converted to ones and zeroes by comparing it to a threshold level in the same manner as with other serial data. The Data, Start, Stop, and Clock input signals are all compared to the same threshold (TTL or Variable), allowing the 308 to be compatible with many logic families.

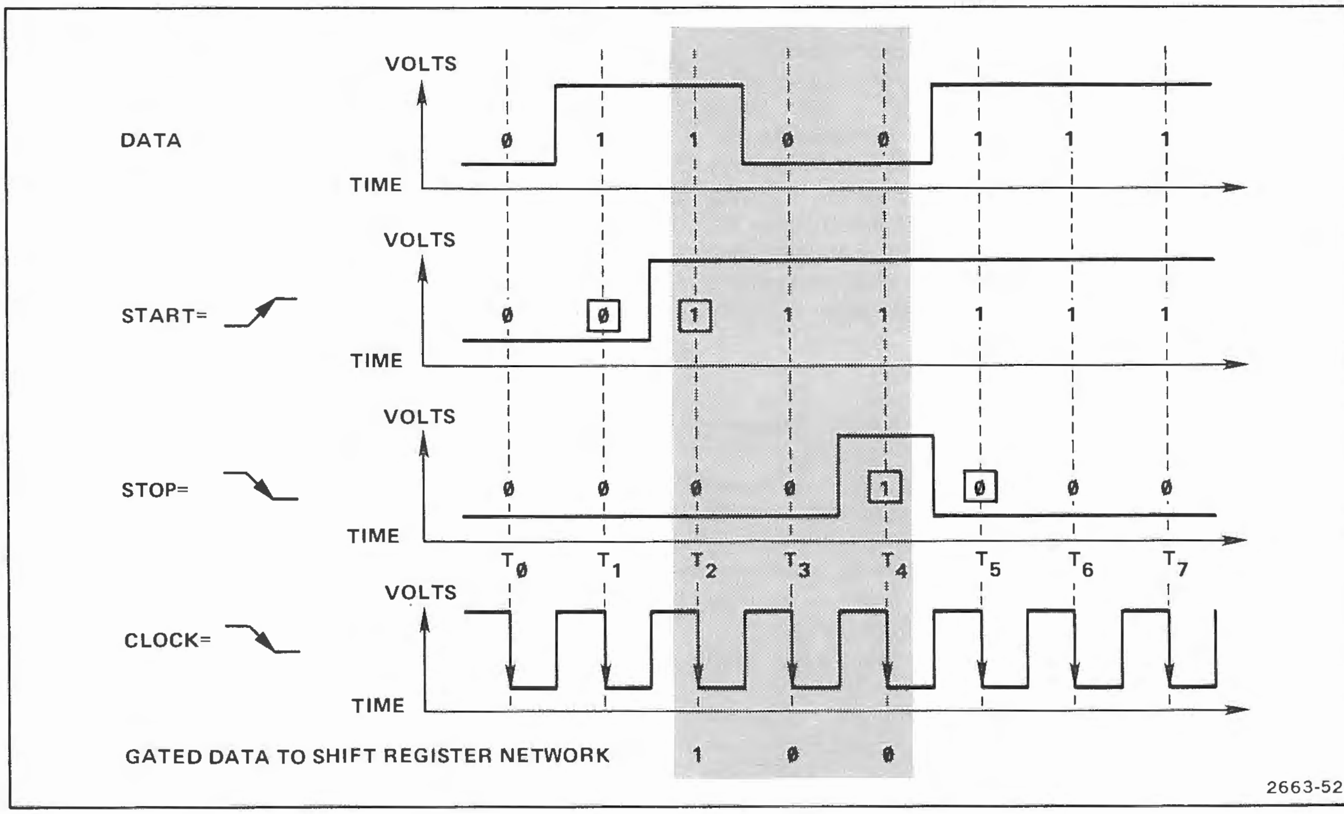


Figure 2-15. Typical signature data sequences.

Figure 2-15 shows the relationship between the Data, Start, Stop, and Clock inputs and indicates when there is a gated data output sequence. The sample periods are dependent on the inputs making a level transition and staying at that level until the next Clock edge occurs. Signature analysis forms sequences of ones and zeroes on the three input lines. These three lines are sampled by the clock input on the basis of the operator-selected clock edge. The data sequence is formed into a signature starting from the clock edge associated with a Start and to (but not through) the edge associated with a Stop. Figure 2-15 illustrates that a Start sequence includes a zero followed by a one at consecutive clock edges in the example shown. The opposite sequence would be true if the operator had selected the other Start transition direction. Stop works the same way as Start, and either sequence may be selected.

Figure 2-16 shows how data is gated to a signature sequence.

Nodes are tested for their ability to provide the proper data sequence (correct signature). A node that does not assert the proper values for each clock-generated sample during an open gate will produce the wrong signature 99.998% of the time (probably a wrong or unstable signature). Some of the situations that will produce unstable signatures follow:

1. Any of the sequences not repeating in a stable cycle.

2. An open circuit on the data node or the selected driving circuit.

3. A tri-state node in the high-impedance state during a data-sequence-sample time.

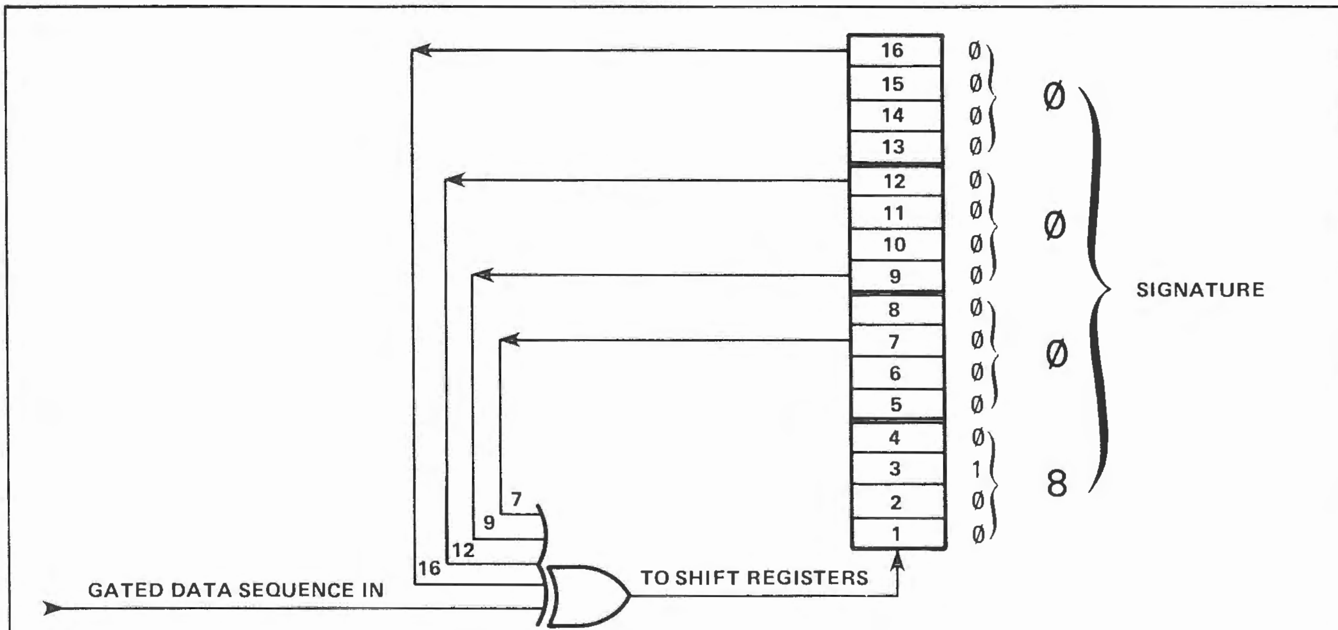
Some of the situations that will produce incorrect (but stable) signatures are as follows:

1. A faulty circuit in the previous stage.

2. A shorted line.

TYPICAL APPLICATION

All four modes of 308 operation are demonstrated in the following example. Then the intermixing of data, Compare, Search, and Re-start examples will be explained. All of these applications are explained with reference to a



HEXADECIMAL NUMBERS	Ø	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
SIGNATURE DIGITS	Ø	1	2	3	4	5	6	7	8	9	A	C	F	H	P	U

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Figure 2-16. Data to signature sequence.

partial schematic, Figure 2-17, which illustrates a typical serial port on a bus-oriented instrument. The port accepts eight-bit parallel data and changes it to asynchronous serial data with Start and Stop bits at 9600 baud.

The testing sequence first takes Signature verification, makes a Parallel Acquisition, then a Serial Acquisition, and then examines the data acquired in one mode in a different mode. Finally, the Re-start, Search, and Compare subfunctions are demonstrated. The circuit in Figure 2-17 is TTL, so place the **VAR/TTL** switch in the TTL position.

Displays in the Control Function Access Chart are referred to by display number as examples of data entries and screen displays.

Signature Verification

Power-up the 308. After the 308 has completed the self-test diagnostic routine and is displaying a Parallel Timing Menu, press the **SIGNATURE** key. Then press the _/‾ key twice and the ‾_ key once. This sets the 308 to use a positive-going clock edge, begins acquiring signature data on a zero-one start sequence, and stops acquiring data on a one-zero sequence. The screen display now shows this information.

Connect the Data Acquisition probe to the 308, the C lead to TP1, the 0 lead to TP2, and the 1 lead to TP3. Now connect the Serial/Signature probe to the 308, with the ground clip lead to TP4, circuit ground. This probe will be used to acquire the actual signature data. Refer to Table 2-3 for the application example signature list.

At this point the operator would normally refer to the manual for the particular equipment under test for information on how to place this circuit in a specific loop or mode of operation. This allows the operator to determine exactly what data will be present on the bus or at certain pins of the components. Some examples of how this is accomplished (depending on the particular equipment) would be: user callable routines, grounding or connecting certain pins to a supply voltage, or placing control switches to a certain position.

Place the probe tip on TP4 and press the **HOLD** key three times. The screen display now shows three signatures of ØØØØ. Place the probe tip on +5 V and press the **HOLD** key. Now another signature of 175A has been added to the display. By doing this the operator has proved that the 308 is correctly starting and stopping with the clock start and stop edges.

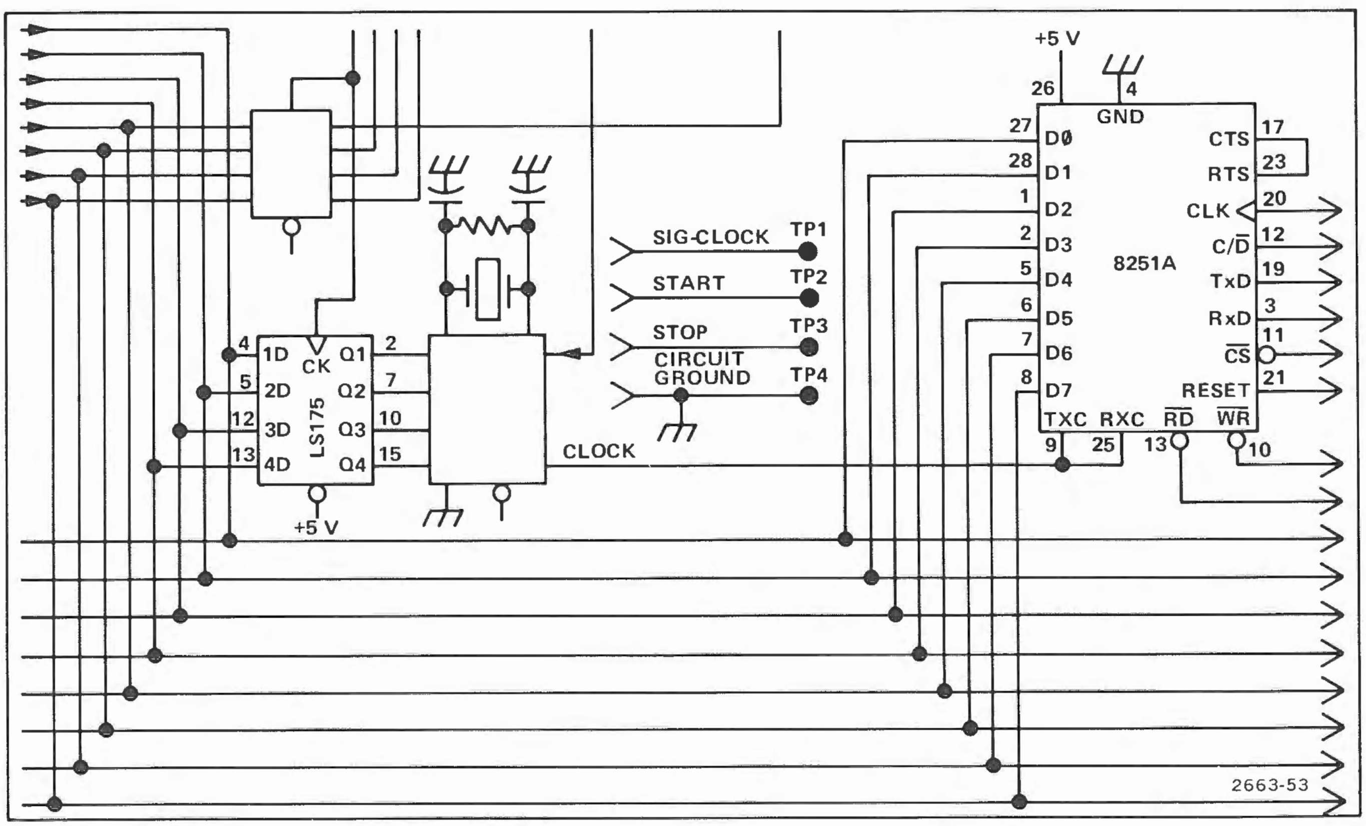

Figure 2-17. Test schematic for the 308 application example.

Table 2-3

Signature List

TEST POINT	SIGNATURE
+5 V	175A[1]
GROUND	0000[1]
74LS175 Pin 2	6PF9
7	PHFF[1]
10	028A
15	75PF[1]
8251A Pin 8	0771
7	6HCH
6	H233
5	P9CF[1]
2	7322
1	0007[1]
28	U8H0
27	4698
12	2H92
11	6PF0

[1] **Used in this test example.**

During any signature test, finding a pin with a ØØØØ signature instead of the one listed for it suggests that the pin is stuck to ground. The same would be true of a pin reading the signature for +5 V instead of what is listed for it. That pin is probably stuck to +5 V.

Place the probe tip at the following test points and press the **HOLD** key one time while at each test point: 74LS175 pins 7 and 15, 8251A pins 5 and 1. Any of the other test points and signatures listed in the table could have been used as needed. Press **STOP** once to end this signature acquisition process.

Parallel and Serial Data Acquisition

PARALLEL. Connect the Serial/Signature probe to 8251A pin 19. This is the serial data output port of this device. Connect Data Acquisition probe leads 0—7 to 8251A pins 27, 28, 1, 2, 5, 6, 7, and 8 respectively and the ground lead to TP4. Connect the clock lead to pin 10. The 0—7 leads are now connected to the parallel data inputs of 8251A, and the clock lead to the WR pin.

On the 308, press the following keys and enter the data listed or perform the action required.

KEY	DATA OR ACTION
PARALLEL STATE	Press once
HEX	None
POS	None
POST	None
DELAY =	0000
FASTER	Press once (to set up an EXT =↑ sample rate)
DATA =	9D
EXT =	X

The 308 is now set to make a parallel acquisition with data entries to be made in hexadecimal, positive logic, data to be displayed after the Delayed Trigger (POST), no delay acquisition times, a positive-going external clock, the trigger word to be 9D, and the External Qualifier set to don't care. The screen display now matches the menu portion of display 4.

Press the **START** key. The 308 does an acquisition, and the screen displays a portion of the Data Memory contents. Press the **CURSOR** key, and the screen display changes to indicate the Cursor position is —12 bytes relative to the Delay Trigger. Press the ↳ **POSITION** key five times, and the screen now matches display 5. Press the **STORE DATA→ REF** key to copy the contents of the Data Memory into the Reference Memory. This will be compared later to data acquired in a Serial Acquisition.

SERIAL. After next doing a Serial Acquisition, the operator will examine the serial data output of 8251A and compare it to the parallel data input that was stored in the Reference Memory.

Press the **SERIAL STATE** key twice. The 308 is now set to examine the data output port using the same clock that was used for the Parallel Acquisition. The screen display now matches display 8, except that part of the menu for synchronization is displaying ASYN = 9600 Hz. The serial output port provides the necessary start and stop bits for asynchronous operation as discussed in Serial Protocol Variables.

Press the **START** key. The 308 does an acquisition and displays a page of data on the screen. Any piece of data that was or should have been acquired can be searched for and displayed. Press the **SEARCH** = key and enter ØB in the inverse video block. The screen display now matches display 10, showing the desired word in inverse video at the top of the screen display. Also, the data in the screen display matches displays 5 and 6, except that the right column is the ASCII equivalent instead of the octal equivalent. The desired word position is —007 (same as the cursor position relative to the Delay Trigger in the previous parallel acquisition). This shows that the serially acquired data is, at least for the first part, the same as the data acquired in parallel. The search function can be used to step through the data, and every occurrence of the desired word will cause it to be displayed at the top of the screen in inverse video.

Compare and Re-Start

The operator will next do a Compare function and a Re-start function to prove that: the data acquired in both parallel and serial modes is the same in this example, and the device under test is correctly accepting parallel data and outputting that same data in a serial format. Remember that the data acquired in parallel is stored in the Reference Memory.

The data acquired during the last Serial Acquisition is in the Data Memory and can be compared to the data stored in the Reference Memory. Press the **COMPARE** key. Any data that is different will be displayed in inverse video.

Page through the entire memory contents by pressing and holding the **POSITION** keys alternately and you will find no differences displayed. The Compare function can be proved to be functioning properly by pressing the **NEG** key. This will invert the logic sense of the display and compare the data in the Data Memory with the Reference Memory. The entire data display is now in inverse video. Again page through the entire memory contents by alternately pressing and holding the **POSITION** keys and you will see that all of the memory contents are displayed in inverse video. Press the **POS** key to return to the positive logic sense in which the data was acquired.

Press the **RE-START IF DATA = REF** key. The 308 now begins to repeat acquisitions in the Serial mode and compare each set of newly acquired data to the Reference Memory. If the new data matches, the 308 increments the re-start counter (whose content is being displayed at the bottom of the screen) and does another acquisition. This process continues until a mismatch is found or the **STOP** key is pressed to provide a manual Stop Trigger. After the 308 has performed a few successful re-starts, press the **STOP** key.

THEORY OF OPERATION

Section Organization

This section of the manual contains a functional description of the circuitry used in the 308 Data Analyzer. It is subdivided into three major categories which are: System Architecture, General System Description, and Detailed Circuit Description. An overall block diagram, wiring diagram, and detailed schematics are found in the tabbed Diagrams section at the rear of this manual.

Each block and the individual circuits are explained in detail. Diagrams are keyed by a numbered diamond symbol in the text, the Table of Contents, and on the schematics. For an optimum understanding of the circuitry, cross-reference the descriptions in this section with the block diagrams. Refer to the Table of Contents at the front of this manual for aid in locating individual circuit descriptions.

Digital Logic Conventions

Digital logic techniques are used to perform many functions within this instrument. Function and operation of the logic circuits are represented by logic symbology and terminology. All logic functions are described using the positive logic convention. Positive logic is a system of notation whereby the more positive of two levels is the true, or 1 state; the more negative level is the false, or 0 state. In the logic description, the true state is referred to as HIGH, and the false state is referred to as LOW. The specific voltages which constitute a HIGH or a LOW state vary between specific devices.

SYSTEM ARCHITECTURE

Microprocessor Unit

The 308 is a parallel and serial data analyzer based on a microcomputer system. An 8085A microprocessor unit (MPU) provides control logic; function selection; and data acquisition, manipulation, and display capability for the 308. The MPU is a bidirectional (read and write), bus-oriented (address bus and data bus), 8-bit parallel device for 16-bit address capability. It provides up to 65,536 discrete addresses, commonly referred to as a 64k byte address capability. The use of this address capability is further defined under system addressing.

Bit patterns, called instructions and contained in a read only memory (ROM), specify the types of MPU activity that cause various instrument operations to be performed. These bit patterns are usually grouped into blocks of instructions to provide complete functions and are called routines. Each of these routines may have subroutines that are either their sole property or shared with other routines. An example of routines used in the 308 and their relationship to each other is shown in Figure 3-1.

Read-Only Memory

The operating system consists of instructions, permanent data, prerecorded messages, and data conversion tables permanently stored in one 2k byte (2048- by 8-bit) and two 8k byte (8192- by 8-bit) ROMs. These ROMs have static memory (i.e., they need no clocking or refresh cycles) and are organized in an 8 bits per byte format with 11 address lines (for 2k byte ROM) or 13 address lines (for 8k byte ROM) and a chip-select line. The address lines and eight data lines are compatible for direct connection to the MPU and common buses without additional drivers. Data in the ROMs are placed in the devices during the manufacturing process and cannot be changed by the functions of the MPU. The data and instructions in these ROMs can be changed only by placing a new programmed device in the instrument.

Data in each RAM is not permanent and is destroyed whenever the instrument is turned off. When power is initially applied, the data occurs as random bits and is therefore meaningless. During operation of the instrument, the MPU places data onto the RAM at various addresses for later recall and use. This process of storing data in the RAM requires the MPU to perform a data-store or data-write operation to a specified address location for each byte of data to be stored.

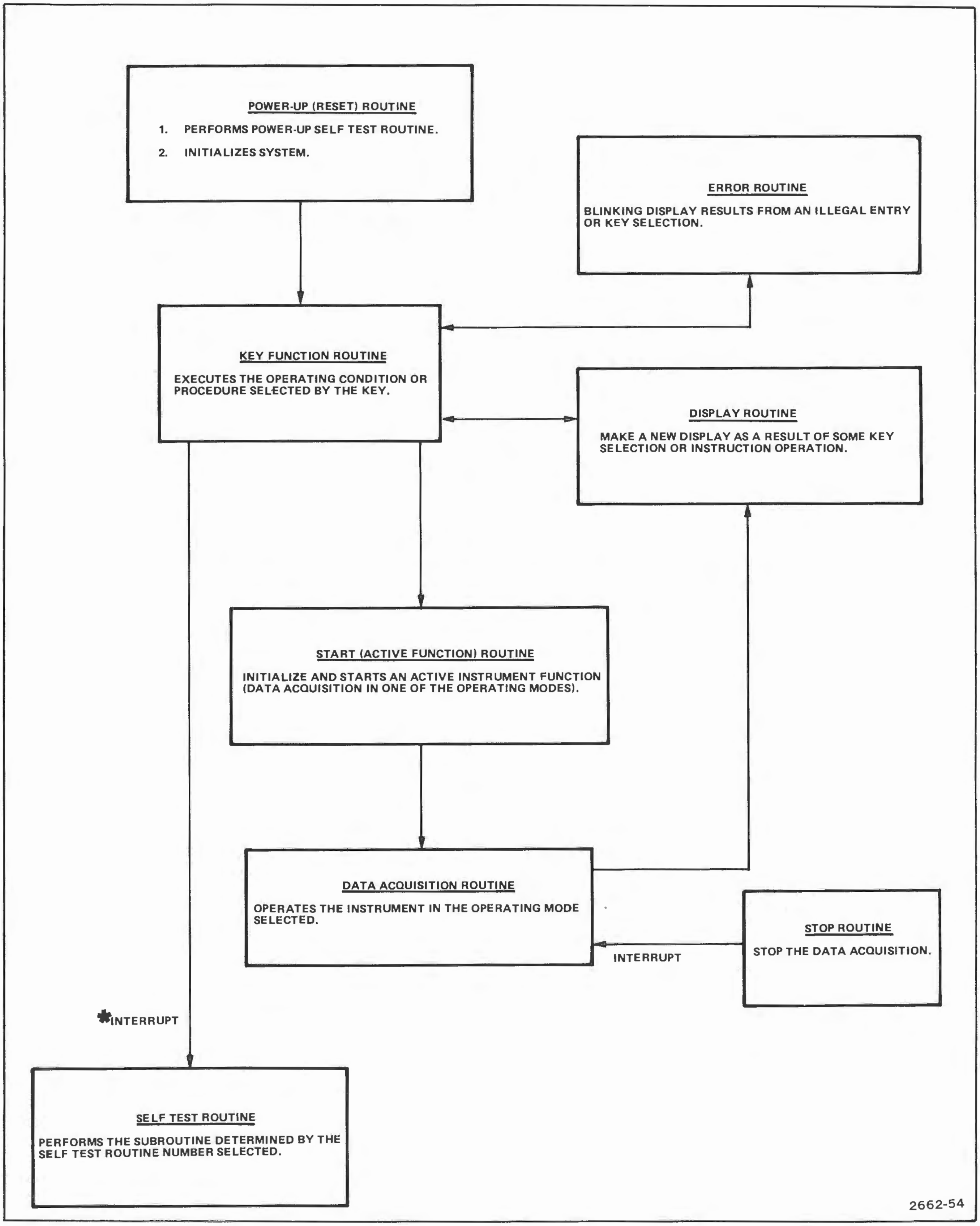

Figure 3-1. Example of block-structured routines in the 308.

In addition to the four 1024- by 4-bit RAMs, two 256- by 4-bit RAMs serve as high-speed buffers for parallel data acquisition. These RAMs also have static memory and are accessible from the MPU via the devices that control the buffer's operation.

Programmable Communication Interface

Acquiring serial data from data communication interfaces such as the RS-232-C is accomplished through the 8251A programmable communication interface, commonly known as a universal synchronous/asynchronous receiver/transmitter (USART), and a serial-data-input selection.

The USART accepts serial data from the serial-data-input section and converts it to parallel data which then appears on the data bus for use by the MPU. Other internal functions of the USART include notifying the MPU when it has either received data destined for the MPU or detected a framing error on incoming serial data.

Display

Displaying relevant data for the operator is accomplished with the cathode-ray tube (crt).

System Addressing

All ROM and RAM inputs and outputs are addressed in the memory space of the MPU. The USART is an example of inputs and outputs within that memory space. Available MPU address space is 65,536 locations. Identification of memory allocation, including beginning and ending addresses in hexadecimal notation, is shown in Figure 3-2.

ADDRESS	DEVICE ADDRESSED AND SIZE	ADDRESS BOUNDARIES	NUMBER OF ADDRESSES USED
000	ROM (DIAGNOSTIC) (2K)	000-7FF	ALL
800	(NOT USED (6K)	800-1FFF	
2000	ROM (OPERATING SYSTEM) (16K)	2000-5FFF	ALL
6000	FOLD BACK (SAME AS 7000-77FF) (2K)	6000-67FF	
6800	(NOT USED) (2K)	6800-6FFF	
7000	HIGH SPEED RAM (U220 & U222) (1K)	7000-73FF	1
7400	SIGNATURE DATA (U382 & U384) (1K)	7400-77FF	1
7800	(NOT USED) (2K)	7800-7FFF	
8000	KEYBOARD (8K	8000-9FFF	1
A000	USART (U390) (8K)	A000-BFFF	2
C000	PARALLEL & SIGNATURE SYSTEM (8K)	C000-DFFF	8
E000	FOLD BACK (SAME AS F000-F3FF (1K)	E000-E3FF	
E400	(NOT USED) (1K)	E400-E7FF	
E800	FOLD BACK (SAME AS F800-FFFF) (2K)	E800-EFFF	
F400	(NOT USED) (1K)	F400-F7FF	
F800	RAM (DISPLAY) (0.6K)	F800-FA7F	ALL
FA80	RAM (1.4K)	FA80-FFFF	ALL
FFFF			

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Figure 3-2. Memory allocation map for the 308.

GENERAL SYSTEM DESCRIPTION

The following discussion provides an overall description of the 308 Data Analyzer. Refer to simplified block diagram, Figure 3-3, and to the functional block diagram located in the Diagrams section of this manual (diagram 12). Each major block in these diagrams represents a major circuit within the instrument. The numbered diamond symbol on each block refers to the associated schematic diagram for that circuit also located in the Diagrams section.

Parallel Data Input

The Parallel Data Input circuit is comprised of threshold voltage circuitry, an ECL-TTL translator, the delay line, an inverter, sample/latch logic, line drivers, and clock delay adjust circuitry. Setting the offset voltage used by the parallel and serial/signature data acquisition probes is accomplished by the threshold voltage stage. The ECL-TTL translator converts ECL clock and data signal levels to TTL levels. The delay line allows the data lines to have appropriate setup and hold times for data acquisition using the external clock. Inversion of data for use by the sample/latch stage and the Word Recognizer circuit is performed in the inverter, while the sample/latch stage permits input to be made in either the sample or the latch mode. Isolation of the Data Input circuit from the Signature Generator circuit is provided by line drivers. The clock delay adjust stage provides selectable taps to a delay line to establish required data delays during acquisitions using external clock.

Word Recognizer

The Word Recognizer circuit produces a high output when the logic states of the Data Acquisition probe inputs and the qualifier input match the states preprogrammed at the 308 front panel controls. If a Word Recognizer probe (optional) is connected to the 308, the Word Recognizer circuit generates a high output whenever the logic states of call the inputs from the Data Acquisition probe, Word Recognizer probe, and the qualifier match preprogrammed states. The Word Recognizer circuit also generates an asynchronous trigger pulse when Internal clock is selected. This asynchronous trigger pulse can be rejected by the filter circuit when it is shorter than the setting of the filter circuit. Filter circuit setting is adjustable from 30 to 300 ns. When External clock is selected, a synchronous trigger pulse is available at the output of the circuit. This output pulse can be used to trigger either the 308 Data Analyzer or other external equipment.

Parallel Acquisition Memory

The Parallel Acquisition Memory circuit consists of the 256- by 4-bit RAM, the address counter, the carry detector, and the clock indicator. The 256- by 4-bit RAM stores 8-bit parallel data at intervals as short as 50 ns. The address counter selects the memory location of storage of each bit. The carry-detect stage provides the trigger enable, address, count, and carry outputs. A clock-indicator stage detects External clock activity.

Trigger Delay

The Trigger Delay circuit includes the trigger delay counter, trigger gate stage, delayed gate stage, data position counter, and clock enable latch. The Trigger output from the Word Recognizer circuit enables the Store/Transfer clock signal to pass through the triggered gate circuit. When delay counting is completed, the delay counter and the delayed gate provide a delayed trigger output and enable the Store/Transfer clock to pass through the delayed gate circuit when the delayed trigger is generated. The data position counter and the clock enable latch provide the signal output when data position counting is completed and disables the data acquisition. The trigger delay counter is programmed from the front panel control, and the date position counter is preset by selecting PRE or POST DATA POSITION at the front panel.

Time Base

The Time Base circuit consists of the 100-MHz crystal-controlled oscillator, the frequency divider, and the sample interval selector. This combination of circuitry generates internal clock pulses that range from 50 ns to 200 ms in a 1-2-5 sequence for parallel data acquisition. The time base circuit provides the clock for the MPU and Display Control circuit.

Serial/Signature Input

The Serial/Signature Input circuit consists of the data input comparator, data delay line, translator, polarity gate logic, and gate delay line. The data input comparator and the data delay line are commonly used in both serial and signature functions. The data delay line provides appropriate delay time to ensure that data is captured, while the gate delay line provides appropriate delay time to ensure correct gate timing. The translator converts ECL signals to TTL levels, and the polarity gate logic selects the polarity of the gating signals.

Signature Generator

The Signature Generator circuit consists of the gating logic, Cyclic Redundancy Check (CRC) generators, and data selector stages. The gating logic stage receives the

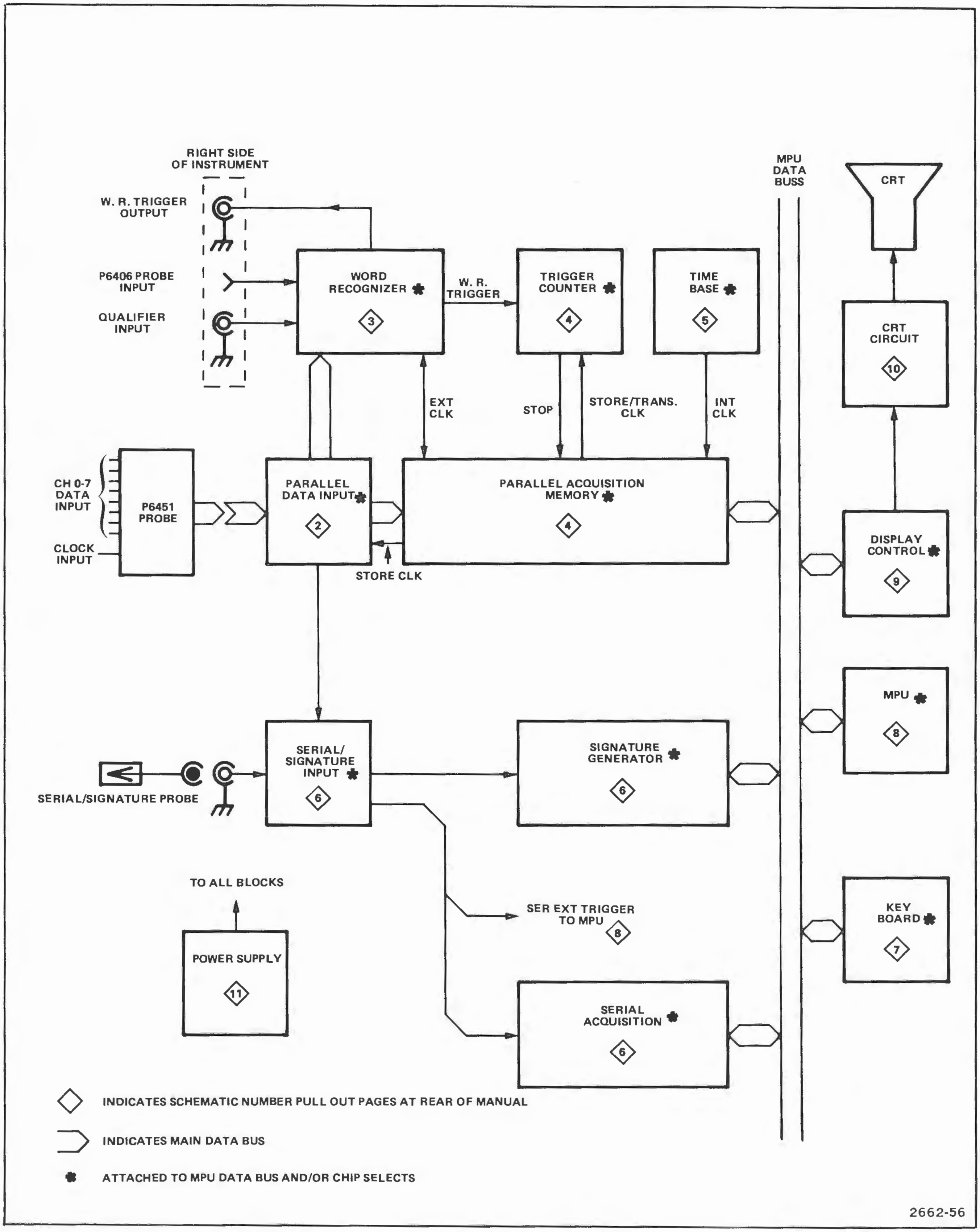

Figure 3-3. Simplified diagram of the 308.

data, clock, start, and stop signals and provides the latched data and clock outputs. The CRC generator decodes the data in signature format and provides a 16-bit output. The data selector determines which 8 bits (upper or lower) are transferred to the display RAM in the MPU circuit.

Serial Data Acquisition

The Serial Data Acquisition circuit consists of the baud rate generator, the programmable communication interface (USART), and the data bus buffer. The baud rate generator provides either internal clock or external clock output. The programmable communication interface receives serial data in asynchronous or synchronous timing and places parallel data on the MPU data base. The data bus buffer isolates the MPU data bus from some I/O devices.

Keyboard and MPU

Signals and data determined by pressing the keyboard buttons are transmitted to the MPU through a latch and a gate.

The MPU circuit consists of an 8085A microprocessor, ROMs, RAMs, address decoder, and status latch. The MPU executes the pre-programmed instructions in the ROMs and stores temporary data in the RAMs. The address decoder provides a specific address for each I/O device to write or read data from another I/O device. The status latch provides the I/O status outputs for the MPU.

Display Control

The Display Control circuit includes a 1024- by 8-bit RAM which provides display data storage and temporary data storage for the microprocessor. Addressing of this RAM is selected by either the MPU address signal or the display-counter signal through the address selector. The display-data output from the RAM selects the appropriate character font from those provided in the character ROM. This character ROM provides a 6-bit parallel signal output which corresponds to one line of one character. The 6-bit parallel signal is shifted out in serial format to be used as the z-axis signal. Besides the z-axis signal, the Display Control circuit provides the H SYNC and V SYNC signals.

CRT

The CRT circuit provides z-axis voltage and the horizontal and vertical deflection-current outputs which are used for the raster-scan display of data. A flyback transformer in the horizontal deflection circuit provides the high voltage, heater voltage, and other crt electrode voltages.

Power Supply

The power supply provides dc voltages of +15 V, +5 V, −5 V, and −15 V to operate 308 circuitry and fan motor. It operates in the line input range of either 90 to 132 V ac or 180 to 250 V ac.

DETAILED CIRCUIT DESCRIPTION

PARALLEL DATA INPUT ⟨2⟩

A simplified diagram of the Parallel Data Input circuit is shown in Figure 3-4.

Threshold Voltage

The Threshold Voltage stage sets the dc offset voltage for the Parallel Data Acquisition probe and the Serial/Signature Input circuit. THRESHOLD VOLTAGE switch S185 selects either VAR or TTL threshold voltage. The selected threshold voltage is inverted, divided, and offset by U185 and can be measured at THRESHOLD VOLTAGE. Appropriate offset voltage at the output of U185 can be calculated with the following formula:

$$V_{off} = \frac{V_{ref} - V_{th}}{4} + V_{ref}$$

where:

V_{off} is the Offset voltage; V_{ref} is the Reference voltage, and V_{th} is the Threshold voltage.

Example: Compute the offset voltage when the threshold voltage is +1.4 V and the reference voltage is −4.8 V.

$$V_{off} = \frac{(-4.8 - 1.4)}{4} + (-4.8) =$$

$$\frac{-6.2}{4} - 4.8 = -1.55 - 4.8 = -6.35\text{ V}$$

The offset voltage is connected to the probe input signal attenuator (see Figure 3-5) to change the effective comparison voltage of the probe comparator. If the offset voltage is known, the threshold voltage can be calculated with the following equation:

$$V_{th} = \frac{R1\ (V_{ref} - V_{off})}{R2} + V_{ref}$$

Using the offset voltage calculated from the preceding example, the threshold voltage is:

$$V_{th} = \frac{800\ [-4.8 - (-6.35)]}{200} + (-4.8)$$

$$V_{th} = 4\ (1.55) - 4.8 = 6.2 - 4.8 = +1.4\text{ V}$$

The threshold voltage to the Serial/Signature Input connector is about one-tenth the voltage at MONITOR jack U185, because the signal is attenuated by a factor of 10 when it passes through the Serial/Signature probe.

ECL-TTL Translator, Delay Line, and Inverter

The ECL-TTL Translator stage receives a push-pull ECL-level signal from the probe comparator via input connector J102 and translates it to a single-ended TTL signal. Delay Line DL112 delays the data from the translator so that its timing, when data reaches the Sample/Latch stage, permits the STORE CLK signal to take valid samples of the input data. The Inverter stage provides the push-pull data output on each channel for the Sample/Latch stage and the Word Recognizer circuit.

Sample/Latch

Figure 3-6 is a simplified diagram of one channel of the Sample/Latch stage, and Figure 3-7 shows the timing of its operation. When the Input Mode Select Line is low, the 308 operates in the Sample mode. The low on the Input Mode Select line disables gate U114B and U114C, and their outputs will be high, permitting flip-flop U120A to operate normally. In this mode the flip-flop operates as a two-stage shift register. The input data is clocked into U120A, and the output of U120A is clocked into U120B by the next clock pulse. When the Input Mode Select line is high, the Sample/Latch stage is set into the Latch mode and U114B and U114C are enabled.

The data inputs to U114B, U114C, and U120 cause outputs as shown in Figure 3-7. If we assume that the Q1 output of U120A and the Q2 output of U120B are low at time TØ, the Q2 output of U120B will be applying a high to the pin 4 input of U114B. A high on the + Data line activates U114B, and the low output of U114B sets the Q1 output of U120A high. U120A remains set until the next Store Clock pulse, at time T1, causing U120A's Q1 output to switch low, because its input data goes low. The Store Clock at T1 clocks the high level from U120A into U120B, whose Q2 output now goes high. At time T2, U120A does not change states (its input is still low), but U120B receives the low level from U120A.

As a result of this operation, the narrow input data present between TØ and T1 is formatted during the Store Clock interval on the Q2 output. The same cycle occurs for subsequent input data between times T2 and T9 to format the data on the Q2 output. The Sample/Latch stage provides the 8-bit data outputs to be stored in the Parallel Acquisition Memory.

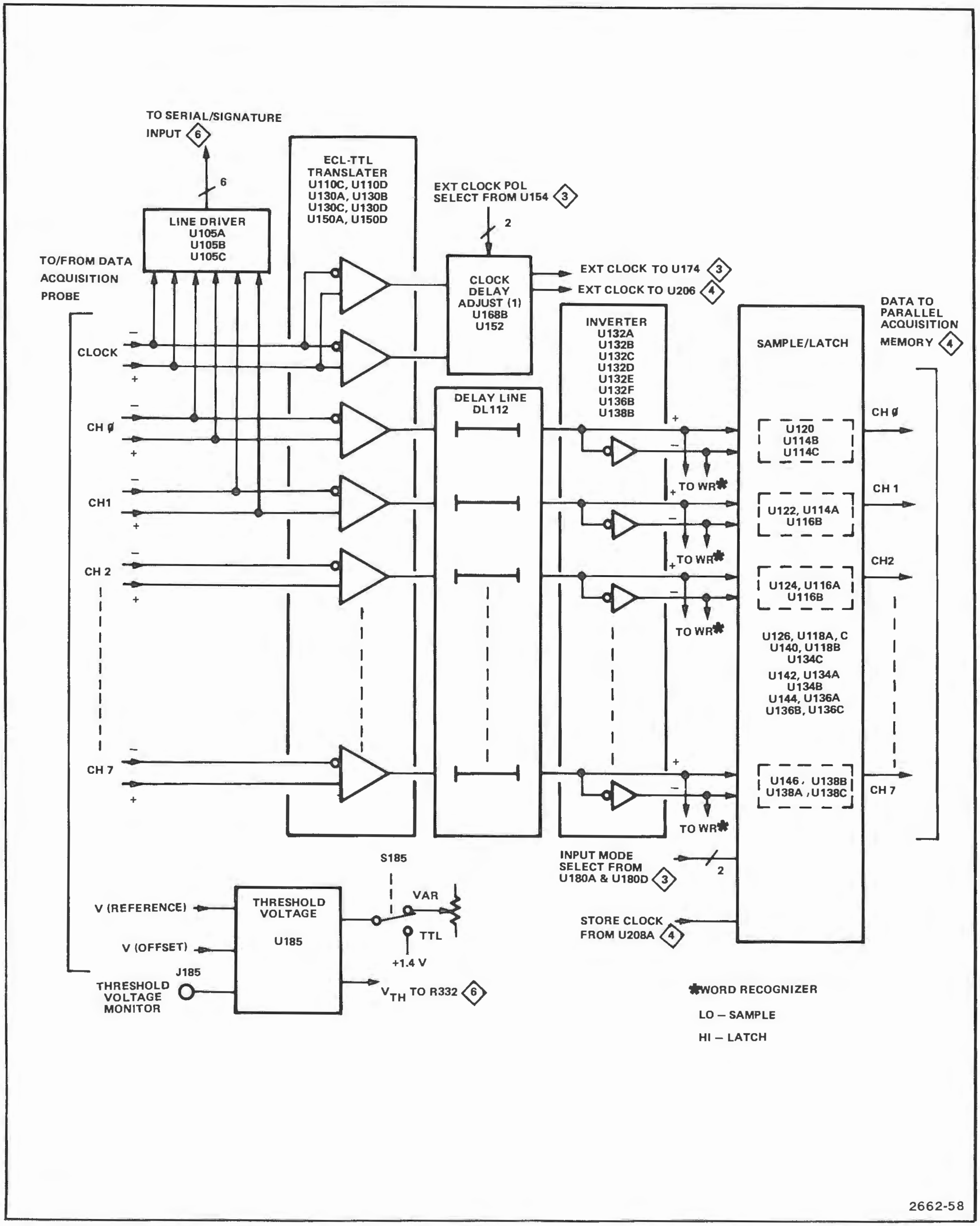

Figure 3-4. Simplified diagram of the parallel data input circuit.

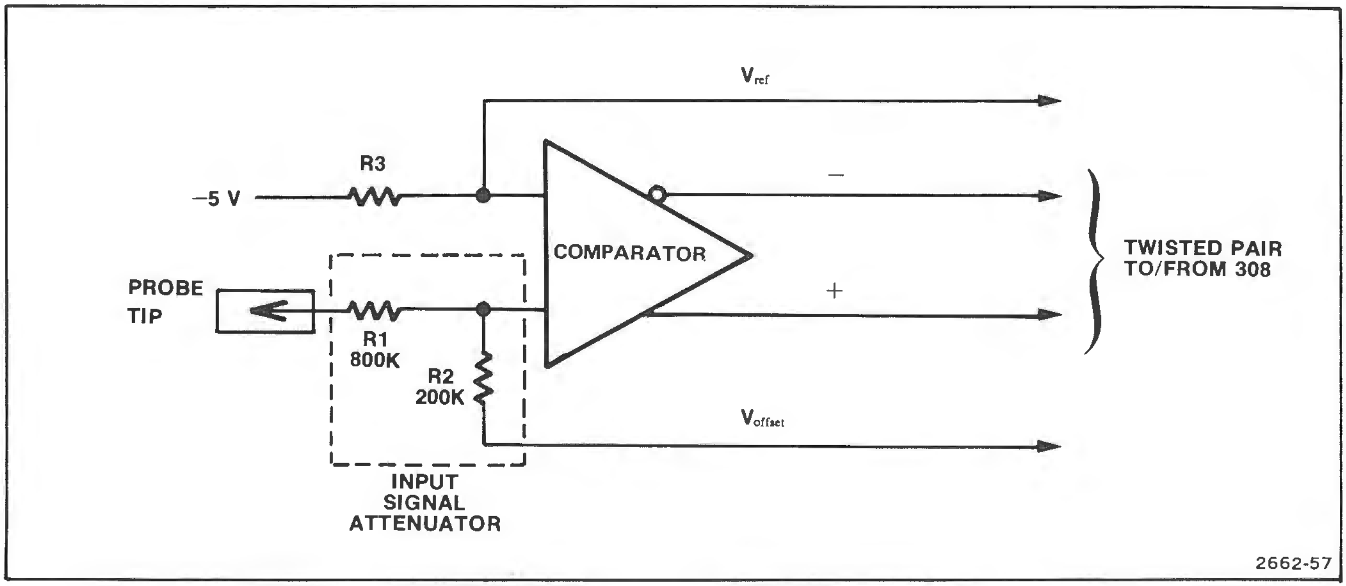

Figure 3-5. Equivalent circuit of one channel of the P6451 Data Acquisition Probe.

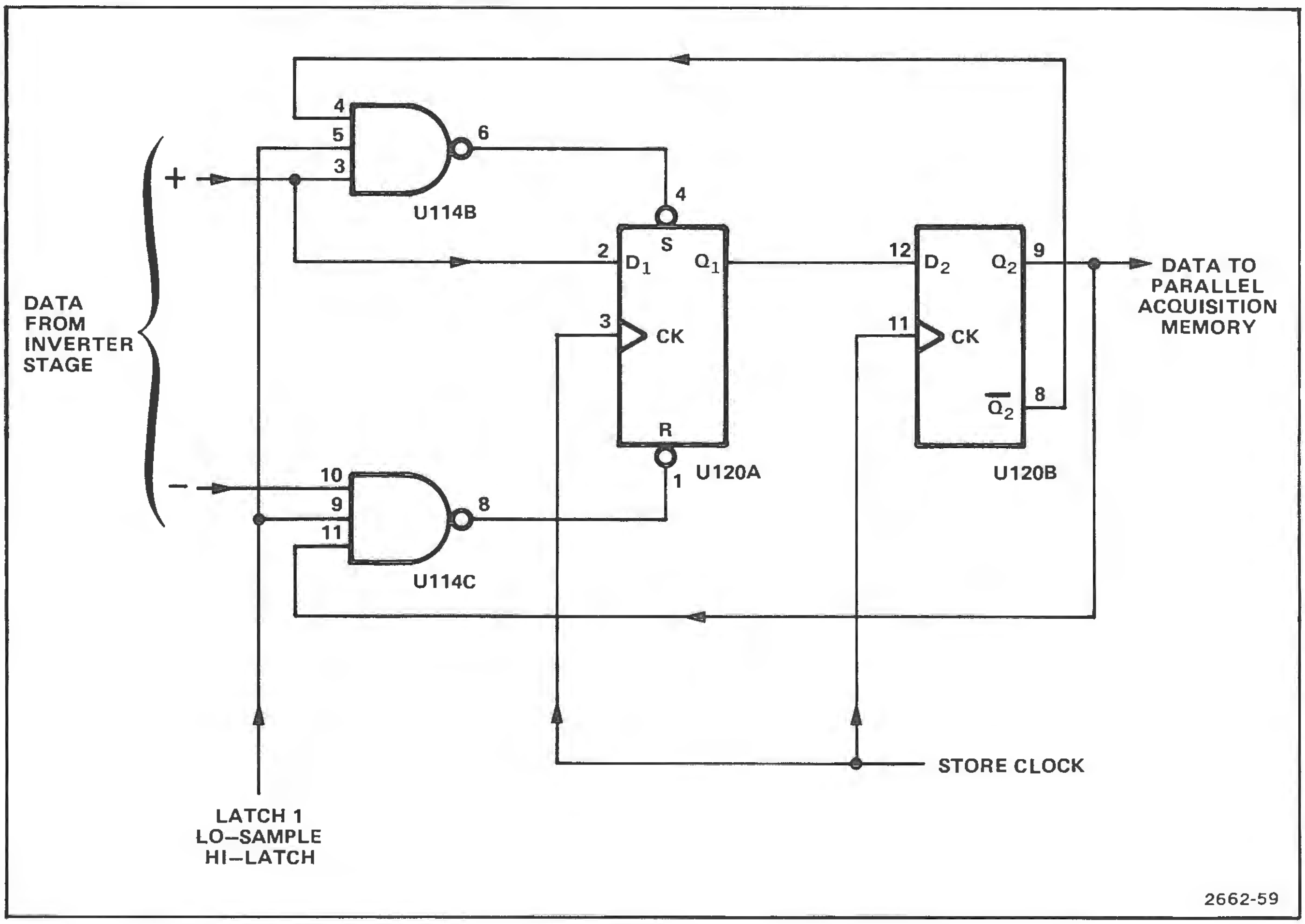

Figure 3-6. Simplified diagram for one channel of the sample/latch stage.

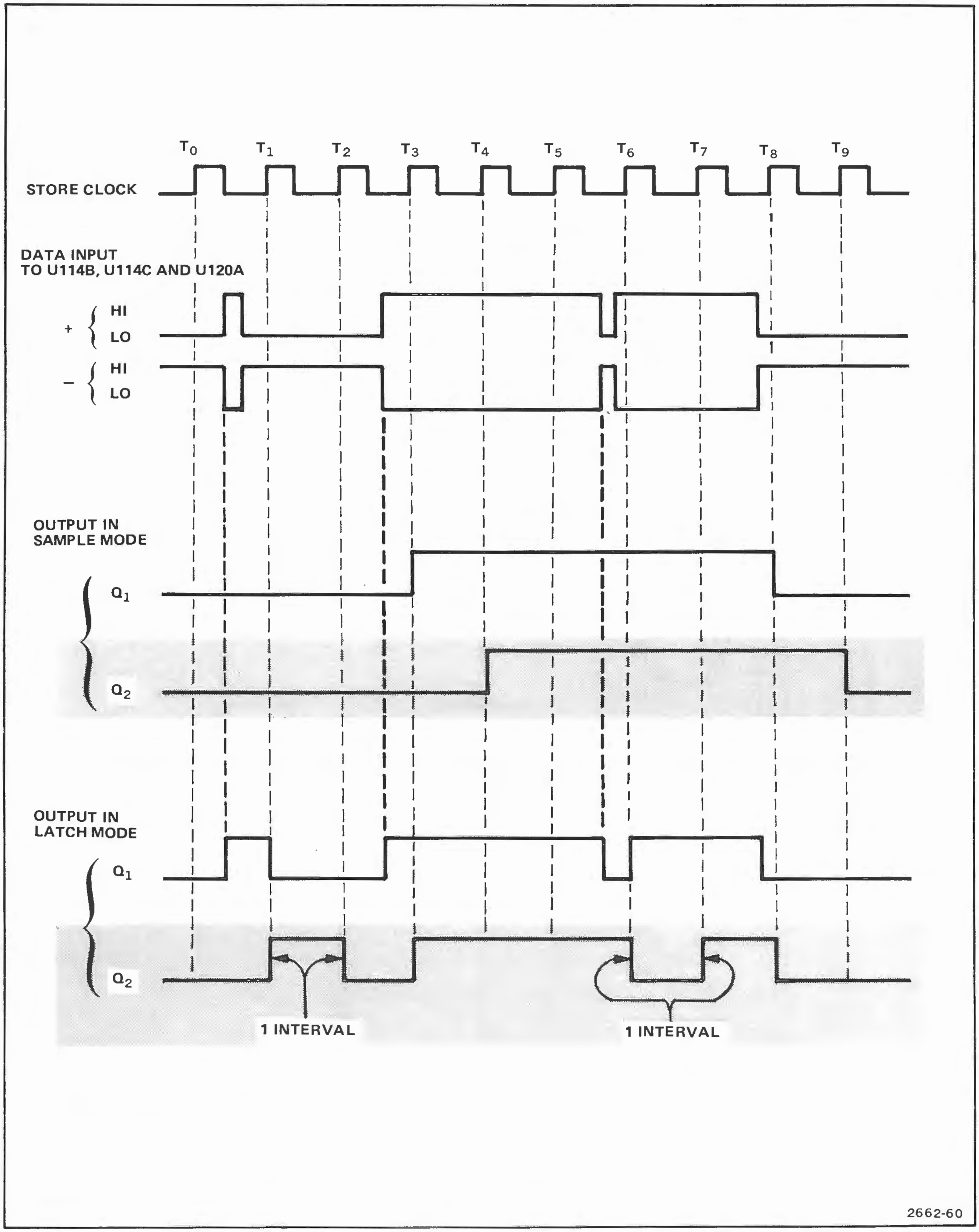

Figure 3-7. Simplified timing diagram of sample/latch stage.

Clock Delay Adjust (1)

The Clock Delay Adjust (1) stage provides the tapped delay, via U152, for the clock signal. The tapped delay is set so that the Store Clock signal arrives at the clock input of the Sample/Latch stage to store the input data in the correct timing specified by the data setup and hold time specification. External clock polarity is selected by U168 and depends on the External Clock Polarity Select signal from U154 pins 10 and 11 as shown in Table 3-1.

Line Driver

The Line Driver stage consists of U105A, B, and C, and provides isolation between the parallel Data Input and the Serial/Signature Input circuits. The output level of the Line Driver is push-pull ECL.

WORD RECOGNIZER ⟨3⟩

A simplified block diagram of the Word Recognizer circuit is shown in Figure 3-8.

Word Recognizer Latch and Driver

The Word Recognizer Latch stage consists of shift registers U154, U156, and U158 connected in series. Register U154 receives a series of data bits from the buffered MPU bus on line DBØ and shifts the data to U156 and U158. The positive-going edge of the CS7 signal clocks the shift registers. Parameters for the Input Mode Select, Sync/Async Select, External Clock Polarity, Data Word Recognizer, and Qualifier lines are set by the parallel outputs of the registers. Table 3-1 shows the truth table for setting of the parameters. Drivers U180A and U180D invert the output of U154 and provide current to drive the Sample/Latch stage of the Parallel Data Input circuit.

Table 3-1

Truth Table for Setting Parameters

Shift Registers	U154-								U156-								U158-							
Parameters	**3**	**4**	**5**	**6**	**10**	**11**	**12**	**13**	**3**	**4**	**5**	**6**	**10**	**11**	**12**	**13**	**3**	**4**	**5**	**6**	**10**	**11**	**12**	**13**
INPUT MODE																								
SAMPLE	1	1																						
LATCH	Ø	Ø																						
SYNC/ASYNC																								
SYNC				1																				
ASYNC				Ø																				
EXT CLOCK POL																								
↑ (+)					1	Ø																		
↓ (−)					Ø	1																		
EXT QUALIFIER																								
1 (HI)							1	Ø																
Ø (LO)							Ø	1																
X (Don't Care)							Ø	Ø																
DATA WORD RECOGNIZER																								
CH → 7654321Ø									7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
DATA B = ØØØØØØØØ									Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	1	1	1	1	1	1	1	1
DATA B = 11111111									1	1	1	1	1	1	1	1	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø
DATA B = XXXXXXXX									Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø

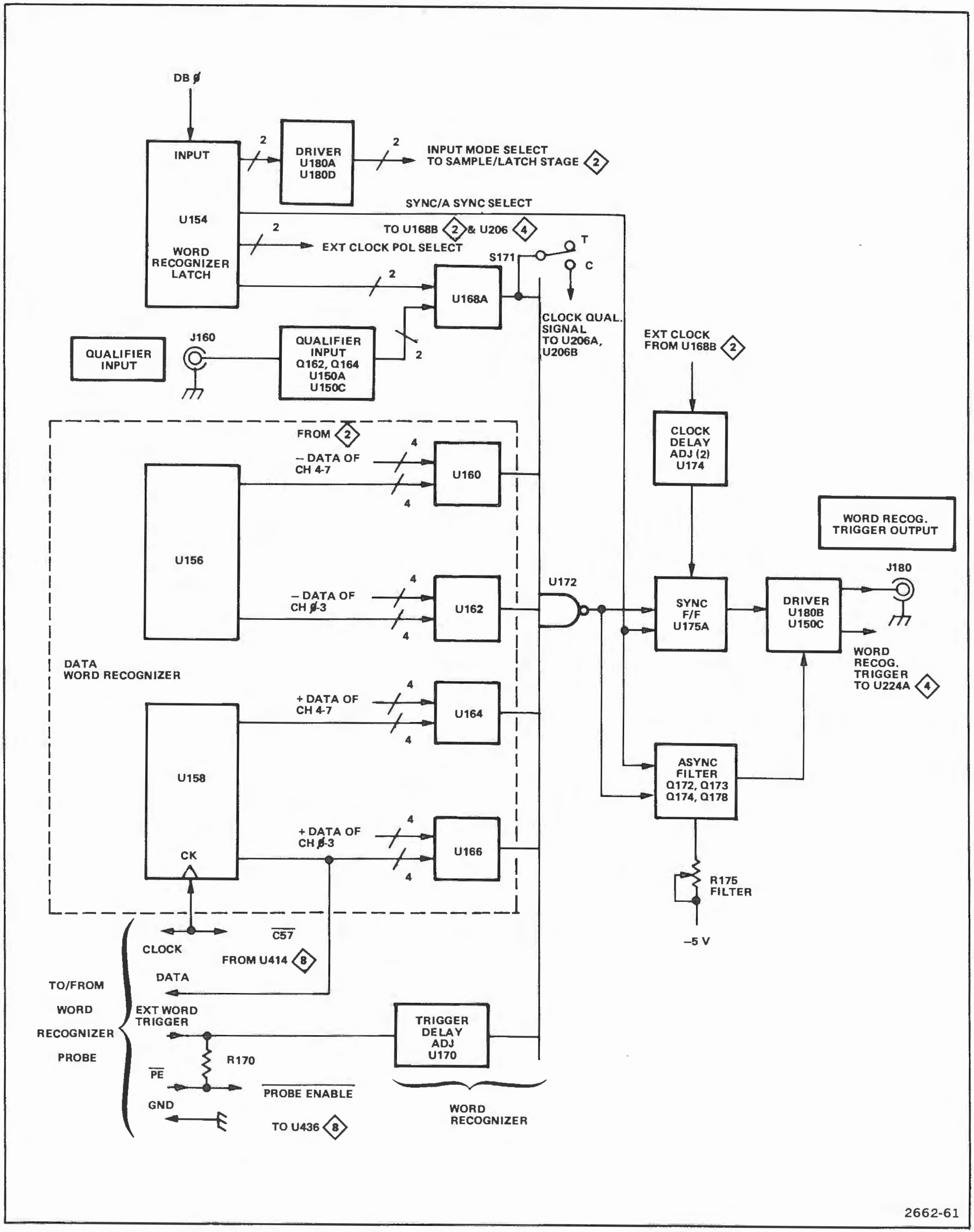

Figure 3-8. Simplified diagram of the word recognizer circuit.

Qualifier Input

The Qualifier Input stage consists of Q162, Q164, and U150B and C. Together Q162 and Q164 form a comparator which is referenced to a voltage of about +1.4 V at the base of Q164. The comparator senses the Qualifier Input signal and produces an output based on its level. Transistor Q164 produces an ECL-level output, which is the non-inverted version of the Qualifier Input. The output is applied to the input of ECL-TTL translator U150B and C, which provides the push-pull TTL output for the Word Recognizer stage.

Word Recognizer and Trigger Delay Adjust

The Word Recognizer stage consists of U160, U162, U164, U166, U168A, and U172. It receives both inverted data bits (from U132, U136B, and U138B on diagram 2) and non-inverted data bits (from DL112 on diagram 2) in addition to the Qualifier Input signal. The 1-bit Trigger signal (Ext Word) from the Word Recognizer probes passes through Trigger Delay Adjust stage U170 to the Word Recognizer stage. The Ext Word signal is generated when the Word Recognizer probe recognizes an operator selected, preset word pattern. The Ext Word input ensures that the Word Recognizer operates only when the Word Recognizer probe is connected to the 308. Gates U162 and U166 form a word recognizer for data channels 0—3, and U160 and U164 form the word recognizer for data channels 4—7.

When the Data Word Recognizer is set to 0000 0000_2 (binary), U166 receives a preset word pattern (all high) from U158 for channels 0—3. A high on any of the channel 0—3 input lines causes the output of U166 to remain low. If all the channel 0—3 input lines are low, U166 will be disabled and will produce a high output. Operation of U164 for data channels 4—7 is the same as U166. Meanwhile, U160 and U162 provide high outputs, because their inputs are set to 0000 0000_2 by U156.

When the Data Word Recognizer is set to 1111 1111_2, the highs from U156 are applied to the inputs of U160 and U162. Gates U164 and U166 receive inputs of 0000 0000_2, which disables them and they produce high outputs. When the Data of Channels 0—7 input lines are all low, U160 and U162 are disabled and produce high outputs. The four high logic levels from U160, U162, U164, and U166 plus the two from the Qualifier Input and the Ext Word activate U172, generating a negative-going pulse.

Qualifier U168A receives the preset bit pattern from pins 12 and 13 of U154 and the Qualifier Input signal from U150B and C. The outputs of U150B and C are connected so that a low on the Qualifier Input line causes U150C to disable U168A, and a high on the Qualifier Input causes U150B to disable U168A. Accordingly, either input disables U168A, allowing it to enable U172.

The output of U168A can also be used for the Clock Qualifier signal by setting switch S171 to C. If the Word Recognizer probe is not connected, the input to the Trigger Delay Adjust stage is pulled to +5 V via R170 and R4421, depending on the position of jumper P170. This holds the pin 1 input of U172 high. If the probe is connected, the Probe Enable line is grounded, and the Ext Word pulse is applied to the input of the Trigger Delay Adjust stage. The Trigger Delay Adjust stage provides the noninverted Ext Word pulse to word recognizer gate U172. Selecting the position of jumper P170 permits correct timing for the Ext Word pulse at the input of U172. When all its inputs are high, U172 provides a negative-going pulse.

Clock Delay Adjust

The Clock Delay Adjust stage consists of U174A, B, C, and D, forming a tapped delay line. Selecting the position of jumper P174 determines the amount of time that the Ext Clock signal will be delayed enroute to the clock input of U175.

Sync Flip-Flop, Async Filter, and Driver

The 308 operates in either the Sync or Async trigger mode, depending on the setting of the SAMPLE INTERVAL controls. When the external clock is chosen for the sample interval, the 308 operates in the Sync trigger mode. When the internal clock is chosen, the 308 operates in the Async mode. The Q_D output of U154 selects either the Sync or Async trigger mode as shown in Table 3-1.

When operating in the Sync mode and a clock pulse reaches U175A (the output of word recognizer gate U172 is low), flip-flop U175A produces a negative-going output pulse. Drivers U180B and C invert this pulse to form the Word Recognizer Trigger output signal. In the Async mode, the low from U154's Q_D output sets U175A's Q output high. The output of U175A enables drivers U180B and C.

When word recognizer gate U172 produces a low (turning off Q172), C176 starts discharging through Q174, R174, and R175. As the voltage of C176 crosses the threshold voltage (+0.7 V, which is U180's threshold voltage of +1.4 V minus Q178's emitter-base voltage of +0.7 V), Q178 disables drivers U180B and C. The drivers then produce positive-going outputs as shown in Figure 3-9. This condition continues until the end of the output pulse from word recognizer gate U172. Filter potentiometer R175 controls the discharge rate of C176, which determines the time interval T2 from the leading edge of the word recognizer pulse to the leading edge of the output pulse. If the word recognizer pulse width (T1) is shorter than the preset discharge time (T2), the drivers will not produce an output pulse.

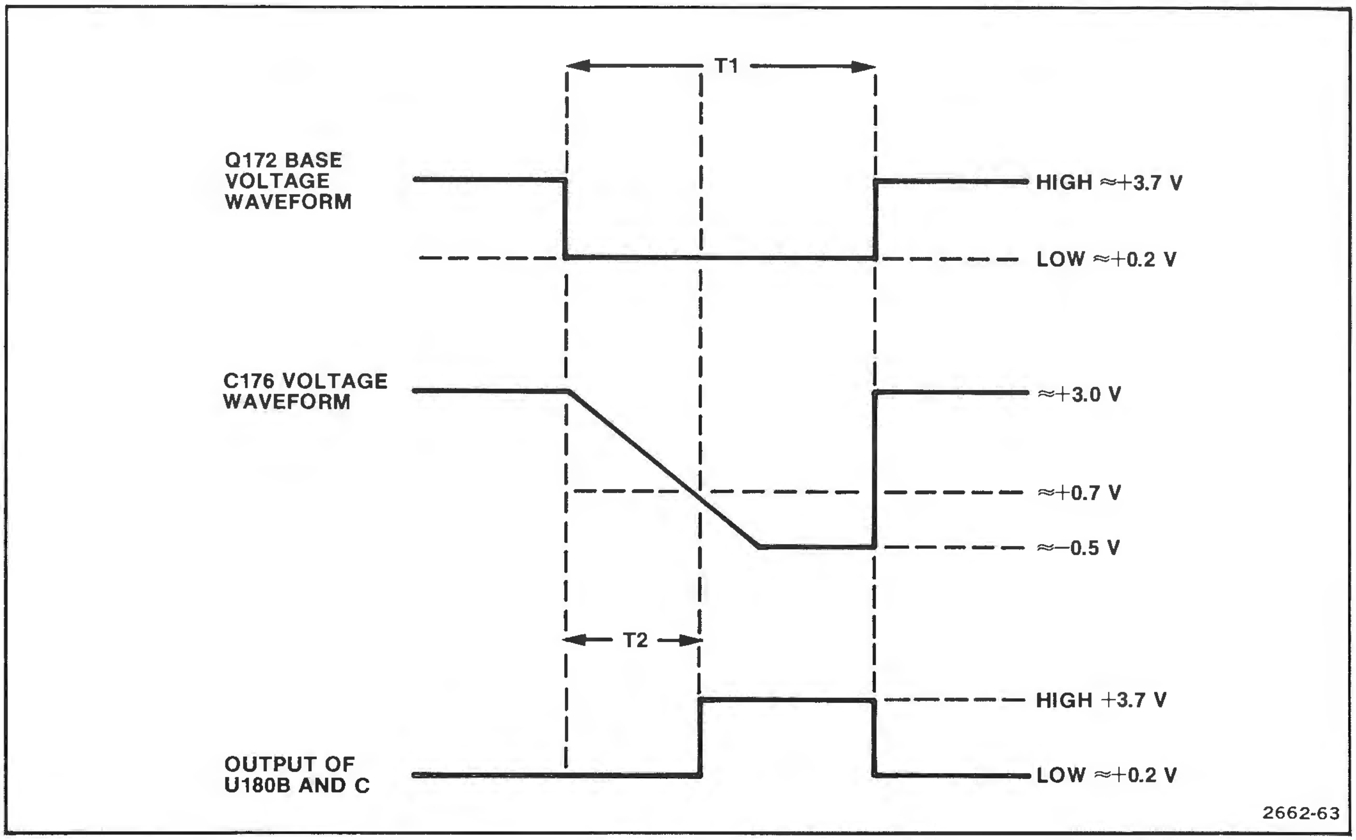

Figure 3-9. Async filter timing diagram.

PARALLEL ACQUISITION MEMORY AND TRIGGER DELAY ⟨4⟩

A simplified block diagram of the Parallel Acquisition Memory and Trigger Delay circuits is shown in Figure 3-10, and timing of the data acquisition sequence is illustrated in Figure 3-11.

When the START key is pressed at the 308 front panel, the Parallel Acquisition Memory, the Trigger Delay, and other circuits are reset. During the reset time, acquisition parameters are loaded into the latch flip flops and counters. Near the end of the Internal Reset period, the Store Clock is enabled, the data acquisition starts, and the Trigger circuit is enabled to receive a trigger. When the trigger occurs, the Trigger Delay Counter starts counting and produces a delayed trigger pulse, initiating data position counting. At the end of data position counting, the Store Clock is disabled, and the data acquisition is stopped. The number of the data position count depends on the setting of the DATA POSITION front panel controls (PRE or POST). The data Acquisition Window is positioned around the Delayed Trigger point as shown in Figure 3-11.

Clock Gate

The Clock Gate stage consists of U202A, U206A and B, U208A and B, and U210B and D. It selects one of four clock signals (positive External Clock, negative External Clock, Internal Clock, or the CS15 signal) and provides the Store Clock and the Store/Transfer Clock outputs. Table 3-2 shows the truth table for the Clock Gate stage.

256- by 8-Bit Memory (High-Speed)

The 256- by 8-Bit High-Speed Memory consists of RAMs U220 and U222. The memory location of each data bit to be stored is controlled by the Address Counter. This memory operates in either store or read mode. In the store mode, the negative-going edge of the Store Clock pulse, applied to pin 20 of each RAM, stores the input data in the location defined by the Address Counter. During the store operation, a high on the CS15 line disables the memory outputs of the RAMs. When the RAMs are in the read mode, a high on their WE inputs prevents them from accepting new data. A low on the CS15 line enables the outputs of each RAM. Data in the RAMs can be sequentially read by incrementing the Address Counter after each read operation. The outputs of the RAMs connect to the Buffered MPU Data bus.

Address Counter and Carry Detect

The Address Counter designates the memory location of each data bit to be stored. The counter, consisting of U214 and U216, is a synchronous, 8-bit (÷256) binary counter which is reset to zero by the CS8 signal at the beginning of each store cycle. The AØ—A7 outputs connect to both U220 and U222.

Counter U216 provides a carry output to the Carry Detect stage, consisting of U218A and B. After one full memory cycle, Carry Detect stage provides a latched high on the pin 5 output of U218. The application of this signal depends on the mode of operation selected for the 308. If the 308 is in the Full Valid Data Display mode, the signal serves as the Trig Enable 1 pulse; but if the 308 is in the First Trigger mode, it serves as the Address Count Carry signal.

Clock Indicator

The Clock Indicator stage consists of U202C and D, U204A and B, and U226A and B. It provides a signal that drives EXT CLOCK indicator light-emitting diode DS500 to display external clock activity. The Ext Clk Indicator line stays high when the Ext Clk input is at a continuous low, but it stays low when the Ext Clk input is at a continuous high. When the Ext Clk input is active, the Ext Clk Indicator line changes levels at intervals of about 100 ms. This circuit operates similarly to the Sample/Latch circuit previously described.

Triggered Gate

The Triggered Gate stage consists of U224A and B and U226D. When jumper P224 connects pins 1 and 2 of J224, U224A latches on the first trigger signal after reset. When jumper P224 is disconnected, U224A latches after reset and one memory cycle. Jumper P224 is positioned on just one pin for storage.

When U224A is set and reset inputs are high, the Word Trig signal clocks a high into U224A. The Store/Transfer Clk latches U224A's output into U224B, whose Q output enables U226D to pass the Store/Transfer Clk signal (Gated Clock) to the Trigger Delay Counter.

Trigger Delay Counter and Delayed Gate

The Trigger Delay Counter, consisting of U230, U232, U234, and U236, is a 16-bit binary counter which counts the number of clocks for the trigger delay entered by the front panel DELAY controls. At the beginning of each data acquisition cycle, the Trigger Delay Counter receives a number, in binary one's complement format, that represents the number of clocks to be delayed. The CS9 pulse loads the data into U230 and U232, and the CS10 pulse loads the data into U234 and U236. The 16-bit output is ANDed and inverted in the Delayed Gate stage, comprised of U210A, U240B and C, U226C, U242, U244, and U246B. When all outputs of the counters are high, the high-logic level parts of the Store/Transfer Clk from

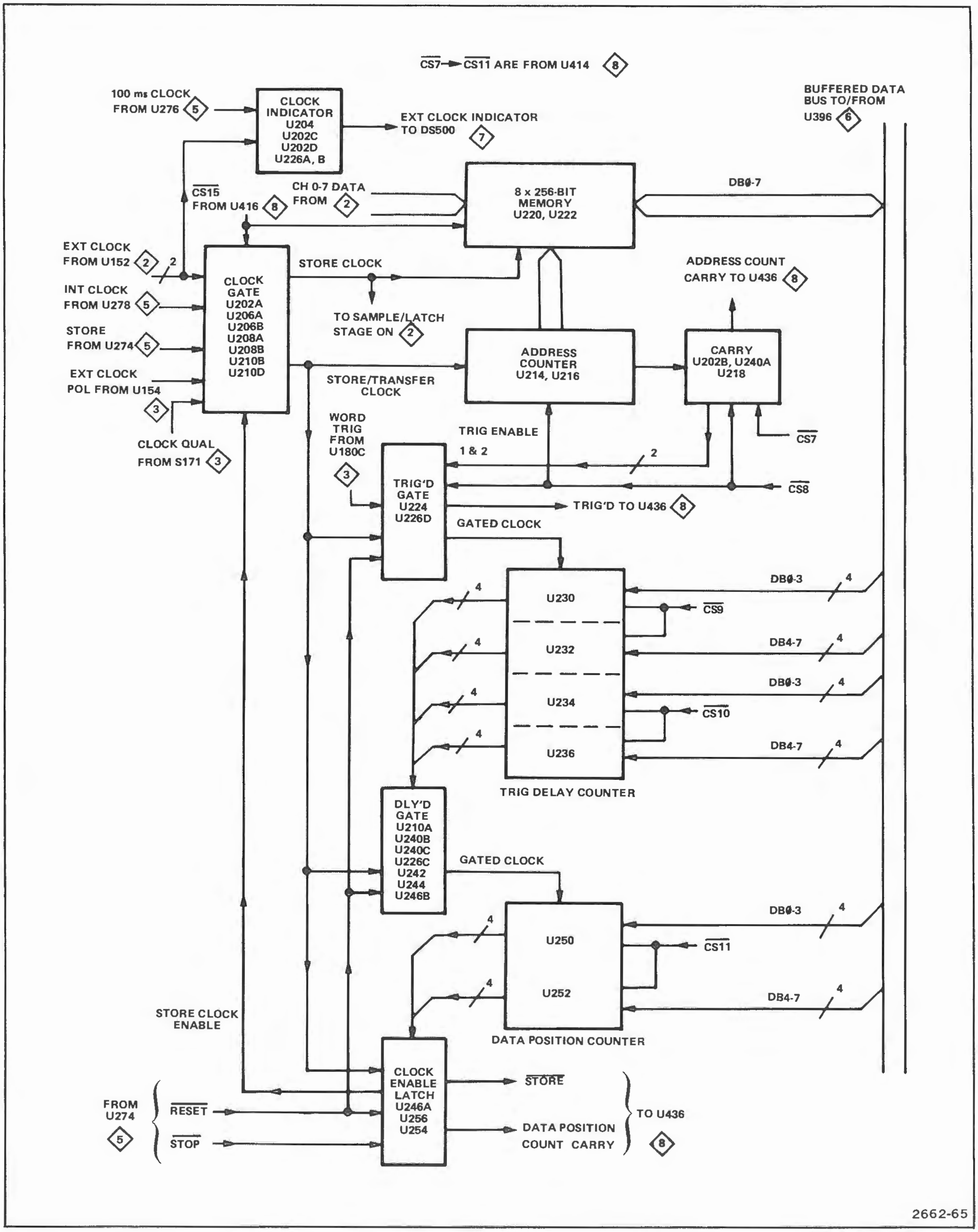

Figure 3-10. Simplified diagram of the parallel acquisition memory and trigger delay circuits.

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U226D activate U240C, producing a low output. When the Store/Transfer Clk returns to a low, it disables U240C, producing a positive-going signal. The positive transition of U240C's output clocks U246B, and its Q output enables U226C to pass the Store/Transfer Clk to the Data Position Counter stage.

Data Position Counter and Clock Enable Latch

The Data Position Counter, U250 and U252, is an 8-bit binary counter which counts clock cycles for the data position entered by the front panel DATA POSITION controls.

The Clock Enable Latch stage consists of gate U254 and flip-flops U246A, U256A, and U256B. At the start of each data acquisition cycle the CS11 pulse loads the binary counter with data representing the number of clocks to be counted, and the Reset pulse resets U246A, U256A, and U256B. When the designated number of clocks have occurred, the eight output lines of U250 and U252 will be high, activating U254. Gate U254 then produces a low, which is latched into U246A by the next Store/Transfer Clk pulse. Flip-flop U246A then asserts a high on its Q output, and the next Store/Transfer Clk latches that high into U256A and U256B. Flip-flop U256A then asserts a low on the Store line which disables U202A, U206A, and U206B, thereby stopping the Store/Transfer Clk pulses. The Store line stays low while the Data Position Counter increments and enables U398D, the Store/Sig Stop gate on diagram 6. Flip-flop U256B produces the Data Pos Count Carry signal. When the STOP key is pressed, the Stop signal sets U256A, producing a high on the Store line. This high stops the data acquisition process.

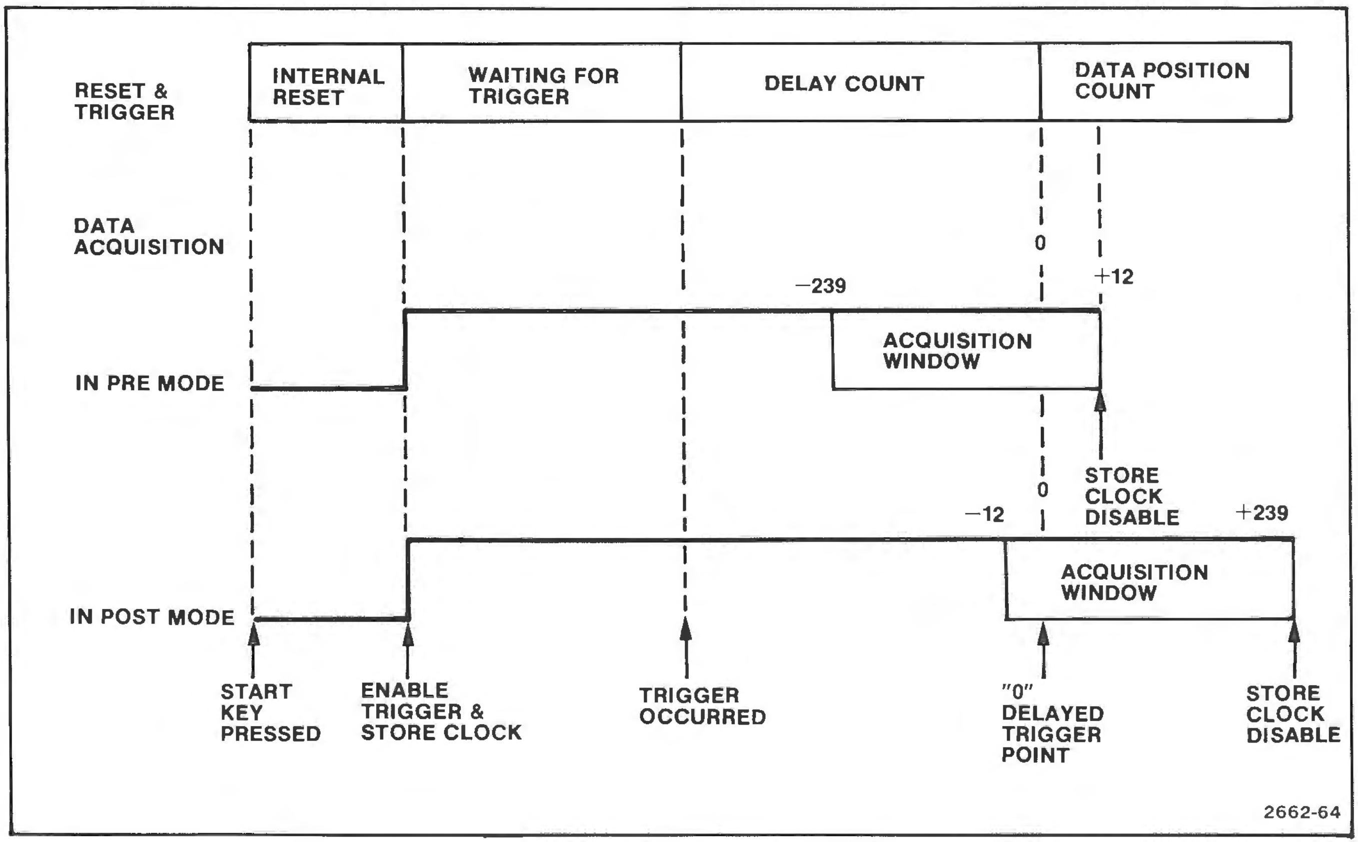

Figure 3-11. Simplified timing diagram for data acquisition sequence.

Table 3-2

Truth Table for the Clock Gate

CLOCK GATE I/O				SAMPLE INTERVAL SELECTION: SAMPLE = 50 ns TO 200 ms	SAMPLE INTERVAL SELECTION: SAMPLE = EXT ↑	SAMPLE INTERVAL SELECTION: SAMPLE = EXT ↓	WHEN READING OUT THE DATA FROM U220, U222
INPUT	U206A	1	EXT CLOCK POL –	0	0	1	X
INPUT	U206A	2	CLOCK QUAL	1	1	1	X
INPUT	U206A	4	EXT CLOCK –	X	X		X
INPUT	U206A	5	STORE CLOCK ENABLE	1	1	1	0
INPUT	U206B	9	STORE CLOCK ENABLE	1	1	1	0
INPUT	U206B	10	EXT CLOCK +	X		X	X
INPUT	U206B	12	CLOCK QUAL	1	1	1	X
INPUT	U206B	13	EXT CLOCK POL +	0	1	0	X
INPUT	U202A	1	STORE CLOCK ENABLE	1	1	1	0
INPUT	U202A	2	INT CLOCK		0	0	X
INPUT	U210B	4	STORE	1	1	1	0
INPUT	U210B	5	$\overline{CS15}$	1	1	1	X
INPUT	U208B-9		$\overline{CS15}$	1	1	1	
OUTPUT	U208A-6		STORE CLOCK				1
OUTPUT	U208B-8		STORE/TRANS CLOCK				

TRUTH TABLE WHEN
STORE CLOCK ENABLE
AND CLOCK QUAL ARE TRUE.

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TIME BASE 5

The Time Base circuit generates the internal clock for the Parallel Data Acquisition circuit and the Display Control circuit. A simplified diagram of the Time Base circuit is shown in Figure 3-12.

Oscillator

The Oscillator consists of Y260, U260A and B, U262, Q263, and Q264. Crystal Y260 and U260B form a 100-MHz crystal-controlled oscillator. The 100-MHz oscillator is isolated from frequency divider U262 by U260A. Frequency divider U262 divides the 100-MHz signal by five (to 20 MHz), producing a clock pulse with a 50-ns period. Transistors Q263 and Q264 invert the clock and shift its level from ECL to TTL.

Divider and Selector

The Frequency Divider consists of a series of counters (U266, U268, and U270) which provide the 500-ns to 50-ms clock outputs to Selector U272. It also provides a 250-ns clock output to the Display Control circuit. Selector U272 generates a clock output determined by the select signals on its A, B, and C inputs. The selected clock is applied to Selector U278 and to Frequency Divider U276. Divider U276 generates ÷2- and ÷4-outputs to be selected by U278. It also provides the 100-ms clock to the Clock Indicator stage of the Parallel Acquisition Memory circuit. Selector U278 sends an Internal Clock signal to the Parallel Data Acquisition circuit.

Sample Interval Latch

The CS12 signal causes the Sample Interval Latch to hold the sample-interval parameters and the Store, Reset, and Stop signals. Outputs 1Q through 5Q on U274 select the sample interval appearing at the pin 7 output of U276 as shown in Table 3-3.

SERIAL/SIGNATURE INPUT 6

The Serial/Signature Input circuit consists of the Input Comparator, Delay Adjust, Translator, Polarity Selector, and Polarity Latch stages. It provides the signature data and the start, stop, and clock signals for Signature Analyzer operation. It also provides the serial data, external clock, and external trigger signals for Serial State Analyzer operation. A simplified diagram of the Serial/Signature Input circuit is shown in Figure 3-13.

Input Comparator

The Input Comparator consists of source-followers Q330A and B and comparator U344B. Serial/Signature Data is applied to pin 10 of comparator U344B via Q330A. Threshold Voltage reaches pin 9 of U344B via Q330B. Comparator U334B compares the Serial/Signature Data input at pin 10 with the Threshold Voltage input at pin 9. If the Serial/Signature Data input voltage is higher than the Threshold Voltage, U330B will assert a high at its pin 7 output. The pin 6 output of U344B is the complement of the pin 7 output. The output of comparator U344B is amplified and shaped by U344A and C.

Table 3-3

Sample Interval Selection

Output of U274					Selected Internal Clock at pin 7 of U278
5Q	4Q	3Q	2Q	1Q	
0	0	0	0	0[a]	50 ns
0	0	0	0	1[b]	100 ns
0	0	0	1	0	200 ns
0	0	1	0	0	500 ns
0	0	1	0	1	1 μs
0	0	1	1	0	2 μs
0	1	0	0	0	5 μs
0	1	0	0	1	10 μs
0	1	0	1	0	20 μs
0	1	1	0	0	50 μs
0	1	1	0	1	100 μs
0	1	1	1	0	200 μs
1	0	0	0	0	500 μs
1	0	0	0	1	1 ms
1	0	0	1	0	2 ms
1	0	1	0	0	5 ms
1	0	1	0	1	10 ms
1	0	1	1	0	20 ms
1	1	0	0	0	50 ms
1	1	0	0	1	100 ms
1	1	0	1	0	200 ms
1	1	1	1	1	Low Output[c]

[a]0 = Low.
[b]1 = High.
[c]Disables internal clock.

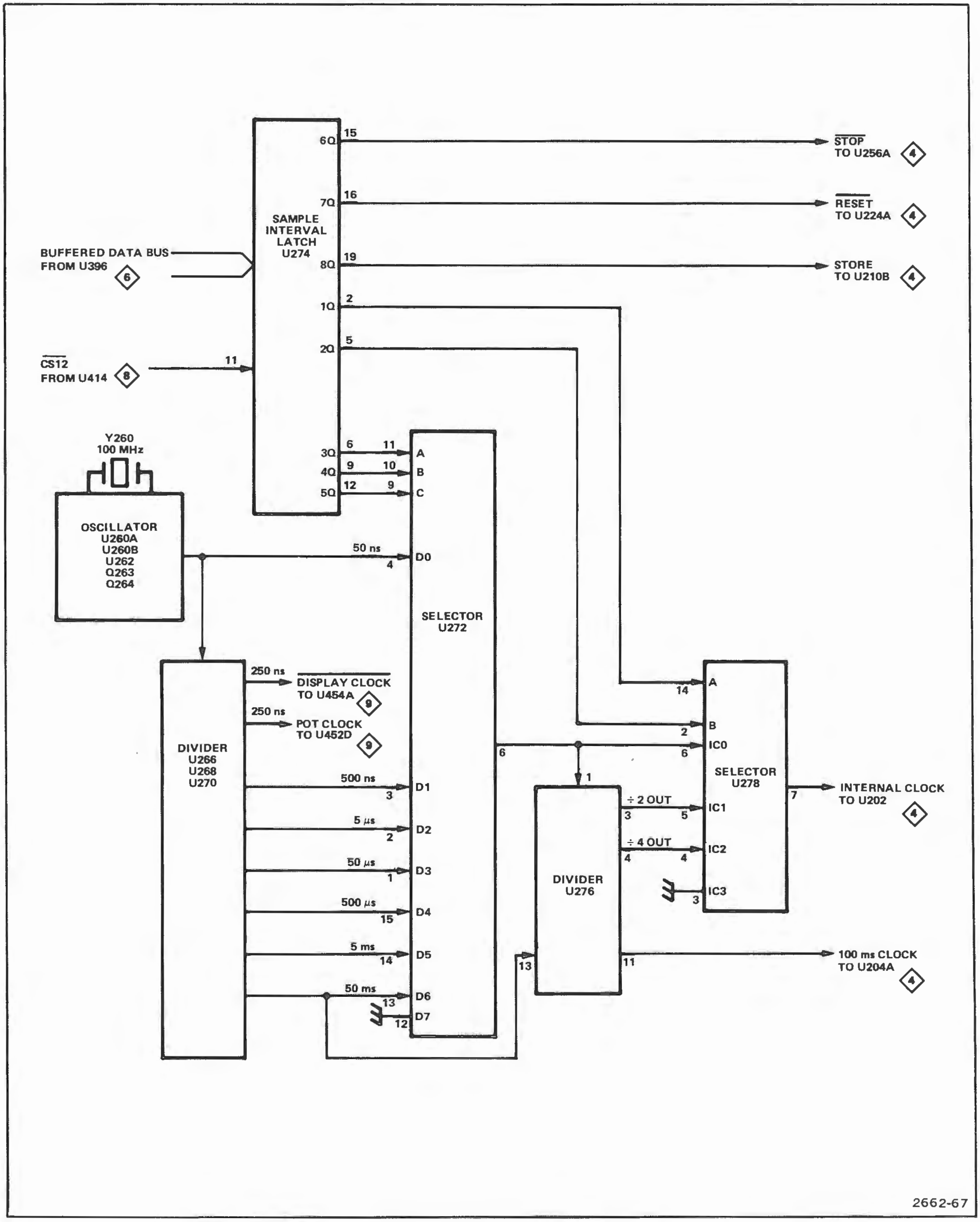

Figure 3-12. Simplified diagram of the time base circuit.

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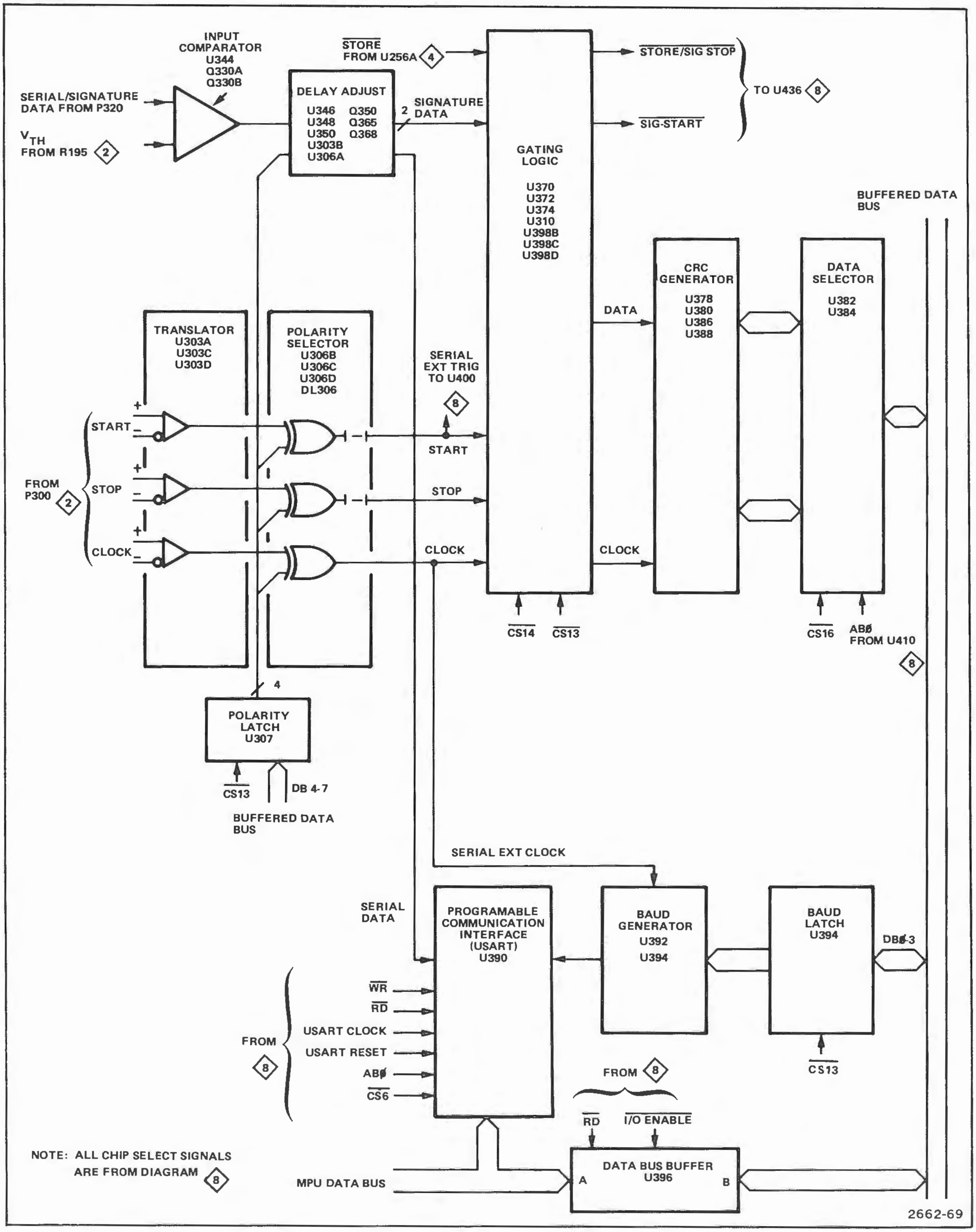

Figure 3-13. Simplified diagram of the serial/signature input, signature generator, and serial data acquisition circuits.

Balance potentiometer R355 sets all the inputs to U344B at an equal voltage level whenever all inputs to Q330A and B are held at an equal voltage level. This is done by grounding the Serial/Signature probe and adjusting the THRESHOLD VOLTAGE to 0 V. DC Bias potentiometer R340 adjusts the dc bias voltage at the inputs to U344B to the ECL threshold level (≈−1.3 V).

Delay Adjust

The Delay Adjust stage consists of the tapped delay, the variable delay, and the translator. The tapped delay in U346, U348C and D is selected by positioning jumper P346. The variable delay in U348A and B, U350, and Q350A and B is adjusted by Data Delay potentiometer R355. The total delay of the data is the sum of the tapped delay and the variable delay.

Figure 3-14 shows a simplified diagram of the Variable Delay circuit and its timing. This circuit provides an adjustable delay which adds to the delay of the tapped delay, ensuring that input data is timed correctly when it reaches the Gating Logic. Differential amplifiers U350A, B, and C; Q350A and B; and U348A and B form the variable delay circuit.

Data from the Tapped Delay line enters U350A at pin 5 (point A in Figure 3-14). The capacitors and current sources on the emitters of U350A's output transistors permit rapid transitions in the positive direction only; negative transitions take place at a much slower rate.

A high at point A turns on the positive output transistor in U350A and turns off the negative output transistor. The + output line of U350A (point B) goes positive as quickly as C353 and the turned-on output transistor permit. Point C starts going negative as C354 discharges at a rate set by current-source transistor Q350B.

A low at point A turns off Q350A's positive output transistor and turns on its negative one. The + output line of U350A (point B) goes negative as C353 discharges, and point C goes positive as quickly as C354 and the turned-on output transistor permit.

Differential amplifiers U350B and U350C shape the point B and point C outputs of U350A. Because their minus inputs are connected to −1.3 V, they switch when their input voltages pass −1.3 V. Data Delay potentiometer R355 sets the current conducted by Q350A and B, controlling the slope of waveforms B and C in Figure 3-14. Varying R355 controls the time between the original transition and the time U350A's output voltage crosses the threshold voltage of U350B and C.

Gates U348A and B form a bistable flip-flop. A high at U348B's pin 7 input causes the flip-flop to assert a low on its pin 3 output. A high on U348A's pin 5 input resets the flip-flop, which then asserts a high on its pin 3 output. A translator consisting of Q365 and Q368 provides a push-pull output of the signature data.

Translator and Polarity Selector

The Translator, comprised of U303A, C, and D, receives the push-pull ECL-level Stop, Start, and Clock signals and generates TTL-level outputs. Polarity Selector U306B, C, and D selects the polarity of the outputs reaching the gating logic stage. When a polarity-select line (Stop Pol, Start Pol, and Clk Pol) is low, the appropriate polarity-select gate provides a noninverted output; and when the polarity-select line is high, the gate inverts its output. Delay Line DL306 delays the signals from U306B and C to provide correct timing for the signature operation. In the Serial State mode, the output signal from U306C serves as the Serial External Trigger, and the Clock signal from U306D serves as the Serial External Clock.

Polarity Latch

Polarity Latch U307 latches the 4-bit signal from the Buffered Data bus on the positive-going edge of the CS13 signal. The 4-bit output of U307 selects the polarity for the serial Data Pol, Serial Ext Trigger, Serial Ext Clock, Sig Start Pol, Stop Pol, and Clock Pol signals.

SIGNATURE GENERATOR ⟨6⟩

The Signature Generator circuit consists of Gating Logic, CRC (Cyclic Redundancy Check) Generator, and Data Selector stages as shown in Figure 3-13.

Gating Logic

The Gating Logic stage consists of U310, U370, U372, U374, and U398B, C, and D. Figure 3-15 shows the timing of gating logic events. At the beginning of each signature-generation cycle, U370B generates a negative-going pulse. The negative-going pulse from U370B resets U372B, U374B, and the CRC Generator. The Q output of U372B enables gate U310B.

Signature data at the inputs of U370A is latched by the negative-going edge of the inverted Clock signal from U310C. Gate U310A inverts the signature data from U370A and applies it to U386A.

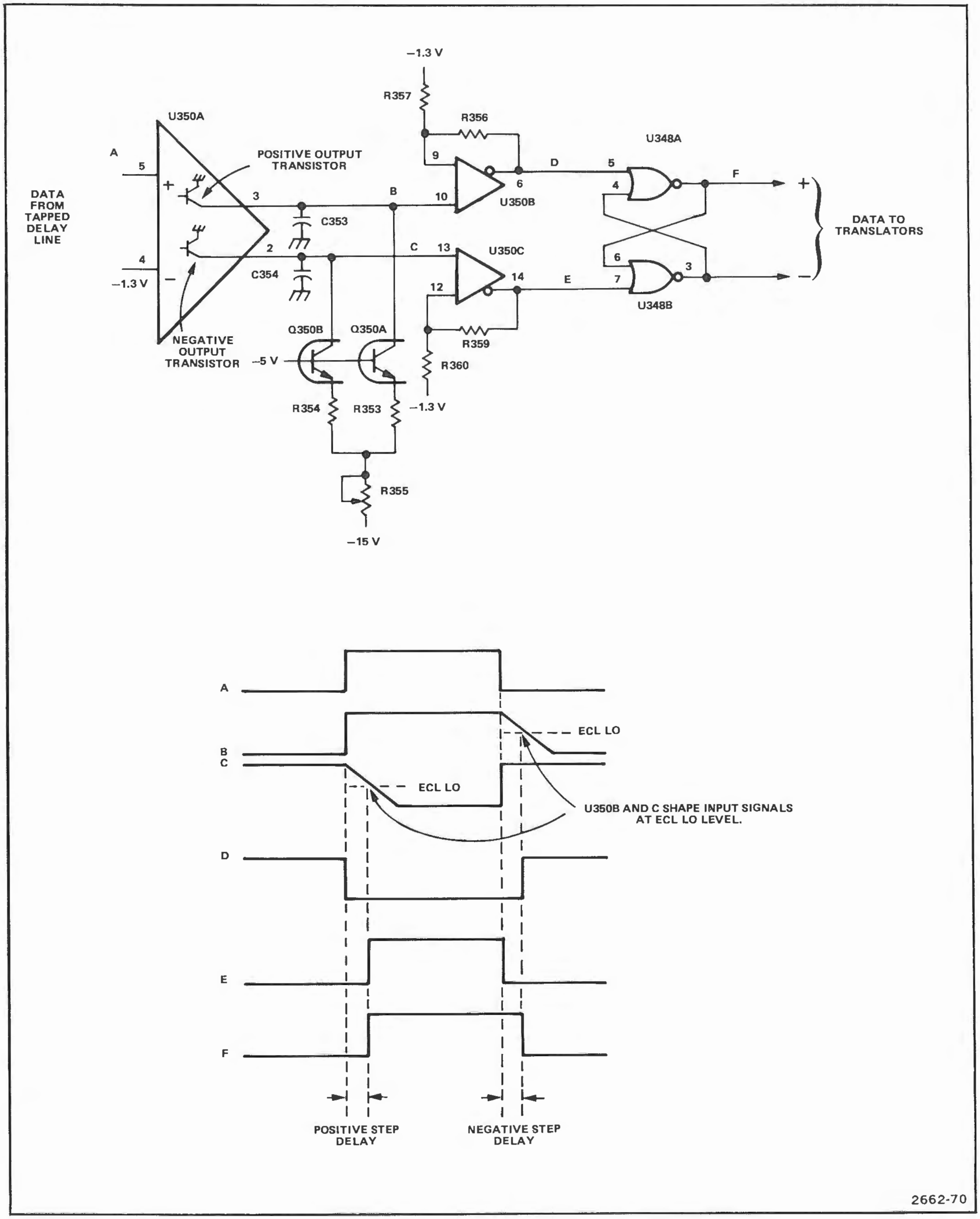

Figure 3-14. Simplified diagram of the variable delay circuit and its timing.

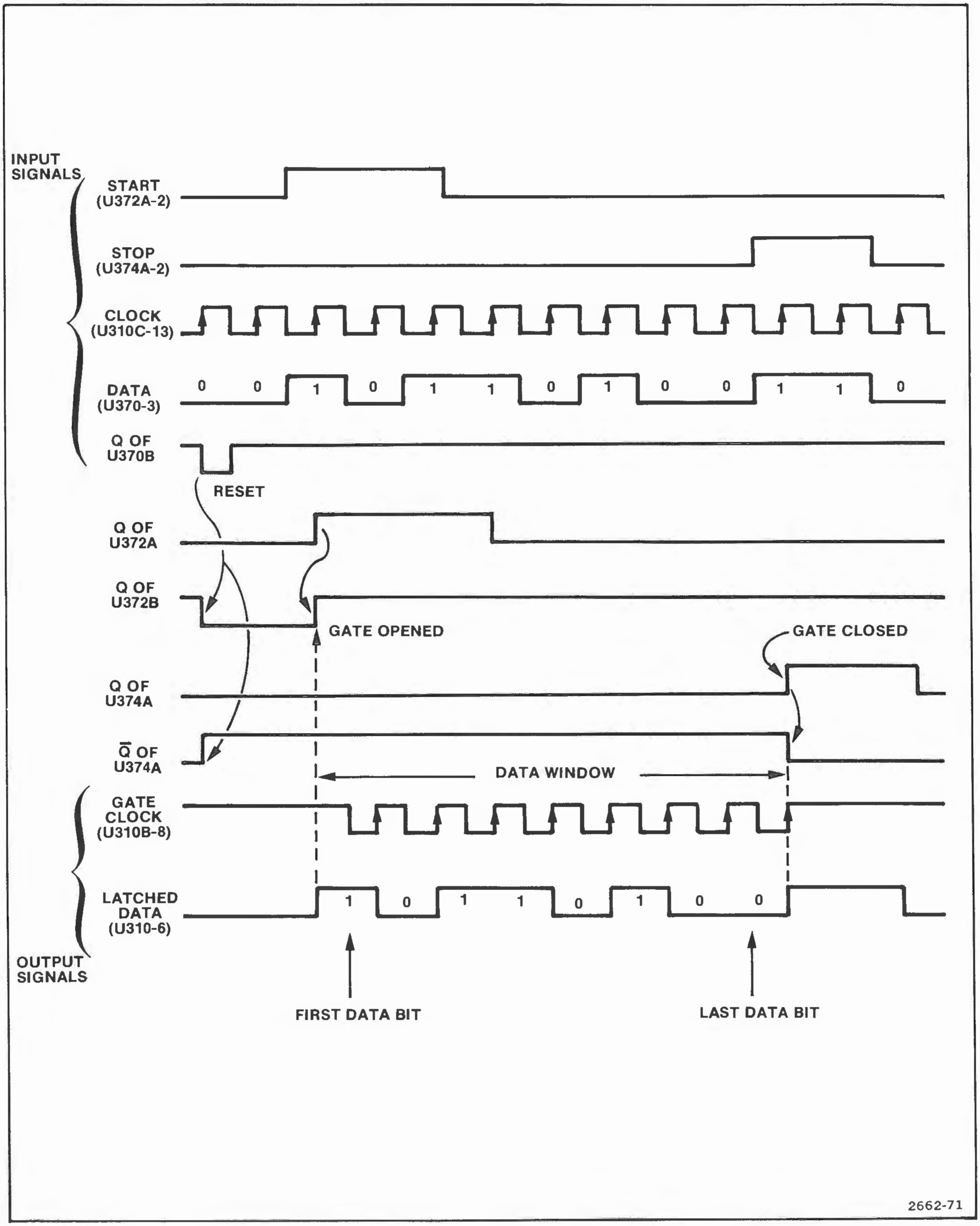

Figure 3-15. Timing diagram of the gating logic stage.

The Clock output from U306D latches the Start signal into flip-flop U372A. If the Start line is high when the Clock pulse occurs, the Q output of U372A will clock U372B. Flip-flop U372B will then assert a high on its Q output, which, with the Q output of U374B, enables U310B. The inverted Clock signal from U310C activates U310B and reaches the CRC Generator. If the inverted Stop signal is high when the Clock signal goes positive, U374A's Q output will go positive, clocking U374B. This will set U374B's Q output low, which will disable U310B and will stop Clock pulses from reaching the CRC Generator.

When U310B is enabled, the CRC Generator stage decodes the data it receives from U310A. That data is the CRC code.

Gates U398B, C, and D provide the Store/Sig Stop signal for the MPU circuit. When the Q output of U374B is high, U398D's output is high, turning on the TRIG'd indicator LED at the front panel.

CRC Generator

The CRC Generator stage consists of U378, U380, U386, and U388. This stage is reset at the beginning of each CRC generation cycle. The signature data at the input of modulo-2 adder U386A and is added to the data fed back to it from U386B. The output of U386A is then applied to the input of the 16-bit shift register, U378 and U380. The data at U378's input is shifted by the gated clocks at pin 8 of U378 and U380. The shifted data at pins 11 and 13 of U378 are added in modulo-2 adder U386D, and the output is clocked to the Q output of U388A. The shifted data at pins 5 and 12 of U380 are added in modulo-2 adder U386C, and the output is clocked to the Q output of U388B. Outputs of U388A and B are added in modulo-2 adder U386B, and the output is fed back to the input of U386A. The D-type flip flops, U388A and B, are provided to eliminate the delay time caused by adders U386C, D, and to allow operation at faster clock speeds, such as 20 MHz. Assuming slow speed operation, the diagram of the CRC Generator stage can be shown with the simplified diagram in Figure 3-16.

Data Selector

The Data Selector, comprised of U382 and U384, is a 2-line-to-1-line multiplexer with tri-state outputs. It selects the 8-bit output from either U378 or U380, depending on the ABØ signal. A low on the ABØ line causes the multiplexer to select the output from U378. A high on ABØ causes the multiplexer to select the output from U380. The logic level on the CS16 line controls the output gates in U382 and U384. A low on CS16 enables the gates, and a high turns them off. When the gates are turned off, U382 and U384 present a high output impedance.

SERIAL DATA ACQUISITION ⟨6⟩

The Serial Data Acquisition circuit consists of the Baud Rate Generator, Programmable Communication Interface (USART), and Data Bus Buffer stages, as shown in Figure 3-13.

Baud Rate Generator

The Baud Rate Generator stage consists of programmable bit-rate generator U392 and baud-rate latch U394. Programmable bit-rate generator U392 supplies the USART with the Receiver Clock signal, which may be either the Serial External Clock or the signal from the internal rate generator. The output rate is determined by the logic input on pins 11, 12, 13, and 14 (S3 through SØ, respectively) of U392. Table 3-4 shows the 16 input combinations and the corresponding output rates.

Table 3-4

Programmable Bit-Rate Generator Outputs

S3	S2	S1	SØ	OUTPUT RATE (Z)*
L	L	L	L	1 MHz Input
L	L	L	H	1 MHz Input
L	L	H	L	50 Baud
L	L	H	H	75 Baud
L	H	L	L	134.5 Baud
L	H	L	H	200 Baud
L	H	H	L	600 Baud
L	H	H	H	2400 Baud
H	L	L	L	9600 Baud
H	L	L	H	4800 Baud
H	L	H	L	1800 Baud
H	L	H	H	1200 Baud
H	H	L	L	2400 Baud
H	H	L	H	300 Baud
H	H	H	L	150 Baud
H	H	H	H	110 Baud

*When the crystal frequency is 2.4576 MHz, the actual output frequency is 16 times the indicated output rate above.

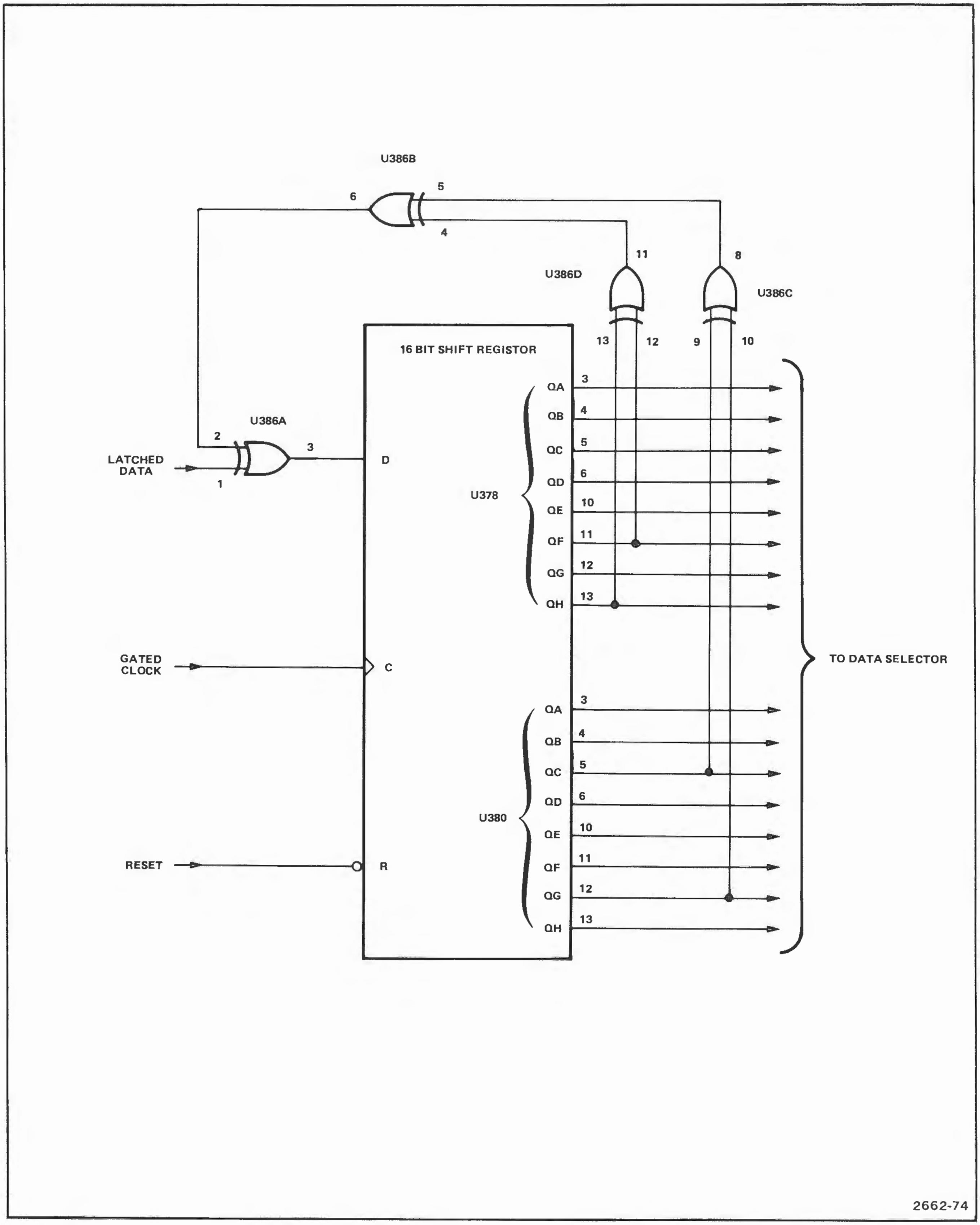

Figure 3-16. Simplified diagram of the CRC generator stage.

Baud-rate latch U394 receives the DBØ—DB3 data bits from the Buffered Data bus. The data is clocked into U394 on the positive-going edge of the CS13 signal. Its 4-bit output is applied to the SØ—S3 inputs of U392 and determines U392's output rate as shown in Table 3-4.

Data Bus Buffer

Bidirectional bus transceiver U396, with tri-state outputs, serves as the Data Bus Buffer to allow data transmission either from the A-side bus to the B-side bus or from the B-side bus to the A-side bus. The logic level on the RD line controls the direction of data transmission, and the I/O ENABLE line either enables or isolates the entire transceiver. The control of data transmission direction and bus isolation is accomplished as depicted in Table 3-5.

Table 3-5

Data Bus Buffer Control

I/O Enable	RD	Data Transmission
Low	Low	B side to A side
Low	High	A side to B side
High	X (don't care)	Isolated

Programmable Communication Interface

Programmable Communication Interface U390 is a Universal Synchronous/Asynchronous Receiver/Transmitter (USART) designed for microcomputer systems involving data communications. It performs the serial-to-parallel data conversion for all data transfers between the Serial Data line and the MPU.

The following information is intended as a discussion of a specific application of the device. For additional details, consult the manufacturers data.

In addition, the USART:

1. Controls the character length in bits.

2. Checks incoming synchronous data inputs for double synchronizing characters.

3. Detects asynchronous framing errors. These are errors occurring either when the received character is not properly framed with a start bit and at least one stop bit, or when there is a mismatch in baud rate or bits per character.

The first two of these functions are programmed into the USART by the MPU as a mode instruction (see Figures 3-17 and 3-18). The last function is read by the MPU during a USART status-read instruction (see Figure 3-19).

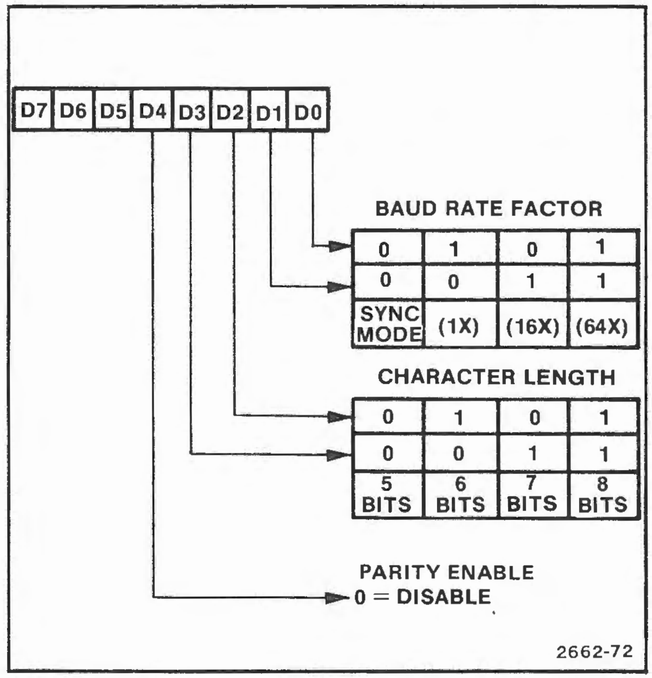

Figure 3-17. Asynchronous mode instruction format.

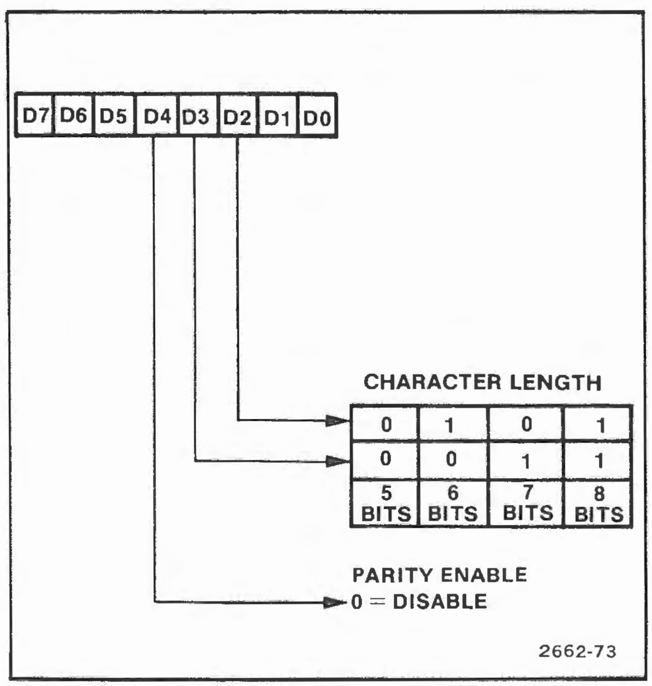

Figure 3-18. Synchronous mode instruction format.

Mode instructions can be input only during an external or internal USART reset. The external reset (pin 21) is tied to the MPU. The minimum reset time for the USART is six clock cycles (two less than for the MPU). The internal reset is a software reset generated by a command instruction from the MPU to the USART. This instruction automatically returns the USART to a condition of awaiting a mode instruction. Figure 3-20 shows the arrangement of a typical data block for USART control.

The WR input (pin 10) is pulled low when the MPU is writing to the USART (data, mode instruction, or command instruction).

The RD input (pin 13) is pulled low when the MPU is reading from the USART (data or status information).

The C/D input (pin 12) is set either high or low to indicate whether the information on the data bus is data, mode instructions, command instructions, or status information. A low represents data, and a high represents instructions or status information.

The CS input (pin 11) is pulled low to enable the USART. This input is provided by address decoder U412-6 (CS6 BXXX).

A summary of the various logic conditions of the C/D, RD, WR, and CS lines and the resultant USART actions are shown in Table 3-6.

Once the USART functions have been set by the mode instruction, the command instruction (see Figure 3-21) and the USART Clk control the actual operation of the USART. The USART Clk input was not covered previously under timing, since its only purpose is to provide internal timing for the USART. Its only criteria is that its rate must exceed the TxC clock rates by at least 30 times (for synchronous operation) or 4.5 times (for asynchronous operation).

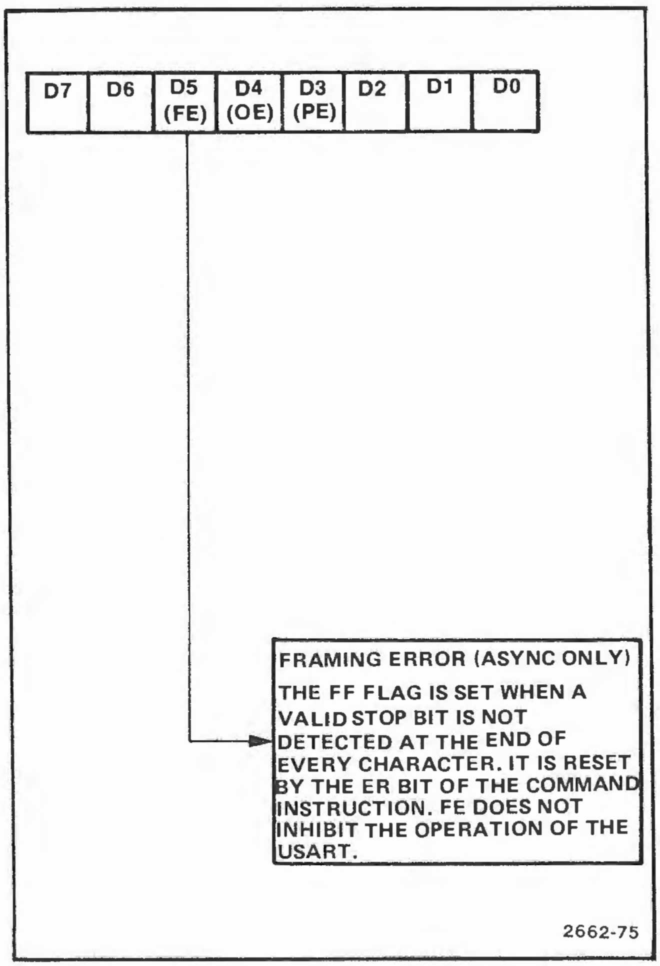

Figure 3-19. Status information format.

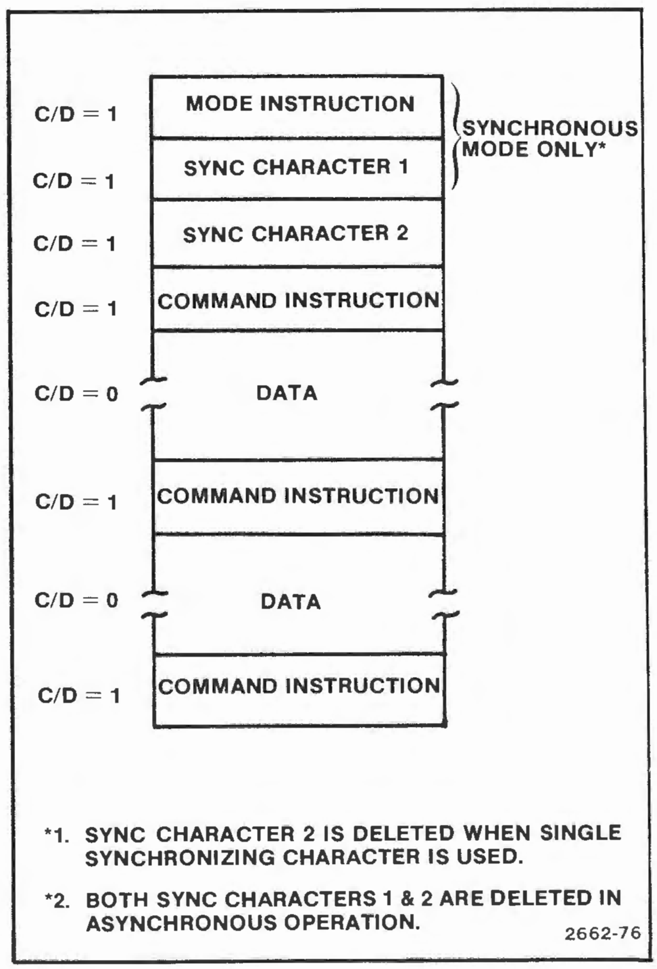

Figure 3-20. Typical data block for a USART.

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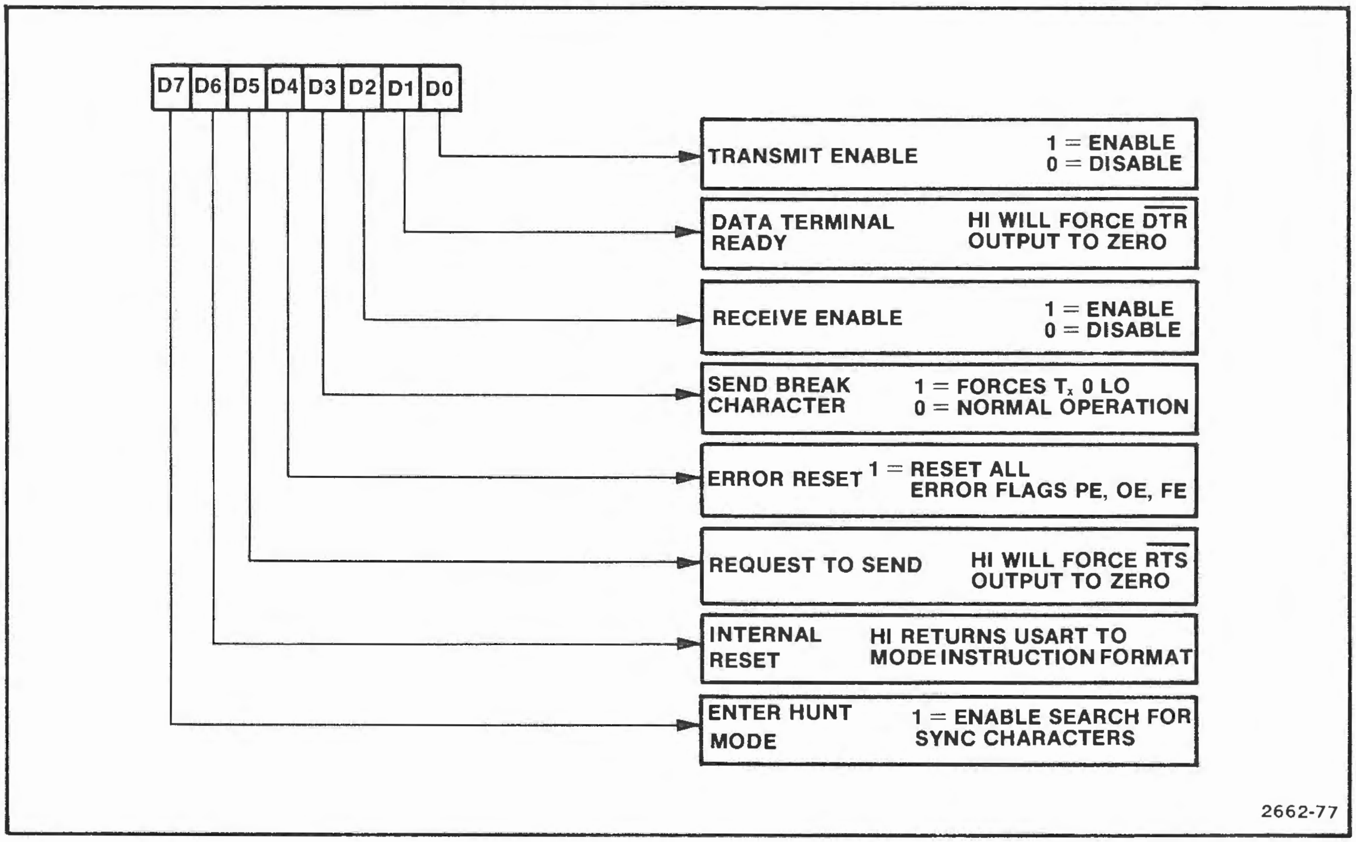

Figure 3-21. USART command instruction format.

Table 3-6

USART Read/Write Control Logic

Control Inputs				
C/D	RD	WR	CS	USART Action
0	0	1	0	USART transfers data to data bus.
0	1	0	0	USART receives data from data bus.
1	0	1	0	USART status information is transferred to data bus.
1	1	0	0	USART takes information from data bus as control information.
X	1	1	0	USART data bus is in high impedance state.
X	X	X	1	USART data bus is in high impedance state.

KEYBOARD ⟨7⟩ and MPU ⟨8⟩

A simplified diagram of the Keyboard and MPU circuits is shown in Figure 3-22. The main elements of these circuits are the MPU, Address Latch, Address Decoder, Hardware Status Gate, and Keyboard Controller stages; the ROMs; the RAMs; and front panel keyboard controls. Microprocessor unit U400 is the heart of the 308. All other stages of the circuitry either provide or accept data and/or instructions for (or from) it. Due to the complexity of its operation, a description of U400 will not be attempted in this manual. If detailed information is needed, refer to the manufacturer's data.

Address Latch

Address Latch U410 latches the lower eight bits of the address information on the MPU Data bus. The Data bus contains both data and the lower eight bits of the address. During the first MPU machine cycle, the ALE signal input at pin 11 goes high and enables the outputs to follow the inputs. When the ALE signal goes low, the outputs are latched at the levels of the data that were set up.

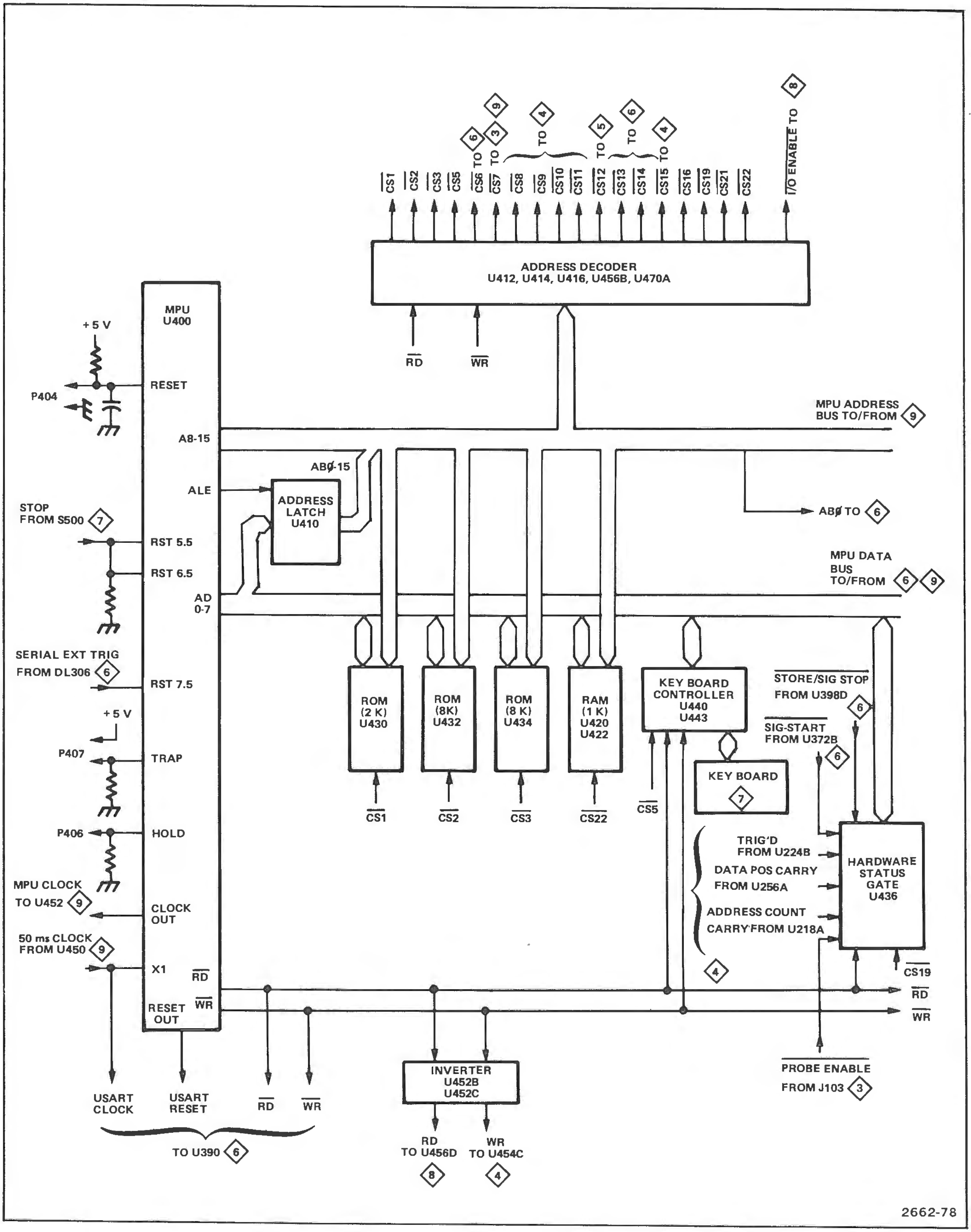

Figure 3-22. Simplified diagram of the MPU and Key Board circuits.

ROMs

Permanent storage for MPU instructions is provided in ROMs U430, U432, and U434. When the MPU addresses a location in a ROM, the ROM connects the addressed information to the MPU Data bus. This information is read and manipulated by the MPU.

RAMs

Temporary storage of data and addresses for the MPU and of data acquired from the probe inputs is provided by RAMs U420 and U422.

Address Decoder

The Address Decoder consists of U412, U414, U416, U456B, and U470A. It provides the chip-select and enable signals which determine the specific devices that are to communicate with the MPU. This selection is made by outputs from dual 2-line-to-4-line decoders U412 and U416 and from 3-line-to-8-line decoder U414. Gate U470A supplies the Data Bus Buffer with the I/O ENABLE signal.

Hardware Status Gate

Hardware Status Gate U436 is a hex bus driver with tri-state outputs. When its RD and CS19 inputs are both low, the hardware status inputs are read by the MPU through U436 via the MPU Data bus.

Keyboard and Keyboard Controller

Control-inputs from keys on the front panel, except the STOP key, are sampled by the MPU through tri-state buffer U442 to cause specific functions of the 308 to be performed. This is accomplished as follows. The MPU sends lows to keyboard lines KYBD8—KYBD13 through keyboard latch U440. When one of the keys connected to this Column Drive line (diagram 7) is pressed, one of the keyboard Row Read lines KYBDØ—KYBD5 connected to this key drops low. The MPU then reads this low through buffer U442 and performs the function of the key that was pressed.

For example, when the MPU outputs a low on KYBD8 and reads a low on KYBD2, it identifies the DATA= key. The STOP key is connected to the RST5.5 and RST6.5 inputs of U400. When the STOP key is pressed, the MPU performs the routines associated with the RST5.5 and RST6.5 inputs.

DISPLAY CONTROL ⑨

Figure 3-23 shows a simplified block diagram of the Display Control circuit which supplies the CRT circuit with Z-axis, Horizontal Sync, and Vertical Sync signals to create the appropriate displays on the crt screen.

Display Timing Generator

The Display Timing Generator stage consists of U450; U452D, E, and F; and U454A and B. This stage receives inputs of Dot, DISPLAY, and MPU clocks and provides the outputs of 750-ns, MPU, Counter, Data Bus Latch, and Character Latch clocks to other stages of the circuit as shown in Figures 3-23 and 3-24.

Display Counter

The Display Counter stage consists of the Column Counter (U464, U470C, and U471D), Line Counter (U466), and Row Counter (U468 and U470D). These counters provide the addresses of display locations on the crt, and the address outputs from the counters are used to read out data corresponding to the addressed display locations. One page of display information is composed of a matrix of 32 columns by 20 rows of characters.

The Column Counter is a ÷42 counter which divides the frequency of the inverted MPU clock and provides the 5-bit outputs of column addresses to be selected for Display RAM address inputs AØ—A4. These 5-bit outputs are used to read out the data that will achieve 32 columns of display characters. The counter also outputs the Horizontal Sync pulse to the H, V, Z Logic stage which forms H SYNC to determine the horizontal sweep frequency and which is used to blank the display during sweep retrace. Blanking time corresponds to the sweeping time needed for 10 columns of display.

The Line Counter is composed of a ÷10 counter which divides the horizontal sweep frequency generated by the Column Counter. It provides the 3-bit outputs that are applied to line select inputs AØ—A2 of the character ROM to select read out of the data for each of the eight sweep lines in each character. The Line Counter also generates the signal output used to count two more lines which provide the two lines of blanked space between characters.

The Row Counter stage is composed of a ÷24 counter which divides the Line Counter output frequency from U466 pin 8. It provides the 5-bit outputs of row addresses to be selected for Display RAM address inputs A5—A9. The 5-bit outputs are used to read out the data that will achieve 20 rows of display characters and provide the four

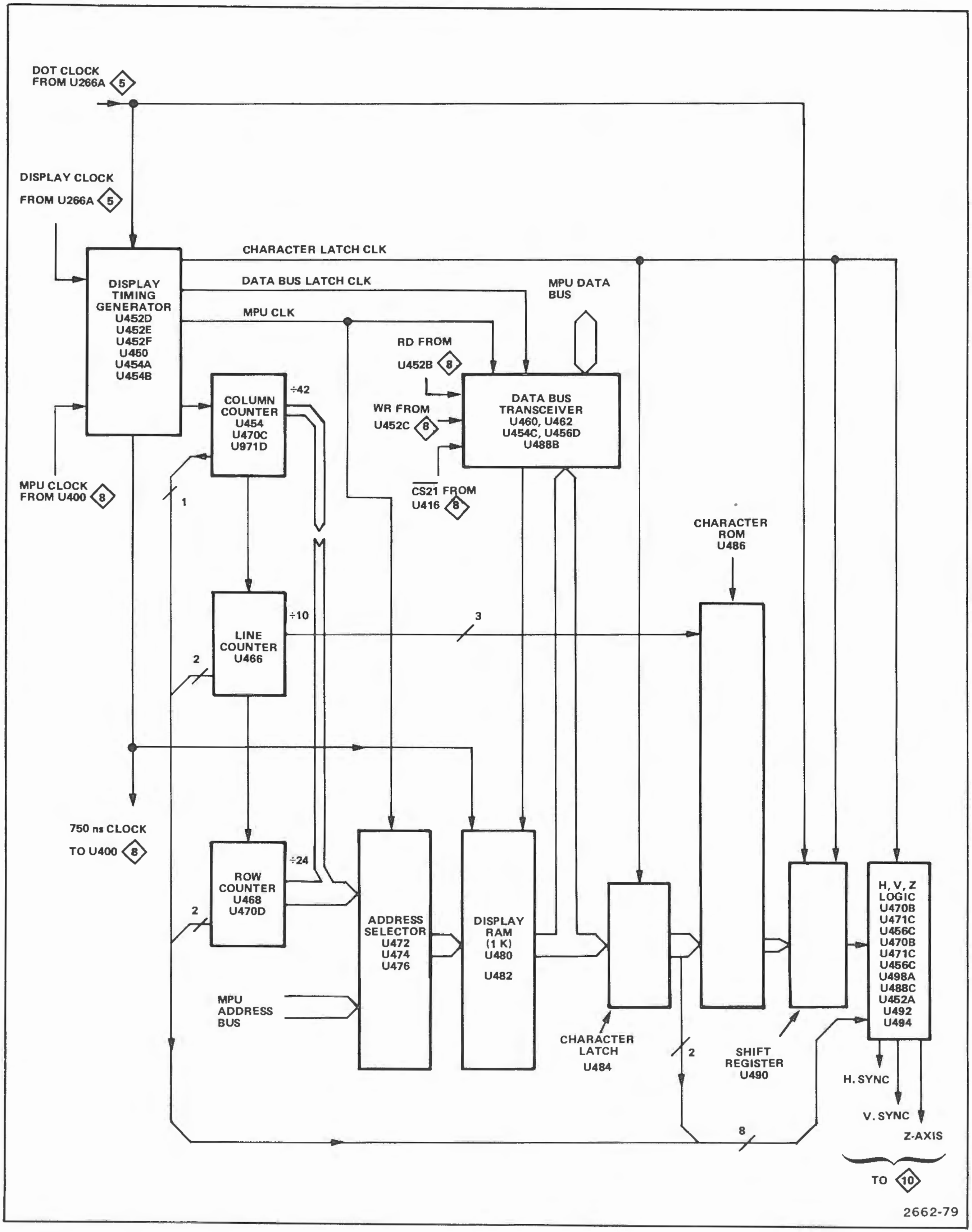

Figure 3-23. Simplified diagram of the display control circuit.

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rows of blanked space. The counter also outputs to the H, V, Z Logic stage and Vertical Sync pulse.

Address Selector

The Address Selector stage consists of U472, U474, and U476. They allow the Display RAM to be addressed by either the MPU (to load the RAM) or by the Display Counter (for display). While pin 1 of these devices is high, the MPU address is selected, and while it is low, the Display Counter address is selected.

Display RAM

Display RAM U480 and U482 provide 1024-by-8-bit bytes of data storage memory consisting of two areas, the display data area and the scratch pad area. Both areas can be accessed by the MPU to either write or read data. The display data area is sequentially accessed by the Display Counter to cause read out of the data on the crt.

Data Bus Transceiver

The Data Bus Transceiver stage consists of U460, U462, U454C, U456D, and U488B. This stage controls the

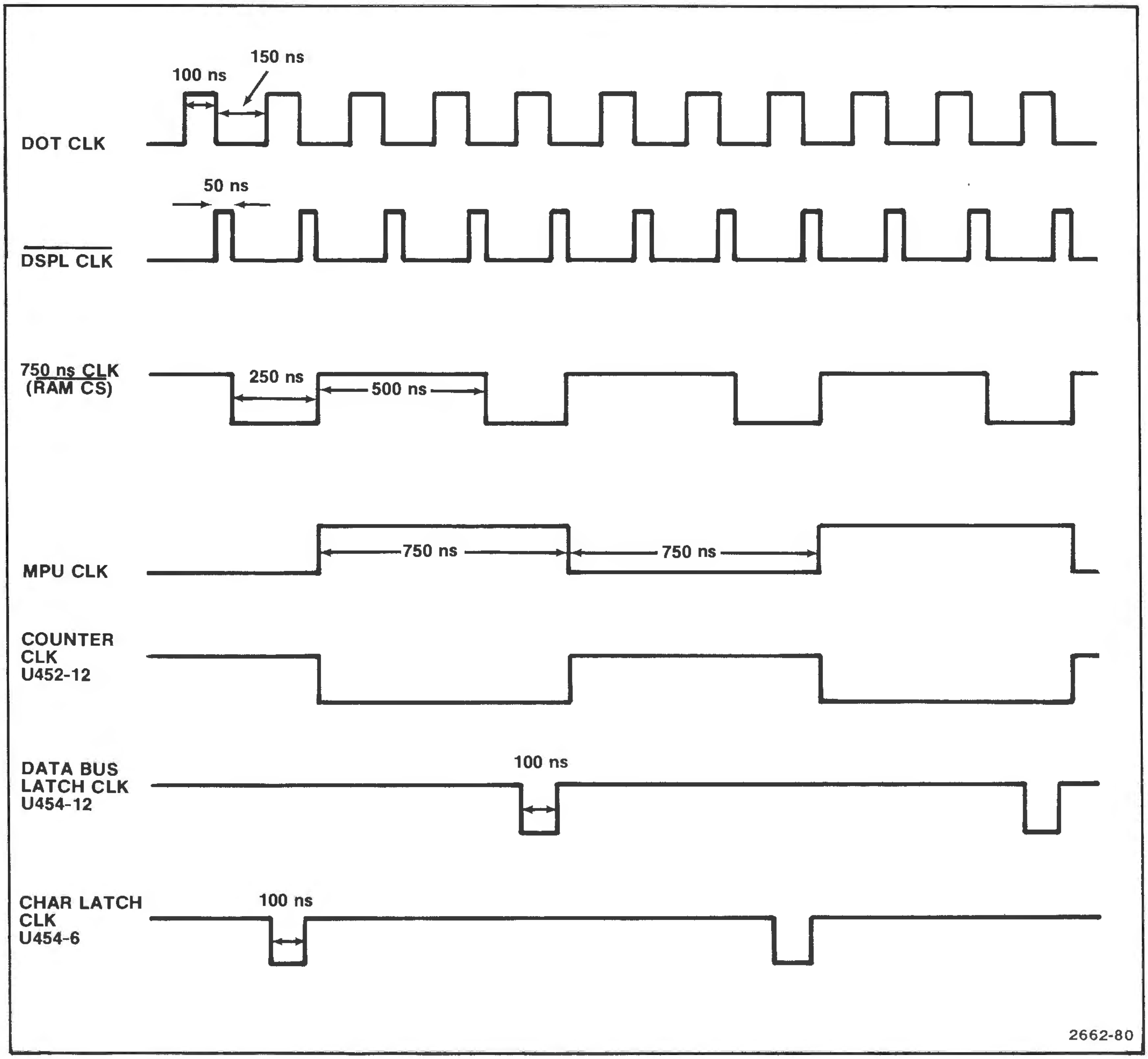


Figure 3-24. Timing diagram of the display timing generator stages.

data communication between the MPU and the Display RAM and allows the MPU to either write data into or read data from the Display RAM while the display RAM address is accessed by the MPU Address bus.

Character Latch

Character Latch U484 latches the 8-bit data read out from the Display RAM, and the latched data is maintained for six display clock cycles to achieve six dots of display per character. When the 750-ns clock and the MPU clock are both low, the input data to the Character Latch stage is provided and is latched on the positive-going edge of the Character Latch clock.

Character ROM and Shift Register

Character ROM U486 provides the character fonts to allow a variety of displays. Each character font in this ROM is composed of a 6- by 8-dot matrix and is selected by the 8-bit signal from the Character Latch stage. The top eight lines of each character font are selected by the line select signal from the Line Counter. The six dots on each line of each character font are read out from the ROM when each character is addressed. The 6-bit parallel output is loaded into shift register U490 by the clock and is shifted out in serial format to be used as a Z-axis signal.

H, V, Z Logic

The H, V, Z Logic stage consists of U470B, U471C, U456C, U488A, U488C, U488D, U452A, U492, and U494. This stage generates the Horizontal Sync pulse, Vertical Sync pulse, and Z-axis signal to be used in the CRT circuit. Gate U470B provides a high output from the blanking signal to blank rows 21 through 24 and U471C provides a high output from the V SYNC signal at the beginning of row 23. Gate U488A provides a low output during the 9th and 10th lines. U456C provides a low output when the outputs from U484 pins 16 and 19 are both high. This means that when the inverted ASCII character font in U486 is selected, the U456C output level will be low. When the inverted ASCII character font is selected, U488C provides a low output to unblank the 9th sweep line and a high output to blank the 10th sweep line. Inverter U452A inverts the character latch clock and clocks the input data of U492 to the output. Output timing is synchronized by the clock from U452A. Hex D-type flip-flop U492 provides the positive pulse outputs for the H SYNC and V SYNC signals and also provides the outputs to produce the Z-axis signal on the U494 output. A high output signal unblanks the display.

CRT 10

The CRT circuit provides the Horizontal and Vertical deflection currents and electrode voltages for the crt. A simplified diagram is shown in Figure 3-25.

Z-Axis Amplifier

The Z-Axis Amplifier stage (Q605, Q606, and R626) controls the beam current of crt V635 to create the display on the screen. The Z-Axis signal at the base of Q605 is compared with the dc voltage ($\approx$+1.4 V) at the base of Q606, and the inverted output from the collector of Q605 is supplied to the cathode of V635. Less positive voltage at the cathode brightens the display, while more positive voltage blanks it. Voltage at G1 of V635, supplied from potentiometer R626, controls brightness of the display.

Horizontal Sweep Generator

The Horizontal Sweep Generator stage consists of the Horizontal Amplifier, Damper, Flyback Transformer, and High Voltage Supply. Horizontal sweep current is generated by the combined operation of the Horizontal Amplifier, Damper, and Flyback Transformer.

To aid in understanding circuit operation, a simplified diagram and associated waveforms are shown in Figure 3-26. The H SYNC pulse is applied to the base of Q610, and the inverted H SYNC output is ac coupled to the base of Q615. Assume that Q615 is conducting just before T_0 and that current I_1 is passing through Q615. When Q615 is turned off at T_0 by the inverted H SYNC pulse, the energy stored in L635 and L672 is discharged through C617, causing current I_2. Current I_2 charges up C617 to about +45 volts at T_1, and the stored energy in C617 is discharged during the time interval T_1 to T_2. Discharging current I_3 charges L635 and L672, and Q615 collector voltage goes negative. When the Q615 collector voltage goes more negative than −5 volts at T_2, diode CR620 conducts. The stored energy in L635 and L672 is then discharged through CR620. The discharging current decreases to zero at T_4, and the discharging voltage in L635 and L672 becomes less than the power supply voltage. Therefore, L635 and L672 stop discharging and are charged again by the power supply voltage. Charging current I_1 passes through Q615, since Q615 was turned on at T_3.

Current I_1 increases until Q615 is turned off again. The Q615 collector waveform is shown in Figure 3-26 as the ideal waveform; the actual waveform may contain more noise. Collector voltage at Q615 is applied to the primary winding of T620. This transformer provides voltages for the heater, G_1, G_2, and anode inputs to the crt. It also provides voltages for the Z-Axis amplifier. A high voltage multiplier is included in the flyback transformer box.

Vertical Sweep Generator

The Vertical Sweep Generator stage consists of transistors Q645, Q656, Q665, and Q668 and is a Miller integrator, producing the sawtooth current for vertical deflection in yolk L635. The V SYNC signal, a 1.26-ms

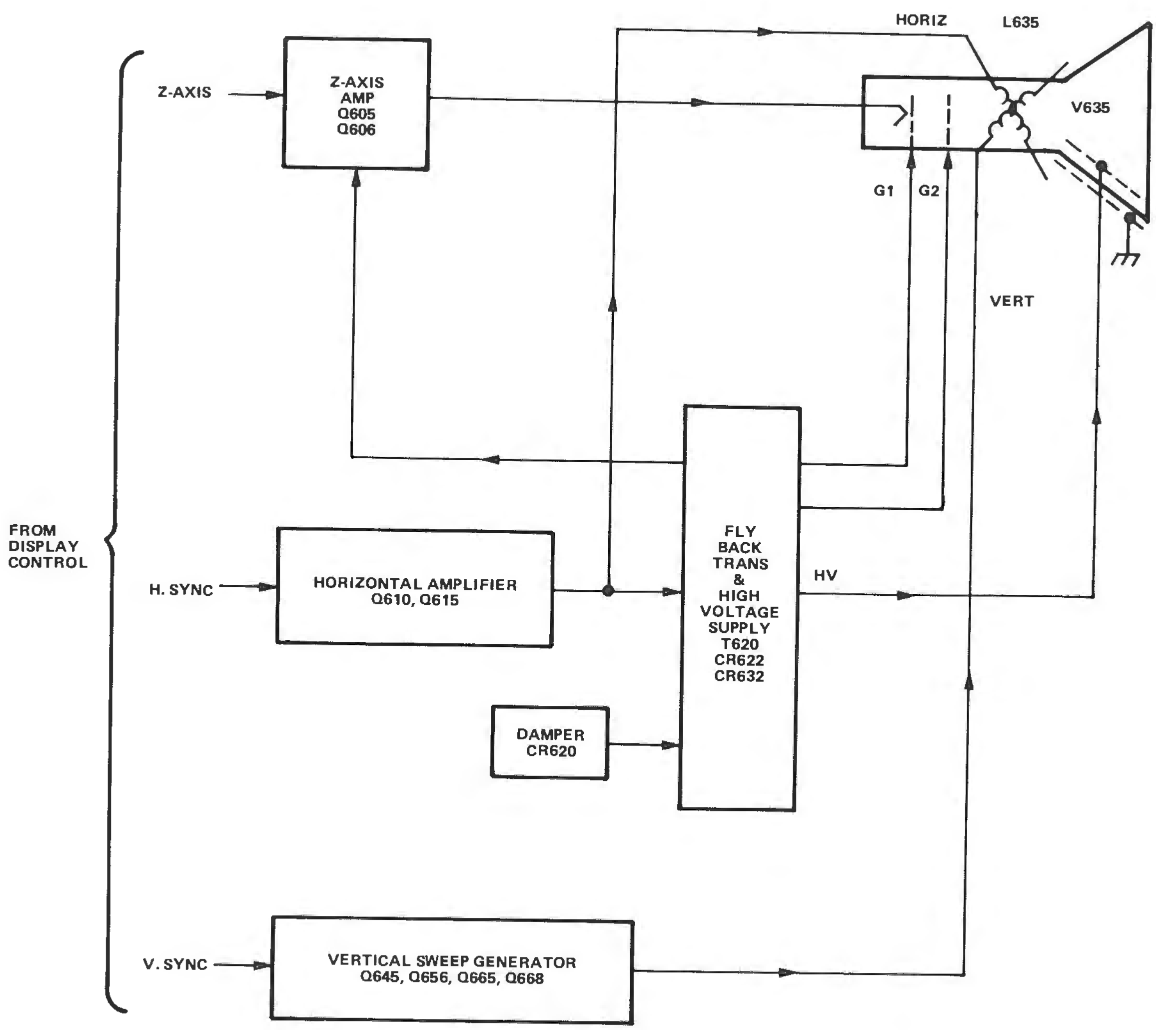


Figure 3-25. Simplified diagram of the CRT circuit.

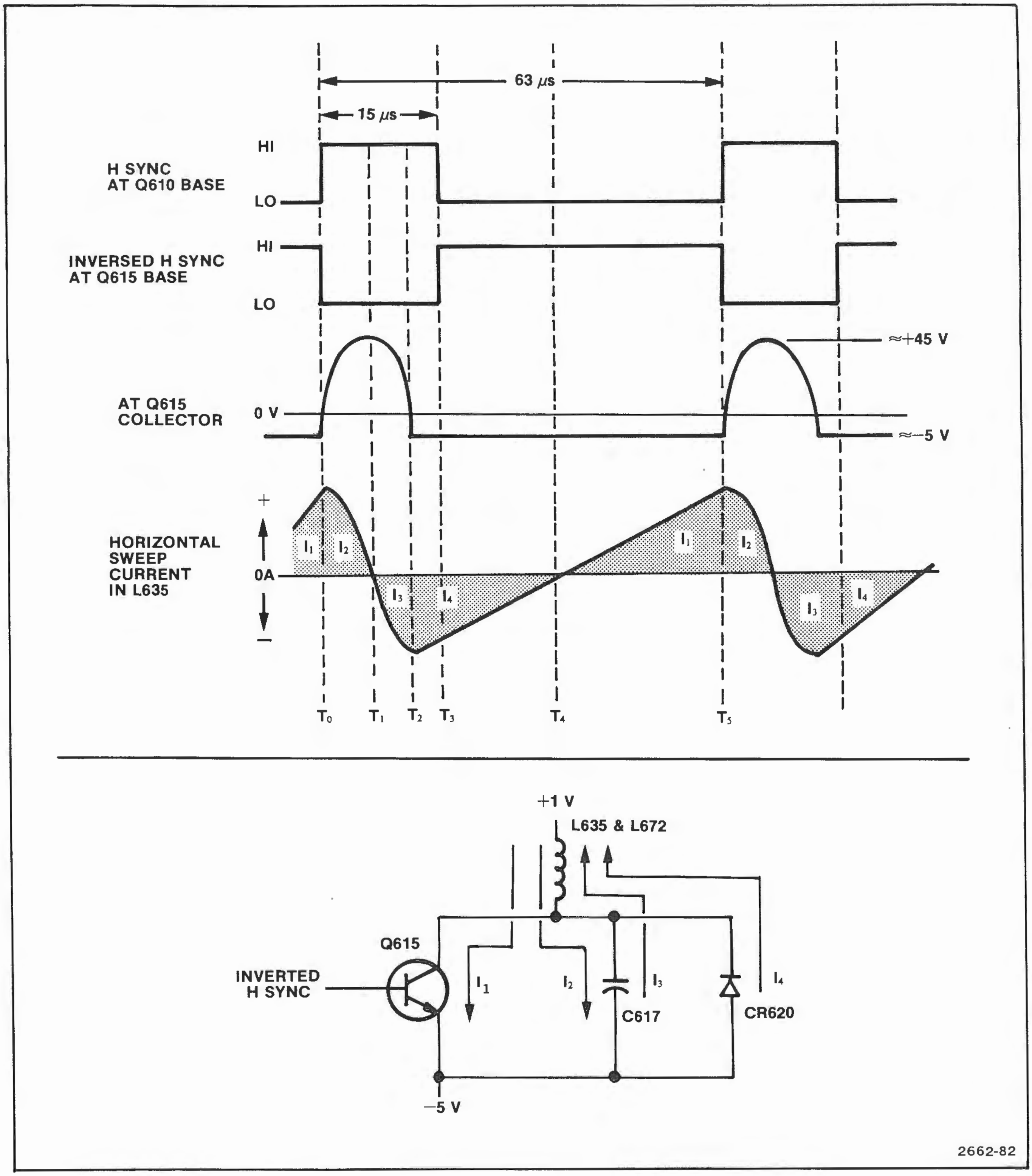


Figure 3-26. Simplified diagram and waveforms of the horizontal sweep generator.

pulse, triggers this circuit every 15.12 ms. When the V SYNC signal steps high, Q645 is turned on and C652 starts discharging rapidly through Q645 and R649. As this happens, the collector of Q645 drops low, turning off Q656 through C653. Transistor Q665 is turned on, and its emitter steps high. This positive-going step is fed back to the base of Q645 through C667, R643, and C643, keeping Q645 on. When Q665 is turned on, the current is conducted to −5 V through C667, L635, and R650. Therefore, the positive-going voltage is caused at the junction of R650 and C652. This positive-going voltage is fed to the base of Q656 through C652 and C653, and the amplifier (Q656, Q665, and Q668) is forward biased to operate in the linear region. When the amplifier gets into the linear region, the emitter of Q665 produces a negative-going transition which is fed back to the base of Q645 through C667, R643, and C643, turning the transistor off. At this moment, C652 is allowed to charge up by the current fed through R647 and R645. The current determined by R647 and R645 is integrated by C652 and generates the negative-going sawtooth voltage at the junction of C652 and R650. This voltage results in the sawtooth current in deflection coil L635.

The current integration by C652 stops when the positive-going edge of the V SYNC signal is received at the base of Q645. The cycle then repeats. If the H SYNC signal is not received, the junction voltage of C652 and R650 goes more negative and Q645 is turned on. Therefore, the circuit repeats the same operation previously described, but the repetition rate is slightly slower than the rate of the V SYNC signal.

POWER SUPPLY ⟨11⟩

The Power Supply circuit provides the operating power for the 308 from the ac line-voltage source. Figure 3-27 is a simplified block diagram of the Power Supply circuit.

Line Input

Power is applied through Line Filter FL700, line fuse F700, thermal cutout switch S700, and POWER switch S702. The Line Filter is designed to keep power-line interference from entering the instrument and to keep the approximately 20-kHz Inverter signal from entering the power line.

Line Voltage Selector switch S710 allows the instrument to operate from either a 115-volt nominal or a 230-volt nominal line voltage source. In the 115 V position, rectifier CR716 operates as a full-wave doubler with energy-storage capacitors C717 and C718, so the voltage across the two capacitors in series will be the approximate peak-to-peak value of the line voltage. For 230-volt operation, C716 is connected as a bridge rectifier, and the voltage across C717 and C718 will be the approximate peak value of the line voltage. Thus, the dc voltage applied to the Inverter stage is about the same for either 115-volt or 230-volt operation.

Thermistors RT707 and RT708 limit the surge current when the power supply is first turned on. After the instrument is in operation, the resistance of the thermistors decreases so that they have little effect on the circuit. When the instrument is turned off, the Inverter Control stage turns off the Inverter, preventing it from discharging C717 and C718; C717 and C718 discharge slowly through R717 and R718 to allow for thermistor thermal-recovery time. This ensures sufficient thermistor resistance to limit the turn-on surge current to a safe level. Since C717 and C718 discharge slowly, dangerous potentials exist within the power supply for several minutes after the POWER switch is turned off. The presence of voltage in the circuit is indicated by relaxation oscillator R719, C719, and DS719. Neon bulb DS719 will blink until the potential across C717 and C718 drops to about 80 volts.

Spark gap electrodes DS714 and DS715 are surge-voltage protectors. When the Line Voltage Selector switch is in the 115 V position, only DS714 is connected across the line input. If a peak voltage greater than 230 volts is present on the line, DS714 will conduct and quickly open Line Fuse F700 to interrupt the input power before the instrument can be damaged. When the Line Voltage Selector switch is in the 230 V position, DS714 and DS715 are connected in series across the line input to provide protection for peak voltages greater than 460 volts.

Transformer T715 provides a sample of the line voltage to the Inverter Control stage to sense when line voltage is present.

Inverter Start Network

Voltage divider R722-R723 is connected through T720 between the ac input line and the negative side of C718. The voltage across R723 charges C725 on each half cycle of the input line voltage. When the charge on C725 reaches about 32 volts, trigger diode CR725 conducts and C725 is discharged through CR725 to provide the base drive to turn on Q744 through C742. When Q744 is turned on, it shock-excites series-resonant network L745-C745 to generate a damped oscillation. This damped oscillation provides the drive necessary to start the Inverter switching action. After the Inverter is operating, the recurrent waveform at the collector of Q744 keeps C725 discharged through CR745. This disables the Inverter Start Network while the instrument is on.

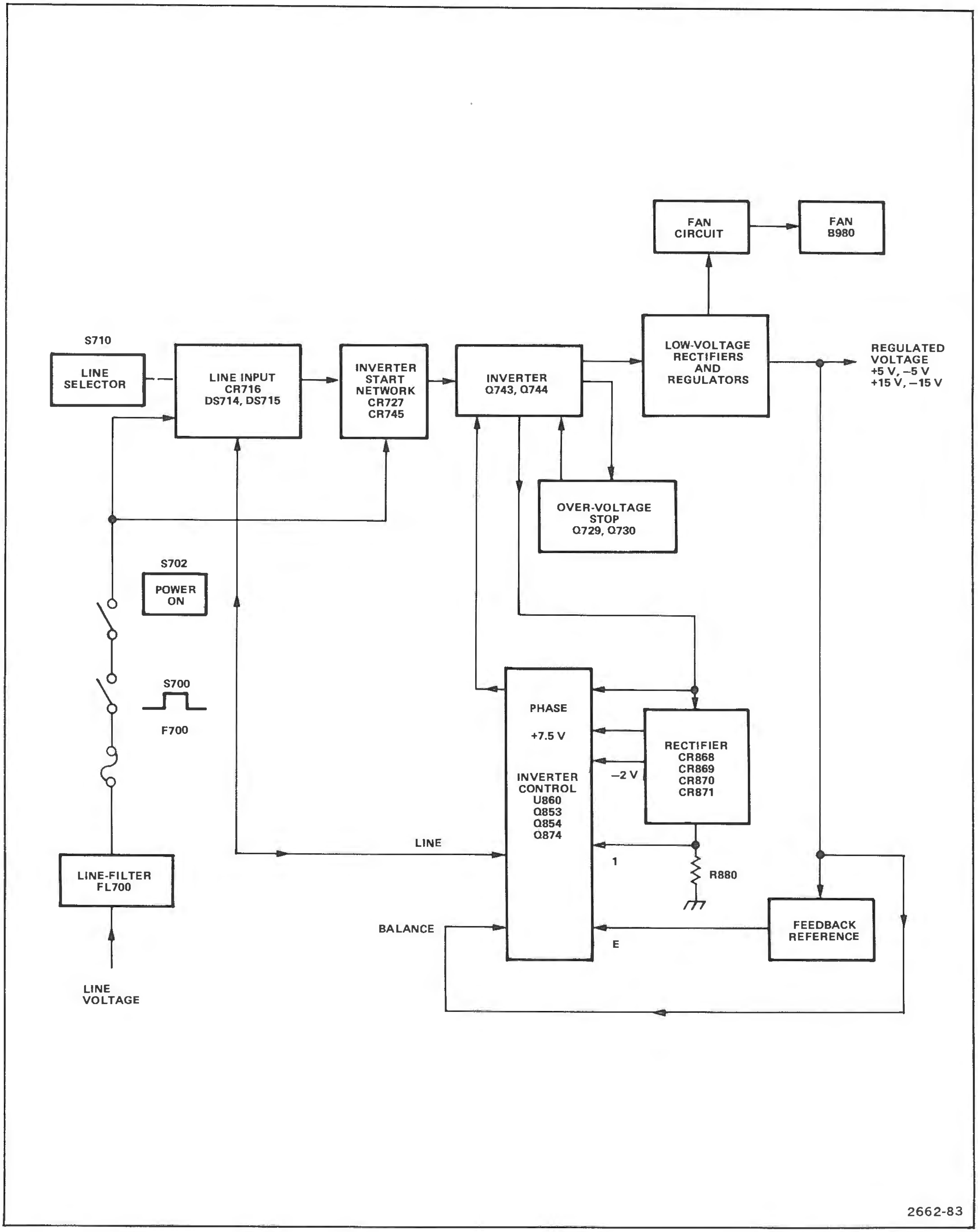


Figure 3-27. Simplified diagram of the power supply circuit.

Inverter

The Inverter stage converts the dc voltage across C717 and C718 to a sine-wave current to drive power transformer T800. Once the Inverter has been started by the Inverter Start Network, transformer T740 provides feedback to the bases of Q743 and Q744 to sustain oscillation. These transistors operate at a forced beta of 4 due to the turns ratio of T740. Also, T740 provides a 120-turn, center-tapped winding for regulation and fault protection shutdown. The Inverter Control stage short-circuits one-half of this winding to either delay the turn-on of Q743 and Q744 or completely stops their switching action.

The switching action of Q743 and Q744 generates a square wave with an amplitude approximately equal to the dc voltage at the input to this stage. The square-wave voltage at the emitter of Q743 supplies the drive necessary to maintain a sine-wave current in the series-resonant network of L745 and C745. Diodes CR743 and CR744 provide paths for series-resonant current when Q743 and Q744 are held off for regulation.

To aid in understanding circuit operation, Figure 3-28A shows a representation of the Inverter stage as a switch. The three possible states of the Inverter are depicted by the three switch positions: Q743 is on in position (a); Q744 is on in position (c); or both transistors are held off for regulation in position (b). In the composite current waveform (Figure 3-28B) the relative phase and amplitude of each component of I_t is shown for periods T_a, T_b, and T_c. Each period corresponds to the respective switch position previously explained for Figure 3-28A. Figures 3-28C and D show the relationship of Inverter voltage and primary winding voltage with respect to the current waveform.

The normal sequence of operation is as follows. Assume that I_t is passing through zero and is increasing in the direction which forward biases CR744 to conduct I_1 as shown in Figure 3-28B. When the Inverter current crosses through zero, the Inverter Control stage holds off Q743 and Q744. At a time determined by the Inverter Control stage, Q743 is allowed to conduct I_2, reverse biasing CR744. Transistor Q743 conducts as I_2 goes through its peak and back to zero. At the zero crossing, the Inverter Control stage again holds off Q743 and Q744. During this hold-off time, CR743 conducts I_3. Next, Q744 is turned on to conduct I_4, reverse biasing CR743. Transistor Q744 conducts as I_4 goes through its peak and back to zero. The cycle then repeats itself.

During conduction of Q743, power is delivered to series resonant circuit L745-C745 and to T800. Part of this power, stored in the resonant circuit, is returned to the supply when diode CR743 conducts. Regulation is achieved by varying the holdoff of the inverter transistors, period T_b in Figure 3-28B, thereby determining the net power delivered to T800.

Over-Voltage Stop

The circuit formed by Q729 and Q730 stops the Inverter whenever the voltage across the primary of T800 exceeds a safe level. This circuit will be active whenever the connector between the Primary Power Supply and Secondary Power Supply boards is removed or whenever the normal regulating path through Q854 and T740 is inoperative. CR746 charges C733 to the peak of the voltages across T800. If this voltage exceeds a safe level, VR731 will conduct, turning on Q729. Capacitor C733 will then discharge through R728 into the base of Q730. When Q730 is on, Q744 will be held off, stopping the Inverter. The Inverter cannot restart until CR727 has charged C733 to the breakdown voltage of CR725.

Inverter Control

The Inverter Control stage, made up primarily of U860, provides regulation and fault protection functions. For regulation purposes, U860 varies hold-off time T_b (see Figure 3-28B) of the Inverter switching transistors.

Under normal operating conditions, only the E Sens input at pin 15 of U860 controls the hold-off time. However, various fault conditions can either affect hold-off time or stop Inverter operation altogether. The operation of each individual function of the Inverter Control stage is described in the following discussion.

REGULATOR. The pre-regulator operation of U860 maintains constant voltage at the outputs of the low-voltage rectifiers. Transformer T847 provides Inverter phase information and power to U860. The phase information is connected to pins 10 and 11 through C866 and C867. The bridge rectifier (CR868, CR869, CR870, and CR871) provides positive and negative operating voltages to U860. A shunt regulator in U860 maintains the +7.5 volts at pin 6. The −2-volt (nominal) supply connected to pin 7 is unregulated. Zener diode VR873 is for protection against open circuit conduction (U860 removed) and is normally not conducting.

Pin 15 is the voltage-sensing (E Sens) point of the Regulator circuit. Zero volts at pin 15 indicates proper regulation. Zener diode VR893 provides a stable reference voltage for sensing-divider resistors R887, R890, R891, and R892. Resistor R890 in this divider adjusts the ratio of the divider to adjust the output of the +5-volt supply. Outputs of the other supplies are then set by the turns ratio of T800.

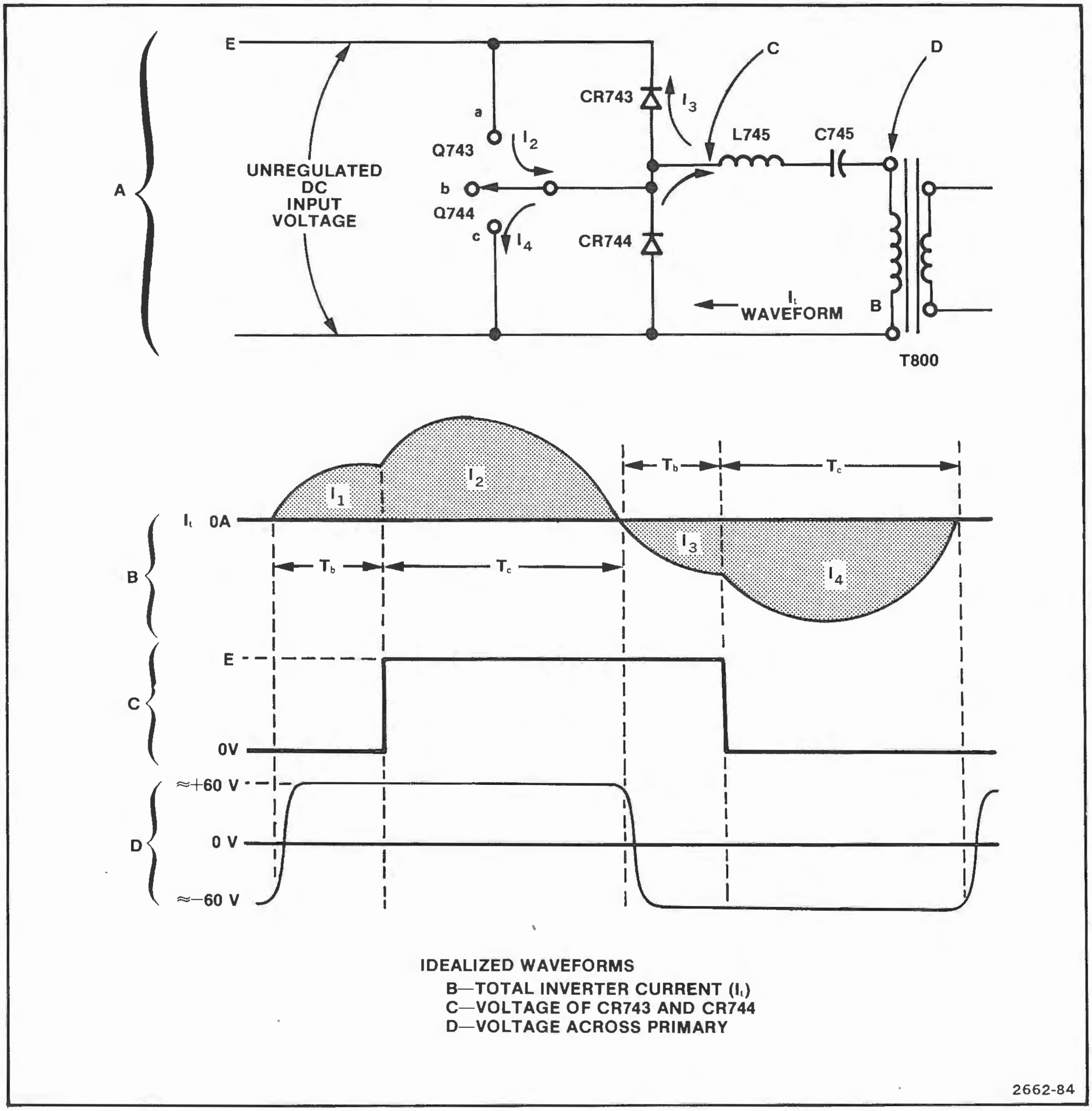


Figure 3-28. Representation of inverter stage and idealized waveforms.

Integrated circuit U860 regulates the Inverter by varying the hold-off time of switching transistors Q743 and Q744. A variable-pulse-width, monostrable multivibrator in U860 is triggered at pins 10 and 11 whenever the Inverter current changes direction. The pulse width holds off the Inverter by turning on transistor Q854 through pin 9 of U860, thus shorting out the base drives to Q743 and Q744. The pulse width, and therefore hold-off time, is controlled by a ramp input at pin 12. If the voltage at the E Sens input (pin 15) is too low, the ramp is not allowed to rise very high and the pulse width and hold-off time are short. As the E Sens voltage rises, the ramp is allowed to rise to a higher voltage level, increasing the hold-off time.

FAULT PROTECTION. The fault-protection portions of U860 provide protection of power-supply components from damage due to short circuit, turn-on surge currents, and other malfunctions. When a fault is detected at the Bal Sens input (pin 2) or I Sens input (pin 13), a current from the Fault Holdoff Time output (pin 1) charges C861. If the detected fault lasts longer than about 10 milliseconds, C861 will charge positive enough to initiate a positive output at pin 8. This output turns on Q853 and Q854, which turns off the Inverter. The Inverter will remain off while C853 discharges through R853, keeping Q853 and Q854 turned on. When the Inverter restarts, C853 is recharged through CR852 and R852. This cycle repeats until the fault is corrected, with the Inverter on for about 10 milliseconds, and off for about 500 milliseconds.

INVERTER CURRENT LIMITER. The Inverter Current Limiter provides protection of Inverter components from damage due to excessive turn-on current or short circuits. Operation of this stage is similar to the Regulator (voltage regulation). The Inverter Current Limiter takes control of Inverter hold-off time whenever pin 13 of U860 starts to go negative. T847 is a current step-down transformer. The current is rectified and flows through R880, the current-sensing resistor. The voltage across R880 is negative and proportional to the Inverter current. The I Sens input at pin 13 is normally held positive through divider R878 and R879. The Inverter Current Limiter takes control of regulation when pin 13 approaches zero volts. If the voltage at pin 13 remains near zero for more than about 10 milliseconds, pin 8 will go positive to turn off the Inverter.

BALANCE. The Balance portion of U860 provides overload protection for all regulated DC voltages. Resistive networks from supplies are connected to the Bal Sens input at pin 2 of U860. During normal operation, the voltage at the Bal Sens input remains near zero. If one of the inputs changes sufficiently to cause this voltage level to vary 200 millivolts (positive or negative) for more than 10 milliseconds, a positive output is produced at pin 8 of U860 to stop the Inverter.

LINE STOP. The Line Stop portion of U860 stops the Inverter when the POWER switch is turned off. The Line Stop stage will also stop the Inverter if the ac line voltage falls below a minimum value.

The line-frequency signal from transformer T715 is connected to pin 4, the Line Stop Sens input of U860. During normal operation, the line-frequency signal causes the Line Stop Timer terminal (pin 3) to periodically discharge to ground. When the line-frequency signal is interrupted or falls below a minimum value, C860 will charge to approximately +0.7 volt, causing the Line Stop stage to produce a positive output at pin 8 of U860 to stop the Inverter.

Low-Voltage Rectifiers and Regulators

The rectifiers and filter components in the secondaries of T800 provide rectified, regulated voltages. Regulators U807 and U808 provide regulated + volts and − volts from ±20 volts.

Fan Circuit and Fan

The Fan motor used in the 308 is a brushless motor with three field windings driven by a three-phase oscillator circuit. Fan motor speed is controlled by the emitter voltage of Q985, which is determined by the voltage-dividing ratio of RT986 and R987. When temperature increases, the value of thermistor RT986 decreases, increasing the emitter voltage of Q985. The frequency of the oscillator then becomes high, and the speed of the motor increases.

CALIBRATION

Introduction

This section of the manual is in two parts: Performance Check and Adjustment Procedure. Each subsection has a different purpose and important information regarding their use is included at the beginning of both subsections. These procedures also may be useful as a preliminary troubleshooting aid.

Test Equipment Required

The test equipment listed in Table 4-1, or equivalent equipment, is required to complete the Performance Check and Adjustment Procedure. A partial list of equipment needed for each individual Check and Adjustment is also shown at the beginning of each step.

In Table 4-1 the specifications given for the equipment are the minimum necessary to provide accurate results. Therefore, the equipment used must meet or exceed the listed specifications. Detailed operating instructions for the test equipment are not given in this procedure. Refer to the appropriate instruction manual if more test equipment operating information is required.

Calibration Interval

To ensure correct instrument operation, check instrument performance every 1,000 hours of operation or every six months if used infrequently. Before performing the adjustment procedures, perform preventive maintenance as outlined in the Maintenance section.

Table 4-1

Test Equipment Required

Item and Description	Minimum Specification	Use	Example of Applicable Test Equipment
1. Variable Auto-transformer	Capable of supplying at least 3 A over a range of 90 V to 132 V.	Check line voltage range.	General Radio W8MT3VM.
2. Digital Multimeter (DMM)	DC volts range to ±20 V.	Check power supply voltage.	TEKTRONIX DM 501.
3. Oscilloscope	175 MHz bandwidth.	Check delay time, compensation.	TEKTRONIX 475[1].
N 4. Pulse Generator	15 ns pulse width. 50 ns period. 100 ns variable delay.	Signal source for timing check.	TEKTRONIX PG 508.
5. Pulse Generator	24.5 ns pulse width. 50 ns period.	Signal source for timing check.	TEKTRONIX PG 502.
N 6. Delay Counter	20 MHz.	Use as standard clock delay counter.	TEKTRONIX DD 501.
N 7. Serial Data Generator	9.6 kHz. 5, 6, 7, and 8 bits/character in Sync and Async timing.	Check serial data acquisition.	TEKTRONIX 832.
8. Power Module		To provide operating voltages for TEKTRONIX TM 500-Series test equipment.	TEKTRONIX TM 505 or TM 506.

N = Need

Table 4-1 (cont)

Test Equipment Required

Item and Description	Minimum Specification	Use	Example of Applicable Test Equipment
9. ADAPTER	Probe tip to bnc male	Signal interconnection.	Tektronix Part No. 013-0084-01.
10. Termination	Impedance, 50 Ω. Connectors, bnc.	Signal termination.	Tektronix Part No. 011-0049.01.
11. T-Connector	Connectors, 2 bnc female to 1 bnc male.	Signal interconnection.	Tektronix Part No. 103-0030-00.
12. Attenuator	Attenuation factor, 10X. Impedance, 50 Ω. Connector, bnc.	Signal attenuation.	Tektronix Part No. 011-0059-02.
13. Cable	Impedance, 50 Ω. Connector, bnc.	Signal interconnection.	
14. Normalizer	1 MΩ paralleled by 40 pF.	Check input capacitance.	Tektronix Part No. 067-0935-00.
15. Adapter	BNC male to dual binding post.	Signal interconnection.	Tektronix Part No. 103-0035-00.
16. Screwdriver	Length, 3-inch shaft; bit size, 3/32 inch.	Adjust variable resistors.	Xcelite R-3323.
17. Low-Capacitance Screwdriver	Length, 1-inch shaft; bit size, 3/32 inch.	Adjust variable capacitors.	J.F.D. Electronics Corp. Adjustment Tool Number 5284.
18. Passive Probe	Attenuation factor, 10X. Impedance, 1 MΩ, paralleled by 40 pF.	Serial data acquisition.	Tektronix Part No. 010-6107-03 P6107 (308 standard accessory).
19. Data Acquisition	Eight data channels, one clock channel, and one ground.	Parallel data acquisition.	Tektronix Part No. 010-6451-05 P6451 (308 standard accessory).
20. Word Recognizer Probe	16 input channels, four grounds, and one output channel.	Programmed word recognition with output signal.	Tektronix Part No. 010-6406-01. P6406
21. Bus Wire	18 gauge or larger. At least 4 inches in length.	Signal interconnection.	

[1] **Accessory probes should both be the same type.**

PERFORMANCE CHECK

Introduction

The following procedure is intended to be used for incoming inspection to determine the acceptability of newly-purchased or recently-recalibrated instruments. This procedure does not check every facet of the instrument's calibration; rather it is concerned primarily with those portions of the instrument that are essential to measurement accuracy and correct operation. Removing the instrument's dust cover is not necessary to perform this procedure. All checks are made from the front and right side panels.

Each major step in this procedure is written such that it can be independently performed. The numerically numbered parts within each major step must be performed in the sequence presented.

Limits and Tolerances

All limits and tolerances given in this procedure are performance guides and should not be interpreted as instrument specifications unless they are contained in the Specification section of this manual.

Line Voltage Selection

Ensure the Line Voltage Selector switch, located on the bottom of the 308, is set to the proper range for the voltage source being used.

Equipment Required

Equipment required to perform a complete Performance Check is described in Table 4-1. At the beginning of each major step is a list of equipment, keyed to Table 4-1 item numbers, that is required for the accomplishment of that step.

When equipment other than that recommended is used, control settings or test setups may need to be altered. If the exact item of equipment given as an example in Table 4-1 is not available, first check the Minimum Specification column carefully to determine whether any other equipment might suffice. Then check the Use column for the purpose of this item. If used for a check that is of little or no importance to your measurement requirements, the item and corresponding steps can be deleted.

Preparation

Connect test equipment and instrument to be checked to an appropriate power input source. Turn on and allow a 15-minute warmup period and set the T/C switch on the side panel to T before commencing the Performance Check procedure.

NOTE

In this procedure, timings such as pulse width, period, and delay time are measured at +1.4 V for TTL level signals or −1.25 V for ECL level signals unless otherwise specified.

Leave 308 settings as initialized by power-on, unless otherwise specified.

Index of Performance Checks

POWER-ON DIAGNOSTICS

Equipment Required
None.

1. Power-on Diagnostic Check

a. Set POWER switch to ON.

b. CHECK—after approximately 10 seconds no error message is displayed and the screen display is initialized to the Parallel Timing menu.

OPERATOR-INITIATED DIAGNOSTICS

Equipment Required
Digital Multimeter (DMM) (Item 2) Adapter (Item 15) Passive Probe (Item 18) Active Probe (Item 19) Active Probe (Item 20) Bus Wire (Item 21)

NOTE

Diagnostics checks Ø through 5 must be performed and must be accomplished in the sequence presented. If any expected CHECK display is not obtained, refer to the Maintenance section of the manual and correct the fault. Diagnostic 6 enables the chip selects and is only used for troubleshooting.

2. Keyboard Check—Diagnostic Ø

a. Set POWER switch to ON.

b. After approximately 10 seconds verify that the Parallel Timing menu is displayed.

c. Press the STOP key seven times.

d. Allow 15 minutes for the 308 to stabilize.

e. Press the 0 key.

f. Press each key on the 308 keyboard and concurrently CHECK that the number appearing on the screen display matches the respective code for that key as shown in Figure 4-1.

3. Parallel Low-Data Acquisition Check—Diagnostic 1

a. Connect test setup as shown in Figure 4-2.

b. Connect the DMM minus (−) lead to chassis ground and connect plus (+) lead to the MONITOR jack on the 308.

c. Set the VAR/TTL switch to VAR.

d. Adjust the THRESHOLD VOLTAGE control to a value greater than +5 V.

e. Press the 1 key.

f. CHECK—screen displays OK in inverse video.

g. Press the STOP key.

4. Parallel High-Data Acquisition Check—Diagnostic 2

a. Set the VAR/TTL control to TTL.

b. Press the 2 key.

c. CHECK—screen displays OK in inverse video.

d. Press the STOP key.

5. Serial High-Data Acquisition Check—Diagnostic 3

a. Press the 3 key.

b. CHECK—screen displays OK in inverse video.

c. Press the STOP key.

6. Serial Low-Data Acquisition Check—Diagnostic 4

a. Set the VAR/TTL control to VAR.

b. Press the 4 key.

c. CHECK—screen displays OK in inverse video.

d. Press the STOP key.

7. Parallel Word Recognizer Check—Diagnostic 5

a. Set the VAR/TTL control to TTL.

b. Press the 5 key.

c. CHECK—screen displays OK in inverse video.

d. Press the STOP key.

e. Press the START key.

f. If no other Performance Check is to be accomplished, disconnect the test setup and set the POWER switch to OFF.

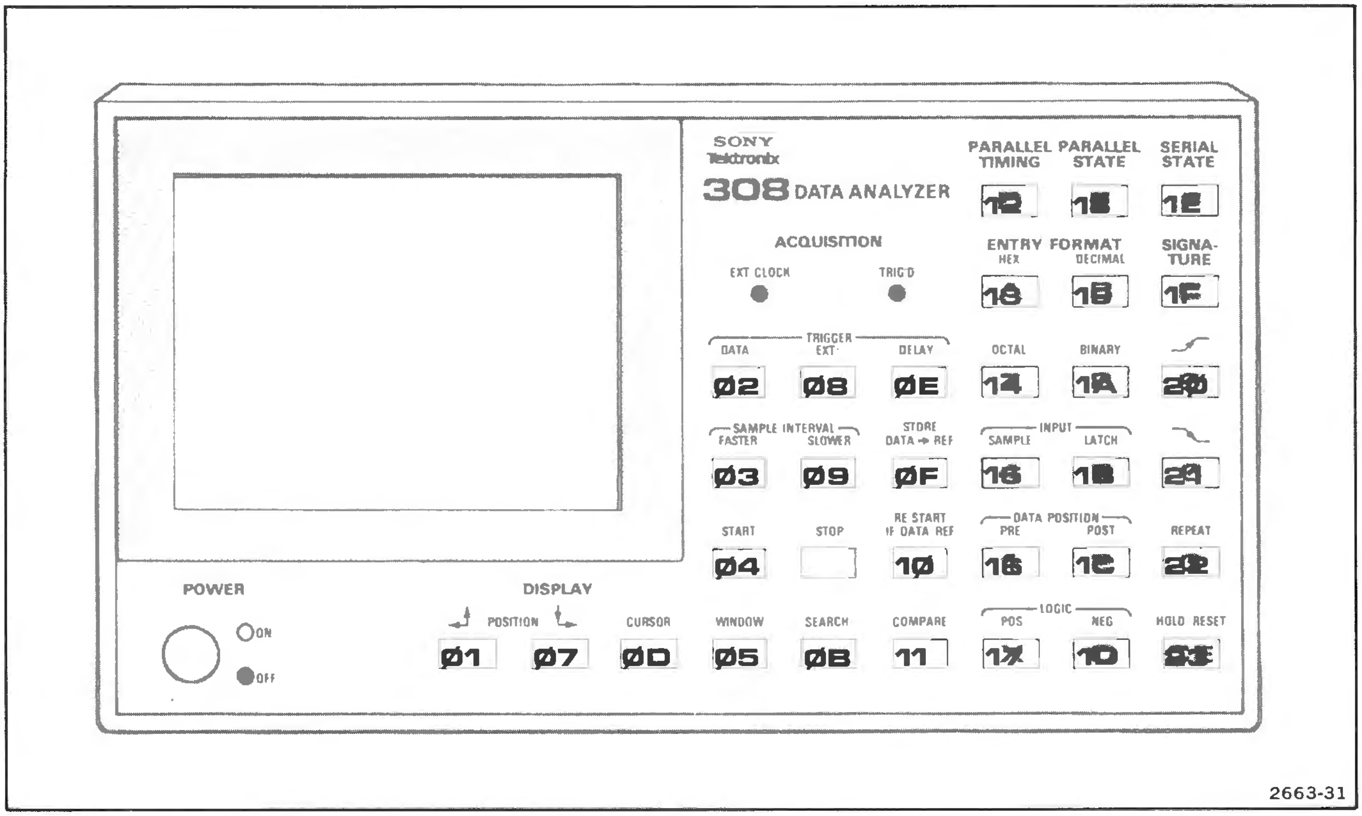
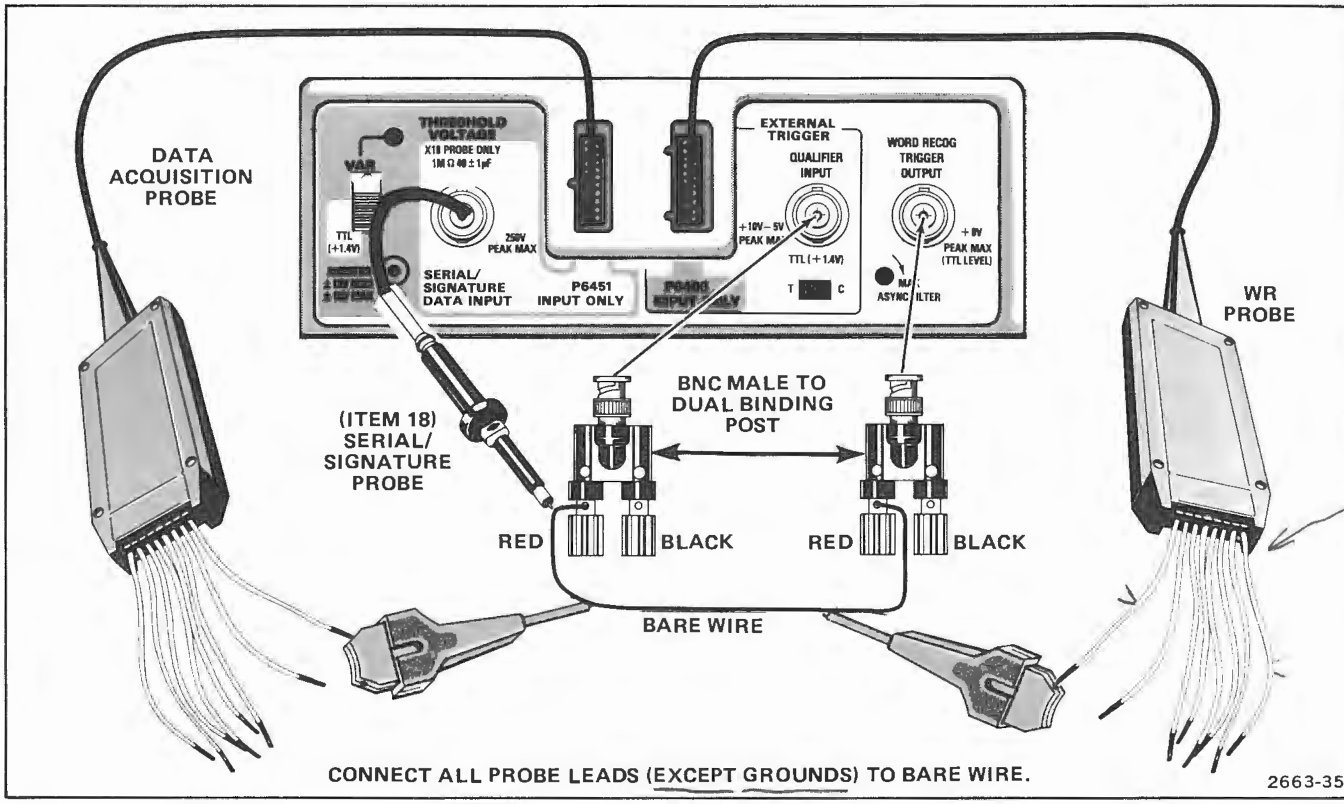


Figure 4-1. Diagnostic Ø keyboard code.



2 sets leads

4 Gnds

Figure 4-2. Diagnostic test setup.

THRESHOLD VOLTAGES

Equipment Required

Digital Multimeter (DMM) (Item 2)
Screwdriver (Item 16)
Passive Probe (Item 18)
Active Probe (Item 19)
Bus Wire (Item 21)

8. Threshold Voltages

a. Set POWER switch to ON.

b. After approximately 10 seconds, verify that the Parallel Timing menu is displayed.

c. Set the VAR/TTL switch to TTL.

d. Allow 15 minutes for the 308 to stabilize.

e. Connect DMM minus (−) lead to chassis ground and plus (+) lead to 308 MONITOR jack.

f. CHECK—DMM for an indication of +1.4 V ±0.2 V.

g. Set VAR/TTL switch to VAR.

h. Rotate THRESHOLD VOLTAGE potentiometer ccw.

i. CHECK—DMM that an indication of −12 V or less can be obtained.

j. Rotate THRESHOLD VOLTAGE potentiometer cw.

k. CHECK—DMM that an indication of +12 V or greater can be obtained.

l. Connect Data Acquisition probe (Item 19) to the 308 and all leads to the bus wire. incl. Gnd.

m. Press the STOP key seven times.

n. Set THRESHOLD VOLTAGE potentiometer for a DMM indication of +0.25 V.

o. Press the 1 key.

p. CHECK—screen displays OK in inverse video.

q. Press the STOP key.

r. Set THRESHOLD VOLTAGE potentiometer for a DMM indication of −0.25 V.

s. Press the 2 key.

t. CHECK—screen displays OK in inverse video.

u. Press the STOP key.

v. Connect the Serial/Signature probe (item 18) to the 308 and its ground clip to its tip.

w. On the 308 press the 3 key.

x. CHECK—screen displays OK in inverse video.

y. Set THRESHOLD VOLTAGE potentiometer for a DMM indication of +0.25 V.

z. Press the 4 key.

aa. CHECK—screen displays OK in inverse video.

ab. If no other Performance Check is to be accomplished, disconnect the test setup and set the POWER switch to OFF.

MINIMUM EXTERNAL CLOCK PERIOD

Equipment Required
Oscilloscope (Item 3)
Pulse Generator (Item 4)
Adapter (Item 9)
Termination (Item 10)
T-Connector (Item 11)
Adapter (Item 15)
Active Probe (Item 19)
Bus Wire (Item 21)

9. Minimum External Clock Period Check

a. Set POWER switch to ON.

b. After approximately 10 seconds verify that the Parallel Timing menu is displayed.

c. Set the VAR/TTL switch to TTL.

d. Press the SAMPLE INTERVAL/FASTER key twice.

e. Observe that the menu portion of the display shows SMPL=EXT↓.

f. Allow 15 minutes for the 308 to stabilize.

g. Connect test setup as shown in Figure 4-3.

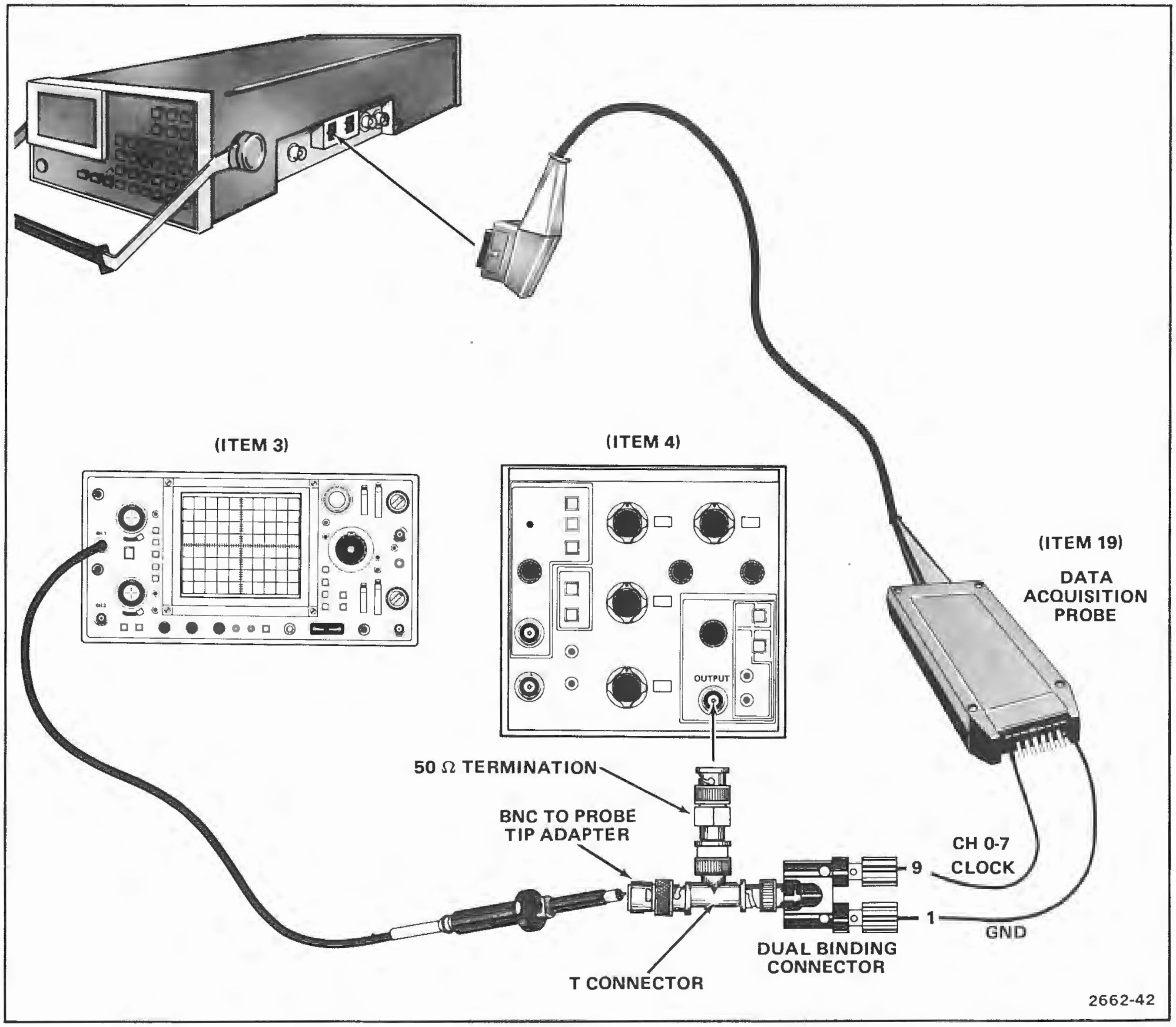


Figure 4-3. Test setup for checking minimum external clock period.

@

h. Set Pulse Generator for output waveform as shown in Figure 4-4 as follows:

Low Level	+0.8 V or less
High Level	At least +2.0 V
High Level Pulse	
Duration	23—24.5 ns
Period	50 ns

i. Press the START key.

j. CHECK—stored valid data is all HI on 308 display.

k. Set Pulse Generator duration to 25.5 ns.

l. Press the SAMPLE INTERVAL/SLOWER key.

m. CHECK—menu display has changed to EXT↑.

n. Press the START key.

o. CHECK—stored valid data is all LO on 308 display.

p. If no other Performance Check is to be accomplished, disconnect the test setup and set the POWER switch to OFF.

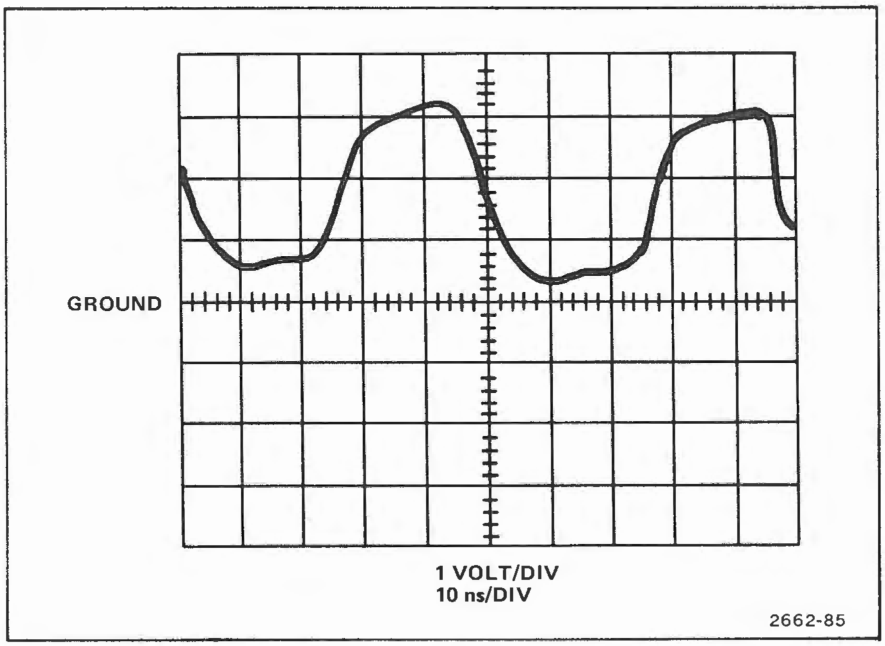


Figure 4-4. Test waveform for minimum external clock period.

MINIMUM SAMPLE INTERVAL AND MINIMUM DATA PULSE WIDTH

Equipment Required

- Oscilloscope (Item 3)
- Pulse Generator (Item 4)
- Adapter (Item 9)
- Termination (Item 10)
- T-Connector (Item 11)
- Adapter (Item 15)
- Active Probe (Item 19)
- Active Probe (Item 20)

10. Minimum Sample Interval and Minimum Data Pulse Width Check

a. Set POWER switch to ON.

b. After approximately 10 seconds verify that the Parallel Timing menu is displayed.

c. Set the VAR/TTL switch to TTL.

d. Allow 15 minutes for the 308 to stabilize and observe that the menu portion of the display shows SMPL=50 ns.

e. Connect test setup as shown in Figure 4-3.

f. Set Pulse Generator to obtain the oscilloscope display as shown in Figure 4-5A as follows:

Low Level	+0.8 V or less
High Level	At least +2.0 V
High Level Pulse	
Duration	60 ns
Period	1 μs

g. Set Pulse Generator Duration to 10 ns and use the Calibration control.

h. Change oscilloscope settings as required to obtain the oscilloscope display shown in Figure 4-5B.

i. Press the 308 START key.

j. CHECK—one or two bits of High data on all channels spaced at approximately every 20 bits.

k. Set Pulse Generator Duration to 10 ns.

l. Set 308 Input mode to LATCH.

m. Press the 308 START key.

n. CHECK—one bit of High data on all channels spaced at approximately every 20 bits.

o. If no other Performance Check is to be performed, disconnect the test setup and set the POWER switch to OFF.

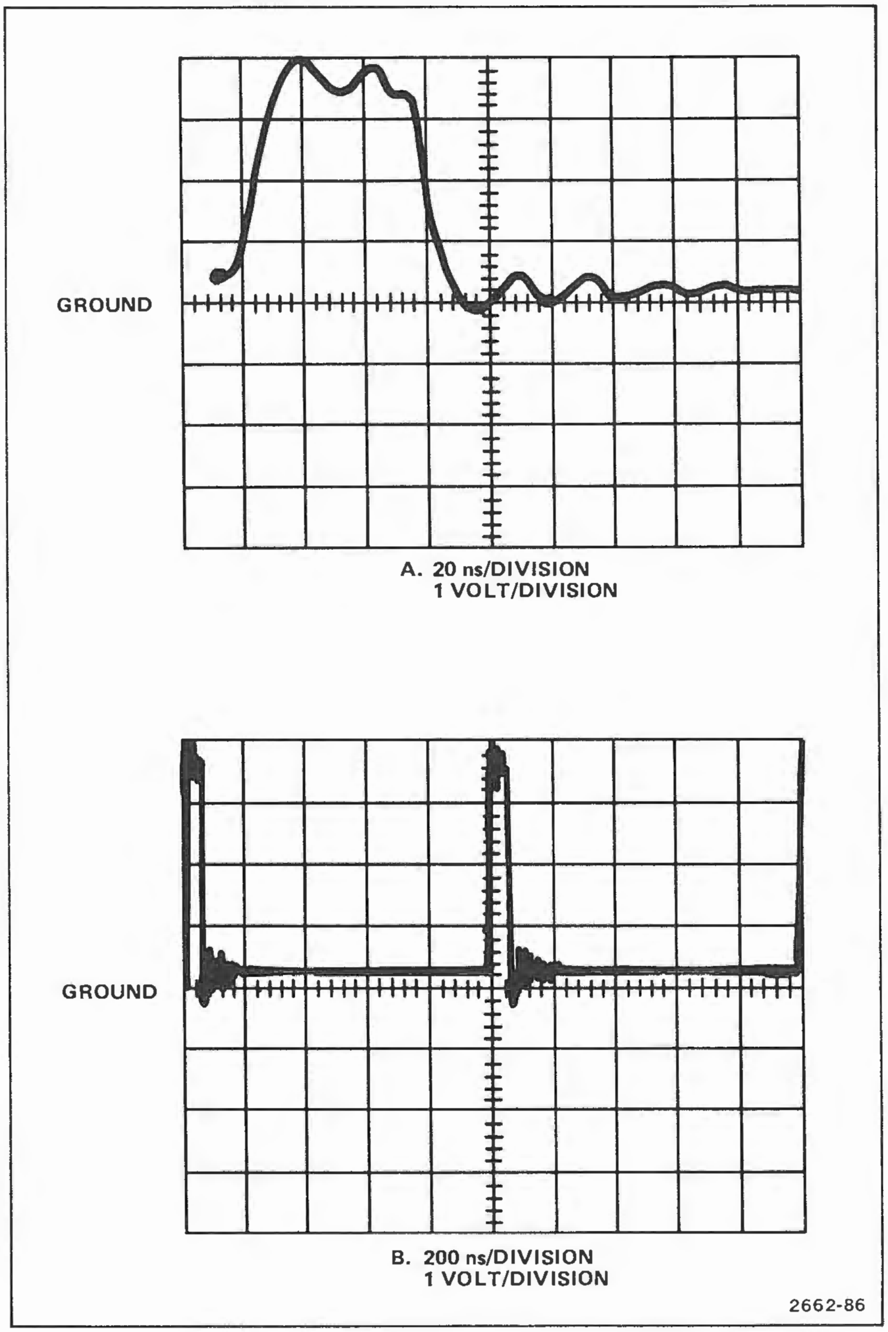


Figure 4-5. Test waveforms for minimum sample interval and minimum data pulse width.

WORD RECOGNIZER FILTER

Equipment Required

Oscilloscope (Item 3)
Pulse Generator (Item 4)
Adapter (Item 9)
Termination (item 10)
T-Connector (Item 11)
Adapter (Item 15)
Screwdriver (Item 16)
Active Probe (Item 19)
Active Probe (Item 20)

11. Word Recognizer Filter Check

a. Set POWER switch to ON.

b. After approximately 10 seconds verify that the Parallel Timing menu is displayed.

c. Set the VAR/TTL switch to TTL.

d. Rotate the ASYNC FILTER potentiometer fully ccw.

e. Press the following keys in the sequence listed:

BINARY	Press once
DATA=	Press once
X	Press seven times
1	Press once

f. Allow 15 minutes for the 308 to stabilize and observe that the menu portion of the display shows BIN, DATA B =XXXXXXX1.

g. Connect test setup as shown in Figure 4-3.

h. Set Pulse Generator control to obtain the oscilloscope display shown in Figure 4-6A as follows:

Low Level	+0.8 V or less
High Level	At least +2.0 V
High Level Pulse	
Duration	20 ns
Period	1 μs

i. Change oscilloscope settings as required to obtain the oscilloscope display shown in Figure 4-6B.

j. Press the 308 START key.

k. CHECK—that TRIG'D light is on.

l. Connect test oscilloscope Channel 2 probe to 308 WORD RECOG TRIGGER output through the bnc-to-probe-tip adapter.

m. CHECK—at least 5 ns pulse width is present at WORD RECOG TRIGGER output at the +1.4 V level of the waveform.

n. Set Pulse Generator Duration to 300 ns.

o. Set ASYNC FILTER potentiometer fully cw.

p. CHECK—trigger signal remains below 0.5 V peak at WORD RECOG TRIGGER output connector.

q. Set ASYNC FILTER potentiometer fully ccw.

r. If no other Performance Check is to be performed, disconnect the test setup and set the POWER switch to OFF.

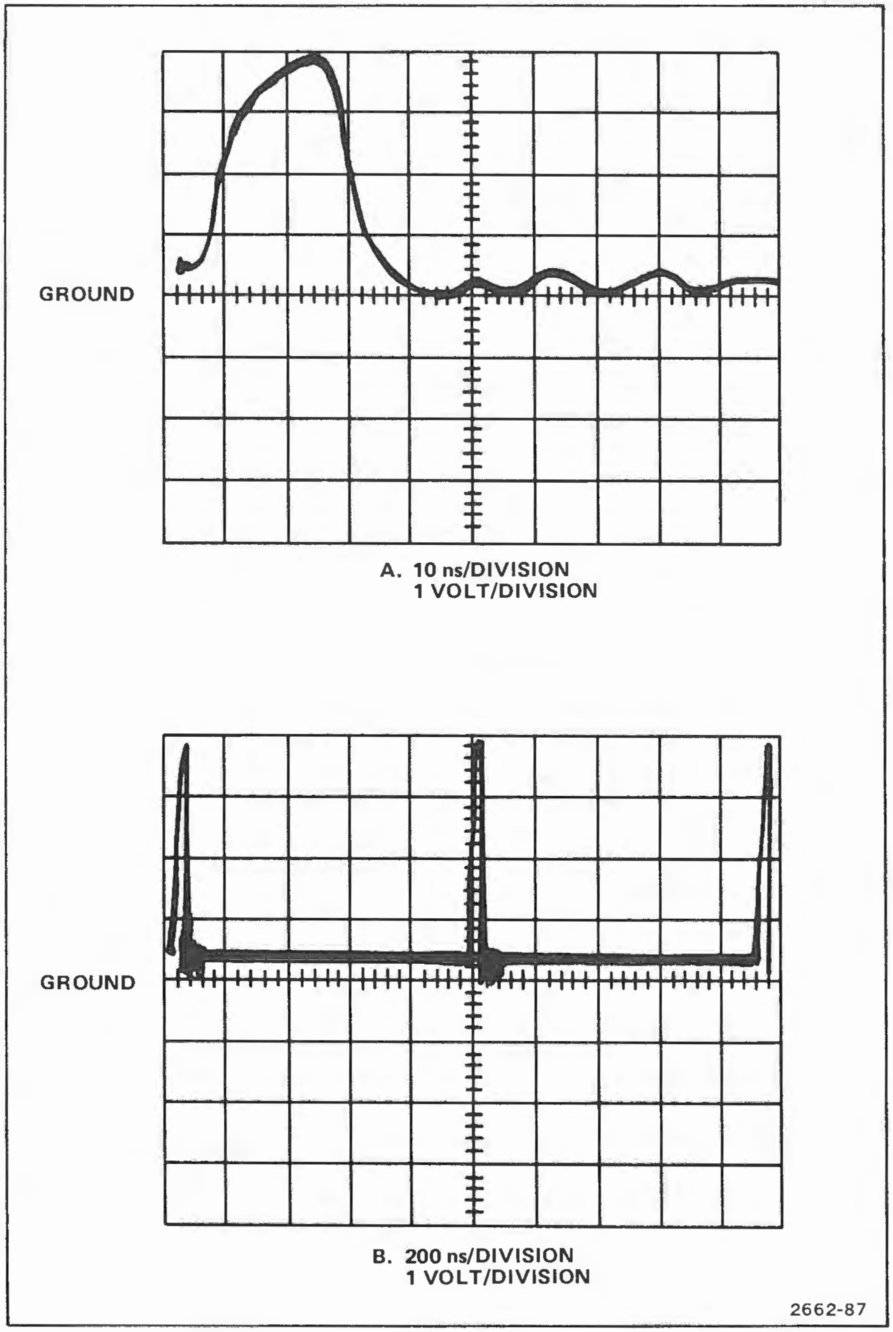


Figure 4-6. Test waveforms for word recognizer filter.

MINIMUM WORD RECOGNIZER PULSE WIDTH

Equipment Required

Oscilloscope (Item 3)
Pulse Generator (Item 4)
Adapter (Item 9)
Termination (Item 10)
T-Connector (Item 11)
Cable (Item 13)
Adapter (Item 15)
Passive Probe (Item 18)
Active Probe (Item 19)
Active Probe (Item 20)

12. Minimum Word Recognizer Pulse Width

a. Set POWER switch to ON.

b. After approximately 10 seconds verify that the Parallel Timing menu is displayed.

c. Set the VAR/TTL switch to TTL.

d. Press the SERIAL STATE key.

e. Allow 15 minutes for the 308 to stabilize and observe that the menu portion of the display shows SERIAL STATE.

P6107

f. Connect the Serial/Signature probe (Item 18) to the 308 and connect the probe ground clip to the probe tip.

g. Press the following keys in the sequence given: START, STOP, and STORE DATA→REF.

h. Remove the Serial/Signature probe (Item 18) and connect the Word Recognizer probe (Item 20). P6406

i. Press the following keys in the sequence listed:

PARALLEL TIMING	Press once
DATA=	Press once
F	Press two times
EXT=	Press once
X	Press four times
0	Press once
SAMPLE INTERVAL/ FASTER	Press two times

j. CHECK—menu portion of the display shows <HEX>, PRL TIMING EXT=XXXX, SMPL=EXT↓, DATA H =FF.

k. Connect the WORD RECOG TRIGGER OUTPUT to the EXTERNAL TRIGGER QUALIFIER INPUT through the 50 Ω cable (Item 13).

l. Connect test setup as shown in Figure 4-3, leaving the Word Recognizer probe (Item 20) connected to the 308.

m. Set the Pulse Generator as follows to obtain the oscilloscope display shown in Figure 4-7A:

Low Level	+0.8 V or less
High Level	At least +2.0 V
High Level Pulse	
Duration	35 ns
Period	1 μs

n. Adjust the oscilloscope as necessary to obtain the oscilloscope display shown in Figure 4-7B.

o. Press the RE-START IF DATA=REF key.

p. CHECK—the RST number on the 308 display counts up periodically.

q. CHECK—the RST counting stops when the STOP key is pressed.

r. Connect the Channel 0 through 15 input clips and the Ground clips of the Word Recognizer probe (Item 20) to the Pulse Generator output in the same manner as the Data Acquisition probe (Item 19).

s. Press the following keys in the sequence listed:

EXT=	Press once
F	Press four times
0	Press once
RE-START IF DATA=REF	Press once

t. CHECK—the RST number on the 308 display counts up periodically.

u. Press the STOP key.

v. If no other Performance Check is to be performed, disconnect the test setup and set the POWER switch to OFF.

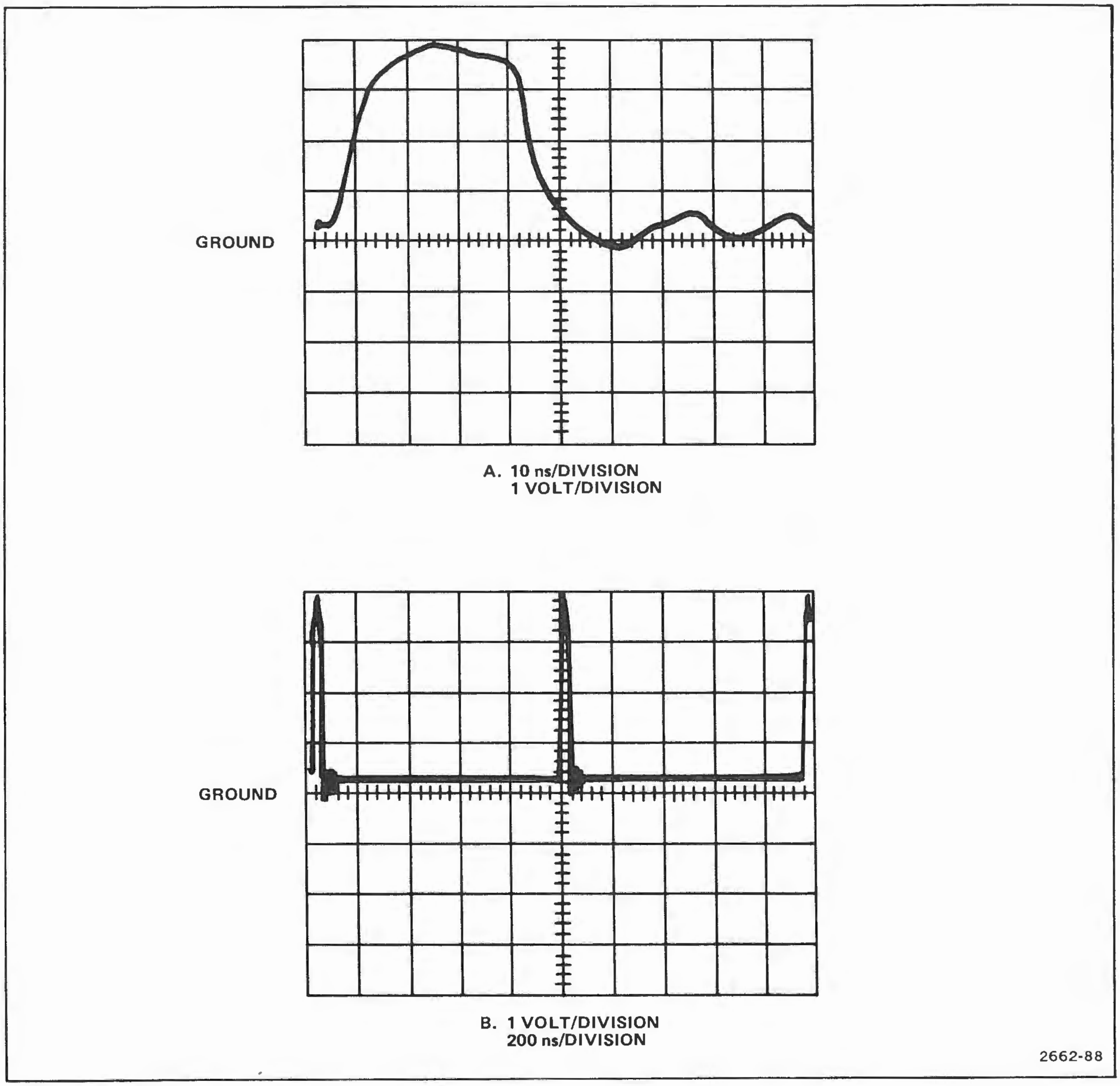


Figure 4-7. Test waveforms for minimum word recognizer pulse width.

TRIGGER DELAY COUNTER

Equipment Required

Oscilloscope (Item 3)
Pulse Generator (Item 4)
Pulse Generator (Item 5)
Delay Counter (Item 6)
Adapter (2 required) (Item 9)
Termination (4 required) (Item 10)
T-Connector (2 required) (Item 11)
Cable (4 required) (Item 13)
Adapter (2 required) (Item 15)
Active Probe (Item 19)
Bus Wire (Item 21)

13. Trigger Delay Counter Check

a. Set POWER switch to ON.

b. After approximately 10 seconds verify that the Parallel Timing menu is displayed.

c. Press the following keys in the sequence listed:

DATA=	Press once
F	Press two times
DECIMAL	Press once
DLY=	Press once
0	Press three times
5	Press once
0	Press once
SAMPLE INTERVAL/ FASTER	Press two times

d. Allow 15 minutes for the 308 to stabilize and observe that the menu portion of the display shows DATA H =FF, DLY=00050, SMPL=EXT↓.

e. Connect test setup as shown in Figure 4-8, but do not connect the Serial/Signature probe (Item 18).

f. Set test equipment as follows:

Pulse Generator Channel 2 (Item 4)	Pulse Generator Channel 1 (Item 5)	Delay Counter (Item 6)
Low Level +0.8 V or less	Low Level +0.8 V or less	Delay Count =99
High Level At least +2.0 V	High Level At least +2.0 V	Events Slope +
High Level Pulse Duration: 35 ns Period: EXT	High Level Pulse Duration: 23—25 ns Period: 50 ns as shown in Figure 4-4	Start Slope +
Delay Time Adjust as shown in Figure 4-9	Delay Time Back termination switch pulled out	

g. Press the 308 START key.

CHECK—the CUR position closest to DT position and reads all high data is POS = DT+50.

If no other Performance Check is to be performed, disconnect the test setup and set the POWER switch to OFF.

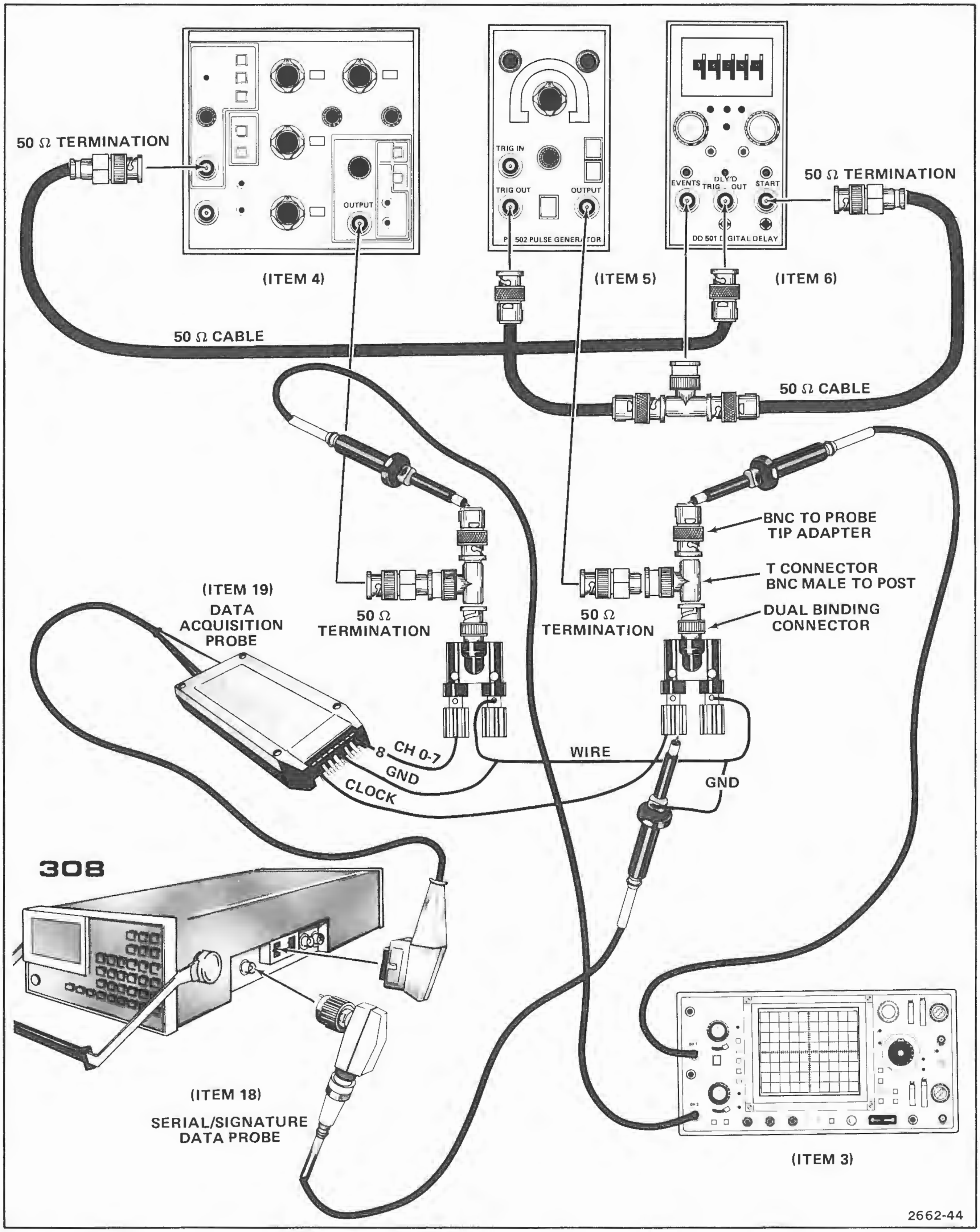


Figure 4-8. Test setup for trigger delay counter.

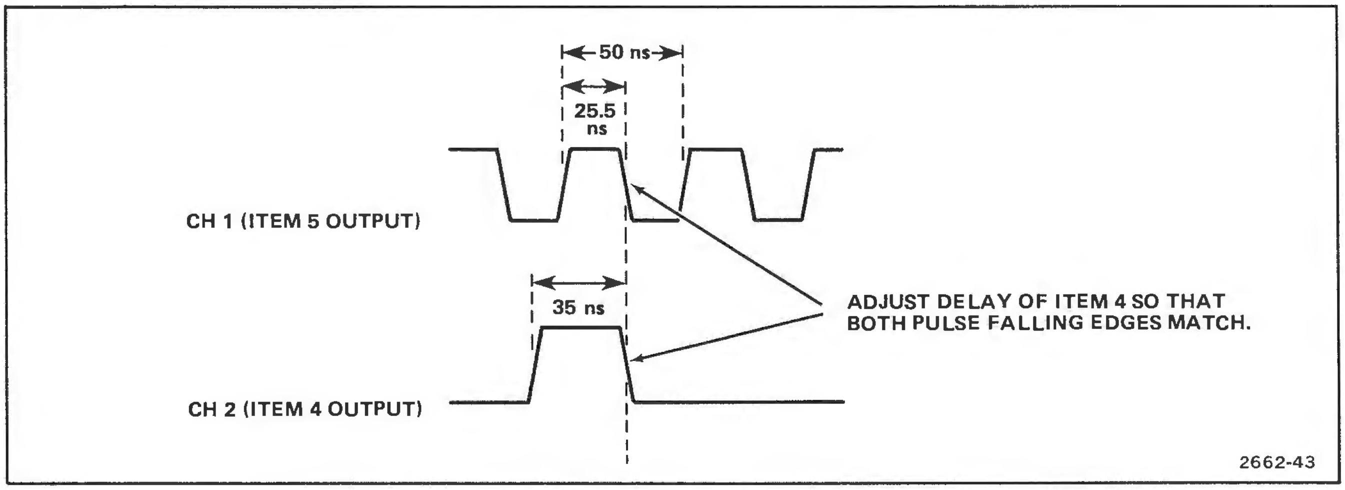


Figure 4-9. Adjusting pulse generators outputs for trigger delay counter check.

SIGNATURE ACQUISITION

Equipment Required

- Oscilloscope (Item 3)
- Pulse Generator (Item 4)
- Pulse Generator (Item 5)
- Delay Counter (Item 6)
- Adapter (2 required) (Item 9)
- Termination (4 required) (Item 10)
- T-Connector (2 required) (Item 11)
- Cable (4 required)
- Adapter (2 required) (Item 15)
- Passive Probe (Item 18)
- Active Probe (Item 19)
- Bus Wire (Item 21)

14. Signature Acquisition Check

a. Set POWER switch to ON.

b. After approximately 10 seconds verify that the Parallel Timing menu is displayed.

c. Press the following keys in the sequence listed:

SIGNATURE — Press once


Press once
Press two times

d. Allow 15 minutes for the 308 to stabilize and observe that the menu portion of the display shows CLOCK=↑, START=↓, STOP=↓.

e. Connect test setup as shown in Figure 4-8.

f. Set test equipment as follows:

Pulse Generator Channel 2 (Item 4)	Pulse Generator Channel 1 (Item 5)	Delay Counter (Item 6)
Low Level +0.8 V or less	Low Level +0.8 V or less	Delay Count = 15
High Level At least +2.0 V	High Level At least +2.0 V	Events Slope +
High Level Pulse Duration 25 ns Period EXT	High Level Pulse Duration 15 ns Period 50 ns	Start Slope +
Delay Time Adjust as shown in Figure 4-10		

g. Press the REPEAT key.

h. CHECK—the display reads UP73.

i. Press the STOP key.

j. Press the following keys in the sequence listed:

SIGNATURE

REPEAT

k. CHECK—the display reads 0001.

l. If no other Performance Check is to be performed, disconnect the test setup and set the POWER switch to OFF.

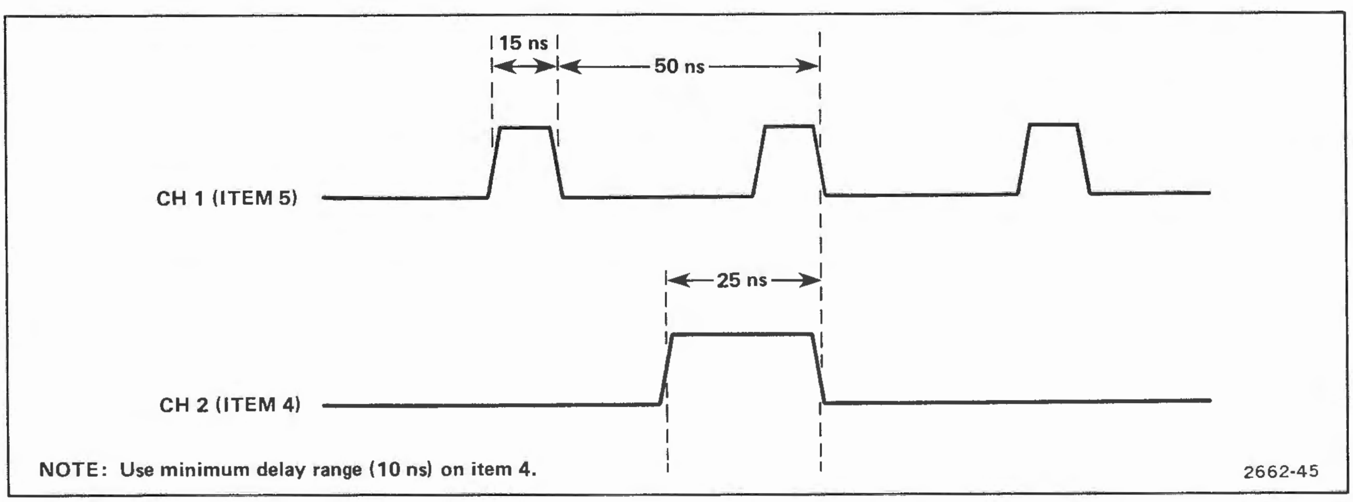


Figure 4-10. Adjusting pulse generator outputs for signature acquisition check.

SERIAL ACQUISITION

Equipment Required

Serial Data Generator (Item 7)
Passive Probe (Item 18)
Active Probe (Item 19)

15. Serial Acquisition Check

a. Set POWER switch to ON.

b. After approximately 10 seconds verify that the Parallel Timing menu is displayed.

c. Set the VAR/TTL switch to TTL.

d. Press the following keys in the sequence listed:

SERIAL STATE	Press once
SAMPLE INTERVAL/ SLOWER	Press two times

e. Allow 15 minutes for the 308 to stabilize and observe the menu portion of the display shows SERIAL STATE, ASYNC=2400 Hz.

f. Connect test setup as shown in Figure 4-11.

g. Set Serial Data Generator (Item 7) controls as follows:

POWER	ON
ASYNC/SYNC	ASYNC
BITS/CHAR	Press
8 (key)	Press
BITS/CHAR	Press
BAUD	2.4 K
SEND	Press
BUFFER	Press
CLEAR	Press

NOTE

To load information into the Serial Data Generator (Item 7) buffer, the operator must (a) press SEND, (b) press BUFFER, (c) press keys for the two hexadecimal characters to be entered, and (d) press ENTER. To load additional data, repeat parts (c) and (d) as needed.

h. Load the following hexadecimal data in the Serial Data Generator: E0, E0, E2, E4, E6, E8.

i. On the Serial Data Generator press REPEAT then MODE keys.

j. Press 308 START key, then press Serial Data Generator START key.

k. When the 308 screen displays data, press the Serial Data Generator STOP key.

l. CHECK—the 308 left column (HEX) for displays of E0, E0, E2, E4, E6, E8.

m. Press the 308 SAMPLE INTERVAL/FASTER key twice and observe that the screen display shows ASYN=9600 Hz.

n. Set Serial Data Generator BAUD to 9.6 K.

o. Set the 308 and Serial Data Generator controls as indicated in step 1 of Table 4-2 and repeat preceding parts j and k.

p. CHECK—the 308 display matches the WORD SEQUENCE column in Table 4-2.

q. Repeat steps 2 through 6 parts o and p for the remainder of Table 4-2.

NOTE

To change the BITS/CHAR and SYNC word for the 308, press the SERIAL STATE key to display the extended menu. Then press the key number for the data to be changed. Enter the data and press the SERIAL STATE key again to return the 308 to normal operation. Use the SAMPLE INTERNAL keys as required to obtain ASYN=EXT↓ and SYNC=EXT↓ displays.

Table 4-2

Serial Acquisition Data

Step	308	Serial Data Generator (Item 7)	Word Sequence (Hex Format)
1	BITS/CHAR = 8	BITS/CHAR = 8	E0, E0, E2, E4, E6, E8
2	BITS/CHAR = 7	BITS/CHAR = 7	60, 60, 62, 64, 66, 68
3	BITS/CHAR = 6	BITS/CHAR = 6	20, 20, 22, 24, 26, 28
4	BITS/CHAR = 5	BITS/CHAR = 5	00, 00, 02, 04, 06, 08
5	ASYN = EXT ↓ BITS/CHAR = 6	SYNC mode BITS/CHAR = 8 SYNC word (1) = E0 SYNC word (2) = E0	30, 30, 31, 32, 33, 34
6	SYNC = EXT ↓ BITS/CHAR = 8 SYNC WORD = 1110 0000		E2, E4, E6, E8, E0, E0

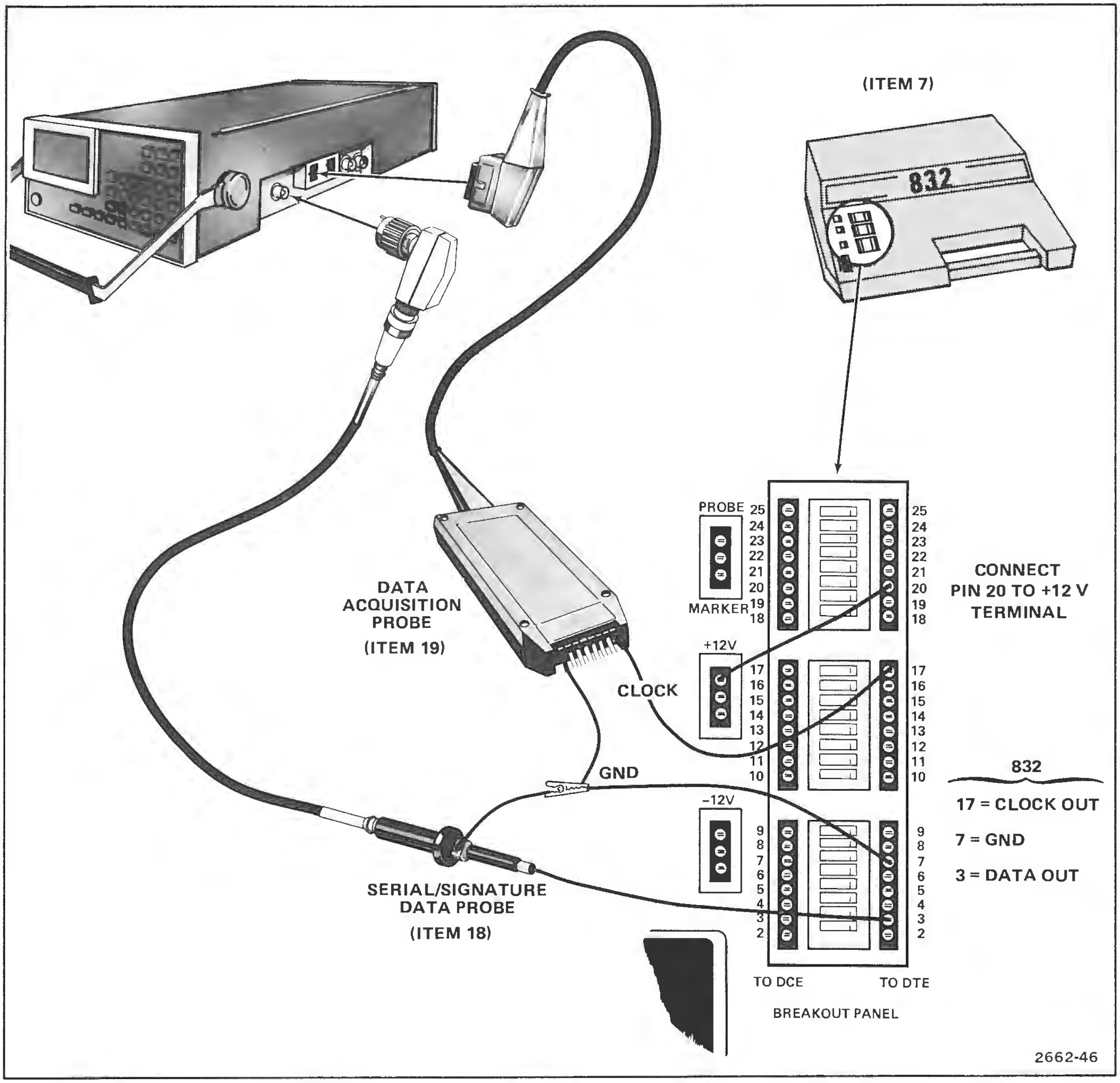


Figure 4-11. Test setup for serial acquisition check.

ADJUSTMENT PROCEDURE

IMPORTANT—PLEASE READ BEFORE USING THIS PROCEDURE

Purpose

The Adjustment Procedure provides a calibration sequence for adjustments and is not a troubleshooting guide.

Limits and Tolerances

All limits and tolerances given in this procedure are calibration guides and should not be interpreted as instrument specifications unless they are also found in the Specification part of this manual.

Tolerances given are for the instrument under test and do not include test equipment error.

Equipment Alternatives and Partial Procedures

When other than recommended test equipment is substituted, control settings or calibration setups might need to be altered. If the exact equipment listed in Table 4-1 is not available, check the Minimum Specification column carefully to see if any other equipment will suffice.

Internal Adjustments

Do not preset the internal controls.

Calibration Interval

To ensure correct instrument operation, adjustment should be checked every 1,000 hours of operation or every six months if used infrequently. Before performing the adjustment procedures, perform preventive maintenance as outlined in the Maintenance section.

NOTE

In this procedure, timings such as pulse width, period, and delay time are measured at +1.4 V for TTL level signals or −1.25 V for ECL level signals, unless otherwise specified.

Leave 308 settings as initialized by power-on, unless otherwise specified. Set T/C switch on side panel to the T position.

Test Sequence

Power supplies should be checked prior to performing any of the other adjustments. Other circuit adjustments may then be performed in any order. If any Power Supply adjustment was made, any or all of the 308 operating circuitry may be affected, and the entire Performance Check and Adjustment Procedure should be performed.

Index of Adjustment Steps

POWER SUPPLIES

Equipment Required

Digital Multimeter (DMM) (Item 2)

CAUTION

If any power supply is out of tolerance, any or all of the 308 operating circuitry may be affected, and the entire Performance Check and Adjustment Procedure should be performed.

1. Adjust Power Supplies

a. Set POWER switch to ON and allow 15 minutes for the 308 to stabilize.

b. Set DMM range to measure 5 V.

c. Connect DMM minus (−) lead to chassis ground.

d. Connect DMM plus (+) lead to J800 pin 5.

e. ADJUST—R890 on Secondary Power Supply board for a reading of +5 V on the DMM.

f. Move DMM + lead to each point shown in Table 4-3 (set DMM range as required).

g. CHECK—DMM readings are within the limits given in Table 4-3.

Table 4-3

Power Supply Tolerances

J800 Pin Number	Voltage Limits
5	+ 4.85 V to + 5.15 V
4	− 4.85 V to − 5.15 V
3	+14.25 V to +15.75 V
2	+14.25 V to −15.75 V

h. If no other adjustments are to be performed, disconnect test setup and set the 308 POWER switch to OFF.

CRT CIRCUIT

Equipment Required

Digital Multimeter (DMM) (Item 2)
Oscilloscope (Item 3)
Bus Wire (Item 21)

2. Adjust CRT Circuit

a. Set POWER switch to ON and allow 15 minutes for 308 to stabilize.

b. Move jumper P604 on the CRT circuit board to connect pins 2 and 3.

c. Set DMM range to measure 50 mV dc.

d. Connect DMM minus (—) lead to junction of R624 and R630 on the CRT circuit board.

e. Connect DMM plus (+) lead to pin 3 of T630.

f. ADJUST—R626 on the CRT circuit board for 50 mV, ±5 mV, to set CRT cathode current at about 50 μA.

g. Disconnect DMM leads from the 308.

h. Move jumper P604 back to pins 1 and 2.

i. Set 308 POWER switch to OFF.

j. Connect two reset terminals on the MPU circuit board S404 together with a piece of wire.

k. Set 308 POWER switch to ON.

l. Connect oscilloscope Channel 1 probe to the collector of Q615 and ground clip to TP624.

m. Select value of C618 (0.01 μF, 4700 pF, or leave open as necessary) to obtain +50 V to +55 V p-p pulse at the collector of Q615. Disconnect the test oscilloscope.

n. ADJUST—L635 placement angle for 1° or less trace rotation between top and bottom of CRT display window.

o. ADJUST—R645 on the CRT circuit board for vertical display size of about 2 mm less than CRT display window.

p. ADJUST—magnet on the CRT ring of L635 to position display to approximately the center of the CRT display window.

q. Repeat parts l, m, and n, if necessary, to minimize interaction.

r. If no other adjustments are to be performed, disconnect setup and press set 308 POWER switch to OFF.

CLOCK DELAY

Equipment Required

Oscilloscope (Item 3)
Pulse Generator (Item 4)
Adapter (Item 9)
Termination (Item 10)
T-Connector (Item 11)
Adapter (Item 15)
Active Probe (Item 19)

3. Adjust Clock Delay

a. Set POWER switch to ON and wait approximately 10 seconds until the Parallel Timing menu is displayed.

b. Set the VAR/TTL switch to TTL.

c. Press the following keys in the sequence listed:

BINARY
EXT=
0
SAMPLE INTERVAL/FASTER

d. Allow 15 minutes for the 308 to stabilize and observe that the menu portion of the display shows BIN, EXT B =0, SMPL=↑.

e. Connect test setup as shown in Figure 4-12, connecting oscilloscope Channel 1 probe tip to Pulse Generator output.

f. Set Pulse Generator for output waveform (as shown in Figure 4-13) as follows:

Low Level	+0.8 V or less
High Level	At least +2.0 V
High Level Pulse	
Duration	50 ns
Period	200 ns

g. Move oscilloscope Channel 1 probe tip to U150A on the Data Input circuit board pin 2 (ECL level), and Channel 2 probe tip to TP146 (TTL level) (see Figure 4-12).

h. Press 308 START key.

i. ADJUST—P152 on the Data Input circuit board for 17.5 ±4.0 ns delay time between the rising edges of Channel 1 and Channel 2 displays.

j. Press 308 STOP key.

k. Press the SAMPLE INTERVAL/FASTER key and CHECK that menu changes to SMPL =EXT↓.

l. Press START key.

m. ADJUST—P153 on the Data Input circuit board for 17.5 ±4.0 ns delay time between the falling edge of Channel 1 and the rising edge of Channel 2 display.

n. Move oscilloscope Channel 2 probe tip to TP174 (TTL level).

o. ADJUST—P174 on the Data Input circuit board for 21.0 ±4.0 ns delay time between the falling edge of Channel 1 and the rising edge of Channel 2 display.

p. If no other adjustment is to be performed, disconnect test setup and set 308 POWER switch to OFF.

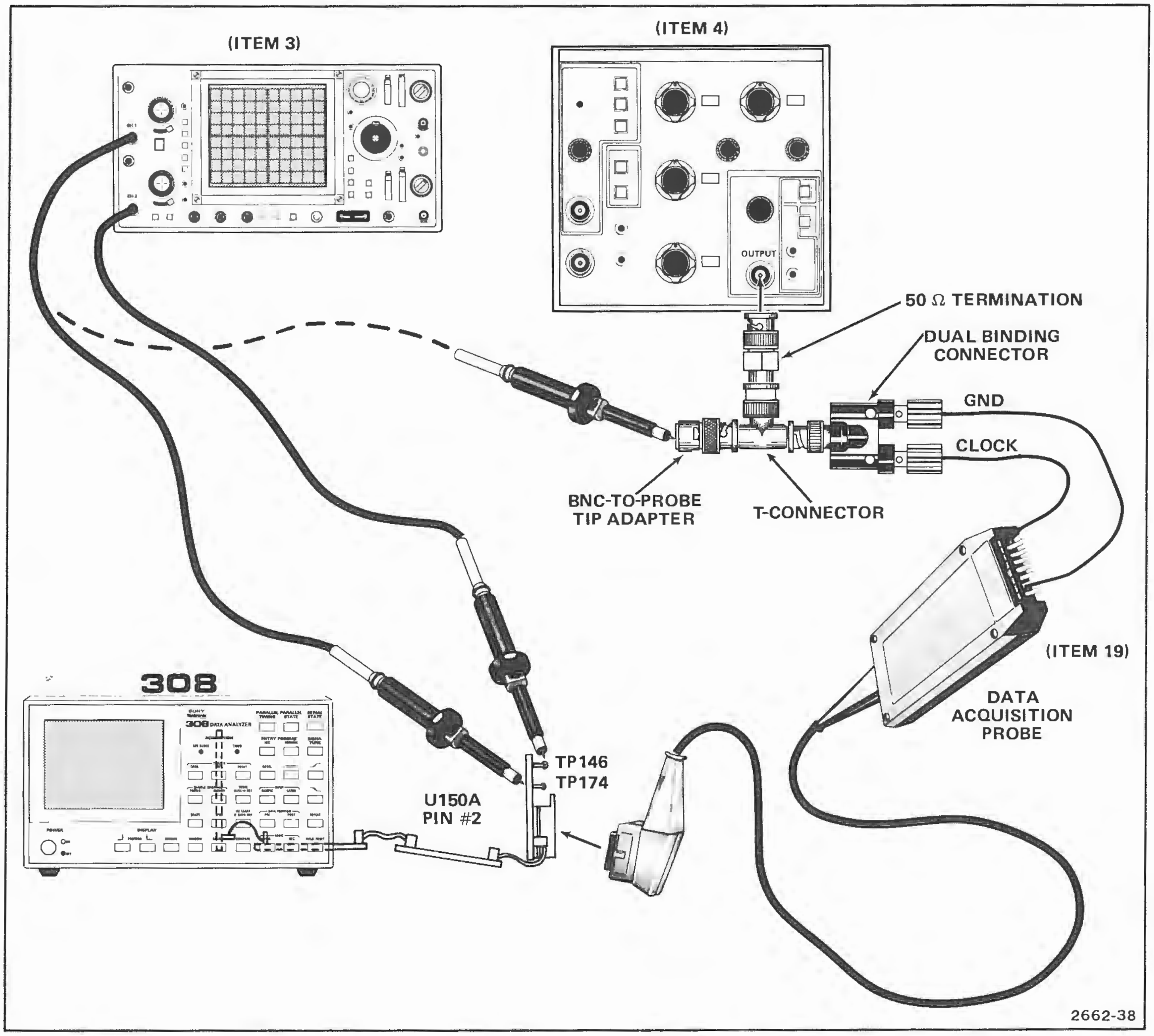


Figure 4-12. Test setup for adjusting clock delay and signature data delay.

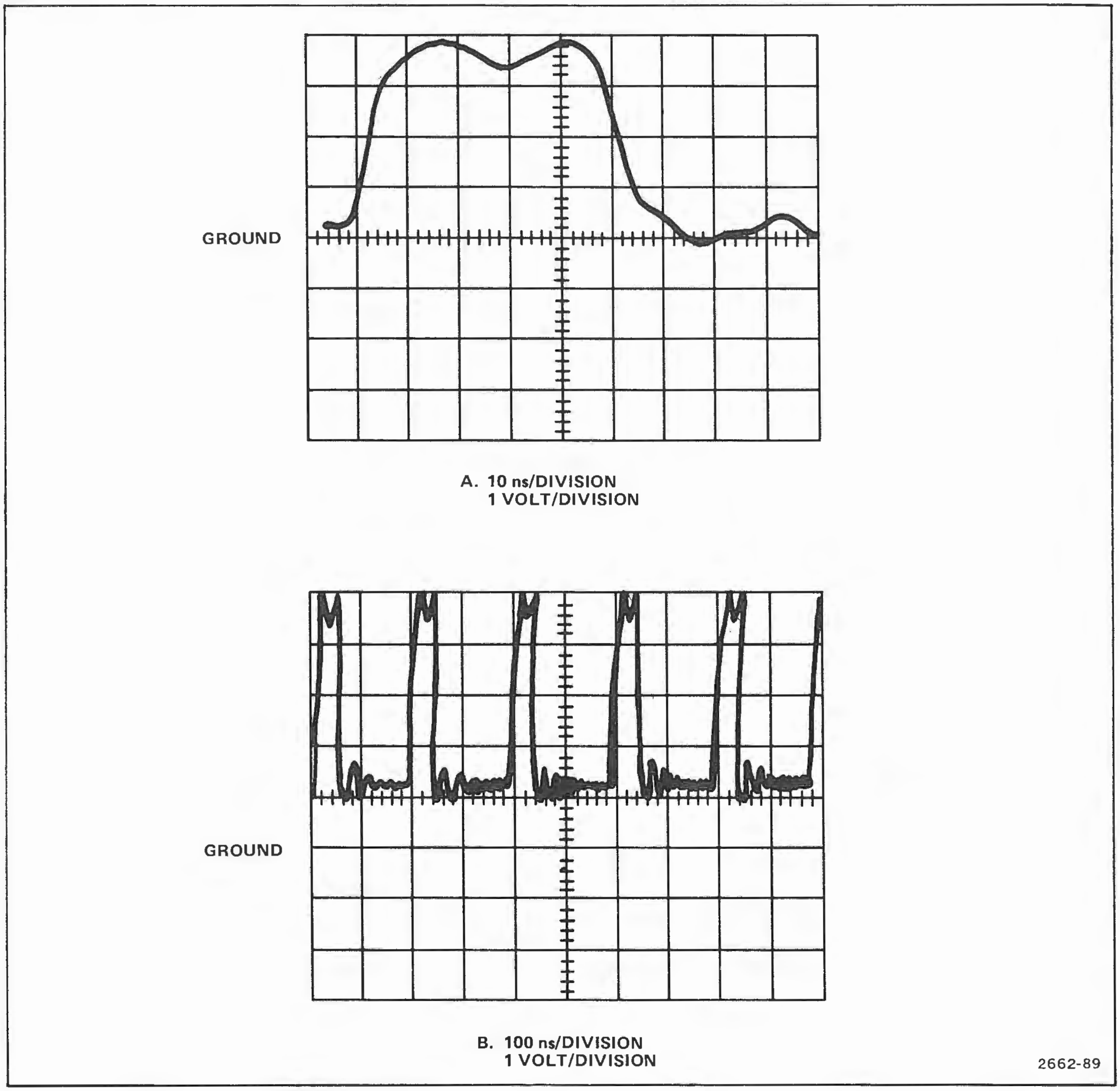


Figure 4-13. Test waveforms for clock delay adjustment, external trigger and signature data delay.

EXTERNAL TRIGGER DELAY

Equipment Required

Oscilloscope (Item 3)
Pulse Generator (Item 4)
Adapter (Item 9)
Termination (Item 10)
T-Connector (Item 11)
Adapter ITem 15)
Active Probe (Item 20)

4. Adjust External Trigger Delay

a. Set POWER switch to ON.

b. After approximately 10 seconds verify that the Parallel Timing menu is displayed.

c. Set the VAR/TTL switch.

d. Press the HEX key.

e. Connect the Word Recognizer Probe (Item 20) to the 308.

f. Press the following keys in the sequence listed:

EXT=	Press once
F	Press four times
X	Press once

g. Allow 15 minutes for the 308 to stabilize and observe that the menu portion of the display shows EXT $\boxed{\text{H}}$ =FFFF-X.

h. Connect ground clips and Trigger Data input clips of the Word Recognizer Probe to the pulse generator output as shown in Figure 4-14.

i. Connect oscilloscope Channel 1 probe tip to the pulse generator output as shown in Figure 4-14.

j. Set pulse generator to obtain the oscilloscope display as shown in Figure 4-13 as follows:

Low Level	+0.8 V or less
High Level	At least +2.0 V
High Level Pulse	
Duration	50 ns
Period	200 ns

k. Connect oscilloscope to the following places on the Data Input circuit board: Channel 1 probe tip to U170 pin 1 and Channel 2 probe tip to TP172.

l. Press the 308 START key.

m. ADJUST—P170 on the Data Input circuit board for 25 ±4 ns delay between the rising edge of the Channel 1 display and the falling edge of the Channel 2 display.

n. If no other adjustments are to be performed, disconnect the test setup and set the 308 POWER switch to OFF.

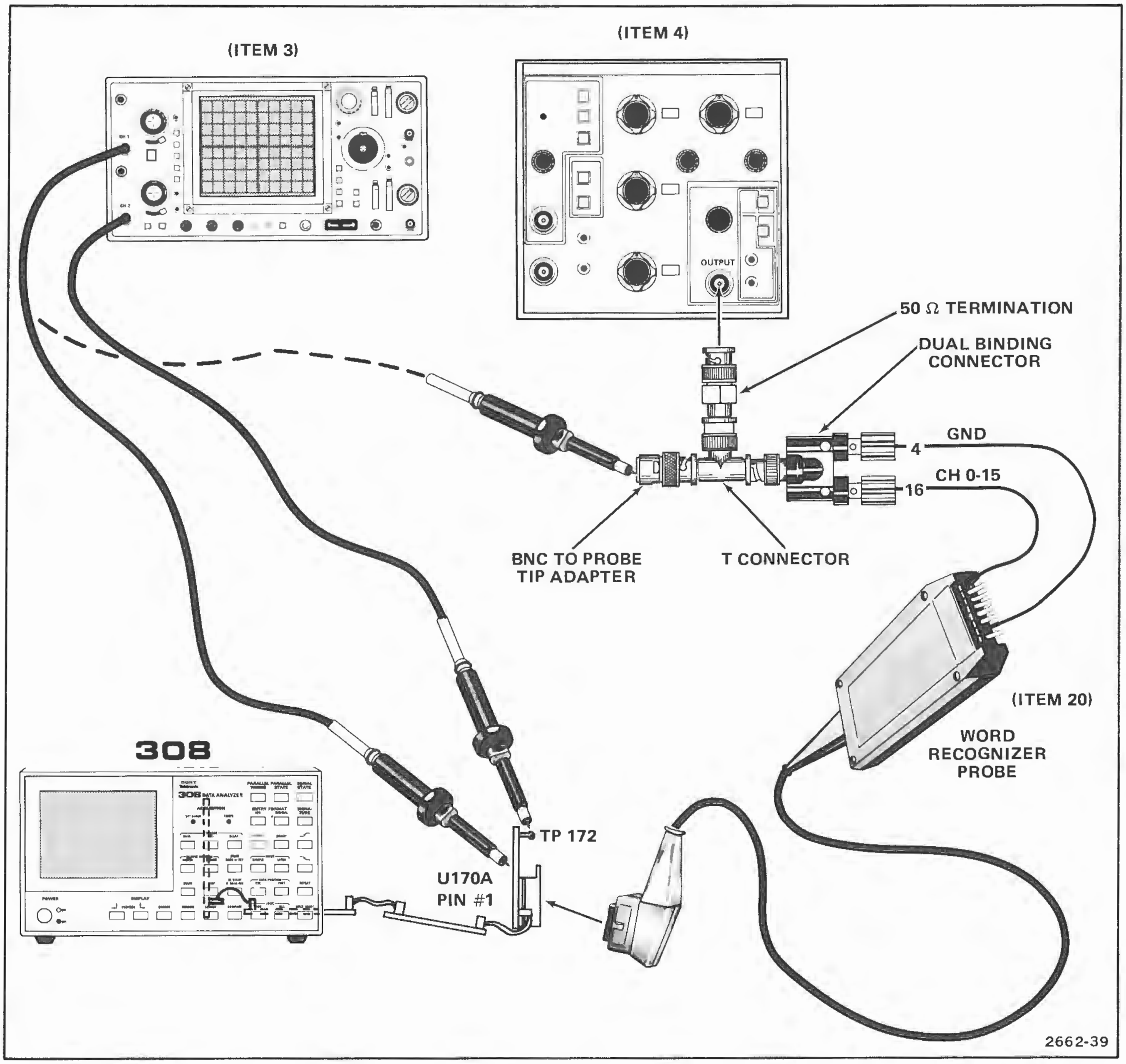


Figure 4-14. Test setup for adjusting external trigger delay.

DC BALANCE AND BIAS

Equipment Required
Digital Multimeter (DMM) (Item 3)
Screwdriver (Item 16)
Passive Probe (Item 18)

5. Adjust DC Balance and Bias

a. Set POWER switch to ON and after approximately 10 seconds observe that the Parallel Timing menu is displayed.

b. Set the VAR/TTL switch to VAR and allow 15 minutes for the 308 to stabilize.

NOTE

All test points and adjustments for this step are located on the Serial & Signature circuit board.

c. Connect DMM minus (−) lead to chassis ground at TP330 and connect plus (+) lead to the MONITOR jack.

d. ADJUST—THRESHOLD VOLTAGE potentiometer for a DMM indication of 0 ±0.05 V.

e. Connect the Serial/Signature probe (Item 18) to the 308 and connect the probe tip to chassis ground.

f. Connect DMM minus (−) lead to TP337 and connect plus (+) lead to TP327.

g. ADJUST—DC Balance R335 for a DMM indication of 0 ±0.0002 V.

h. Move DMM minus (−) lead to chassis ground.

i. ADJUST—DC Bias R340 for a DMM indication of −1.25 ±0.02 V.

j. If no other adjustments are to be performed, disconnect test setup and set the 308 POWER switch to OFF.

INPUT CAPACITANCE

Equipment Required

Digital Multimeter (DMM) (Item 2)
Oscilloscope (Item 3)
Pulse Generator (Item 4)
Adapter (Item 9)
Termination (Item 10)
T-Connector (Item 11)
Cable (Item 13)
Normalizer (Item 14)
Screwdriver (Item 16)
Screwdriver (Item 17)

6. Adjust Input Capacitance

a. Set POWER switch to ON and after approximately 10 seconds observe that the Parallel Timing menu is displayed.

b. Set the VAR/TTL switch to VAR and allow 15 minutes for the 308 to stabilize.

c. Connect DMM minus (−) lead to chassis ground at TP330 on the Serial & Signature circuit board and connect plus (+) lead to the MONITOR jack.

d. ADJUST—THRESHOLD VOLTAGE potentiometer for a DMM indication of 0 ±0.1 V.

NOTE

Both oscilloscope probes must be compensated for the following part.

e. Connect test setup as shown in Figure 4-15.

f. Set the pulse generator to obtain oscilloscope display as shown in Figure 4-16A.

Low Level	−5 V
High Level	+5 V
High Level Pulse	
Duration	Square wave
Period	1 ms

g. Set oscilloscope controls so that both Channel 1 and Channel 2 waveforms are displayed between the 0% and 100% lines on the graticule.

h. ADJUST—C320 on the Serial & Signature circuit board and/or replace C321 (with a different value, as required) for minimum difference between Channel 1 and Channel 2 waveforms as shown in Figure 4-16B.

i. If no other adjustments are to be performed, disconnect test setup and set the 308 POWER switch to OFF.

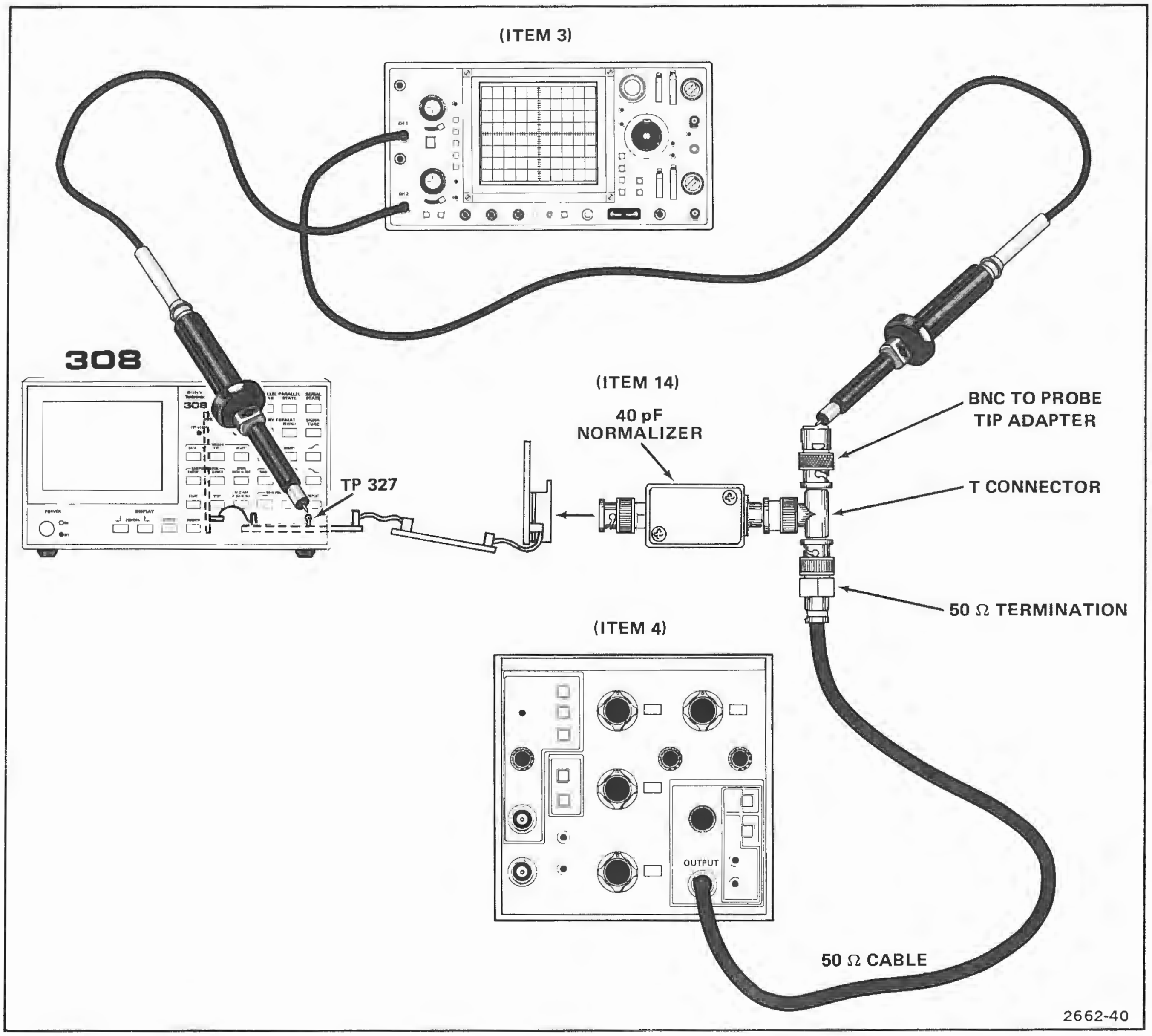
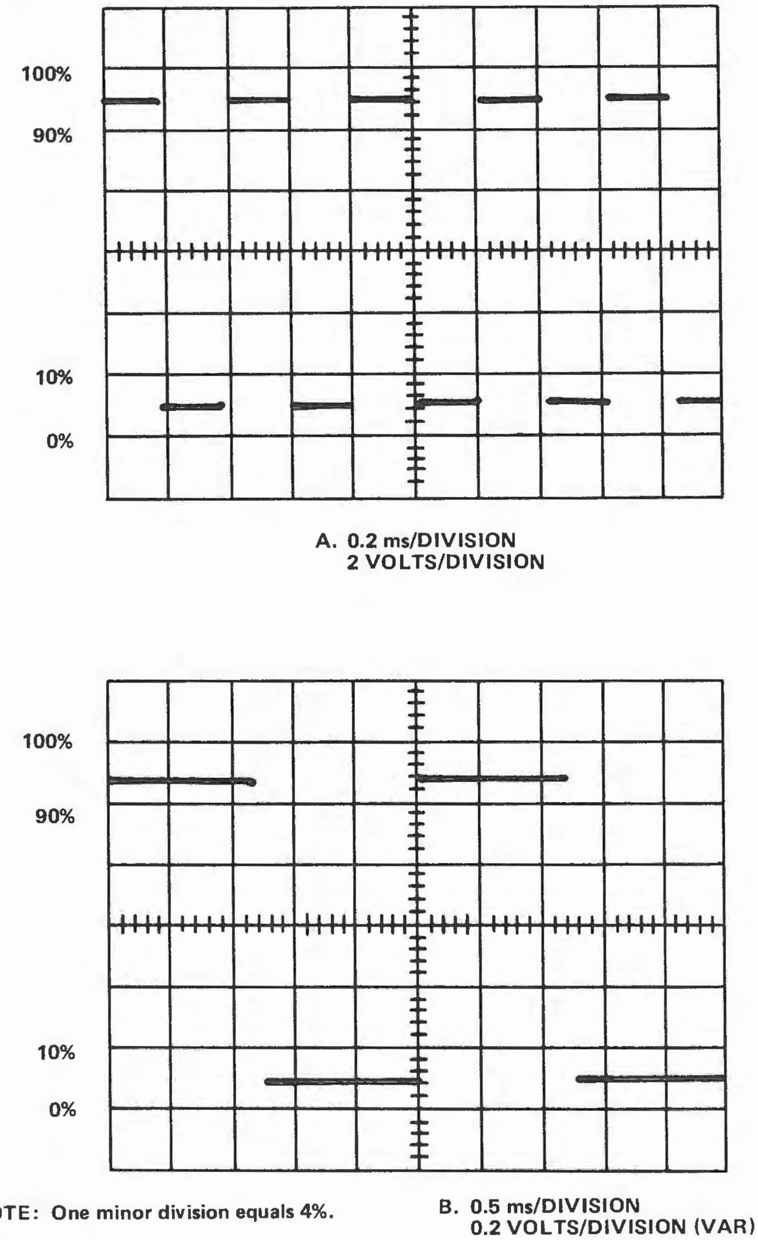


Figure 4-15. Test setup for adjusting input capacitance.



NOTE: One minor division equals 4%.

NOTE: This shows the two traces superimposed after adjustment.

2662-90

Figure 4-16. Test waveforms for adjusting input capacitance.

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SIGNATURE DATA DELAY

Equipment Required

Digital Multimeter (DMM) (Item 2)
Oscilloscope (Item 3)
Pulse Generator (Item 4)
Termination (Item 10)
T-Connector (Item 11)
Attenuator (Item 12)
Screwdriver (Item 16)

7. Adjust Signature Data Delay

a. Set POWER switch to ON and after approximately 10 seconds observe that the Parallel Timing menu is displayed.

b. Set the VAR/TTL switch to TTL and press the following keys in the sequence listed:

SIGNATURE	Press once
	Press three times

c. Allow 15 minutes for the 308 to stabilize and observe that the menu portion of the display shows SIGNATURE, CLOCK=↑, START=↑, STOP=↑.

d. Connect the test setup as shown in Figure 4-12 with the oscilloscope Channel 1 input connected to the pulse generator output.

e. Set the pulse generator to obtain oscilloscope display as shown in Figure 4-13 for an output waveform as follows:

Low Level	+0.8 V or less
High Level	−2.0 V or more
High Level Pulse	
Duration	50 ns
Period	200 ns

f. Connect oscilloscope Channel 1 to U150A pin 2 on the Data Input board (ECL level) and Channel 2 input to TP370 (TTL level) on the Serial & Signature circuit board.

g. MEASURE—Delay time (Dt) by pressing the REPEAT key on the 308 and measuring between the Channel 1 rising edge and Channel 2 falling edge waveforms on the oscilloscope. Take note Dt =

h. Disconnect the test setup and reconnect the test setup as shown in Figure 4-17.

i. Rotate R355 on the Serial & Signature circuit board fully ccw.

j. ADJUST—Jumper P346 on the Serial & Signature circuit board for the value (Dt + 14 ns) ±0.5 ns by measuring between the rising edges of the Channel 1 and Channel 2 waveforms. If delay insertion by P346 is not adequate, adjust R355 to obtain the required value.

k. If no other adjustments are to be performed, disconnect the test setup and set the 308 POWER switch to OFF.

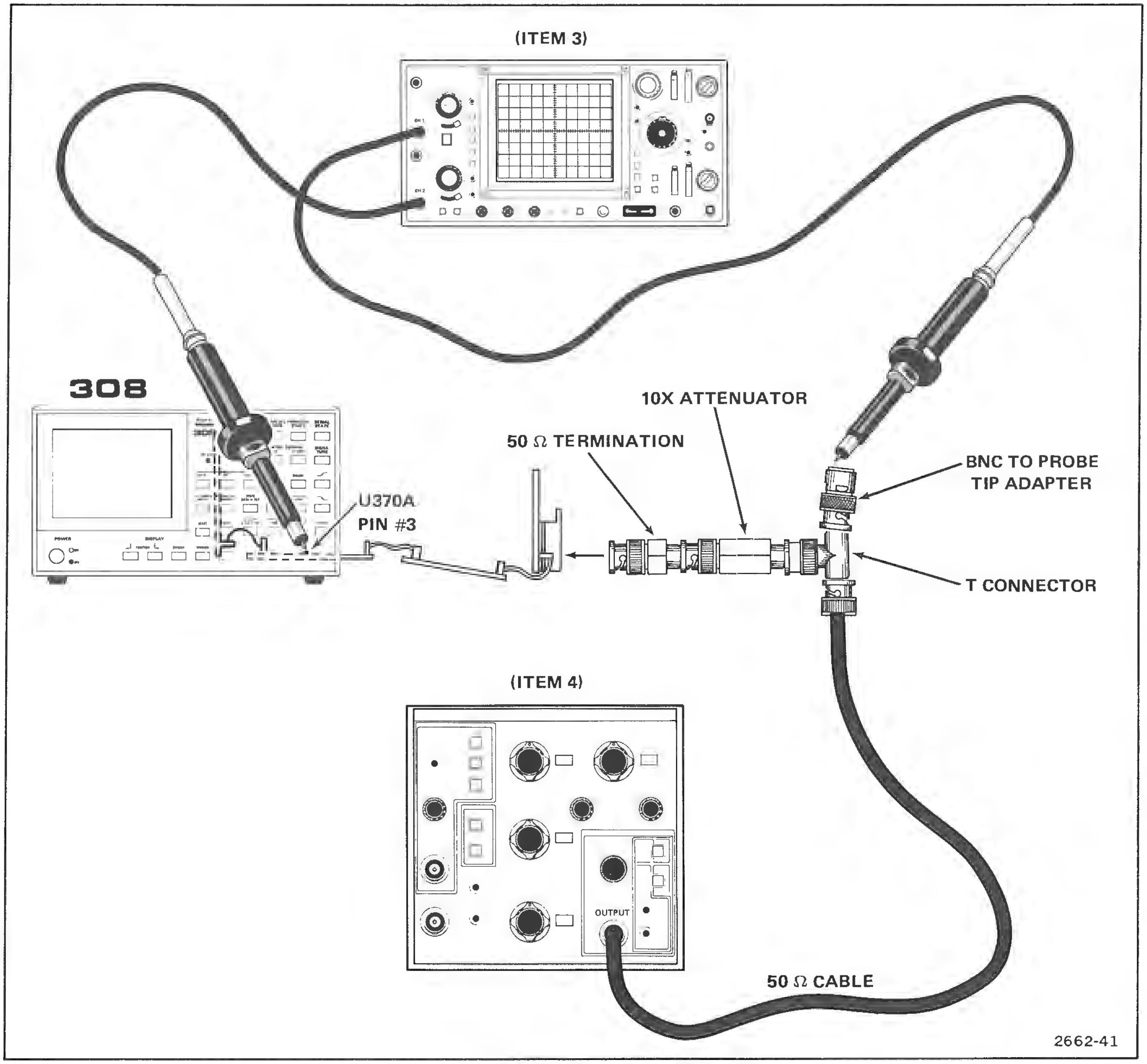

Figure 4-17. Test setup for adjusting signature data delay.

MAINTENANCE

This section of the manual contains information for conducting preventive maintenance, troubleshooting and corrective maintenance on your 308 Data Analyzer.

STATIC-SENSITIVE COMPONENTS

CAUTION

Static discharge can damage any semiconductor component in this instrument.

This instrument contains electrical components that are susceptible to damage from static discharge. Table 5-1 lists the relative susceptibility of various classes of semiconductors. Static voltages of 1 kilovolt to 30 kilovolts are common in unprotected environments.

When performing maintenance observe the following precautions to avoid damage:

1. Minimize handling of static-sensitive components.
2. Transport and store static-sensitive components or assemblies in their original containers, or a metal rail, or on conductive foam. Label any package that contains static-sensitive assemblies or components.
3. Discharge the static voltage from your body by wearing a wrist strap while handling these components. Servicing static-sensitive assemblies or components should be performed only at a static-free work station by qualified service personnel.
4. Nothing capable of generating or holding a static charge should be allowed on the work station surface.
5. Keep the component leads shorted together whenever possible.
6. Pick up components by the body, never by the leads.
7. Do not slide the components over any surface.
8. Avoid handling components in areas that have a floor or work-surface covering capable of generating a static charge.
9. Use a soldering iron that is connected to earth ground.
10. Use only special antistatic suction type of wick type desoldering tools.

Table 5-1

Relative Susceptibility to Static Discharge Damage

Semiconductor Classes	Relative Susceptibility Levels[a]
MOS or CMOS microcircuits or discretes, or linear microcircuits with MOS inputs (Most Sensitive)	1
ECL	2
Schottkey signal diodes	3
Schottkey TTL	4
High-frequency bipolar transistors	5
JFET	6
Linear microcircuits	7
Low-power Schottkey TTL	8
TTL (Least Sensitive)	9

[a] **Voltage equivalent for levels:**

1=100 to 500 V	4=500 V	7=400 to 1000 V (est)
2=200 to 500 V	5=400 to 600 V	8=900 V
3=250 V	6=600 to 800 V	9=1200 V

Voltage discharged from a 100 pF capacitor through a resistance of 100 ohms.

PREVENTIVE MAINTENANCE

Preventive maintenance consists of cleaning, visual inspection, lubrication, and adjustment. Preventive maintenance, performed regularly, may prevent instrument malfunction and enhance reliability of the instrument. The severity of the environment in which the instrument is used determines the frequency of maintenance. An appropriate time to accomplish preventive maintenance is just before adjustment.

CLEANING

The 308 should be cleaned as often as operating conditions require. Accumulation of dirt in the instrument can cause overheating and component breakdown. Dirt on components acts as an insulating blanket preventing efficient heat dissipation, and provides an electrical conduction path that could result in instrument failure.

CAUTION

Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. Use a nonresidue-type cleaner, preferably isopropyl alcohol, totally denatured ethyl alcohol, or a fluorinated solvent such as Freon TF and Spray-On #2002. Before using any other type of cleaner, consult your Tektronix Service Center or representative.

Exterior

Loose dust on the outside of the instrument can be removed with a soft cloth or small brush. The brush is particularly useful for dislodging dirt on and around the controls. Dirt that remains can be removed with a soft cloth dampened in a mild detergent and water solution. Abrasive cleaners should not be used.

CAUTION

To prevent getting water inside the instrument during external cleaning, use only enough water to dampen the cloth or swab.

Interior

To clean the interior, blow off dust with dry, low-pressure air. Remove any remaining dust with a soft brush or cloth dampened with a solution of mild detergent and water. Use a cotton swab for cleaning in narrow spaces. If these methods do not remove all the dust or dirt the instrument may be spray washed using a 5% solution of water and mild detergent as follows:

1. Remove the cabinet. Refer to Removal and Replacement instructions for removing the cabinet and component parts.

2. Remove easily accessible shields and covers.

3. Spray wash and thoroughly rinse the component.

4. Dry the component with low-velocity air.

5. Spray all switch contacts with isopropyl alcohol, wait for 60 seconds, and dry with low-velocity air.

6. Dry all components in an oven or compartment using low-temperature (125° or 150° F) circulating air.

Cathode-Ray Tube (CRT)

Clean the plastic light filter and the crt face with a soft, lint-free cloth dampened with denatured alcohol.

INSPECTION

CAUTION

Instruments that appear to have been dropped or otherwise abused should be checked thoroughly to verify correct operation and adjustment.

External

Table 5-2 lists external items that should be inspected for damage or wear. Items that could cause serious or further damage to the instrument should be repaired immediately.

Internal

Inspect the instrument for internal damage or wear as outlined in Table 5-3.

Table 5-2

External Inspection Checklist

Item	Inspect For	Repair Action
Cabinet, front-panel cover, front panel,	Cracks, scratches, deformations, and damaged hardware or gaskets.	Touch-up paint scratches and replace defective parts.
Carrying handle	Correct Operation.	Replace defective parts.
Accessories	Missing items or parts of items, bent pins, broken or frayed cables, damaged connectors.	Repair frayed cables and defective parts. Replace damaged or missing items.
Front Panel controls	Missing, damaged, or loose pushbuttons.	Repair or replace missing or defective controls.
Connectors	Broken shells, cracked insulation and deformed contacts. Dirt in connectors.	Replace defective parts. Clean or wash out dirt.

Table 5-3

Internal Inspection Checklist

Item	Inspect For	Repair Action
Circuit Boards	Loose, broken, or corroded solder connections. Burned circuit boards. Burned, broken, or cracked circuit-run plating.	Clean solder corrosion with an eraser and flush with isopropyl alcohol. Resolder defective connections. Determine cause of burned items and repair. Repair defective circuit runs.
Chassis	Dents, deformation, and damaged hardware.	Straighten, repair, or replace defective hardware.
Resistors	Burned, cracked, broken, or blistered.	Replace defective resistors.
Solder Connections	Cold solder or rosin joints.	Resolder joint and clean with isopropyl alcohol.
Wiring and Cables	Loose plugs or connectors. Burned, broken, or frayed wiring.	Firmly seat connectors. Repair or re-replace defective wires or cables.
Capacitors	Damaged or leaking cases. Corroded solder on terminals or leads.	Replace defective capacitors. Clean solder connections and flush with isopropyl alcohol.
Semiconductors	Loosely inserted in sockets. Bent pins.	Remove items with bent pins, carefully straighten the pins with long-nose pliers, and reinsert firmly (ensure that the straightening action hasn't cracked the pin such that it will break easily). Firmly seat loose semiconductors.
Pushbutton controls	Binding controls, missing pushbuttons.	Determine cause of binding and repair. Replace pushbuttons as required.

TROUBLESHOOTING

Preventive maintenance performed on a regular basis should reveal most potential problems before an instrument malfunctions. However, should troubleshooting be required, the following information is provided to facilitate location of a fault. In addition, the technical material presented in the Theory of Operation and Diagrams sections of this manual may be helpful while troubleshooting.

TROUBLESHOOTING AIDS

Diagrams

Complete circuit diagrams are located on the foldout pages in the Diagrams section at the rear of this manual. The component number and electrical value of each component are shown on the diagrams (see the first page of the Diagrams section for definitions of reference designators used to identify components). Each main circuit is assigned a series of component numbers to assist in identifying circuit location. A heavy line encloses the circuitry that is mounted on a circuit board.

Diagnostics

For power-up diagnostic failures, a list of power-up error codes is located in Table 2-1, (located in Operating Instructions section). Procedures for performing user-initiated diagnostics are located in the Performance Check portion of the Calibration Section.

If a failure display is obtained during Diagnostic 5, use Figure 5-1 to compare displayed patterns with expected patterns. Start at the lower right corner and progress from right to left, verifying each displayed pattern with its corresponding expected pattern in Figure 5-1. If no discrepancies are found, proceed to the second row up from the bottom and again verify the patterns from right to left. If no discrepancies are found, proceed to the next row up. Continue verifying in this manner, from bottom to top and from right to left until the first discrepancy is found. The first discrepancy in the pattern causes a halt to the diagnostic routine, thus invalidating the remainder of the pattern.

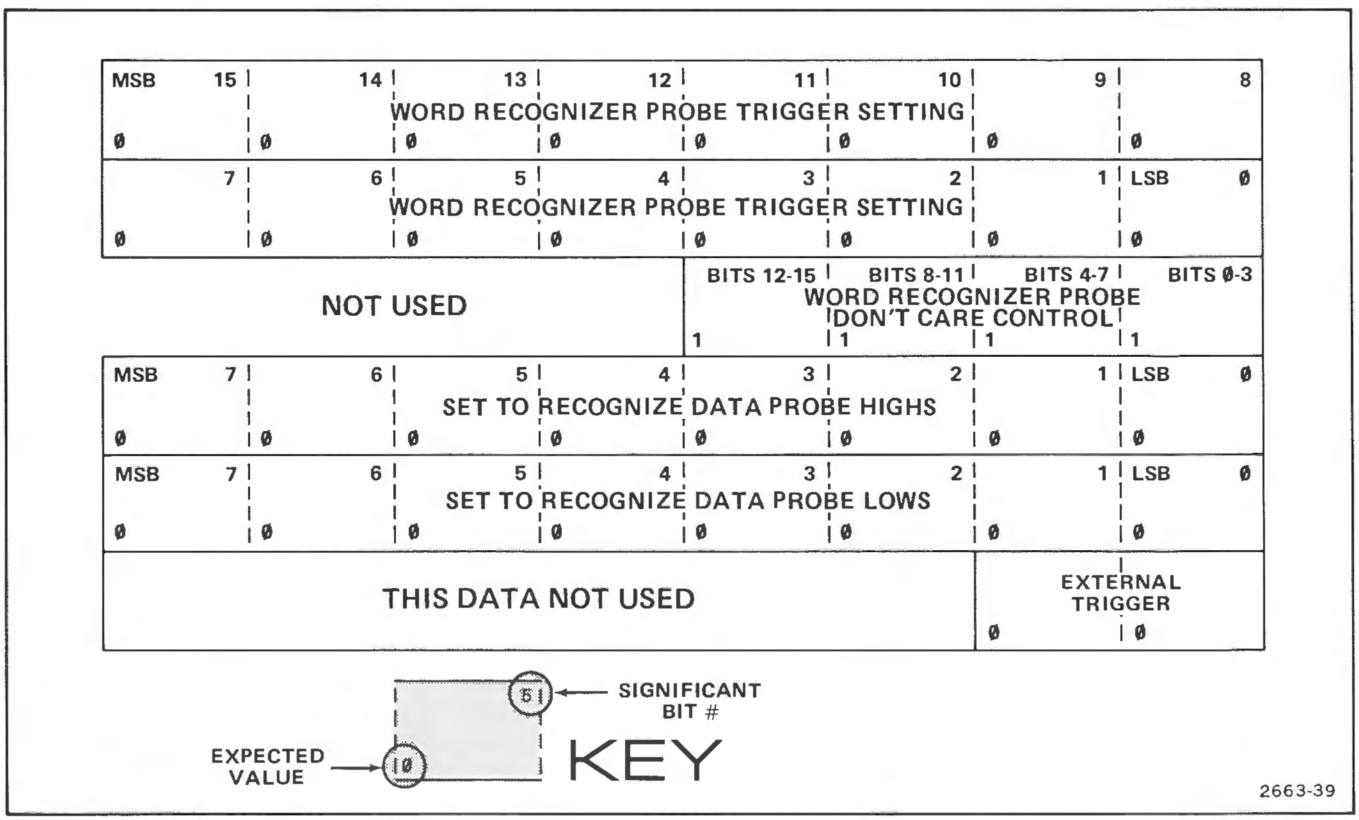

Figure 5-1. Diagnostic 5 reference pattern.

Additional information on the diagnostics may be found in the Signature Lists located in the Diagrams section.

Circuit Board Locations

Figure 5-2 shows the location of the circuit boards within the instrument.

Component Locations

Associated with each circuit diagram is an illustration of the circuit board on which the layout of components are identified by their circuit numbers. Tables listing each component by its circuit number are also provided. These tables enable rapid location of components on both the circuit diagrams and the circuit board illustrations by listing the grid coordinates.

Troubleshooting Tree

The troubleshooting tree located in the Diagrams section of the manual, is intended to be used as a guide in identifying problem areas and isolating component malfunctions. To use the chart start at the beginning and continue until the fault is corrected. If there are further problems start over. Some malfunctions, especially those involving multiple simultaneous failures may require more elaborate approaches with frequent reference to the circuit descriptions.

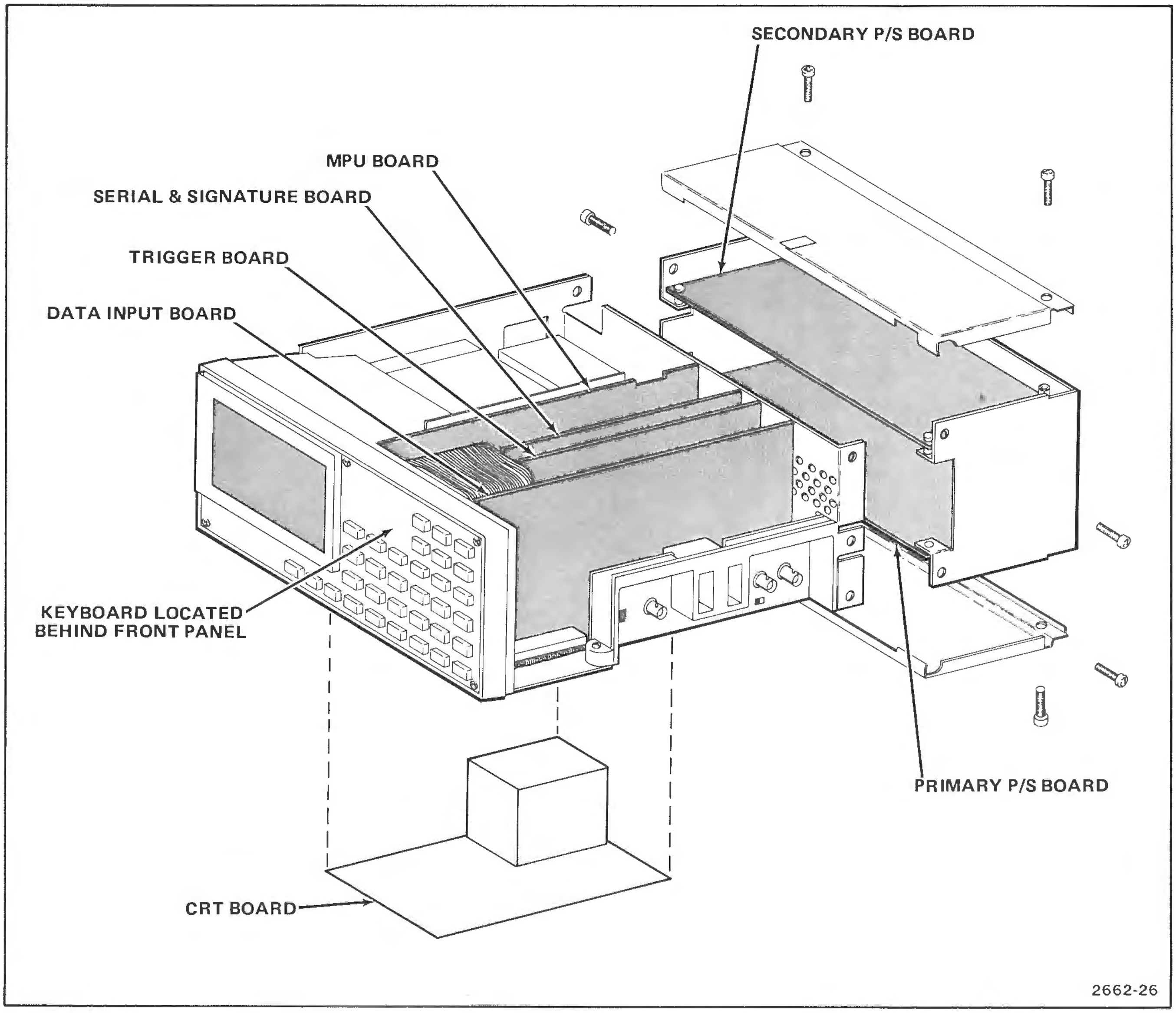

Figure 5-2. Circuit board locations.

Signature Lists

The troubleshooting tree may refer you to signature lists found in the Diagrams section. These are tables comprised of various signatures and setup conditions which can be used to verify the presence of expected data values at selected test points under specific setup conditions. When a signature measurement is called out, the appropriate clock, start, stop, and ground connections should be made as specified in the referenced table.

Test Point Adjustment Locations

The Test Point and Adjustment Location illustrations, also found in the Diagrams section of the manual, are useful for rapidly locating circuit board test points and adjustment components.

Component Color Coding

Resistor Color Code. Resistors used in this instrument are either composition or precision metal-film resistors. They are color-coded with the EIA color code (some metal-film resistors may have the value printed on the body). The color code is read starting with the stripe nearest the end of the resistor. Composition resistors have four stripes which consist of two significant figures, a multiplier, and a tolerance value (see Figure 5-3). Metal-film resistors have five stripes consisting of three significant figures, a multiplier, and a tolerance value.

Capacitor Markings. The capacitance values of common disc capacitors and small electrolytics are marked on the side of the component body. White ceramic capacitors are color coded in picofarads, using a modified EIA code (see Figure 5-3).

The dipped tantalum capacitors are color coded in microfarads (see Figure 5-3). The color dot indicates the positive lead and voltage rating.

Be careful to observe the polarity and voltage rating, since capacitors are easily destroyed by reversed or excessive voltages.

Diode Color Code. The cathode end of each glass encased diode is indicated by a stripe, a series of stripes, or a dot. For most silicon or germanium diodes with a series of stripes, the color code identifies the three significant digits of the Tektronix Part Number using the resistor color-code system (e.g., a diode color coded pink- or blue-, brown-gray-green indicates Tektronix Part Number 152-0185-00). The cathode and anode ends of metal-encased diodes can be identified by the diode symbol marked on the body.

Semiconductor Lead Configuration

Figure 5-4 shows the lead configurations of semiconductor devices used in the 308.

Multi-Connector Holders

Multi-connector holders are keyed with two triangles: one of the holder and one of the circuit board. Slot numbers are usually stamped on the holder. When a connection is made perpendicular to a circuit board surface, ensure that the triangle on the holder and the triangle on the circuit board are aligned pointing toward each other (see Figure 5-5).

TROUBLESHOOTING EQUIPMENT

The following equipment or the equivalent, in addition to that listed in the Calibration section, may be useful when troubleshooting the 308.

Data Analyzer

Description:	Capable of analyzing parallel signal timing, states of serial and parallel data transmissions, and signatures.
Purpose:	Perform signature analysis of data.
Equipment Example:	Sony/Tektronix 308 Data Analyzer.

Oscilloscope

Description:	Frequency response, dc to 150 Mhz; deflection factor, 2 mV to 5 V/div. A 10X, 10 MΩ probe should be used to reduce circuit loading.
Purpose:	Check waveforms.
Equipment Example:	Tektronix 475 Oscilloscope.

Digital Multimeter

Description:	Voltmeter, input impedance of 10 MΩ; range from 0 to 15 Vdc; accuracy within 0.15%; display at least 4 1/2 digits. Ohmmeter, range from 0 to 20 MΩ. Test probes should be insulated to prevent accidental shorting.
Purpose:	Measure voltages and resistances.
Equipment Example:	Tektronix DM 501 Digital Multimeter.

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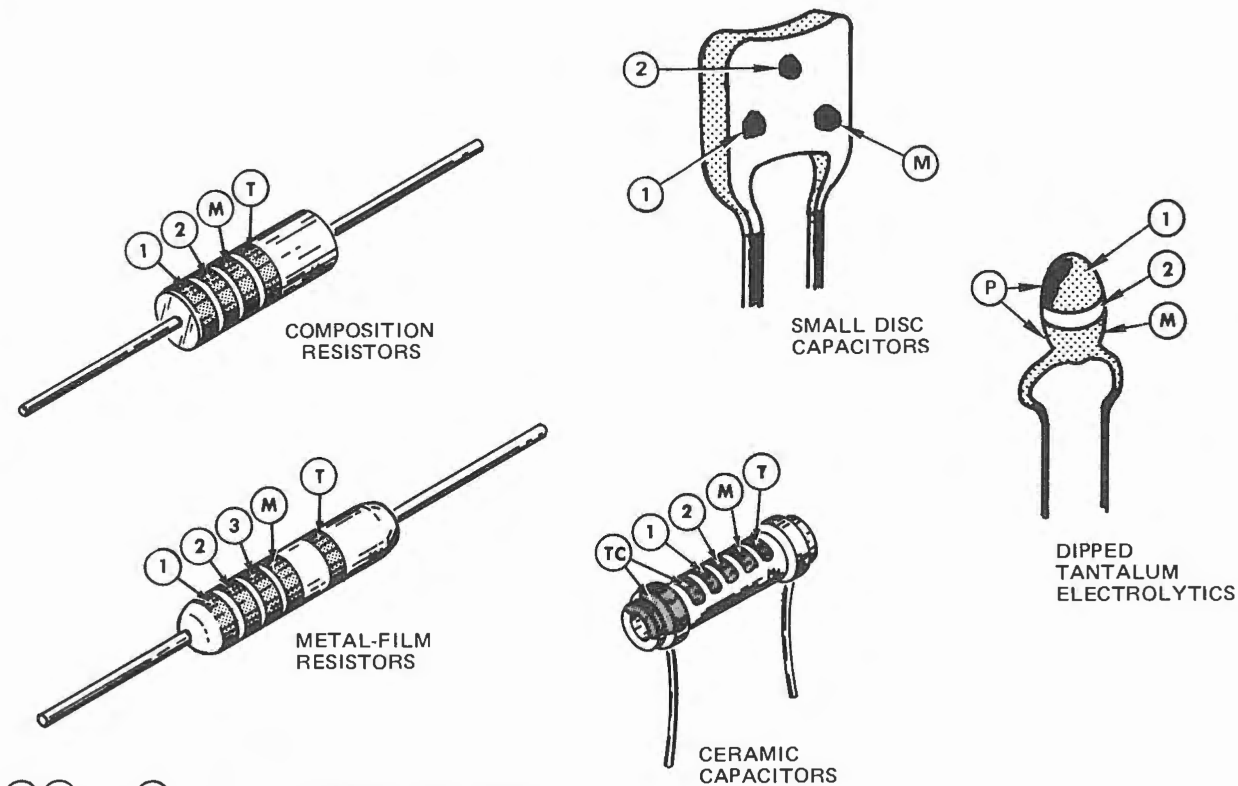
COLOR CODE



(1)(2) and (3) — 1st, 2nd, and 3rd significant figures

(M) —multiplier (T) —tolerance

(TC) —temperature coefficient

(P) —polarity and voltage rating

(T) and/or (TC) color code may not be present on some capacitors

COLOR	SIGNIFICANT FIGURES	RESISTORS		CAPACITORS			DIPPED TANTALUM VOLTAGE RATING
		MULTIPLIER	TOLERANCE	MULTIPLIER	TOLERANCE		
					over 10 pF	under 10 pF	
BLACK	0	1	———	1	±20%	±2 pF	4 VDC
BROWN	1	10	±1%	10	±1%	±0.1 pF	6 VDC
RED	2	10^2 or 100	±2%	10^2 or 100	±2%	———	10 VDC
ORANGE	3	10^3 or 1 K	±3%	10^3 or 1000	±3%	———	15 VDC
YELLOW	4	10^4 or 10 K	±4%	10^4 or 10,000	+100% −9%	———	20 VDC
GREEN	5	10^5 or 100 K	±½%	10^5 or 100,000	±5%	±0.5 pF	25 VDC
BLUE	6	10^6 or 1 M	±¼%	10^6 or 1,000,000	———	———	35 VDC
VIOLET	7	———	±1/10%	———	———	———	50 VDC
GRAY	8	———	———	10^{-2} or 0.01	+80% −20%	±0.25 pF	———
WHITE	9	———	———	10^{-1} or 0.1	±10%	±1 pF	3 VDC
GOLD	—	10^{-1} or 0.1	±5%	———	———	———	———
SILVER	—	10^{-2} or 0.01	±10%	———	———	———	———
NONE	—	———	±20%	———	±10%	±1 pF	———

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Figure 5-3. Color code for resistors and capacitors.

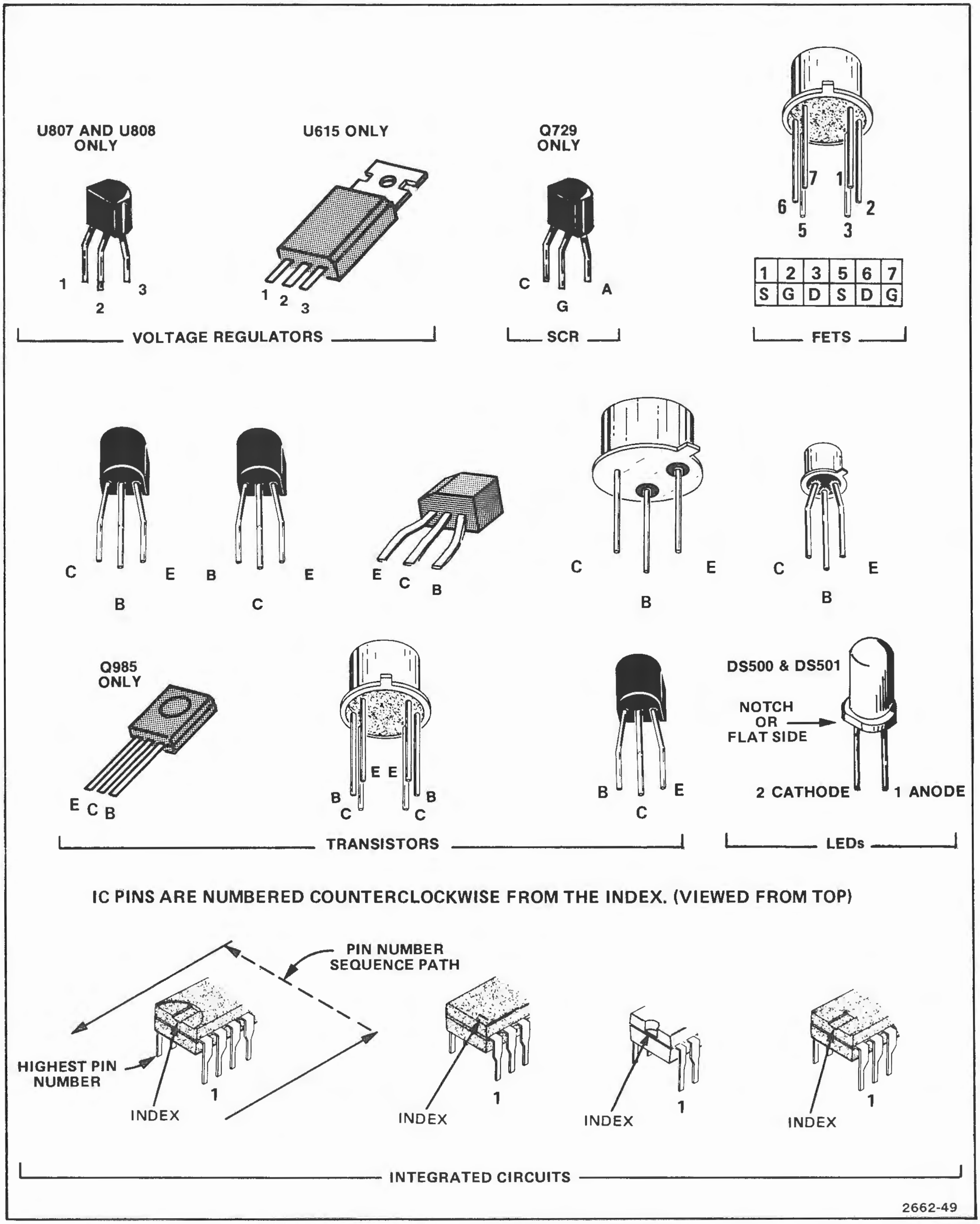

Figure 5-4. Semiconductor lead configurations.

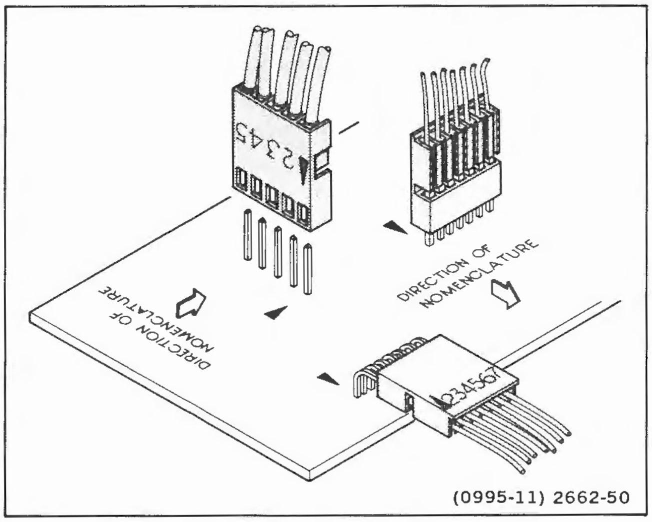

Figure 5-5. Multi-connector holder orientation.

Pulse Generator

Description:	Repetition rate, 10 Hz to 250 MHz; rise time, 1 ns or less; output amplitude, 0 to 5 V.
Purpose:	Signal source.
Equipment Example:	Tektronix PG 502 Pulse Generator.

Variable Autotransformer

Description:	Variable ac output from 0 to 140 V, 1.2 A. Equipped with three-wire power cord, plug, and receptacle.
Purpose:	Vary input line voltage when troubleshooting the power supply.
Equipment Example:	General Radio W8MT3VM or W10MT3W Metered Variac Autotransformer.

TROUBLESHOOTING TECHNIQUES

The following checklist is arranged in an order that enables checking simple trouble possibilities before more extensive troubleshooting is required. The first four checks ensure proper connection, operation, and adjustment. If the trouble is located by these checks, the remaining steps aid in locating the defective component. When the defective component is located, replace it using the appropriate replacement procedure given under Corrective Maintenance in this section.

1. Check Control Settings

Refer to the Operating Instructions of the manual (Section 2) to determine correct control settings and indications.

2. Check Associated Equipment

Before proceeding, ensure that any equipment used with the 308 is operating correctly. Verify that input signals are properly connected and that the interconnecting cables are not defective. Check the power source voltages.

3. Visual Check

Perform a visual inspection. This check may reveal broken connections, damaged components, semiconductors not firmly mounted, damaged circuit boards, or other clues.

4. Check Instrument Adjustment

Check instrument performance by accomplishing the Performance Check in Section 4. An apparent trouble may only be a result of misadjustment. If necessary perform the appropriate Adjustment Procedure.

5. Isolate Trouble To a Circuit

To isolate trouble to a particular circuit note the trouble symptom; the sympton often identifies the circuit in which the trouble is located. When trouble symptoms appear in more than one circuit, check the affected circuits by taking voltage and waveform readings.

Incorrect operation of all circuits often indicates trouble in the power supplies. Check first for the correct output voltage of the individual supplies. A defective component elsewhere in the instrument can appear as a power-supply trouble and may also affect the operation of other circuits. These voltages are measured between the power-supply test points and ground (see the Test Point and Adjustment Locations foldout pages in the Diagrams section for test-point locations). If power-supply voltages and ripple are within the listed ranges, the supply can be assumed to be working correctly. If they are outside the range, the supply may be misadjusted or operating incorrectly. To adjust the power supplies, refer to the Adjustment Procedure in Section 4.

6. Check Circuit Board Interconnections

After the trouble has been isolated to a particular circuit, again check for loose or broken connections, improperly seated transistors, and heat-damaged components.

7. Check Voltages

The defective component can often be located by checking for the correct power supply voltages in the circuit.

Only power supply voltages given on the Diagrams are not absolute. They may vary slightly between instruments. To obtain operating conditions similar to those used to make these readings see the Adjustment portion of the Calibration section.

8. Check Individual Components

The following procedures describe methods of checking individual components. Two-lead components that are soldered in place are best checked by first disconnecting one end. This isolates the measurement from the effects of surrounding circuitry. See Figure 5-3 for value identification.

WARNING

To avoid electric shock always disconnect the 308 from the power source before removing or replacing components.

Transistors. A good check of transistor operation is actual performance under operating conditions. A transistor can be most effectively checked by substituting a new component (or one which has been checked previously). However, be sure that circuit conditions are not such that a replacement transistor might also be damaged. If subsititute transistors are not available, use a dynamic tester. Static type testers are not recommended, since they do not check operation under simulated operating conditions.

When troubleshooting transistors in the circuit with a voltmeter, measure the emitter-to-base and emitter-to-collector voltages to determine if the voltages are consistant with normal circuit voltages. Voltages across a transistor vary with the type of device and its circuit function. Some of these voltages are predictable. The emitter-to-base voltages of a conducting silicon transistor will normally be from 0.6 to 0.8 volt. The emitter-to-collector voltages of a saturated transistor is about 0.2 volt. Because these values are small, the best way to check them is by connecting the voltmeter across the junction and using a sensitive voltmeter, rather than by comparing two voltages taken with respect to ground (both leads of the voltmeter must be isolated from ground if this method is used). If values less than these are obtained, either the device is short circuited or no current is flowing in the circuit. If values in excess of the base-emitter values given, the junction is back biased or the device is defective. Values in excess of those given for emitter-collector could indicate either a nonsaturated device operating normally or a defective (open-circuited) transistor. If the device is conducting, voltage will be developed across resistances in series with it; if it is open, no voltage will be developed across resistances in series with it unless current is being supplied by a parallel path.

When troubleshooting field effect transistors, the voltages across its elements can be checked in the same manner as transistors. However, it should be remembered that normal depletion-mode operation has the gate-to-source junction reverse biased, while the enhanced mode has the junction forward biased.

CAUTION

When checking semi-conductors, observe the static sensitivity precautions located at the beginning of this section.

Integrated Circuits. Integrated circuits can be checked with a voltmeter, test oscilloscope, or a direct substitution. A good understanding of circuit operation is essential when troubleshooting circuits containing integrated circuits. Use care when checking voltages and waveforms around the IC so that adjacent leads are not shorted together. A convenient means of clipping a test probe to the IC is with an IC test clip.

CAUTION

When checking diodes do not use an ohmmeter scale that has a high internal current. High currents can damage diodes. Check diodes in the same manner as transistor emitter-to-base junctions. Silicon diodes should have 0.6 to 0.8 volt across the junction when conducting. Higher readings indicate that they are either back biased or defective, depending on polarity.

Diodes. A diode can be checked for an open or shorted condition by measuring the resistance between terminals with an ohmmeter set on a scale having a low internal source current, such as the R X 1 kilohm scale. The diode resistance should be very high in one direction and very low when the meter leads are reversed.

Resistors. Check resistors with an ohmmeter. Check the parts list for tolerances of resistors used in this instrument. Resistors normally need not be replaced unless the measured value varies considerably from the specified value.

Indicators. Check for open inductors by checking continuity with an ohmmeter. Shorted or partially-shorted inductors can usually be found by checking the waveform response when high-frequency signals are passed through the circuit.

Capacitors. A leaky or shorted capacitor can best be detected by checking resistance with an ohmmeter on the highest scale. Do not exceed the voltage rating of the capacitor. The resistance reading should be high after initial charge of the capacitor. An open capacitor can be detected with a capacitance meter or by checking whether the capacitor passes ac signals.

Repair and Readjust the Circuit

If any defective parts are located follow the replacement procedures given under Corrective Maintenance in this section. Check the performance of any circuit that has been repaired or that has had any electrical component replaced. Adjustment of the circuit may be necessary.

CORRECTIVE MAINTENANCE

Corrective maintenance consists of component replacement and instrument repair. Special techniques and procedures required to replace components in the 308 are described in this part of the manual. If it is necessary to ship your instrument to a Tektronix Service Center for repair or service, refer to the repackaging instructions at the end of this section.

OBTAINING REPLACEMENT PARTS

Most electrical and mechanical parts can be obtained through your local Tektronix Field Office or representative. However, you should be able to obtain many of the standard electronic components from a local commercial source in your area. Before you purchase or order a part from a source other than Tektronix, Inc., please check the Replaceable Electrical Parts list for the proper value, rating, tolerance, and description.

NOTE

All replaceable parts should be direct replacements unless it is known that a different component will not adversely affect instrument performance.

Some parts are manufactured or selected by Tektronix, Inc., to our specifications. Most of the mechanical parts have been manufactured by Tektronix, Inc. To determine the manufacturer of a part, refer to the Parts List Cross Index of Code Number to Manufacturer found in the Replaceable Electrical Parts list.

When ordering replacement parts from Tektronix, Inc., include the following information:

1. Instrument type.
2. Instrument serial number.
3. A description of the part (if electrical, include circuit number).
4. Tektronix part number.

SOLDERING TECHNIQUES

WARNING

Before soldering, turn the instrument off, disconnect it from the power source and allow approximately three minutes for the power supply capacitors to discharge.

The reliability and accuracy of this instrument can be maintained only if proper soldering techniques are used when repairing or replacing parts. General soldering techniques, which apply to maintenance of any precision electronic equipment, should be used when working on the 308. Use only 60/40 rosin-core electronic-grade solder. The choice of soldering iron is determined by the repair to be made. When soldering on circuit boards, use a 15- to 25-watt pencil-type soldering iron with a 1/8-inch wide, wedge-shaped tip. Keep the tip properly tinned for best heat transfer to the solder joint. A higher wattage soldering iron may separate the wiring from the base material. Avoid excessive heat; apply only enough heat to remove the component or to make a good solder joint. Also, apply only enough solder to make a firm solder joint; do not apply too much solder. After soldering, clean the area around the solder connection with flux-remover solvent and air dry.

REMOVAL AND REPLACEMENT INSTRUCTIONS

WARNING

To avoid electric shock, disconnect the instrument from the power source before removing or replacing any component or assembly.

The exploded-view drawing associated with the Replaceable Mechanical Parts list may be helpful in the removal or disassembly of individual components or subassemblies. Component locations are shown in the Diagrams and Circuit Board Illustrations section.

Read these instructions completely before attempting any corrective maintenance.

Cabinet

WARNING

Before removing the cabinet, disconnect the power cord from the back of the instrument. As the cabinet is being removed, do not touch any component on the CRT circuit board which is mounted in the chassis under the crt.

The cabinet can be removed by taking out the two screws retaining the rear panel and the one screw that secures the cabinet to the bottom of the chassis. Carefully slide the cabinet off the chassis, being careful not to touch any components on the CRT circuit board. To reinstall the cabinet, slide it over the chassis. Ensure that the coaxial cable leading from the Serial & Signature board to the side panel, fits into the recess in the boards.

Front Panel

Front panel removal is accomplished by using a 1/16-inch hex-key wrench to remove the four screws holding the front panel in place. Then carefully pull the front panel away from the 308 and lay it face-down in front of the instrument. To reinstall the front panel, position the panel in place and secure it with the four screws.

Keyboard Switches

The keyboard switches are attached to the circuit board that fits behind the 308's front panel (the keyboard). Figure 5-6 shows the details of the keyboard assembly. To remove a keyboard switch, proceed as follows:

1. Remove the front panel (see Front Panel Removal).
2. Remove the pushbutton covers from the switch to be replaced and from the switches on either side of it.
3. Using combination pliers to gently grasp the switch body by its sides, remove the switch by pulling it away from the circuit board, using a gentle side-to-side motion.
4. Obtain a new replacement switch and orient it so that the mounting post and guide pins match corresponding holes in the circuit board.
5. Press the switch into the circuit board applying pressure only to the sides of the switch, until it is firmly seated on the board.
6. Install the pushbutton covers on the switch shafts.
7. Reinstall the front panel.

Light-Emitting Diodes (LED)

The EXT CLOCK and TRIG'D LED indicators (DS500 and DS501) are soldered to the keyboard. To replace a defective LED, proceed as follows:

1. Remove the front panel (see Front Panel Removal).
2. Using a thin-shaft Phillips screwdriver, remove the four screws, each with two washers, securing the keyboard to the front subpanel.
3. With your fingers grasp the TP500 post, mounted in the upper left corner of the board, and carefully pull out the keyboard (see Figure 5-6).
4. Unsolder and remove the two leads of the defective LED from the keyboard. Remove all solder from the LED holes in the circuit board with a wick-type or suction-type desoldering tool.

NOTE

LED polarity is indicated by a diode symbol imprinted on the circuit board. The cathode is the upper mounting hole, and the anode is the lower hole.

5. Orient the LED for correct polarity and insert the leads into the mounting holes.

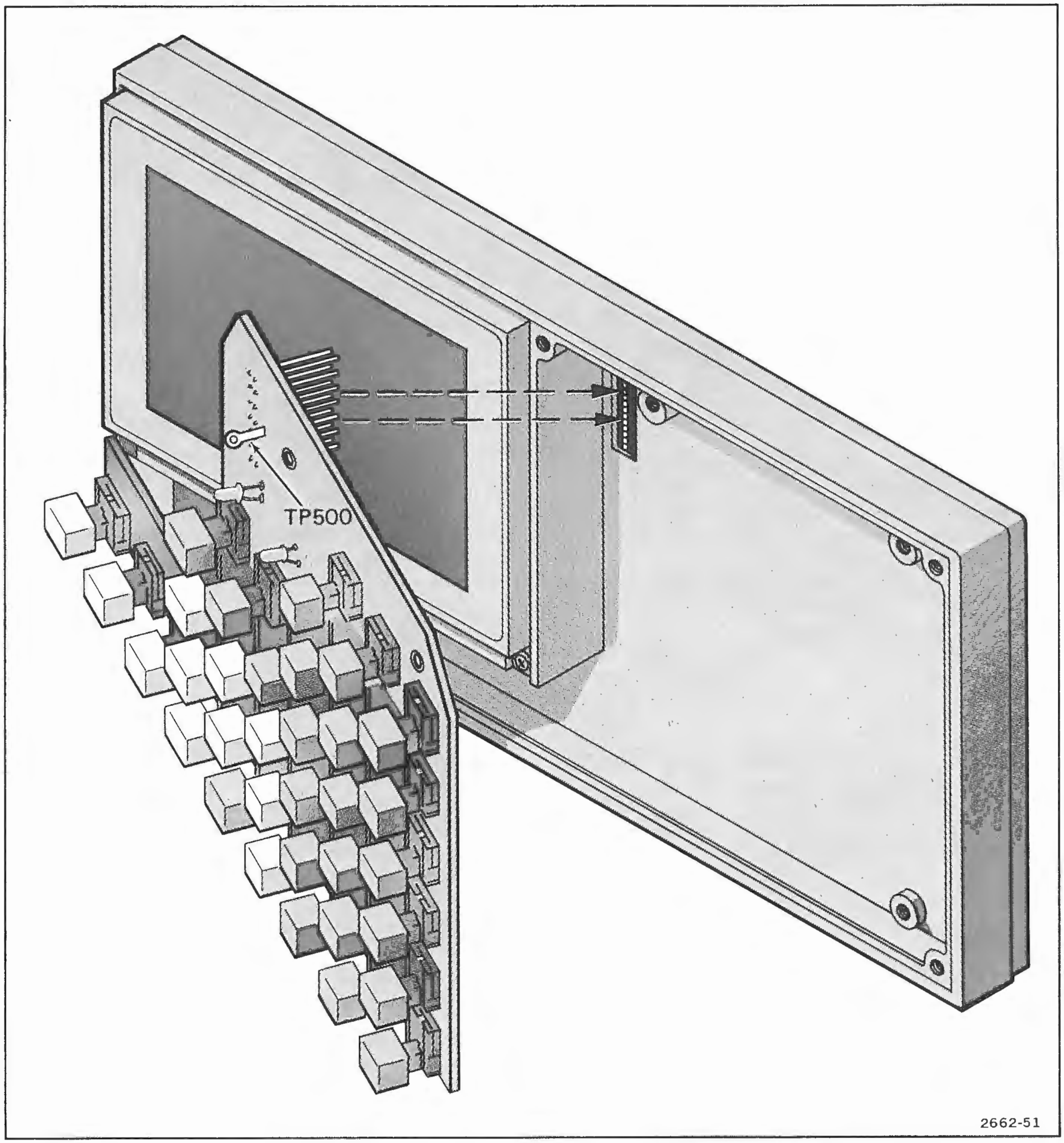

Figure 5-6. Keyboard removal.

6. Position the LED so that it is perpendicular to the circuit board and its tip measures 15/32 ±1/32 inch from the board surface.

NOTE

Proper LED positioning is essential to ensure alignment of the LED with the viewing holes in the front panel and to ensure that the front panel, when installed, does not stress or compress the LED.

7. While holding the LED in its proper position, solder one of its leads to the circuit board.

8. Verify that the LED tip is the correct distance from the circuit board surface, then solder the remaining leads to the board. Clip off excess lead material from the back of the board.

9. Holding the TP500 post with one hand and supporting the keyboard weight with the other hand, carefully align P500 pins with J500 holes and press the board into place until the connector is firmly seated.

10. Secure the keyboard with the four screws and eight washers previously removed.

11. Reinstall the front panel.

Data Input, Trigger, and Serial & Signature Boards

When necessary to access the Data Input, Trigger, Serial & Signature boards, perform the following disassembly and reassembly steps. Most of the connections to the circuit boards are made with pin connectors. To remove any connections soldered to a board, observe the precautions given under Soldering Techniques and under Static-Sensitive Components in this section.

1. Remove the cabinet (see Cabinet Removal).

2. Remove the two screws that fasten the side panel to the chassis and the two screws that retain the three circuit boards (see Figure 5-7).

3. Tilt the top of the Data Input board toward you. At the back of the board disconnect the cable (white with green tracer) from J320 (the X10 PROBE ONLY bnc connector). The three circuit boards are now connected to each other and to the MPU board by:

   a. A 39-wire cable from P100 on the Data Input board to P200 on the Trigger board.

   b. A 39-wire cable from P202 on the Trigger board to P300 on the Serial & Signature board.

   c. A 39-wire cable from P310 on the Serial & Signature board to P400 on the MPU board and

   d. Three solder power-supply wires (+5 V, Gnd, −5 V), leading through strain-relief holes, between each of the boards.

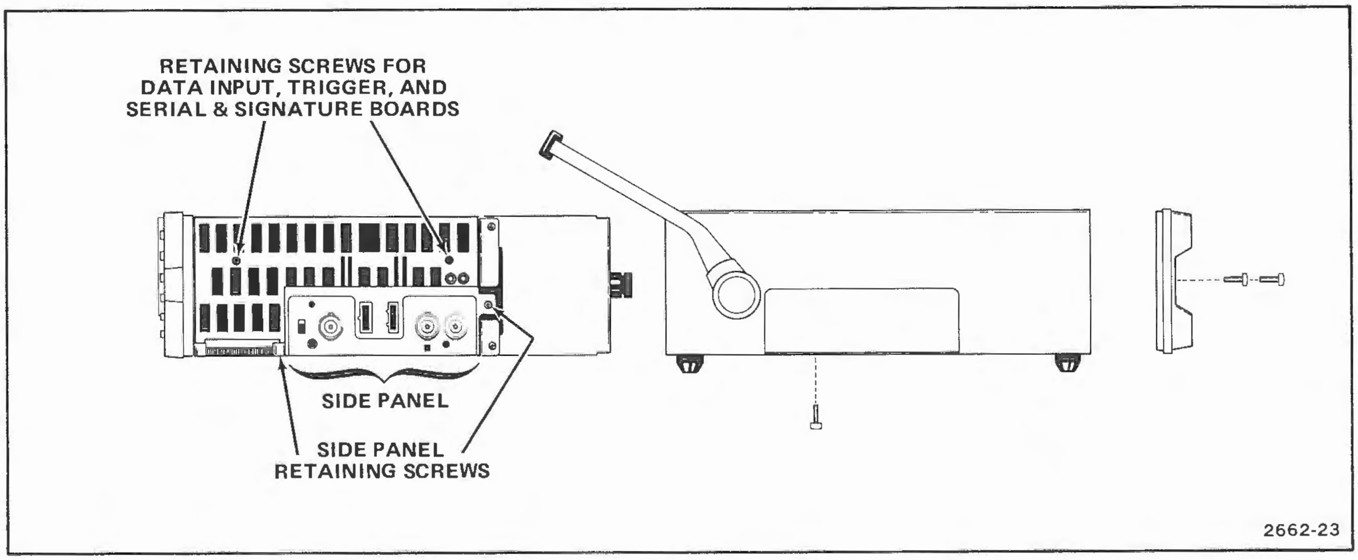

Figure 5-7. Side panel and circuit board removal.

@

4. To gain access to any of the three circuit boards and the MPU board, carefully pull the three-board assembly out of the instrument chassis as far as required.

5. To remove any of the three boards, disconnect the appropriate 39-wire cables and unsolder the power-supply wires leading to and from it.

6. To reinstall the three-board assembly, resolder any power supply wires that were previously removed. Before soldering verify correct lead terminations and insert the wires through their appropriate strain-relief holes on the board.

7. Reconnect any cables that were previously disconnected. Refer to step 3 for cable connection information.

8. Position the boards into the instrument chassis, ensuring that the bottom of each board is fitted into its respective formed slot or detent in the chassis.

9. Replace the two screws that retain the three board assembly and replace the two screws that fasten the side panel to the chassis.

10. Reinstall the cabinet.

MPU Board

1. Remove the front panel (see Front Panel Removal).

2. Using a thin-shaft Phillips screwdriver, remove the four screws, each with two washers, securing the keyboard to the front subpanel.

3. With your fingers grasp the TP500 post, mounted in the upper left corner of the board, and carefully pull out the keyboard (see Figure 5-6).

4. Perform steps 1 through 4 of the preceding Data Input, Trigger, and Serial & Signature Board procedure.

5. Disconnect P852 and P853 from the power supply and disconnect P492 from the MPU board (see Figure 5-8).

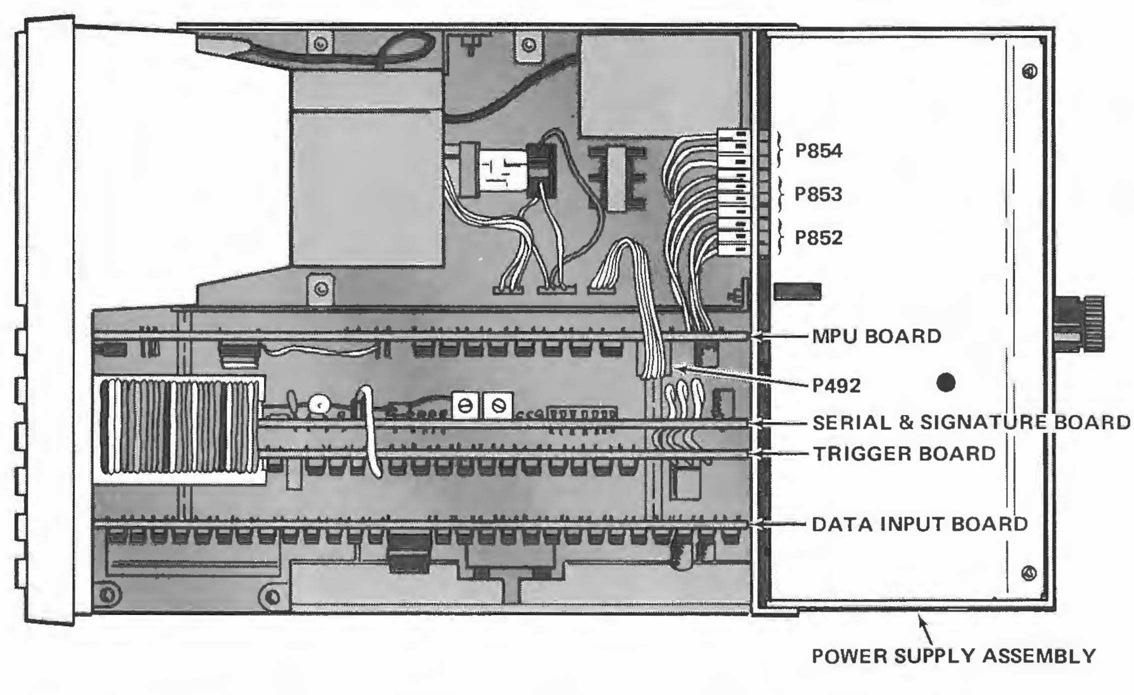

Figure 5-8. 308 top view.

6. Use a 3/16-inch nutdriver or socket wrench to remove the two fastener-spacers holding the MPU board to the chassis.

7. Lift out the MPU board and its three companion boards.

8. To reinstall the MPU board and its three companion boards first position the MPU board into the instrument chassis, ensuring that the bottom of the board is fitted into its respective formed slot or detent in the chassis.

9. Reinstall the two fastener-spacers to secure the MPU board to the chassis.

10. Position the three companion boards into the chassis, ensuring that each is fitted into its respective formed slot or detent.

11. Replace the two screws that retain the three-board assembly and replace the two screws that fasten the side panel to the chassis.

12. Reinstall the cabinet.

Power Supply Circuit Boards

The power supply assembly is fastened to the main chassis with four screws and contain the Primary and Secondary Power Supply boards. To remove the Power Supply boards, proceed as follows:

1. Remove the cabinet (see Cabinet Removal).

WARNING

Dangerous potentials may exist in the power supply circuitry. Allow approximately three minutes for the power supply filter capacitors to discharge before proceeding with the next step. Capacitor discharge to a safe voltage level can also be verified by observing that the indicator on the Primary Power Supply board (seen through the holes adjacent to the Voltage Selector switch) stops blinking.

2. Disconnect the switch-actuating bar from the power switch by spreading the fingers that grip the switch shaft (see Figure 5-9).

3. Disconnect P852, P853, and P854 from the power supply (see Figure 5-8).

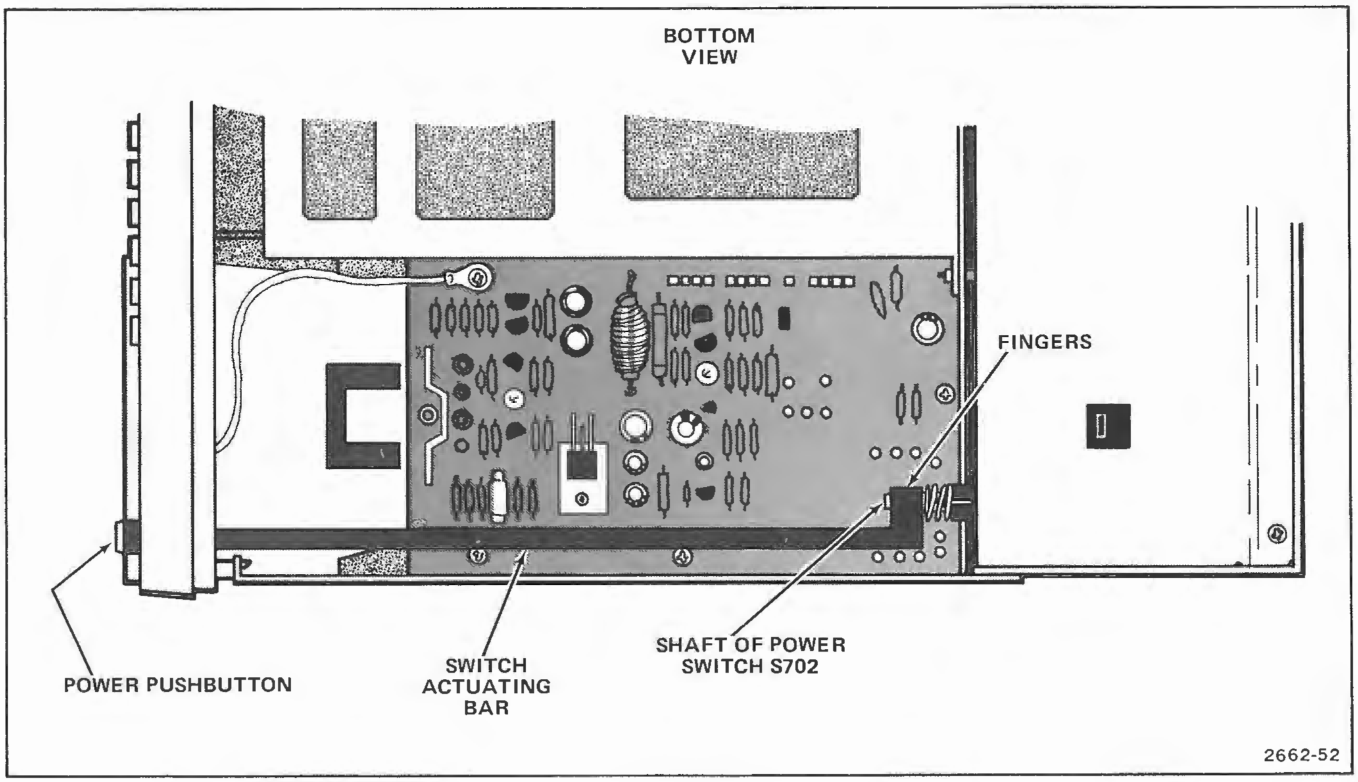

Figure 5-9. Power switch actuation linkage.

4. Support the power supply assembly with one hand while removing the four screws that fasten it to the main chassis. Lift off the power supply assembly.

5. If the Secondary Power Supply board is being taken out, remove the two screws that retain the cover plate at the top of the power supply assembly and lift off the plate. If the Primary Power Supply board is being taken out, remove the two screws that retain the bottom cover plate and lift off the plate.

6. Remove the two screws and the two hex standoffs (using a 3/16-inch nutdriver) that hold the board to the power supply assembly chassis.

7. If the Secondary Power Supply board is being removed, disconnect P850, P851, and P960 from the board. If the Primary Power Supply board is being removed, disconnect P750 and P751 from the board.

8. Lift out the board and replace any defective components.

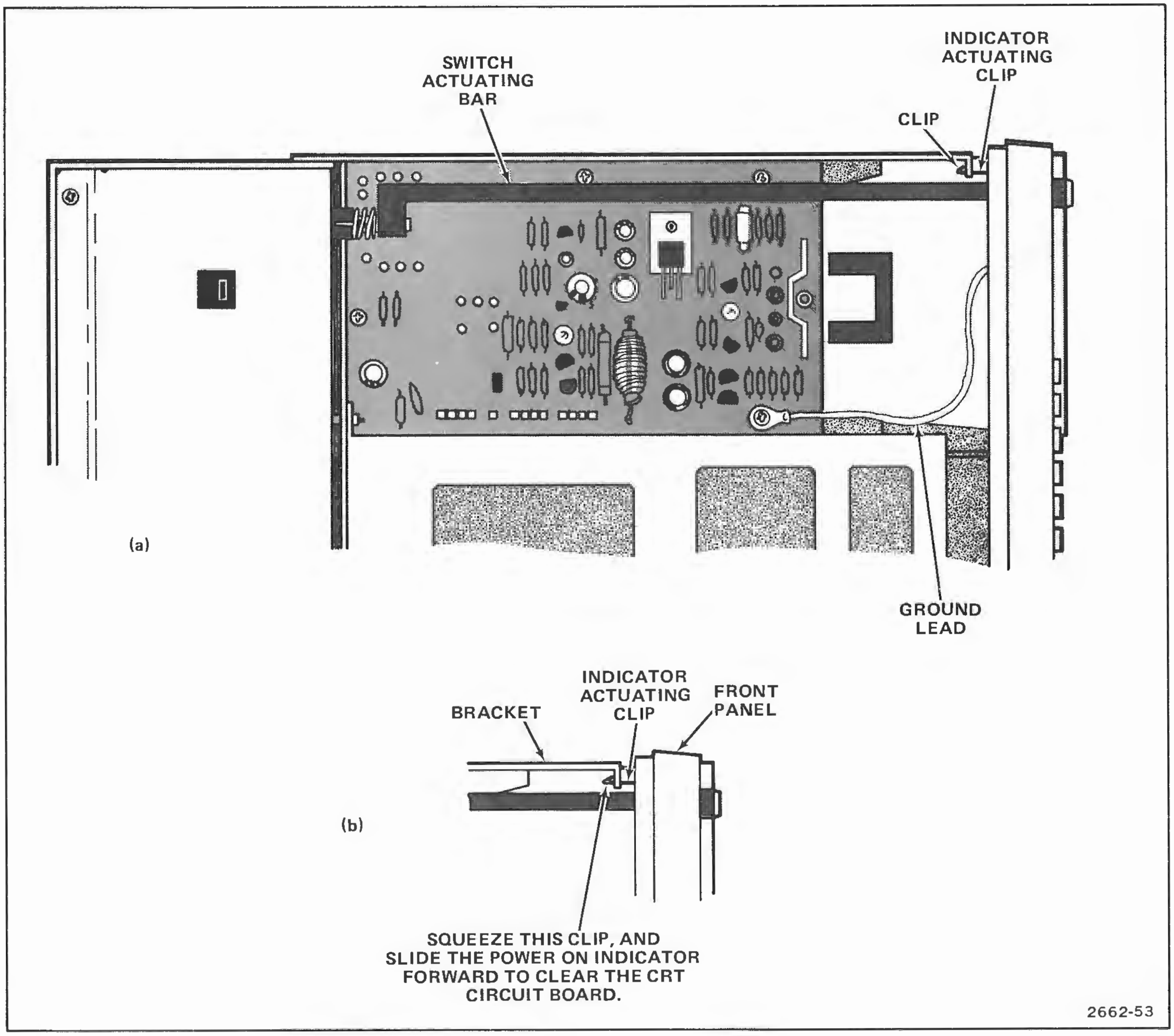

Figure 5-10. CRT Circuit board removal details.

WARNING

Handle silicon grease with care. Avoid getting silicon grease in the eyes. Wash hands thoroughly after use.

The power supply transistors and their mounting bolts are insulated from the board in addition, silicon grease is used to increase heat transfer capabilities. Reinstall the insulators and replace the silicon grease when replacing these transistors. The grease should be applied to both sides of the mica insulators and should be applied to the bottom side of the transistor, where it comes in contact with the insulator.

NOTE

After replacing a power transistor, check that the collector is not shorted to ground before applying power.

9. To reinstall the board, position it in place on the chassis and replace the two screws and two hex standoffs.

10. Reinstall connections previously disconnected in step 7 observing correct arrow alignment.

11. Position the cover plate in place and secure it with its two retaining screws.

12. Secure the power supply assembly to the instrument main chassis with the four retaining screws.

13. Reconnect P852, P853, and P854, observing correct arrow alignment.

14. Reconnect the switch-actuating bar fingers to the power switch.

15. Reinstall the cabinet.

CRT Circuit Board

To remove the CRT Circuit board, proceed as follows:

1. Remove the cabinet (see Cabinet Removal).

WARNING

The crt anode and the output terminal of the high-voltage multiplier may retain a high-voltage charge after the instrument is turned off. To avoid electrical shock, ground both the output terminal of the multiplier and the crt high-voltage anode lead to chassis ground before disconnecting the high-voltage lead.

2. Ground the crt high-voltage lead to chassis ground, then disconnect the high-voltage lead from the crt by squeezing the spring clip in the connector and pulling it outward.

3. Loosen the high-voltage lead from any tight places on the chassis, so that it will permit removal of the CRT Circuit board.

4. On the CRT Circuit board disconnect P600, P601, P605, and P635, noting their location.

5. Disconnect the switch actuating bar from the power switch by spreading the fingers that grip the switch shaft (see Figure 5-9).

6. Use a small flat-head screwdriver to compress the clip on the end of the indicator-actuating bar while sliding the switch-actuating bar forward to clear the CRT Circuit board (see Figure 5-10).

7. Remove the four screws that secure the board to the chassis, noting the location of the front panel ground lead.

8. Carefully remove the CRT Circuit board from the chassis.

CAUTION

When reinstalling the CRT Circuit board screws, ensure that the front panel ground lead is reinstalled on the inside front screw.

9. To reinstall the CRT Circuit board, position it into place on the chassis and secure it with the four retaining screws. Ensure that the front panel ground lead is reinstalled on the inside front screw (see Figure 5-10).

10. Reinsert the clip at the end of the indicator-actuating bar to the chassis bracket.

11. Reconnect the switch-actuating bar fingers to the power switch shaft.

12. Reconnect P600, P601, P605, and P635, observing correct arrow alignment.

13. Reroute the high-voltage lead and connect it to the crt.

14. Reinstall the cabinet.

Cathode-Ray Tube (CRT)

To remove the crt, proceed as follows:

1. Remove the cabinet (see Cabinet Removal).

WARNING

The crt anode and the output terminal of the high-voltage multiplier may retain a high-voltage charge after the instrument is turned off. To avoid electrical shock, ground both the output terminal of the multiplier and the crt high-voltage anode lead to chassis ground before disconnecting the high-voltage lead.

2. Ground the crt high-voltage lead to chassis ground, then disconnect the high-voltage lead from the crt by squeezing the spring clip in the connector and pulling it outward.

3. Disconnect P635 from the CRT Circuit board.

4. Carefully disconnect the socket from the back of the crt.

5. Remove the front panel (see Front Panel Removal). This exposes the lower part of the crt bezel and its two retaining screws.

6. On the CRT Circuit board loosen the rear retaining screws and remove the three remaining screws. This will permit the board to move away from the crt so that the grounding contact will not obstruct the crt as it is being removed.

7. Remove the two bezel-retaining screws.

WARNING

To prevent injury resulting from the crt dropping out, keep the instrument in a horizontal position, leaving sufficient work area in front of the crt.

8. Swing the bottom of the bezel outward and remove both the bezel and light filter.

WARNING

Use care when handling a crt. Protective clothing and safety glasses should be worn. Avoid striking it on any object which might cause it to crack or implode. When storing a crt, place it in a protective carton or set it face down on a smooth surface in a protective location with a soft mat under the faceplate to protect it from scratches.

9. Carefully guide the crt out of the front of the 308. While you are removing it, hold the CRT Circuit board away from the crt to keep the grounding clip from obstructing the crt.

10. To reinstall the crt, carefully guide the replacement crt into its housing from the front of the 308. While inserting it, hold the CRT Circuit board away from the crt to keep the grounding clip from obstructing the crt.

11. Position the bezel and light filter over the face of the crt and reinstall them. This will require some pressure on the face of the crt to insert it to the proper depth. Press the light filter against the crt while installing the bezel. Then hold the bezel and install the two retaining screws.

CAUTION

When reinstalling the CRT Circuit board screws, ensure that the front panel ground lead is reinstalled on the inside front screw.

12. Reinstall the screws that retain the CRT Circuit board. Ensure that the front panel ground lead is reinstalled on the inside front screw (see Figure 5-10).

13. Reinstall the front panel.

14. Reconnect the socket at the back of the crt.

15. Reconnect P635 to the CRT Circuit board, observing correct arrow alignment.

16. Reconnect the high-voltage lead to the crt.

17. Reinstall the cabinet.

Side Panel

The side panel can be removed for replacement of the three bnc connectors and MONITOR jack that are mounted to it. It can also be removed for gaining access to parts that are mounted on the Data Input board behind the panel. To remove the side panel, proceed as follows:

1. Remove the cabinet (see Cabinet Removal).

2. Remove the two screws that fasten the side panel to the chassis. Figure 5-9 shows the screws.

3. Remove the two screws that retain the three circuit boards (see Figure 5-7).

4. Fold the Data Input board outward to expose its back side.

5. Unplug the coaxial cable from J320 in the back of the side panel.

6. Remove the three screws that fasten the side panel to the Data Input board.

7. Unsolder the two 100-ohm resistors from J160 and J180.

8. Hold the side panel in one hand and heat the solder joint where J185 (the MONITOR jack) connects to the circuit board. Remove the side panel and clean the solder from the J185 connection hole.

9. To reinstall the side panel, place it against the circuit board and guide P6406 and P6451 connectors into their holes. Move the VAR/TTL control on the side to engage it with the slider in S185. Align the MONITOR jack lead J185 into its connection hole on the Data Input board.

10. At the back of the Data Input board, resolder the MONITOR jack lead to its connection hole.

11. Resolder the two 100-ohm resistors to their respective bnc connectors (J160 and J180).

12. Reinstall the three screws that fasten the slide panel to the Data Input board.

13. Position the Data Input board into the chassis, ensuring that it is fitted into its formed slot. Check the two inboard circuit boards for positioning into their respective slots.

14. Reinstall the two screws that retain the three circuit boards.

15. Reinstall the two screws that fasten the side panel to the chassis.

16. Reinstall the cabinet.

Interconnecting Cable and Pin Connectors

Most interconnecting cable assemblies (cables and connectors) are factory assembled. They must be replaced only as a complete unit.

Some cables have multi-connector holders. It is possible for pin connectors to become dislodged from the plastic holders. If this happens, the connector can be reinstalled as follows (see Figure 5-11):

1. Bend grooved portion of holder away from cable as shown.

2. Reinsert connector into its hole in the plug-in portion of the holder.

Some cables have wires soldered directly to board pads and to plug connections. It is important to note and remember wire positions when removing and replacing these cables.

RECALIBRATION

Whenever components or assemblies are removed and reinstalled, or the instrument repaired, preventive maintenance should be accomplished and the instrument performance rechecked (see Section 4).

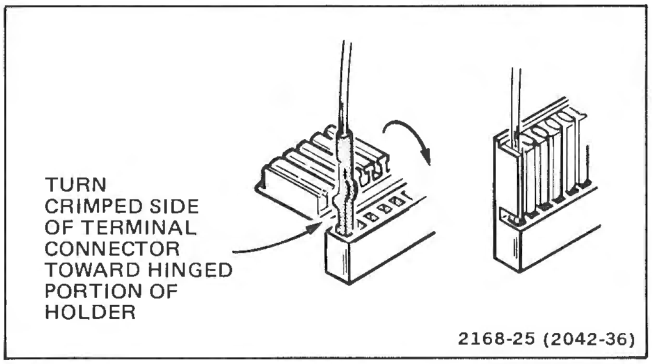

Figure 5-11. Pin connector replacement.

INSTRUMENT REPACKAGING

Should reshipment become necessary, reuse the original carton in which your instrument was shipped. If original packaging is unfit for use or is not available, repackage the instrument as follows:

1. Obtain a corrugated cardboard carton having inside dimensions of no less than six inches more than the instrument dimensions; this will allow for cushioning. Use a carton having a test strength of at least 200 pounds.

2. Surround the instrument with protective polyethylene sheeting.

3. Cushion the instrument on all sides by tightly packing dunnage or urethane foam between carton and instrument, allowing three inches on all sides.

4. Seal carton with shipping tape or industrial stapler.

Required Reshipment Information

If the instrument is to be shipped to a Tektronix Service Center for service or repair, before packaging, attach a tag containing the following information:

1. Owner's name and address, with the name of an individual at your firm that can be contacted.

2. Complete instrument serial number.

3. Description of the services required.

INSTRUMENT OPTIONS

Your instrument may be equipped with one or more instrument options. A brief description of each option is given below. For further information on instrument options, see your Tektronix Catalog or contact your Tektronix Field Office. If additional options are made available for this instrument, they may be described in a Change Information insert at the back of this manual or in this section.

OPTION 01

Option 01 adds a P6406 Word Recognizer Probe as a standard accessory included with the 308. The part number for the P6406 added by Option 01 is 010-6406-00. Specific information pertaining to the P6406 probe may be packaged with it.

REPLACEABLE ELECTRICAL PARTS

PARTS ORDERING INFORMATION

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

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

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

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

LIST OF ASSEMBLIES

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

CROSS INDEX-MFR. CODE NUMBER TO MANUFACTURER

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

ABBREVIATIONS

Abbreviations conform to American National Standard Y1.1.

COMPONENT NUMBER (column one of the Electrical Parts List)

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

Example a.

component number

A23R1234 — A23 R1234

Assembly number — Circuit number

Read: Resistor 1234 of Assembly 23

Example b.

component number

A23A2R1234 — A23 A2 R1234

Assembly number — Subassembly number — Circuit number

Read: Resistor 1234 of Subassembly 2 of Assembly 23

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

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

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

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

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

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

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

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

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

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

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

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

Indicates actual manufacturers part number.

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
000AX	BUEHLER PROD.	HIGHWAY 70 EAST	KINGSTON, NC 28501
0000L	MATSUSHITA ELECTRIC	200 PARK AVENUE, 54TH FLOOR	NEW YORK, NY 10017
0000M	SONY/TEKTRONIX CORPORATION	P O BOX 14, HANEDA AIRPORT	TOKYO 149, JAPAN
00779	AMP, INC.	P O BOX 3608	HARRISBURG, PA 17105
00853	SANGAMO ELECTRIC CO., S. CAROLINA DIV.	P O BOX 128	PICKENS, SC 29671
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P O BOX 5012, 13500 N CENTRAL EXPRESSWAY	DALLAS, TX 75222
02777	HOPKINS ENGINEERING COMPANY	12900 FOOTHILL BLVD.	SAN FERNANDO, CA 91342
04222	AVX CERAMICS, DIVISION OF AVX CORP.	P O BOX 867, 19TH AVE. SOUTH	MYRTLE BEACH, SC 29577
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS STREET	MOUNTAIN VIEW, CA 94042
12954	SIEMENS CORPORATION, COMPONENTS GROUP	8700 E THOMAS RD, P O BOX 1390	SCOTTSDALE, AZ 85252
12969	UNITRODE CORPORATION	580 PLEASANT STREET	WATERTOWN, MA 02172
13571	ELECTRONIC RESEARCH CO.	P O BOX 913	SHAWNEE MISSION, KS 66201
14752	ELECTRO CUBE INC.	1710 S. DEL MAR AVE.	SAN GABRIEL, CA 91776
15454	RODAN INDUSTRIES, INC.	2905 BLUE STAR ST.	ANAHEIM, CA 92806
18324	SIGNETICS CORP.	811 E. ARQUES	SUNNYVALE, CA 94086
19396	ILLINOIS TOOL WORKS, INC. PAKTRON DIV.	900 FOLLIN LANE, SE	VIENNA, VA 22180
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
24546	CORNING GLASS WORKS, ELECTRONIC COMPONENTS DIVISION	550 HIGH STREET	BRADFORD, PA 16701
24931	SPECIALTY CONNECTOR CO., INC.	3560 MADISON AVE.	INDIANAPOLIS, IN 46227
27014	NATIONAL SEMICONDUCTOR CORP.	2900 SEMICONDUCTOR DR.	SANTA CLARA, CA 95051
31918	IEE/SCHADOW INC.	8081 WALLACE ROAD	EDEN PRAIRIE, MN 55343
32997	BOURNS, INC., TRIMPOT PRODUCTS DIV.	1200 COLUMBIA AVE.	RIVERSIDE, CA 92507
50157	MIDWEST COMPONENTS INC.	P. O. BOX 787 1981 PORT CITY BLVD.	MUSKEGON, MI 49443
53944	ELT INC., GLOW LITE DIVISION	BOX 698	PAULS VALLEY, OK 73075
54473	MATSUSHITA ELECTRIC, CORP. OF AMERICA	1 PANASONIC WAY	SECAUCUS, NJ 07094
56289	SPRAGUE ELECTRIC CO.		NORTH ADAMS, MA 01247
71400	BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.	2536 W. UNIVERSITY ST.	ST. LOUIS, MO 63107
71785	TRW, CINCH CONNECTORS	1501 MORSE AVENUE	ELK GROVE VILLAGE, IL 60007
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	2500 HARBOR BLVD.	FULLERTON, CA 92634
75378	CTS KNIGHTS, INC.	400 REIMANN AVE.	SANDWICH, IL 60548
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
82389	SWITCHCRAFT, INC.	5555 N. ELSTON AVE.	CHICAGO, IL 60630
83003	VARO, INC.	P O BOX 411, 2203 WALNUT STREET	GARLAND, TX 75040
84411	TRW ELECTRONIC COMPONENTS, TRW CAPACITORS	112 W. FIRST ST.	OGALLALA, NE 69153
90201	MALLORY CAPACITOR CO., DIV. OF P. R. MALLORY AND CO., INC.	3029 E. WASHINGTON STREET P. O. BOX 372	INDIANAPOLIS, IN 46206
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601
91836	KINGS ELECTRONICS CO., INC.	40 MARBLEDALE ROAD	TUCKAHOE, NY 10707
93410	ESSEX INTERNATIONAL, INC., CONTROLS DIV. LEXINGTON PLANT	P. O. BOX 1007	MANSFIELD, OH 44903
98291	SEALECTRO CORP.	225 HOYT	MAMARONECK, NY 10544

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1	670-5814-00			CKT BOARD ASSY:DATA INPUT	80009	670-5814-00
A2	670-5815-00			CKT BOARD ASSY:TRIGGER	80009	670-5815-00
A3	670-5818-00			CKT BOARD ASSY:SERIAL & SIGNATURE	80009	670-5818-00
A4	670-5817-00			CKT BOARD ASSY:MPU	80009	670-5817-00
A5	670-5813-00			CKT BOARD ASSY:KEY	80009	670-5813-00
A6	670-5816-00			CKT BOARD ASSY:CRT CIRCUIT	80009	670-5816-00
A7	670-5820-00			CKT BOARD ASSY:PRIMARY POWER SUPPLY	80009	670-5820-00
A8	670-5819-00			CKT BOARD ASSY:SECONDARY POWER SUPPLY	80009	670-5819-00
B980	119-0830-01			FAN,TUBE AXIAL:12VDC,2.4W,5250RPM,47CFM	000AX	69.11.22
C102	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C105	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C109	290-0746-00			CAP.,FXD,ELCTLT:47UF,+50-10%,16V	56289	502D226
C111	290-0746-00			CAP.,FXD,ELCTLT:47UF,+50-10%,16V	56289	502D226
C114	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C120	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C124	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C134	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C136	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C150	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C156	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C160	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C170	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C176	281-0763-00			CAP.,FXD,CER DI:47PF,10%,100V	72982	8035D9AADC1G470K
C184	281-0815-00			CAP.,FXD,CER DI:0.027UF,20%,50V	72982	8005D9AABW5R273M
C185	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C186	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C191	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C195	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C214	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C222	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C225	290-0746-00			CAP.,FXD,ELCTLT:47UF,+50-10%,16V	56289	502D226
C232	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C236	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C246	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C250	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C252	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C256	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C260	281-0634-00			CAP.,FXD,CER DI:10PF,+/-0.25PF,500V	72982	374011C0G100C
C261	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C262	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C303	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C306	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C307	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C310	290-0746-00			CAP.,FXD,ELCTLT:47UF,+50-10%,16V	56289	502D226
C312	290-0746-00			CAP.,FXD,ELCTLT:47UF,+50-10%,16V	56289	502D226
C320	281-0089-00			CAP.,VAR,CER DI:2-8PF,350V	72982	538-006-A2-8
C321	SELECTED			(SELECTED FROM 281-0593-00)		
C322	281-0772-00			CAP.,FXD,CER DI:0.0047UF,10%,100V	72982	8005H9AADW5R472K
C323	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C327	281-0504-00			CAP.,FXD,CER DI:10PF,+/-1PF,500V	72982	301-055C0G0100F
C330	283-0177-00			CAP.,FXD,CER DI:1UF,+80-20%,25V	72982	8131N039 E 105Z
C332	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C337	281-0504-00			CAP.,FXD,CER DI:10PF,+/-1PF,500V	72982	301-055C0G0100F
C344	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C350	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C353	281-0579-00			CAP.,FXD,CER DI:21PF,5%,500V	72982	301-050C0G0210J

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C354	281-0579-00			CAP.,FXD,CER DI:21PF,5%,500V	72982	301-050C0G0210J
C355	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C370	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C380	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C382	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C390	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C392	283-0095-00			CAP.,FXD,CER DI:56PF,10%,200V	72982	855-535A560K
C393	283-0095-00			CAP.,FXD,CER DI:56PF,10%,200V	72982	855-535A560K
C400	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C403	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C404	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C409	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C410	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C422	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C434	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C442	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C443	290-0746-00			CAP.,FXD,ELCTLT:47UF,+50-10%,16V	56289	502D226
C450	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C454	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C470	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C476	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C482	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C486	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C488	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C494	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C602	290-0755-00			CAP.,FXD,ELCTLT:100UF,+50-10%,10V	56289	502D223
C603	290-0771-00			CAP.,FXD,ELCTLT:220UF,+50-10%,10VDC	0000L	ECE-A10V220L
C609	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C612	281-0809-00			CAP.,FXD,CER DI:200PF,5%,100V	72982	8013T2ADDC1G201J
C615	290-0854-00			CAP.,FXD,ELCTLT:1UF,+75-10%,50V	0000M	290-0854-00
C616	290-0755-00			CAP.,FXD,ELCTLT:100UF,+50-10%,10V	56289	502D223
C617	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C618	SELECTED			(SELECTED FROM 281-0772-00 & 281-0773-00)		
C619	290-0771-00			CAP.,FXD,ELCTLT:220UF,+50-10%,10VDC	0000L	ECE-A10V220L
C624	290-0768-00			CAP.,FXD,ELCTLT:10UF,+50-10%,100VDC	54473	ECE-A100V10L
C626	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C632	283-0013-00			CAP.,FXD,CER DI:0.01UF,+100-0%,1000V	56289	33C29A7
C641	281-0707-00			CAP.,FXD,CER DI:15000PF,20%,100V	72982	8003W5R153K
C643	285-1099-00			CAP.,FXD,PLSTC:0.047UF,20%,200V	19396	473M02PT605
C651	281-0813-00			CAP.,FXD CER DI:0.047UF,20%,100V	04222	GC705-E-473M
C652	290-0735-00			CAP.,FXD,ELCTLT:10UF,20%,16V	0000M	290-0735-00
C653	290-0858-00			CAP.,FXD,ELCTLT:33UF,+50-10%,10V	0000M	290-0858-00
C656	290-0782-00			CAP.,FXD,ELCTLT:4.7UF,+75-10%,35V	56289	503D475G035AS
C661	290-0858-00			CAP.,FXD,ELCTLT:33UF,+50-10%,10V	0000M	290-0858-00
C663	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C665	290-0862-00			CAP.,FXD,ELCTLT:470UF,+30-10%,10V	0000M	290-0862-00
C667	290-0862-00			CAP.,FXD,ELCTLT:470UF,+30-10%,10V	0000M	290-0862-00
C717	290-0860-00			CAP.,FXD,ELCTLT:200UF,+75-10%,200V	0000M	290-0860-00
C718	290-0860-00			CAP.,FXD,ELCTLT:00UF,+75-10%,200V	0000M	290-0860-00
C719	283-0057-00			CAP.,FXD,CER DI:0.1UF,+80-20%,200V	56289	274C10
C721	283-0263-00			CAP.,FXD,CER DI:0.0022UF,20%,3000V	56289	33C319
C722	283-0263-00			CAP.,FXD,CER DI:0.0022UF,20%,3000V	56289	33C319
C723	283-0006-00			CAP.,FXD,CER DI:0.02UF,+80-20%,500V	72982	0841545Z5V00203Z
C725	281-0771-00			CAP.,FXD,CER DI:0.0022UF,20%,200V	72982	314-022Z5U0222M
C733	290-0305-00			CAP.,FXD,ELCTLT:3UF,20%,150V	56289	109D305X0150C2
C736	285-0981-00			CAP.,FXD,PLSTC:2.0UF,10%,400V	14752	C-2176-1
C741	290-0284-00			CAP.,FXD,ELCTLT:4.7UF,10%,35V	56289	150D475X9035B2

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C742	290-0284-00			CAP.,FXD,ELCTLT:4.7UF,10%,35V	56289	150D475X9035B2
C745	285-1191-00			CAP.,FXD,PLASTIC:0.012UF,5%,1000V	84411	TEK-201-123510
C801	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C805	290-0782-00			CAP.,FXD,ELCTLT:4.7UF,+75-10%,35V	56289	503D475G035AS
C806	290-0782-00			CAP.,FXD,ELCTLT:4.7UF,+75-10%,35V	56289	503D475G035AS
C807	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C808	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C820	290-0425-00			CAP.,FXD,ELCTLT:100UF,20%,20V	90201	THF107M020P1G
C822	290-0861-00			CAP.,FXD,ELCTLT:200UF,+30-10%,16V	0000M	290-0861-00
C826	290-0859-00			CAP.,FXD,ELCTLT:100UF,+30-10%,35V	0000M	290-0859-00
C829	290-0859-00			CAP.,FXD,ELCTLT:100UF,+30-10%,35V	0000M	290-0859-00
C853	290-0738-00			CAP.,FXD,ELCTLT:2.2UF,20%,25V	0000M	290-0738-00
C854	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C860	290-0573-00			CAP.,FXD,ELCTLT:2.7UF,20%,50V	56289	196D275X0050JA1
C861	290-0261-00			CAP.,FXD,ELCTLT:6.8UF,10%,35V	12954	D6R8B35K1
C862	283-0597-00			CAP.,FXD,MICA D:470PF,10%,300V	00853	D153E471K0
C863	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C865	281-0812-00			CAP.,FXD,CER DI:1000PF,10%,100V	72982	8035D9AADX7R102K
C866	281-0786-00			CAP.,FXD,CER DI:150PF,10%,100V	72982	8035D2AADX5P151K
C867	281-0786-00			CAP.,FXD,CER DI:150PF,10%,100V	72982	8035D2AADX5P151K
C874	283-0198-00			CAP.,FXD,CER DI:0.22UF,20%,50V	72982	8121N083Z5U0224M
C875	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
C877	281-0815-00			CAP.,FXD,CER DI:0.027UF,20%,50V	72982	8005D9AABW5R273M
C884	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C885	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADWER103K
C891	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C930	290-0859-00			CAP.,FXD,ELCTLT:100UF,+30-10%,35V	0000M	290-0859-00
C952	283-0198-00			CAP.,FXD,CER DI:0.22UF,20%,50V	72982	8121N083Z5U0224M
C953	290-0106-00			CAP.,FXD,ELCTLT:10UF,+75-10%,15V	56289	30D106G015BA9
C957	290-0121-00			CAP.,FXD,ELCTLT:2UF,+75-10%,25V	56289	30D205G025BA9
C962	283-0198-00			CAP.,FXD,CER DI:0.22UF,20%,50V	72982	8121N083Z5U0224M
C963	290-0106-00			CAP.,FXD,ELCTLT:10UF,+75-10%,15V	56289	30D106G015BA9
C966	290-0121-00			CAP.,FXD,ELCTLT:2UF,+75-10%,25V	56289	30D205G025BA9
C972	283-0198-00			CAP.,FXD,CER DI:0.22UF,20%,50V	72982	8121N083Z5U0224M
C973	290-0106-00			CAP.,FXD,ELCTLT:10UF,+75-10%,15V	56289	30D106G015BA9
C976	290-0121-00			CAP.,FXD,ELCTLT:2UF,+75-10%,25V	56289	30D205G025BA9
CR160	152-0327-00			SEMICOND DVC,DI:SIG,SI,BAX13	0000M	152-0327-00
CR161	152-0327-00			SEMICOND DVC,DI:SIG,SI,BAX13	0000M	152-0327-00
CR173	152-0327-00			SEMICOND DVC,DI:SIG,SI,BAX13	0000M	152-0327-00
CR180	152-0327-00			SEMICOND DVC,DI:SIG,SI,BAX13	0000M	152-0327-00
CR182	152-0327-00			SEMICOND DVC,DI:SIG,SI,BAX13	0000M	152-0327-00
CR323	152-0246-00			SEMICOND DEVICE:SILICON,400PIV,200MA	80009	152-0246-00
CR405	152-0327-00			SEMICOND DVC,DI:SIG,SI,BAX13	0000M	152-0327-00
CR615	152-0327-00			SEMICOND DVC,DI:SIG,SI,BAX13	0000M	152-0327-00
CR620	152-0040-00			SEMICOND DEVICE:SILICON,600V,1A	80009	152-0040-00
CR622	152-0040-00			SEMICOND DEVICE:SILICON,600V,1A	80009	152-0040-00
CR632	152-0040-00			SEMICOND DEVICE:SILICON,600V,1A	80009	152-0040-00
CR663	152-0327-00			SEMICOND DVC,DI:SIG,SI,BAX13	0000M	152-0327-00
CR664	152-0327-00			SEMICOND DVC,DI:SIG,SI,BAX13	0000M	152-0327-00
CR716	152-0396-01			SEMICOND DEVICE:SILICON,400V,3A	12969	652-821
CR727	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	80009	152-0107-00
CR733	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR737	152-0061-00			SEMICOND DEVICE:SILICON,175V,100MA	80009	152-0061-00
CR743	152-0400-00			SEMICOND DEVICE:SILICON,400V,1A	80009	152-0400-00
CR744	152-0400-00			SEMICOND DEVICE:SILICON,400V,1A	80009	152-0400-00
CR745	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	80009	152-0107-00
CR746	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	80009	152-0107-00

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CR801	152-0327-00			SEMICOND DVC,DI:SIG,SI,BAX13	0000M	152-0327-00
CR802	152-0327-00			SEMICOND DVC,DI:SIG,SI,BAX13	0000M	152-0327-00
CR803	152-0327-00			SEMICOND DVC,DI:SIG,SI,BAX13	0000M	152-0327-00
CR804	152-0327-00			SEMICOND DVC,DI:SIG,SI,BAX13	0000M	152-0327-00
CR815A,B	152-0692-00			SEMICOND DEVICE:DUAL RECT,SI,30A,20V	83003	VSK3020T
CR817	152-0581-00			SEMICOND DEVICE:SILICON,20V,1A	80009	152-0581-00
CR818	152-0581-00			SEMICOND DEVICE:SILICON,20V,1A	80009	152-0581-00
CR852	152-0327-00			SEMICOND DEVICE:SIG,SI,BAX13	0000M	152-0327-00
CR868	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR869	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR870	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR871	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR880	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR881	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR882	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
CR883	152-0327-00			SEMICOND DEVICE:SIG,SI,BAX13	0000M	152-0327-00
CR990	152-0333-00			SEMICOND DEVICE:SILICON,55V,200MA	80009	152-0333-00
DL112	119-1058-00			DELAY LINE,ELEC:25+/-1.5NS	0000M	119-1058-00
DL306	119-1142-00			DELAY LINE,ELEC:12NS,100 OHM,TAPPED,14 DIP	0000M	119-1142-00
DS500	150-1057-00			LT EMITTING DIO:GREEN,20MA	0000M	150-1057-00
DS501	150-1057-00			LT EMITTING DIO:GREEN,20MA	0000M	150-1057-00
DS714	119-0181-00			SURGE VOLTAGE P:230VAC,+/-15%	80009	119-0181-00
DS715	119-0181-00			SURGE VOLTAGE P:230VAC,+/-15%	80009	119-0181-00
DS719	150-0035-00			LAMP,GLOW:90V,0.3MA	53944	A1B-3
F700	159-0016-00			FUSE,CARTRIDGE:3AG,1.5A,250V,FAST-BLOW	71400	AGC 1 1/2
FL700	119-0420-00			FILTER,RFI:6A,250VAC,400HZ	02777	F-11935-6
J102	131-1897-00			CONNECTOR,RCPT,:25 MALE CONTACT	71785	2805125002
J103	131-1897-00			CONNECTOR,RCPT,:25 MALE CONTACT	71785	2805125002
J160	131-0106-01			CONN,RCPT,ELEC:BNC,FEMALE	91836	KC79-87
J180	131-0106-01			CONN,RCPT,ELEC:BNC,FEMALE	91836	KC79-87
J185	131-0779-00			JACK,TIP:FOR 0.08 INCH DIA TEST POINT	98291	016-8010-00-0208
J320	131-1315-01			CONNECTOR,RCPT,:BNC,FEMALE	24931	28JR235-1
J500	131-2183-00			CONN,RCPT,ELEC:CKT CD,2 X 10FEM,SIDE ENTR	00779	5-87729-6
L260	108-0182-00			COIL,RF:0.3UH	80009	108-0182-00
L624	108-0458-00			COIL,RF:FIXED,76UH	80009	108-0458-00
L635	119-1059-00			COIL,TUBE DEFL:FIXED,DEFLECTION YOKE	0000M	119-1059-00
L672	108-0949-00			COIL,RF:FIXED,53UH	0000M	108-0949-00
L736	108-0422-00			COIL,RF:80UH	80009	108-0422-00
L745	108-0933-00			COIL,RF:FIXED,2.6MH	0000M	108-0933-00
L821	108-0949-00			COIL,RF:FIXED,53UH	0000M	108-0949-00
L828	108-0422-00			COIL,RF:80UH	80009	108-0422-00
Q162	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q164	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q172	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q173	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q174	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q178	151-0188-00			TRANSISTOR:SILICON,PNP	80009	151-0188-00
Q263	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q264	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q330A,B	151-1090-00			TRANSISTOR:SILICON,DUAL,N CHANNEL,FET	80009	151-1090-00
Q350A,B	151-0232-00			TRANSISTOR:SILICON,NPN,DUAL	80009	151-0232-00
Q365	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q368	151-0190-00			TRANSISTOR:SILICON,NPN	80009	151-0190-00

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Q605	151-0702-00			TRANSISTOR:SILICON,NPN	0000M	151-0702-00
Q606	151-0702-00			TRANSISTOR:SILICON,NPN	0000M	151-0702-00
Q610	151-0684-00			TRANSISTOR:SILICON,NPN	0000M	151-0684-00
Q615	151-0601-00			TRANSISTOR:SILICON,NPN	0000M	151-0601-00
Q645	151-0684-00			TRANSISTOR:SILICON,NPN	0000M	151-0684-00
Q656	151-0684-00			TRANSISTOR:SILICON,NPN	0000M	151-0684-00
Q665	151-0686-00			TRANSISTOR:SILICON,NPN	0000M	151-0686-00
Q668	151-1095-00			TRANSISTOR:SILICON,PNP	0000M	151-1095-00
Q729	151-0519-00			SCR:SILICON	04713	SCR5016K
Q730	151-0260-00			TRANSISTOR:SILICON,NPN	80009	151-0260-00
Q743	151-0632-00			TRANSISTOR:SILICON,NPN	80009	151-0632-00
Q744	151-0632-00			TRANSISTOR:SILICON,NPN	80009	151-0632-00
Q853	151-0302-00			TRANSISTOR:SILICON,NPN	80009	151-0302-00
Q854	151-0302-00			TRANSISTOR:SILICON,NPN	80009	151-0302-00
Q874	151-0389-00			TRANSISTOR:SILICON,PNP	80009	151-0389-00
Q955	151-0216-00			TRANSISTOR:SILICON,PNP	80009	151-0216-00
Q958	151-0432-00			TRANSISTOR:SILICON,NPN	80009	151-0432-00
Q965	151-0216-00			TRANSISTOR:SILICON,PNP	80009	151-0216-00
Q968	151-0432-00			TRANSISTOR:SILICON,NPN	80009	151-0432-00
Q975	151-0216-00			TRANSISTOR:SILICON,PNP	80009	151-0216-00
Q978	151-0432-00			TRANSISTOR:SILICON,NPN	80009	151-0432-00
Q985	151-0405-00			TRANSISTOR:SILICON,NPN,SEL FROM MJE800	80009	151-0405-00
R110	307-0503-00			RES NTWK,THK FI:(9)510 OHM,20%,0.125W	91637	MSP10A01-511G
R111	307-0652-00			RES NTWK,THK FI:(5)110 OHM,2%,0.125W	0000M	307-0652-00
R120	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R130	307-0503-00			RES NTWK,THK FI:(9)510 OHM,20%,0.125W	91637	MSP10A01-511G
R131	307-0652-00			RES NTWK,THK FI:(5)110 OHM,2%,0.125W	0000M	307-0652-00
R146	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R160	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R161	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
R162	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R164	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R165	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R167	321-0247-00			RES.,FXD,FILM:3.65K OHM,1%,0.125W	91637	MFF1816G36500F
R168	321-0207-00			RES.,FXD,FILM:1.4K OHM,1%,0.125W	91637	MFF1816G14000F
R170	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R172	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R173	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R174	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R175	311-2041-00			RES.,VAR,NONWW:CKT BD,10K OHM,10%,0.5W	0000M	311-2041-00
R176	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R178	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R182	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R183	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R184	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R185	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R186	321-0816-01			RES.,FXD,FILM:5K OHM,0.5%,0.125W	0000M	321-0816-01
R187	321-0318-00			RES.,FXD,FILM:20K OHM,1%,0.125W	91637	MFF1816G20001F
R189	321-0234-00			RES.,FXD,FILM:2.67K OHM,1%,0.125W	91637	MFF1816G26700F
R190	321-0207-00			RES.,FXD,FILM:1.4K OHM,1%,0.125W	91637	MFF1816G14000F
R191	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R192	311-2039-00			RES.,VAR,NONWW:CKT BD,5K OHM,10%,0.5W	32997	3339 H-1-502
R193	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R195	321-0414-00			RES.,FXD,FILM:200K OHM,1%,0.125W	91637	MFF1816G20002F
R197	321-0322-00			RES.,FXD,FILM:22.1K OHM,1%,0.125W	91637	MFF1816G22101F
R202	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R204	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025

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R206	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R210	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R214	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R218	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R220	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R224	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R225	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R256	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R257	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R260	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R262	307-0598-00			RES NTWK,FXD FI:7,330 OHM,2%,1.0W	91637	MSP08A01331G
R263	315-0161-00			RES.,FXD,CMPSN:160 OHM,5%,0.25W	01121	CB1615
R264	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R265	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R278	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R300	315-0111-00			RES.,FXD,CMPSN:110 OHM,5%,0.25W	01121	CB1115
R301	315-0111-00			RES.,FXD,CMPSN:110 OHM,5%,0.25W	01121	CB1115
R302	315-0111-00			RES.,FXD,CMPSN:110 OHM,5%,0.25W	01121	CB1115
R304	307-0539-00			RES NTWK,THK FI:(7)510 OHM,10%,1W	01121	208A511
R308	315-0680-00			RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805
R307	315-0680-00			RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805
R310	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R320	321-0481-04			RES.,FXD,FILM:1M OHM,0.1%,0.125W	91637	HFF1816D10003B
R322	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R323	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R326	321-0641-07			RES.,FXD,FILM:1.8K OHM,0.1%,0.125W	91637	MFF1816C18000B
R327	321-0201-09			RES.,FXD,FILM:1.21K OHM,1%,0.125W	24546	NE55E1211F
R329	321-0171-09			RES.,FXD,FILM:590 OHM,1%,0.125W	91637	MFF1816C590R0F
R332	315-0155-00			RES.,FXD,CMPSN:1.5M OHM,5%,0.25W	01121	CB1555
R335	311-1236-00			RES.,VAR,NONWIR:250 OHM,10%,0.50W	73138	72X-22-0-251K
R336	321-0641-07			RES.,FXD,FILM:1.8K OHM,0.1%,0.125W	91637	MFF1816C18000B
R337	321-0201-09			RES.,FXD,FILM:1.21K OHM,1%,0.125W	24546	NE55E1211F
R339	321-0171-09			RES.,FXD,FILM:590 OHM,1%,0.125W	91637	MFF1816C590R0F
R340	311-1920-00			RES.,VAR,NONWIR:500 OHM,10%,0.50W	73138	72-190-0
R341	321-0143-07			RES.,FXD,FILM:301 OHM,0.1%,0.125W	91637	MFF1816C301R0B
R343	321-0126-06			RES.,FXD,FILM:200 OHM,0.25%,0.125W	91637	MFF1816C200R0C
R344	307-0539-00			RES NTWK,THK FI:(7)510 OHM,10%,1W	01121	208A511
R345	321-0097-03			RES.,FXD,FILM:100 OHM,0.25%,0.125W	91637	MFF1816D100R06
R346	321-0155-09			RES.,FXD,FILM:402 OHM,1%,0.125W	24546	NE55E4020F
R347	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R348	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R349	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R350	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R351	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R352	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R353	321-0155-09			RES.,FXD,FILM:402 OHM,1%,0.125W	24546	NE55E4020F
R354	321-0155-09			RES.,FXD,FILM:402 OHM,1%,0.125W	24546	NE55E4020F
R355	311-1918-00			RES.,VAR,NONWIR:2K OHM,10%,0.50W	73138	72-199-0
R356	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R357	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R358	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R359	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R360	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R361	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R362	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R363	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R365	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515

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R366	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R367	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R368	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R369	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R370	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R388	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R392	315-0106-00			RES.,FXD,CMPSN:10M OHM,5%,0.25W	01121	CB1065
R398	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R400	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R402	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R403	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R404	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R405	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R406	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R407	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R408	307-0446-00			RES,NTWK,FXD FI:10K OHM,20%,(9) RES	91637	MSP10A01-103M
R409	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R416	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R440	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R442	307-0446-00			RES,NTWK,FXD FI:10K OHM,20%,(9) RES	91637	MSP10A01-103M
R456	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R460	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R604	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R605	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R608	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	01121	CB3625
R609	315-0132-00			RES.,FXD,CMPSN:1.3K OHM,5%,0.25W	01121	CB1325
R610	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R614	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R616	307-0023-00			RES.,FXD,CMPSN:4.7 OHM,10%,0.50W	01121	EB47G1
R623	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R624	301-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.50W	01121	EB2025
R625	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R626	311-1272-00			RES.,VAR,NONWIR:100K OHM,10%,0.50W	32997	3329P-L58-104
R627	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R630	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R632	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R634	301-0106-00			RES.,FXD,CMPSN:10M OHM,5%,0.50W	01121	EB1065
R640	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R643	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R644	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R645	311-1268-00			RES.,VAR,NONWIR:10K OHM,10%,0.50W	32997	3329P-L58-103
R647	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R649	307-0104-00			RES.,FXD,CMPSN:3.3 OHM,5%,0.25W	01121	CB33G5
R650	307-0666-00			RES.,FXD,FILM:1.8 OHM	0000M	307-0666-00
R651	315-0181-00			RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R654	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R656	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R660	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R662	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R663	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R665	307-0034-00			RES.,FXD,CMPSN:8.2 OHM,10%,0.50W	01121	EB82G1
R668	307-0667-00			RES.,FXD,FILM:1.8 OHM,5%,0.25W	0000M	307-0667-00
R670	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R712	301-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.5W	01121	EB1045
R713	301-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.5W	01121	EB1045
R717	301-0184-00			RES.,FXD,CMPSN:180K OHM,5%,0.50W	01121	EB1845
R718	301-0184-00			RES.,FXD,CMPSN:180K OHM,5%,0.50W	01121	EB1845

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R719	301-0685-00			RES.,FXD,CMPSN:6.8M OHM,5%,0.50W	01121	EB6855
R721	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R722	303-0224-00			RES.,FXD,CMPSN:220K OHM,5%,1W	01121	GB2245
R723	315-0433-00			RES.,FXD,CMPSN:43K OHM,5%,0.25W	01121	CB4335
R724	307-0113-00			RES.,FXD,CMPSN:5.1 OHM,5%,0.25W	01121	CB51G5
R725	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R728	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R732	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R734	315-0204-00			RES.,FXD,CMPSN:200K OHM,5%,0.25W	01121	CB2045
R741	301-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.50W	01121	EB2205
R742	301-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.50W	01121	EB2205
R746	301-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.50W	01121	EB1055
R801	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R805	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R806	315-0220-00			RES.,FXD,CMPSN:22 OHM,5%,0.25W	01121	CB2205
R852	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R853	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R854	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R856	315-0224-00			RES.,FXD,CMPSN:220K OHM,5%,0.25W	01121	CB2245
R857	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R858	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R860	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R862	315-0913-00			RES.,FXD,CMPSN:91K OHM,5%,0.25W	01121	CB9135
R864	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R865	321-0290-00			RES.,FXD,FILM:10.2K OHM,1%,0.125W	91637	MFF1816G10201F
R866	321-0335-00			RES.,FXD,FILM:30.1K OHM,1%,0.125W	91637	MFF1816G30101F
R867	321-0335-00			RES.,FXD,FILM:30.1K OHM,1%,0.125W	91637	MFF1816G30101F
R869	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R874	315-0330-00			RES.,FXD,CMPSN:33 OHM,5%,0.25W	01121	CB3305
R875	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R877	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R878	321-0313-00			RES.,FXD,FILM:17.8K OHM,1%,0.125W	91637	MFF1816G17801F
R879	321-0213-00			RES.,FXD,FILM:1.62K OHM,1%,0.125W	91637	MFF1816G16200F
R880	321-0038-00			RES.,FXD,FILM:24.3 OHM,1%,0.125W	91637	MFF1816G24R30F
R884	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R887	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R890	311-1561-00			RES.,VAR,NONWIR:2.5K OHM,20%,0.50W	73138	91A R2500
R891	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R892	321-0238-00			RES.,FXD,FILM:2.94K OHM,1%,0.125W	91637	MFF1816G29400F
R893	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R951	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R952	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R953	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R955	315-0163-00			RES.,FXD,CMPSN:16K OHM,5%,0.25W	01121	CB1635
R957	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R958	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R960	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R961	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R965	315-0163-00			RES.,FXD,CMPSN:16K OHM,5%,0.25W	01121	CB1635
R966	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R968	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R970	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R971	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R975	315-0163-00			RES.,FXD,CMPSN:16K OHM,5%,0.25W	01121	CB1635
R976	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
R980	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R987	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235

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RT655	307-0653-00			RES.,THERMAL:300 OHM,10%	0000M	307-0653-00
RT707	307-0353-00			RES.,FXD,FILM:5 OHM,10%,DISC	15454	5DA5RO-K-270SS
RT708	307-0353-00			RES.,FXD,FILM:5 OHM,10%,DISC	15454	5DA5RO-K-270SS
RT986	307-0124-00			RES.,THERMAL:5K OHM,10%	50157	1D1618
S171	260-1964-00			SWITCH,TOGGLE:SPDT,0.3A,125VAC	0000M	260-1964-00
S185	260-1811-00			SWITCH,SLIDE:DPDT,0.5A,125VAC DC	82389	C56206L2
S404	131-0608-00			TERMINAL,PIN:0.365 L X 0.25 PH,BRZ,GOLD PL	22526	47357
S407	131-0608-00			TERMINAL,PIN:0.365 L X 0.25 PH,BRZ,GOLD PL	22526	47357
S500	263-0019-09			SWITCH PB ASSY:MOMENTARY	80009	263-0019-09
S502	263-0019-09			SWITCH PB ASSY:MOMENTARY	80009	263-0019-09
S503	263-0019-09			SWITCH PB ASSY:MOMENTARY	80009	263-0019-09
S504	263-0019-09			SWITCH PB ASSY:MOMENTARY	80009	263-0019-09
S510	263-0019-09			SWITCH PB ASSY:MOMENTARY	80009	263-0019-09
S512	263-0019-09			SWITCH PB ASSY:MOMENTARY	80009	263-0019-09
S514	263-0019-09			SWITCH PB ASSY:MOMENTARY	80009	263-0019-09
S516	263-0019-09			SWITCH PB ASSY:MOMENTARY	80009	263-0019-09
S520	263-0019-09			SWITCH PB ASSY:MOMENTARY	80009	263-0019-09
S522	263-0019-09			SWITCH PB ASSY:MOMENTARY	80009	263-0019-09
S526	263-0019-09			SWITCH PB ASSY:MOMENTARY	80009	263-0019-09
S530	253-0019-09			SWITCH PB ASSY:MOMENTARY	80009	263-0019-09
S532	263-0019-09			SWITCH PB ASSY:MOMENTARY	80009	263-0019-09
S534	263-0019-09			SWITCH PB ASSY:MOMENTARY	80009	263-0019-09
S536	263-0019-09			SWITCH PB ASSY:MOMENTARY	80009	260-0019-09
S540	263-0019-09			SWITCH PB ASSY:MOMENTARY	80009	263-0019-09
S541	263-0019-09			SWITCH PB ASSY:MOMENTARY	80009	263-0019-09
S542	263-0019-09			SWITCH PB ASSY:MOMENTARY	80009	263-0019-09
S544	263-0019-09			SWITCH PB ASSY:MOMENTARY	80009	263-0019-09
S546	263-0019-09			SWITCH PB ASSY:MOMENTARY	80009	263-0019-09
S548	263-0019-09			SWITCH PB ASSY:MOMENTARY	80009	263-0019-09
S550	263-0019-09			SWITCH PB ASSY:MOMENTARY	80009	263-0019-09
S551	263-0019-09			SWITCH PB ASSY:MOMENTARY	80009	263-0019-09
S552	263-0019-09			SWITCH PB ASSY:MOMENTARY	80009	263-0019-09
S554	263-0019-09			SWITCH PB ASSY:MOMENTARY	80009	263-0019-09
S556	263-0019-09			SWITCH PB ASSY:MOMENTARY	80009	263-0019-09
S558	263-0019-09			SWITCH PB ASSY:MOMENTARY	80009	263-0019-09
S560	263-0019-09			SWITCH PB ASSY:MOMENTARY	80009	263-0019-09
S561	263-0019-09			SWITCH PB ASSY:MOMENTARY	80009	263-0019-09
S562	263-0019-09			SWITCH PB ASSY:MOMENTARY	80009	263-0019-09
S564	263-0019-09			SWITCH PB ASSY:MOMENTARY	80009	263-0019-09
S566	263-0019-09			SWITCH PB ASSY:MOMENTARY	80009	263-0019-09
S568	263-0019-09			SWITCH PB ASSY:MOMENTARY	80009	263-0019-09
S700	260-0638-00			SW,THERMOSTATIC:10A,240V,OPEN 75 DEG	93410	110-364
S702	260-1849-00			SWITCH,PUSH:DPDT,4A,250VAC,W/BRKT	31918	OBD
S710	260-1934-00			SWITCH,SLIDE:DPDT,2A,250V,MKD 230V/115V	82389	ESP1-PC1
T620	120-1205-00			TRANSFORMER,RF:FLYBACK	0000M	120-1205-00
T630	120-1204-00			TRANSFORMER,RF:HEATER	0000M	120-1204-00
T715	120-1223-00			TRANSFORMER,RF:LINE TRIGGER	80009	120-1223-00
T720	120-1228-00			TRANSFORMER,CMR:	0000M	120-1228-00
T740	120-1225-00			TRANSFORMER,RF:BASE DRIVER	80009	120-1225-00
T800	120-1203-00			TRANSFORMER,RF:CONVERTER	0000M	120-1203-00
T847	120-1229-00			TRANSFORMER,CUR:	0000M	120-1229-00
U105	156-0860-00			MICROCIRCUIT,DI:TRIPLE LINE RECEIVER	80009	156-0860-00
U110	156-1334-00			MICROCIRCUIT,DI:QUAD 2 INPUT	0000M	156-1334-00
U114	156-0321-00			MICROCIRCUIT,DI:TRIPLE 3-INPUT NAND GATE	80009	156-0321-00
U116	156-0321-00			MICROCIRCUIT,DI:TRIPLE 3-INPUT NAND GATE	80009	156-0321-00
U118	156-0321-00			MICROCIRCUIT,DI:TRIPLE 3-INPUT NAND GATE	80009	156-0321-00

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U120	156-0331-00			MICROCIRCUIT,DI:DUAL D-TYPE,FLIP-FLOP	80009	156-0331-00
U122	156-0331-00			MICROCIRCUIT,DI:DUAL D-TYPE,FLIP-FLOP	80009	156-0331-00
U124	156-0331-00			MICROCIRCUIT,DI:DUAL D-TYPE,FLIP-FLOP	80009	156-0331-00
U126	156-0331-00			MICROCIRCUIT,DI:DUAL D-TYPE,FLIP-FLOP	80009	156-0331-00
U130	156-1334-00			MICROCIRCUIT,DI:QUAD 2 INPUT	0000M	156-1334-00
U132	156-1333-00			MICROCIRCUIT,DI:BUFFER/INVERTERS	0000M	156-1333-00
U134	156-0321-00			MICROCIRCUIT,DI:TRIPLE 3-INPUT NAND GATE	80009	156-0321-00
U136	156-0321-00			MICROCIRCUIT,DI:TRIPLE 3-INPUT NAND GATE	80009	156-0321-00
U138	156-0321-00			MICROCIRCUIT,DI:TRIPLE 3-INPUT NAND GATE	80009	156-0321-00
U140	156-0331-00			MICROCIRCUIT,DI:DUAL D-TYPE,FLIP-FLOP	80009	156-0331-00
U142	156-0331-00			MICROCIRCUIT,DI:DUAL D-TYPE,FLIP-FLOP	80009	156-0331-00
U144	156-0331-00			MICROCIRCUIT,DI:DUAL D-TYPE,FLIP-FLOP	80009	156-0331-00
U146	156-0331-00			MICROCIRCUIT,DI:DUAL D-TYPE,FLIP-FLOP	80009	156-0331-00
U150	156-1334-00			MICROCIRCUIT,DI:QUAD 2 INPUT	0000M	156-1334-00
U152	156-0739-00			MICROCIRCUIT,DI:QUADR 2-INPUT POS OR GATE	01295	SN74S32N
U154	156-0651-00			MICROCIRCUIT,DI:8-BIT PRL-OUT,SER SHF RGTR	01295	SN74LS164N
U156	156-0651-00			MICROCIRCUIT,DI:8-BIT PRL-OUT,SER SHF RGTR	01295	SN74LS164N
U158	156-0651-00			MICROCIRCUIT,DI:8-BIT PRL-OUT,SER SHF RGTR	01295	SN74LS164N
U160	156-1332-00			MICROCIRCUIT,DI:4 WIDE INPUT/INVERT SEL DLY	0000M	156-1332-00
U162	156-1332-00			MICROCIRCUIT,DI:4 WIDE INPUT/INVERT SEL DLY	0000M	156-1332-00
U164	156-1332-00			MICROCIRCUIT,DI:4 WIDE INPUT/INVERT SEL DLY	0000M	156-1332-00
U166	156-1332-00			MICROCIRCUIT,DI:4 WIDE INPUT/INVERT SEL DLY	0000M	156-1332-00
U168	156-1040-00			MICROCIRCUIT,DI:DUAL 2-WIDE 2INPUT	80009	156-1040-00
U170	156-1331-00			MICROCIRCUIT,DI:QUAD 2 INPUT EX OR SEL DLY	0000M	156-1331-00
U172	156-0418-00			MICROCIRCUIT,DI:8-INPUT,NAND GATE	80009	156-0418-00
U174	156-0739-00			MICROCIRCUIT,DI:QUADR 2-INPUT POS OR GATE	01295	SN74S32N
U175	156-0331-00			MICROCIRCUIT,DI:DUAL D-TYPE,FLIP-FLOP	80009	156-0331-00
U180	156-0180-00			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	01295	SN74S00N
U185	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	80009	156-0067-00
U202	156-0180-00			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	01295	SN74S00N
U204	156-0331-00			MICROCIRCUIT,DI:DUAL D-TYPE,FLIP-FLOP	80009	156-0331-00
U208	156-0419-00			MICROCIRCUIT,DI:DUAL 4-INPUT,NAND GATE	01295	SN74S140N
U206	156-0304-00			MICROCIRCUIT,DI:DUAL 4-INPUT,NAND GATE	18324	N74S20A
U210	156-0382-00			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	80009	156-0382-00
U214	156-1044-00			MICROCIRCUIT,DI:4 BIT SYNC BIN CNTR W/CLR	80009	156-1044-00
U216	156-1044-00			MICROCIRCUIT,DI:4 BIT SYNC BIN CNTR W/CLR	80009	156-1044-00
U218	156-0331-00			MICROCIRCUIT,DI:DUAL D-TYPE,FLIP-FLOP	80009	156-0331-00
U220	156-1223-00			MICROCIRCUIT,DI:RAM,BI-POLAR,22 DIP	07263	93422
U222	156-1223-00			MICROCIRCUIT,DI:RAM,BI-POLAR,22 DIP	07263	93422
U224	156-0331-00			MICROCIRCUIT,DI:DUAL D-TYPE,FLIP-FLOP	80009	156-0331-00
U226	156-0690-00			MICROCIRCUIT,DI:QUAD 2-INP NOR GATE	01295	SN74S02N
U230	156-1183-00			MICROCIRCUIT,DI:PRESET BINARY LATCH/CNTR	01295	SN74S197N
U232	156-0629-00			MICROCIRCUIT,DI:30MHZ PRESETTABLE BIN CTR	01295	SN74LS197N
U234	156-0629-00			MICROCIRCUIT,DI:30MHZ PRESETTABLE BIN CTR	01295	SN74LS197N
U236	156-0629-00			MICROCIRCUIT,DI:30MHZ PRESETTABLE BIN CTR	01295	SN74LS197N
U240	156-0321-00			MICROCIRCUIT,DI:TRIPLE 3-INPUT NAND GATE	80009	156-0321-00
U242	156-0465-00			MICROCIRCUIT,DI:8-INPUT NAND GATE	27014	DM74LS304
U244	156-0465-00			MICROCIRCUIT,DI:8-INPUT NAND GATE	27014	DM74LS304
U246	156-0331-00			MICROCIRCUIT,DI:DUAL D-TYPE,FLIP-FLOP	80009	156-0331-00
U250	156-1183-00			MICROCIRCUIT,DI:PRESET BINARY LATCH/CNTR	01295	SN74S197N
U252	156-0629-00			MICROCIRCUIT,DI:30MHZ PRESETTABLE BIN CTR	01295	SN74LS197N
U254	156-0418-00			MICROCIRCUIT,DI:8-INPUT,NAND GATE	80009	156-0418-00
U256	156-0118-00			MICROCIRCUIT,DI:J-K MASTER-SLAVE FLIP-FLOP	01295	SN74S112N
U260	156-0860-00			MICROCIRCUIT,DI:TRIPLE LINE RECEIVER	80009	156-0860-00
U266	156-0910-00			MICROCIRCUIT,DI:DUAL DECADE COUNTER	80009	156-0910-00
U262	156-0642-00			MICROCIRCUIT,DI:BI-QUINARY CNTR	04713	MC10138L
U268	156-0910-00			MICROCIRCUIT,DI:DUAL DECADE COUNTER	80009	156-0910-00

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U270	156-0910-00			MICROCIRCUIT,DI:DUAL DECADE COUNTER	80009	156-0910-00
U272	156-0324-00			MICROCIRCUIT,DI:8-INPUT DATA,SEL/MULT	01295	SN74S151N
U274	156-0982-00			MICROCIRCUIT,DI:OCTAL D EDGE TRIG F-F	80009	156-0982-00
U276	156-1172-00			MICROCIRCUIT,DI:DUAL 4-BIT BIN CNTR	01295	SN74LS393N
U278	156-0325-00			MICROCIRCUIT,DI:DUAL 4-1 LINE,SEL/MULT	80009	156-0325-00
U303	156-1334-00			MICROCIRCUIT,DI:QUAD 2 INPUT	0000M	156-1334-00
U306	156-1331-00			MICROCIRCUIT,DI:QUAD 2 INPUT EX OR SEL DLY	0000M	156-1331-00
U307	156-0392-00			MICROCIRCUIT,DI:QUAD LATCH	80009	156-0392-00
U310	156-0321-00			MICROCIRCUIT,DI:TRIPLE 3-INPUT NAND GATE	80009	156-0321-00
U344	156-0860-00			MICROCIRCUIT,DI:TRIPLE LINE RECEIVER	80009	156-0860-00
U346	156-0759-00			MICROCIRCUIT,DI:QUAD 2-INPUT OR GATE	80009	156-0759-00
U348	156-0205-00			MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE	80009	156-0205-00
U350	156-0860-00			MICROCIRCUIT,DI:TRIPLE LINE RECEIVER	80009	156-0860-00
U370	156-0118-00			MICROCIRCUIT,DI:J-K MASTER-SLAVE FLIP-FLOP	01295	SN74S112N
U372	156-0331-00			MICROCIRCUIT,DI:DUAL D-TYPE,FLIP-FLOP	80009	156-0331-00
U374	156-0331-00			MICROCIRCUIT,DI:DUAL D-TYPE,FLIP-FLOP	80009	156-0331-00
U378	156-0651-00			MICROCIRCUIT,DI:8-BIT PRL-OUT,SER SHF RGTR	01295	SN74LS164N
U380	156-0651-00			MICROCIRCUIT,DI:8-BIT PRL-OUT,SER SHF RGTR	01295	SN74LS164N
U382	156-0529-00			MICROCIRCUIT,DI:DATA SELECTOR,16 PIN DIP	01295	SN74LS257N
U384	156-0529-00			MICROCIRCUIT,DI:DATA SELECTOR,16 PIN DIP	01295	SN74LS257N
U386	156-1331-00			MICROCIRCUIT,DI:QUAD 2 INPUT EX OR SEL DLY	0000M	156-1331-00
U388	156-0331-00			MICROCIRCUIT,DI:DUAL D-TYPE,FLIP-FLOP	80009	156-0331-00
U390	156-0877-00			MICROCIRCUIT,DI:UNIV SYN AS-SYN DRVR XMTR	80009	156-0877-00
U392	156-0850-00			MICROCIRCUIT,DI:PROGRAMMABLE BIT RATE GEN	80009	156-0850-00
U394	156-0392-00			MICROCIRCUIT,DI:QUAD LATCH	80009	156-0392-00
U396	156-1111-00			MICROCIRCUIT,DI:OCTAL BUS TRANSCEIVERS	80009	156-1111-00
U398	156-0383-00			MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE	80009	156-0383-00
U400	156-1088-00			MICROCIRCUIT,DI:8 BIT MICROPROCESSOR	80009	156-1088-00
U410	156-1065-00			MICROCIRCUIT,DI:OCTAL D TYPE TRANS LATCHES	80009	156-1065-00
U412	156-0390-00			MICROCIRCUIT,DI:DUAL 4-LINE TO 2-LINE	80009	156-0390-00
U414	156-1300-00			MICROCIRCUIT,DI:2K BITE ROM	0000M	156-1300-00
U416	156-0390-00			MICROCIRCUIT,DI:DUAL 4-LINE TO 2-LINE	80009	156-0390-00
U420	156-1127-00			MICROCIRCUIT,DI:1024 X 4 STATIC RAM	80009	156-1127-00
U422	156-1127-00			MICROCIRCUIT,DI:1024 X 4 STATIC RAM	80009	156-1127-00
U430	156-1330-00			MICROCIRCUIT,DI:2K BITE ROM	0000M	156-1330-00
U432	156-1288-00			MICROCIRCUIT,DI:8K BYTE,ROM A	0000M	156-1288-00
U434	156-1289-00			MICROCIRCUIT,DI:8K BYTE,ROM B	0000M	156-1289-00
U436	156-1220-00			MICROCIRCUIT,DI:HEX BUS DRIVER,TTL,16 DIP	0000M	156-1220-00
U440	156-0913-00			MICROCIRCUIT,DI:OCTAL D FF W/ENABLE	80009	156-0913-00
U442	156-1220-00			MICROCIRCUIT,DI:HEX BUS DRIVER,TTL,16 DIP	0000M	156-1220-00
U450	156-0376-00			MICROCIRCUIT,DI:4-BIT PARALLEL I/O SR	80009	156-0376-00
U452	156-0385-00			MICROCIRCUIT,DI:HEX INVERTED	07263	74LS04
U454	156-0321-00			MICROCIRCUIT,DI:TRIPLE 3-INPUT NAND GATE	80009	156-0321-00
U456	156-0384-00			MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	80009	156-0384-00
U460	156-0982-00			MICROCIRCUIT,DI:OCTAL D EDGE TRIG F-F	80009	156-0982-00
U462	156-0956-00			MICROCIRCUIT,DI:OCTAL BFR W/3STATE OUT	80009	156-0956-00
U464	156-1172-00			MICROCIRCUIT,DI:DUAL 4 BIT BIN CNTR	01295	SN74LS393N
U466	156-1222-00			MICROCIRCUIT,DI:DECADE COUNTER,14 DIP	0000M	156-1222-00
U468	156-1172-00			MICROCIRCUIT,DI:DUAL 4 BIT BIN CNTR	01295	SN74LS393N
U470	156-0480-00			MICROCIRCUIT,DI:QUAD 2-INPUT AND GATE	80009	156-0480-00
U471	156-0480-00			MICROCIRCUIT,DI:QUAD 2-INPUT AND GATE	80009	156-0480-00
U472	156-0530-00			MICROCIRCUIT,DI:QUAD 2-INP MUX,16 PIN DIP	80009	156-0530-00
U474	156-0530-00			MICROCIRCUIT,DI:QUAD 2-INP MUX,16 PIN DIP	80009	156-0530-00
U476	156-0530-00			MICROCIRCUIT,DI:QUAD 2-INP MUX,16 PIN DIP	80009	156-0530-00
U480	156-1127-00			MICROCIRCUIT,DI:1024 X 4 STATIC RAM	80009	156-1127-00
U482	156-1127-00			MICROCIRCUIT,DI:1024 X 4 STATIC RAM	80009	156-1127-00
U484	156-0865-00			MICROCIRCUIT,DI:OCTAL D TYPE FF W/CLEAR	80009	156-0865-00

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
U486	156-1290-00			MICROCIRCUIT,DI:2K BYTE,ROM	0000M	156-1290-00
U488	156-0383-00			MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE	80009	156-0383-00
U490	156-0789-00			MICROCIRCUIT,DI:8-BIT SR,PRL LOAD	80009	156-0789-00
U492	156-0391-00			MICROCIRCUIT,DI:HEX LATCH WITH CLEAR	80009	156-0391-00
U494	156-0452-00			MICROCIRCUIT,DI:4-WIDE 2-INP AND-OR-INVERT	80009	156-0452-00
U615	156-1224-00			MICROCIRCUIT,LI:3 TERM POS VOLTAGE REG	0000M	156-1224-00
U807	156-1261-00			MICROCIRCUIT,LI:VOLTAGE REGULATOR	04713	MC78L15ACP
U808	156-1260-00			MICROCIRCUIT,LI:VOLTAGE REGULATOR	04713	MC79LS15ACP
U860	155-0067-02			MICROCIRCUIT,DI:ML,POWER SUPPLY REGULATOR	80009	155-0067-02
V635	154-0814-00			ELECTRON TUBE:CRT,CT556	0000M	154-0814-00
VR725	152-0401-00			SEMICOND DEVICE:SILICON,3-LAYER,TRIGGER	04713	1N5761
VR731	152-0357-00			SEMICOND DEVICE:ZENER,0.4W,82V,5%	80009	152-0357-00
VR873	152-0243-00			SEMICOND DEVICE:ZENER,0.4W,15V,5%	80009	152-0243-00
VR893	152-0317-00			SEMICOND DEVICE:ZENER,0.25W,6.2V,5%	80009	152-0317-00
Y260	158-0106-00			XTAL UNIT,QTZ:100MHZ,+/-0.0025%,SERIES	13571	TEK158-0106-00
Y392	158-0124-00			XTAL UNIT,QTZ:2.4576 MHZ,0.05% PARALLEL	75378	MP-024

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols and Reference Designators

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

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

Resistors = Ohms (Ω).

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

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

The overline on a signal name indicates that the signal performs its intended function when it goes to the low state.

Abbreviations are based on ANSI Y1.1-1972.

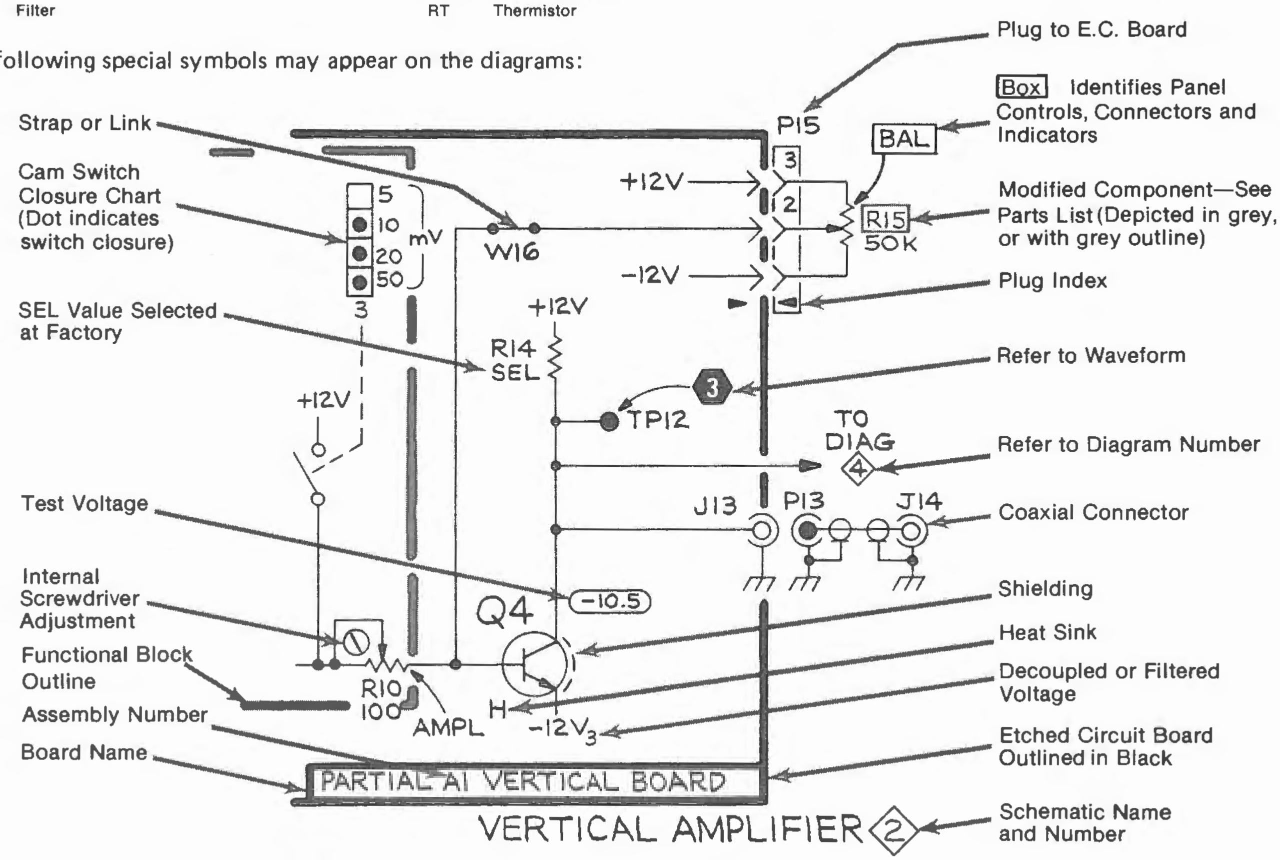
Other ANSI standards that are used in the preparation of diagrams by Tektronix, Inc. are:

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

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

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

The following special symbols may appear on the diagrams:



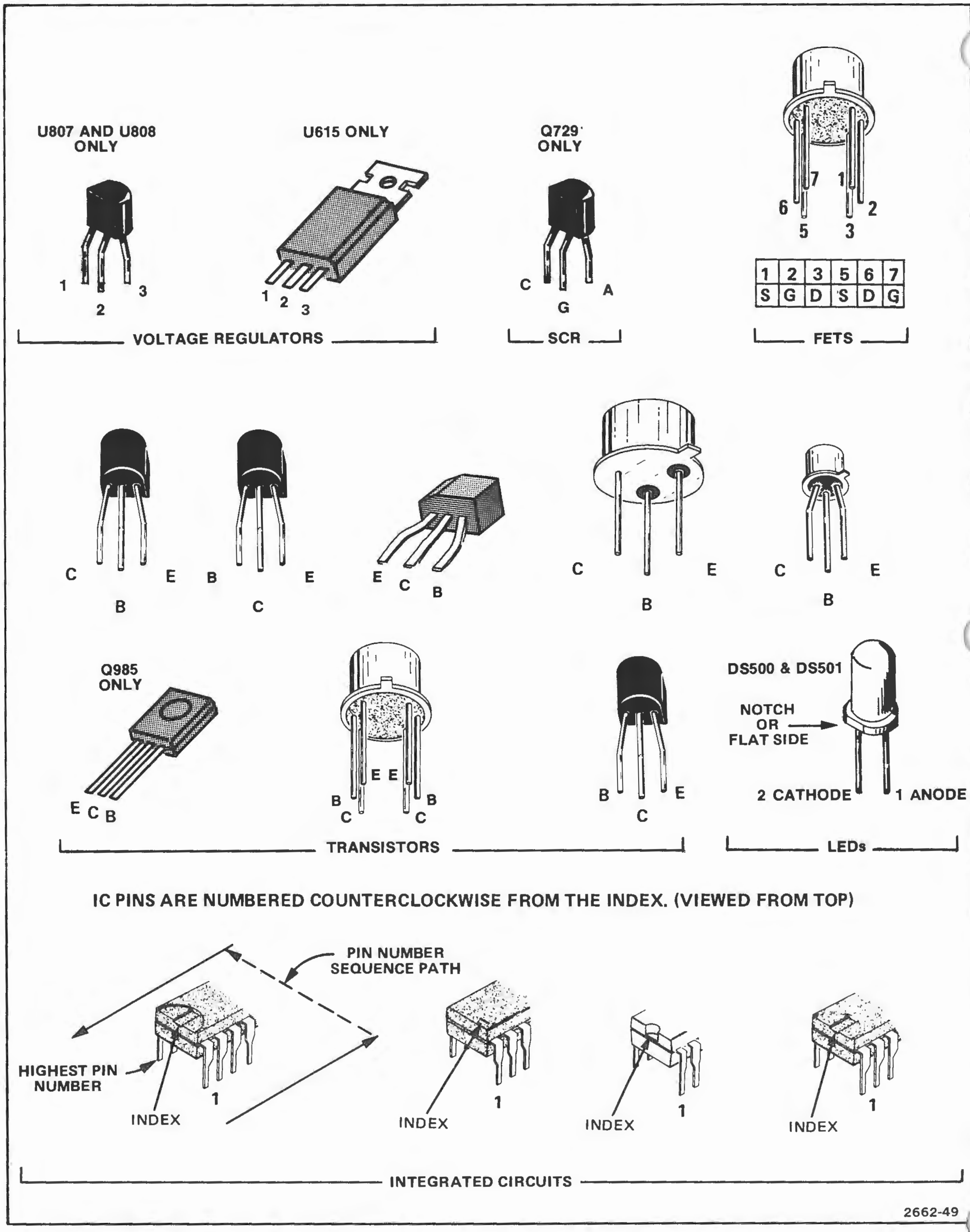
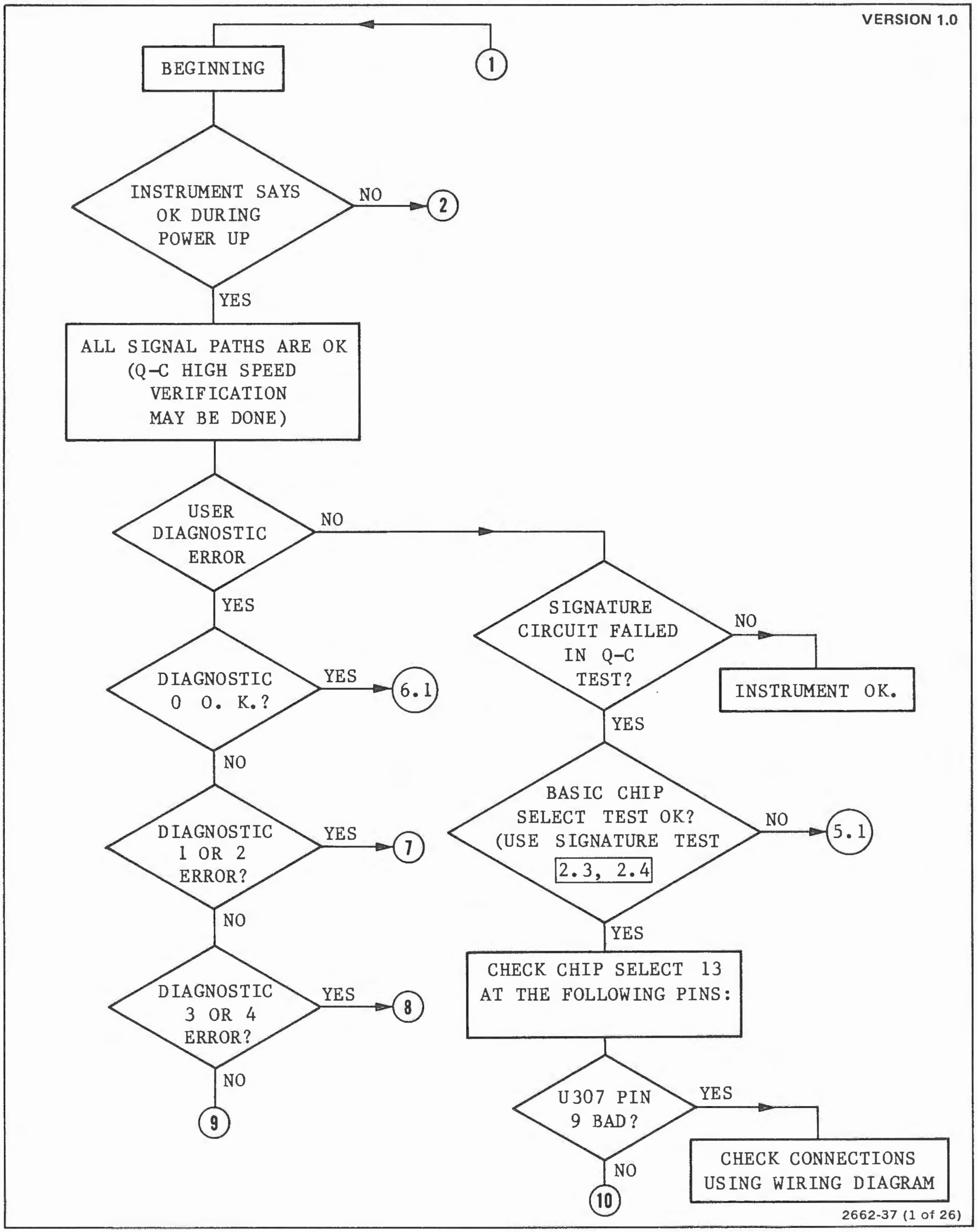


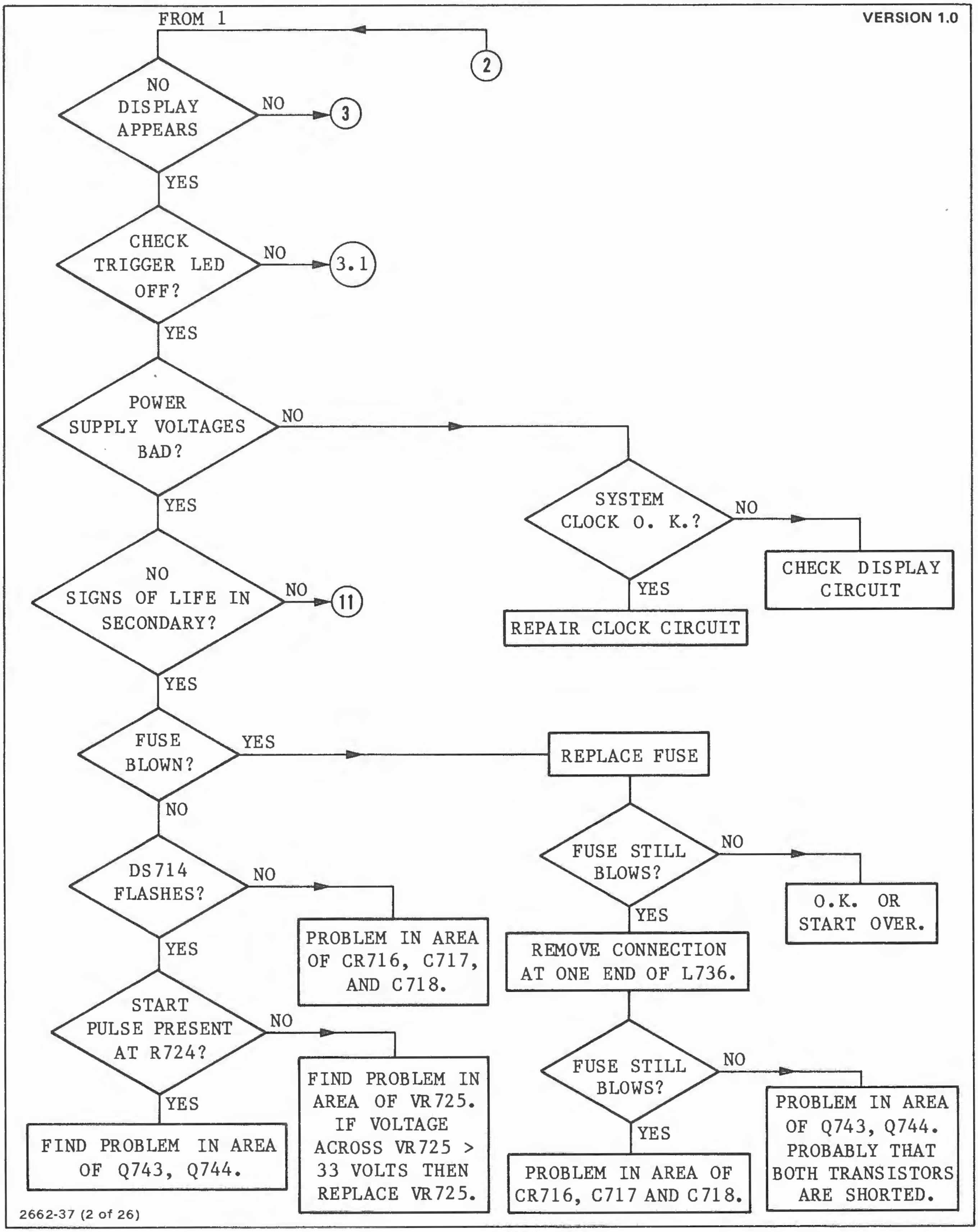
Figure 8-1. Semiconductor lead configurations.

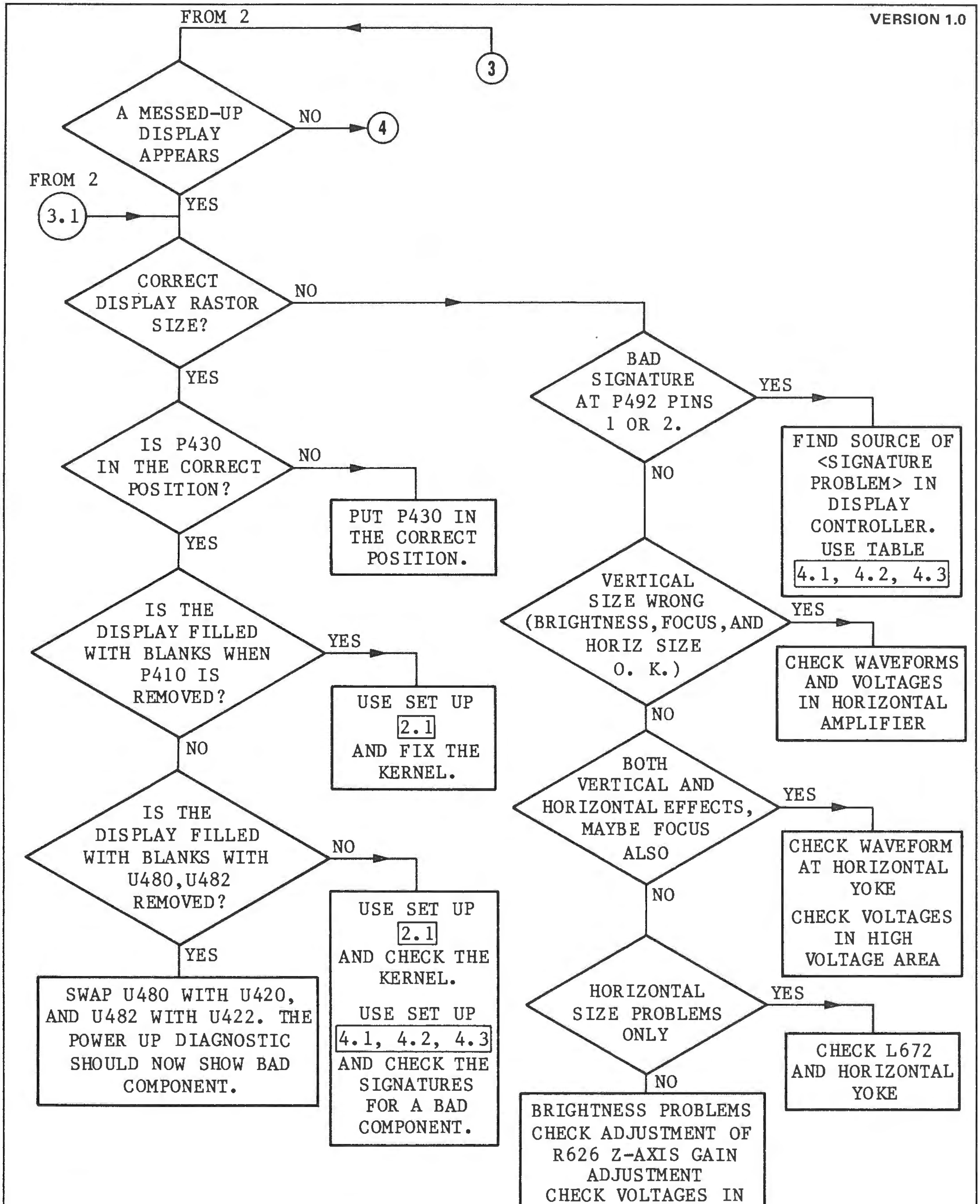
NOTICE

Troubleshooting Tree Introduction

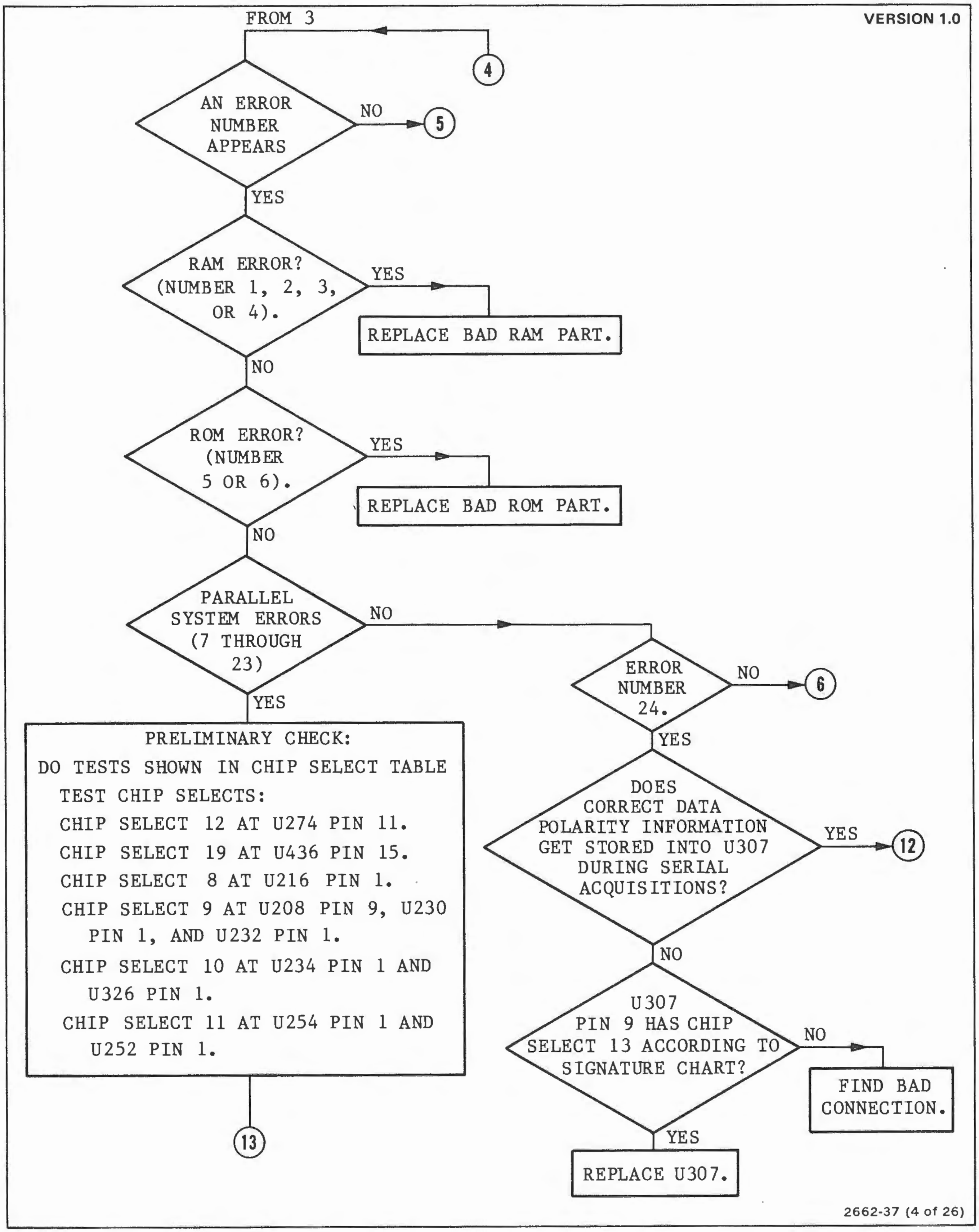
The following Troubleshooting Tree is a historical document and begins with version 1.0. Future firmware or hardware changes to the 308 may require an update to portions of the Troubleshooting Tree. These updated pages (e.g., for versions 1.1, 1.2, and 1.3) should be inserted behind the corresponding earlier versions which should remain in the manual. This allows one manual to support all versions of the 308.


VERSION 1.0
BEGINNING
1
INSTRUMENT SAYS OK DURING POWER UP
NO
2
YES
ALL SIGNAL PATHS ARE OK (Q-C HIGH SPEED VERIFICATION MAY BE DONE)
USER DIAGNOSTIC ERROR
NO
YES
SIGNATURE CIRCUIT FAILED IN Q-C TEST?
NO
INSTRUMENT OK.
DIAGNOSTIC 0 O. K.?
YES
6.1
YES
NO
BASIC CHIP SELECT TEST OK? (USE SIGNATURE TEST 2.3, 2.4
NO
5.1
DIAGNOSTIC 1 OR 2 ERROR?
YES
7
NO
YES
CHECK CHIP SELECT 13 AT THE FOLLOWING PINS:
DIAGNOSTIC 3 OR 4 ERROR?
YES
8
NO
9
U307 PIN 9 BAD?
YES
CHECK CONNECTIONS USING WIRING DIAGRAM
NO
10
2662-37 (1 of 26)

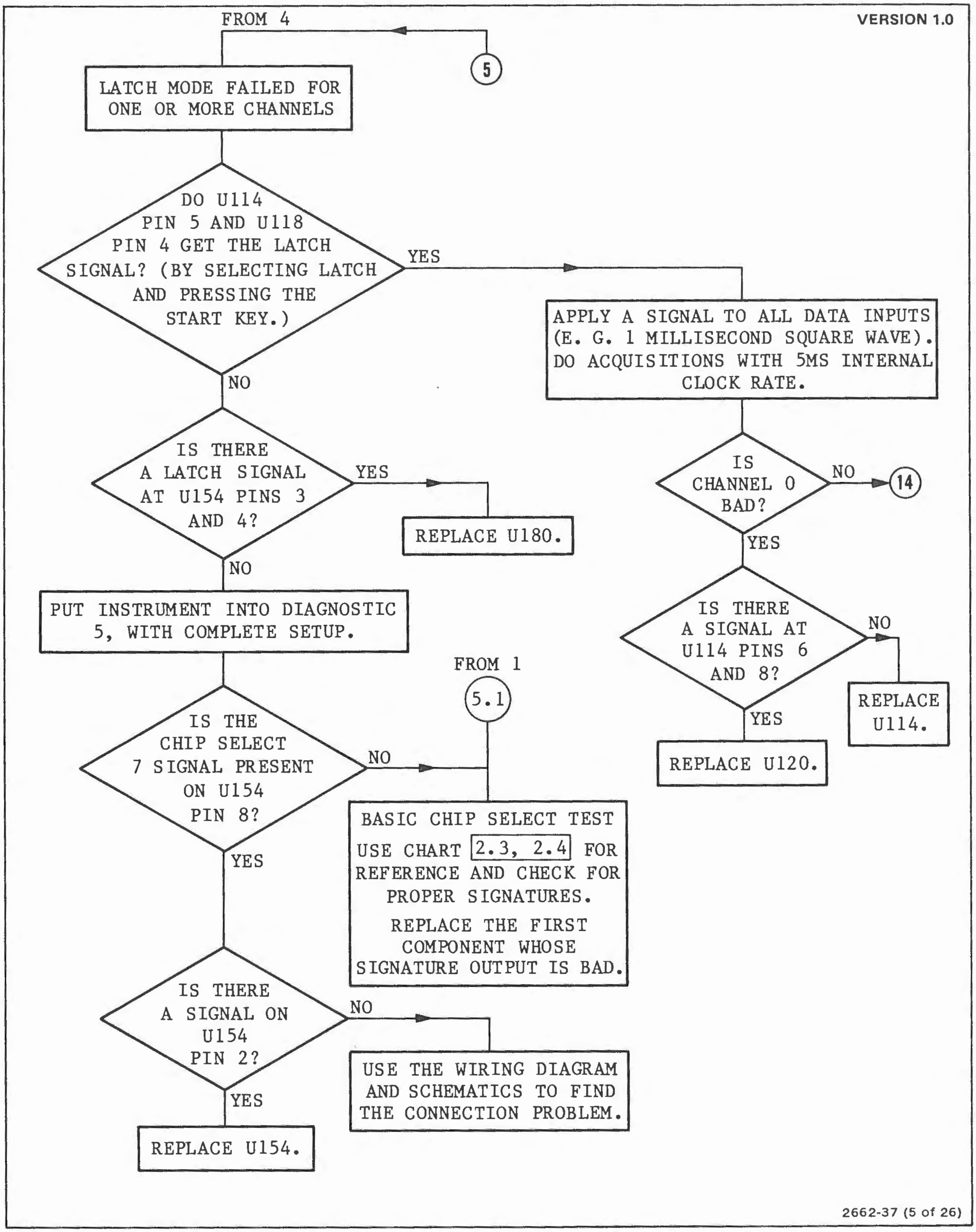

VERSION 1.0
FROM 1
2
NO DISPLAY APPEARS
NO
3
YES
CHECK TRIGGER LED OFF?
NO
3.1
YES
POWER SUPPLY VOLTAGES BAD?
NO
SYSTEM CLOCK O. K.?
NO
CHECK DISPLAY CIRCUIT
YES
REPAIR CLOCK CIRCUIT
YES
NO SIGNS OF LIFE IN SECONDARY?
NO
11
YES
FUSE BLOWN?
YES
REPLACE FUSE
FUSE STILL BLOWS?
NO
O.K. OR START OVER.
YES
REMOVE CONNECTION AT ONE END OF L736.
FUSE STILL BLOWS?
NO
PROBLEM IN AREA OF Q743, Q744. PROBABLY THAT BOTH TRANSISTORS ARE SHORTED.
YES
PROBLEM IN AREA OF CR716, C717 AND C718.
NO
DS714 FLASHES?
NO
PROBLEM IN AREA OF CR716, C717, AND C718.
YES
START PULSE PRESENT AT R724?
NO
FIND PROBLEM IN AREA OF VR725. IF VOLTAGE ACROSS VR725 > 33 VOLTS THEN REPLACE VR725.
YES
FIND PROBLEM IN AREA OF Q743, Q744.
2662-37 (2 of 26)



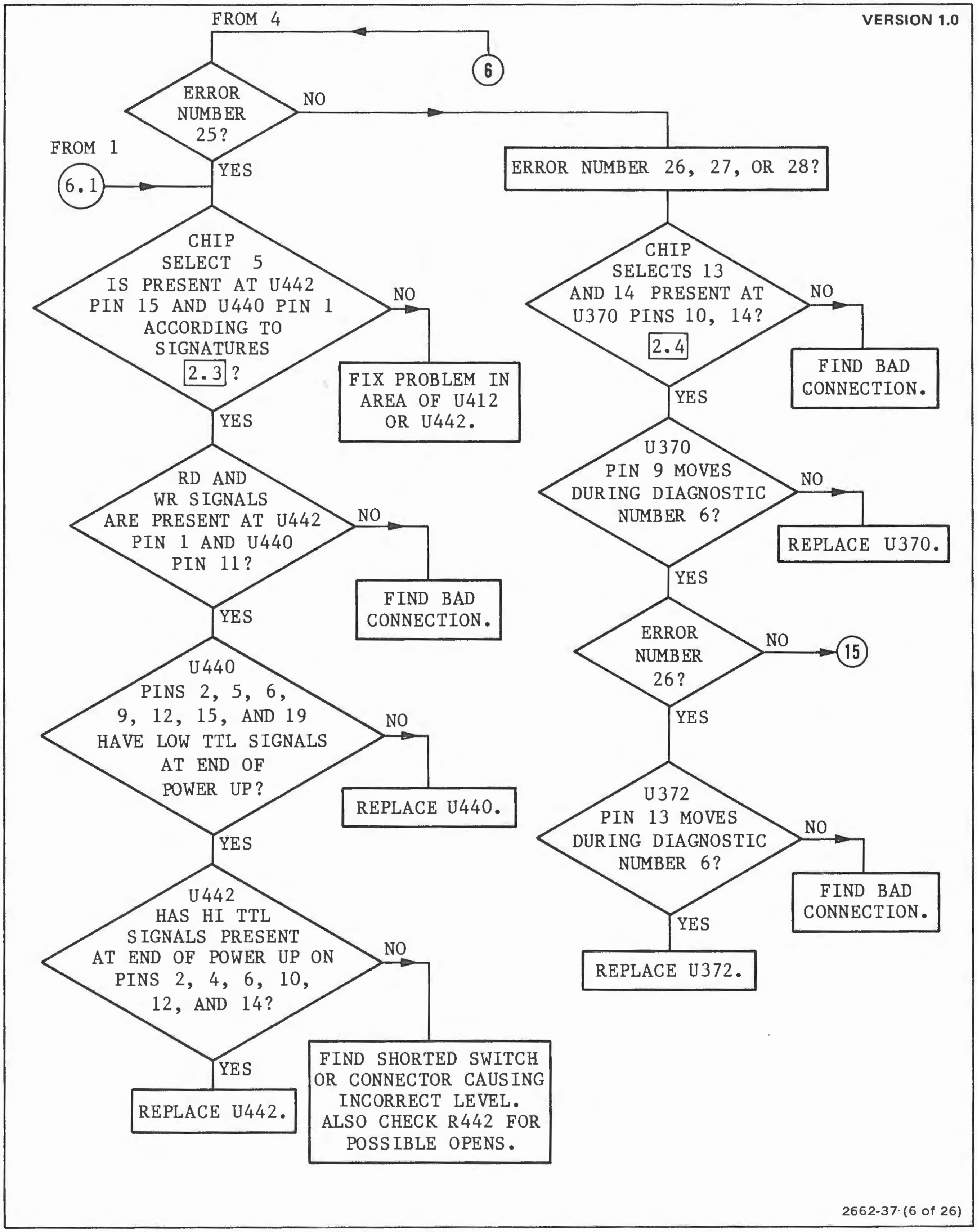
2662-37 (3 of 26)



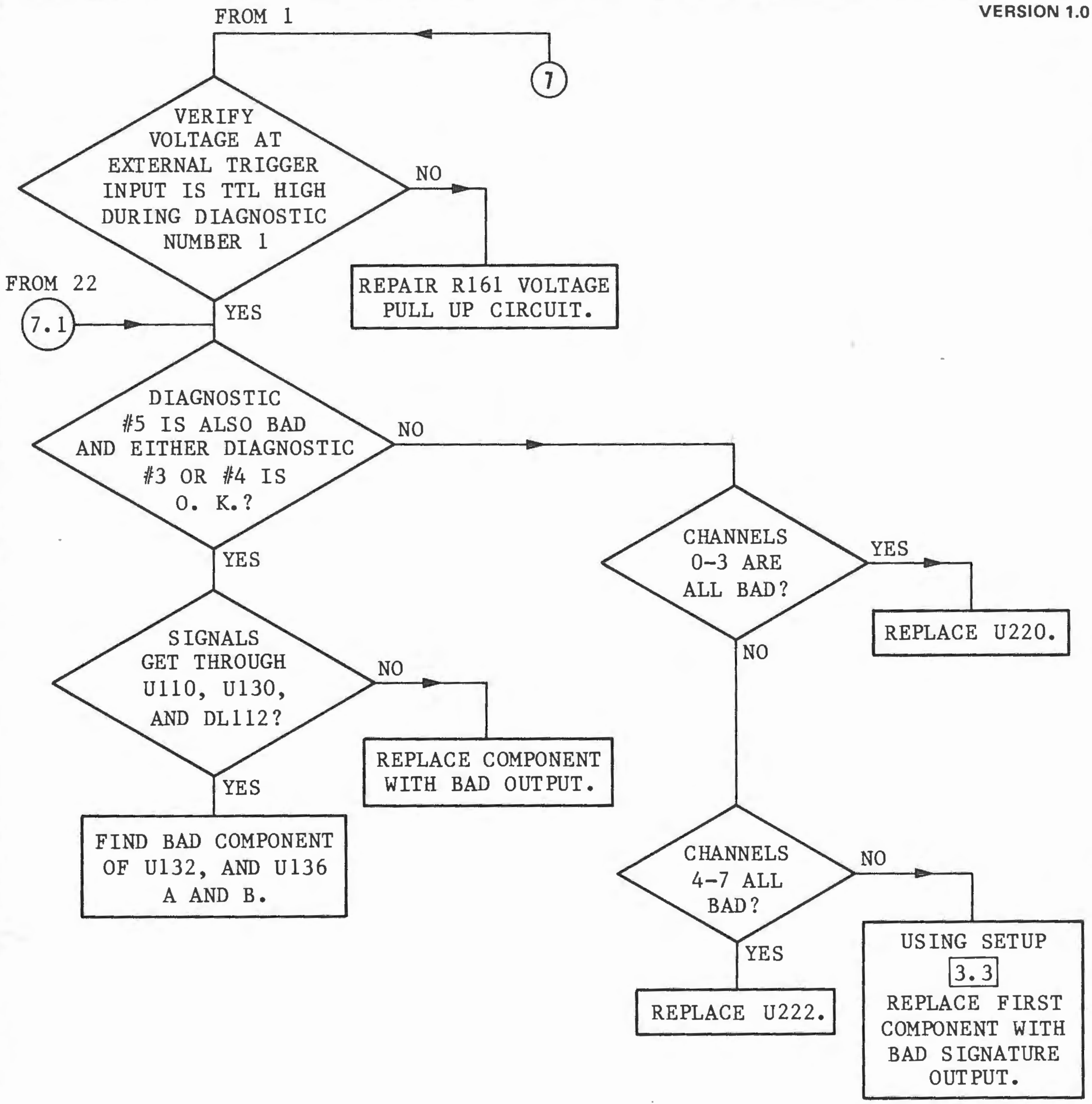
2662-37 (4 of 26)



2662-37 (5 of 26)

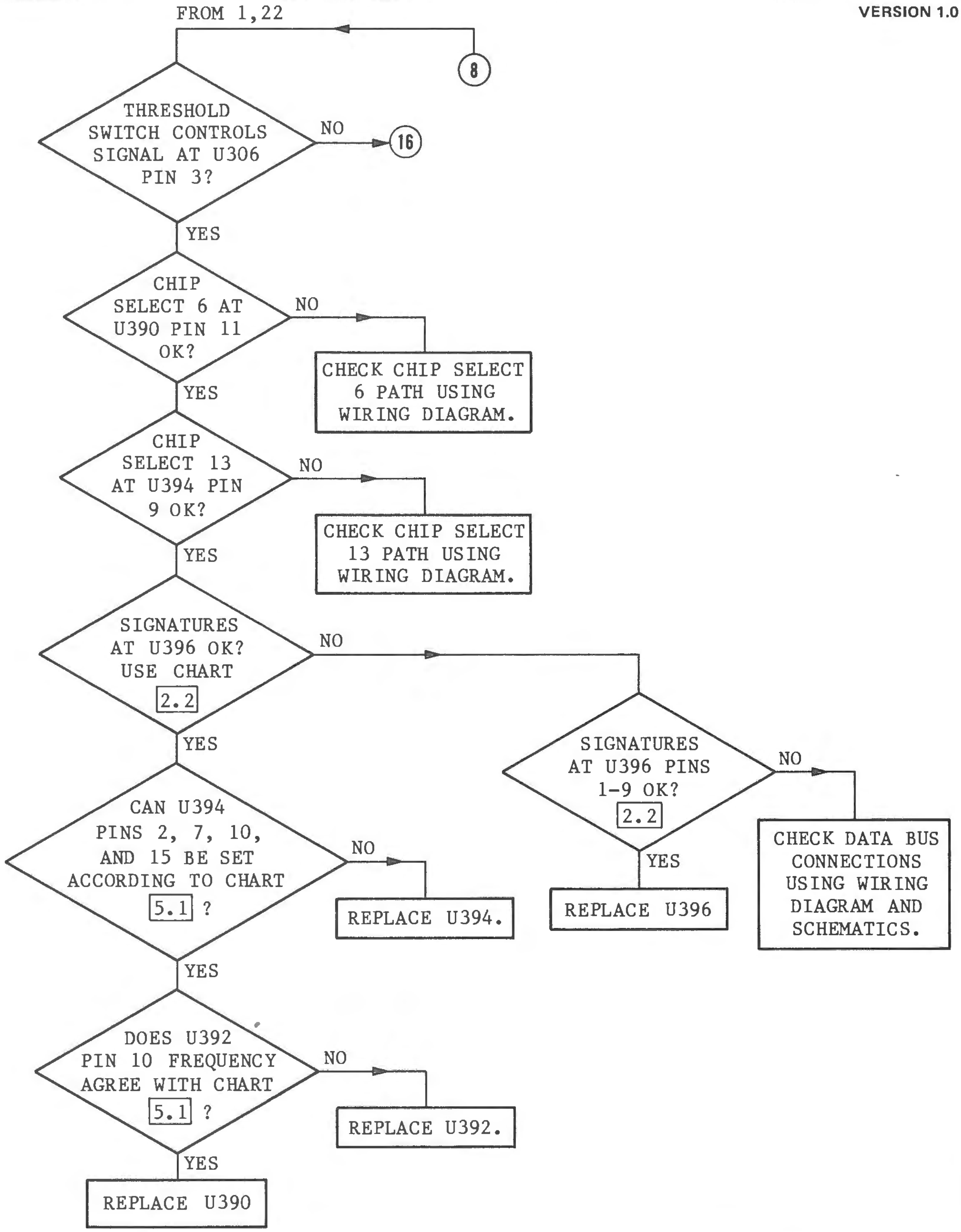

VERSION 1.0
FROM 4
6
ERROR NUMBER 25?
NO
YES
FROM 1
6.1
ERROR NUMBER 26, 27, OR 28?
CHIP SELECT 5 IS PRESENT AT U442 PIN 15 AND U440 PIN 1 ACCORDING TO SIGNATURES 2.3 ?
NO
FIX PROBLEM IN AREA OF U412 OR U442.
YES
RD AND WR SIGNALS ARE PRESENT AT U442 PIN 1 AND U440 PIN 11?
NO
FIND BAD CONNECTION.
YES
U440 PINS 2, 5, 6, 9, 12, 15, AND 19 HAVE LOW TTL SIGNALS AT END OF POWER UP?
NO
REPLACE U440.
YES
U442 HAS HI TTL SIGNALS PRESENT AT END OF POWER UP ON PINS 2, 4, 6, 10, 12, AND 14?
NO
FIND SHORTED SWITCH OR CONNECTOR CAUSING INCORRECT LEVEL. ALSO CHECK R442 FOR POSSIBLE OPENS.
YES
REPLACE U442.
CHIP SELECTS 13 AND 14 PRESENT AT U370 PINS 10, 14? 2.4
NO
FIND BAD CONNECTION.
YES
U370 PIN 9 MOVES DURING DIAGNOSTIC NUMBER 6?
NO
REPLACE U370.
YES
ERROR NUMBER 26?
NO
15
YES
U372 PIN 13 MOVES DURING DIAGNOSTIC NUMBER 6?
NO
FIND BAD CONNECTION.
YES
REPLACE U372.
2662-37 (6 of 26)

VERSION 1.0



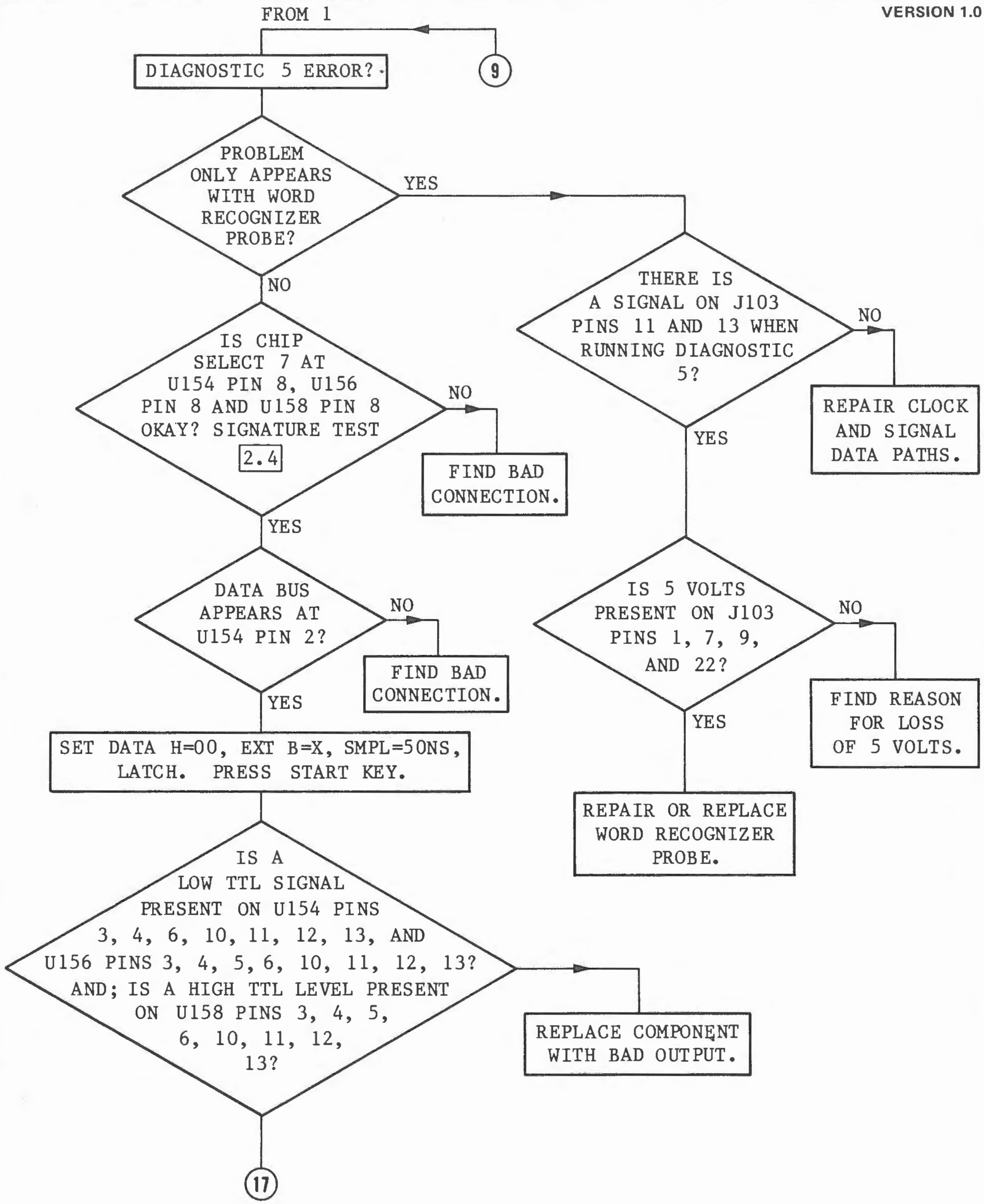
2662-37 (7 of 26)

VERSION 1.0



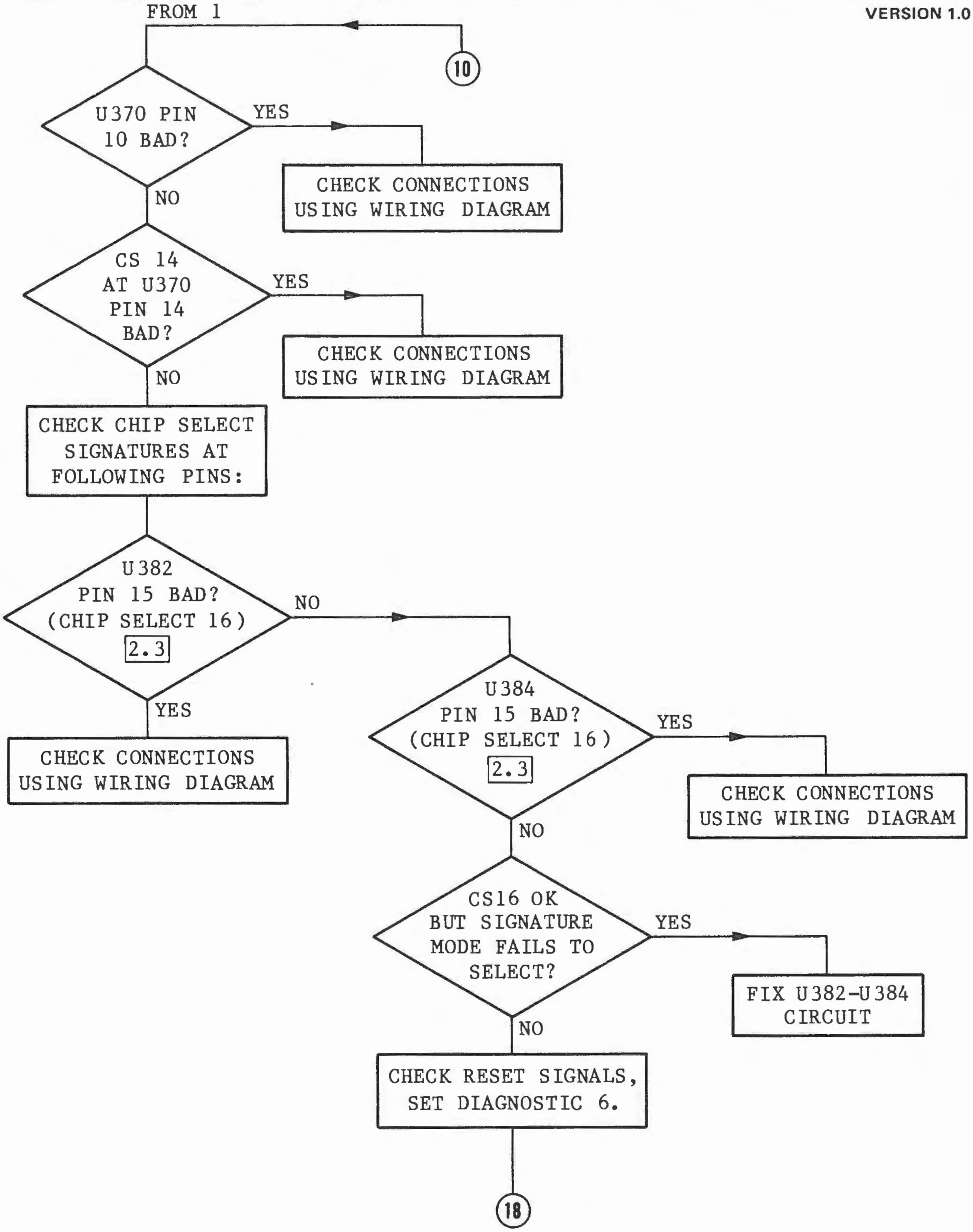
2662-37 (8 of 26)

VERSION 1.0

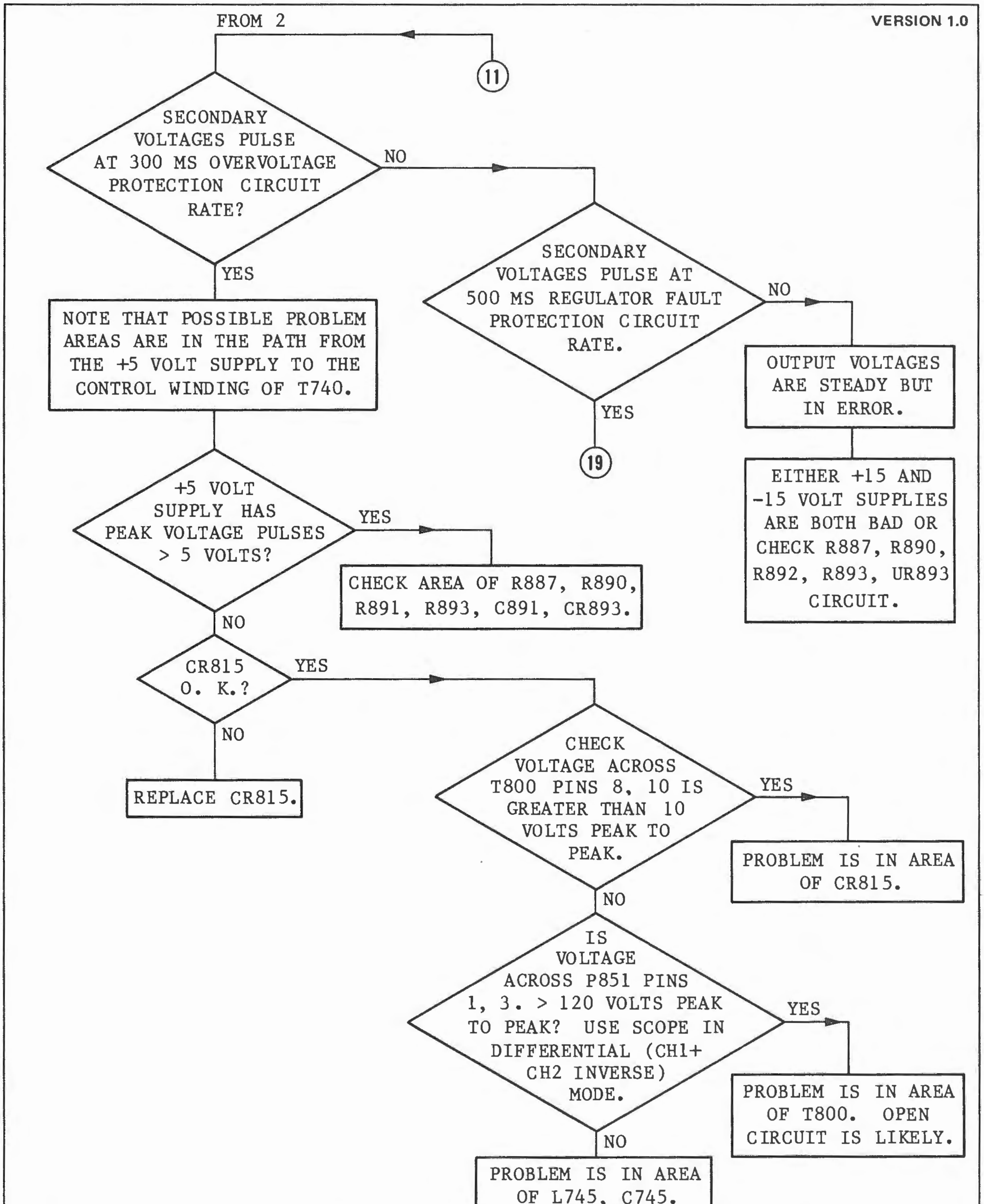


2662-37 (9 of 26)

VERSION 1.0

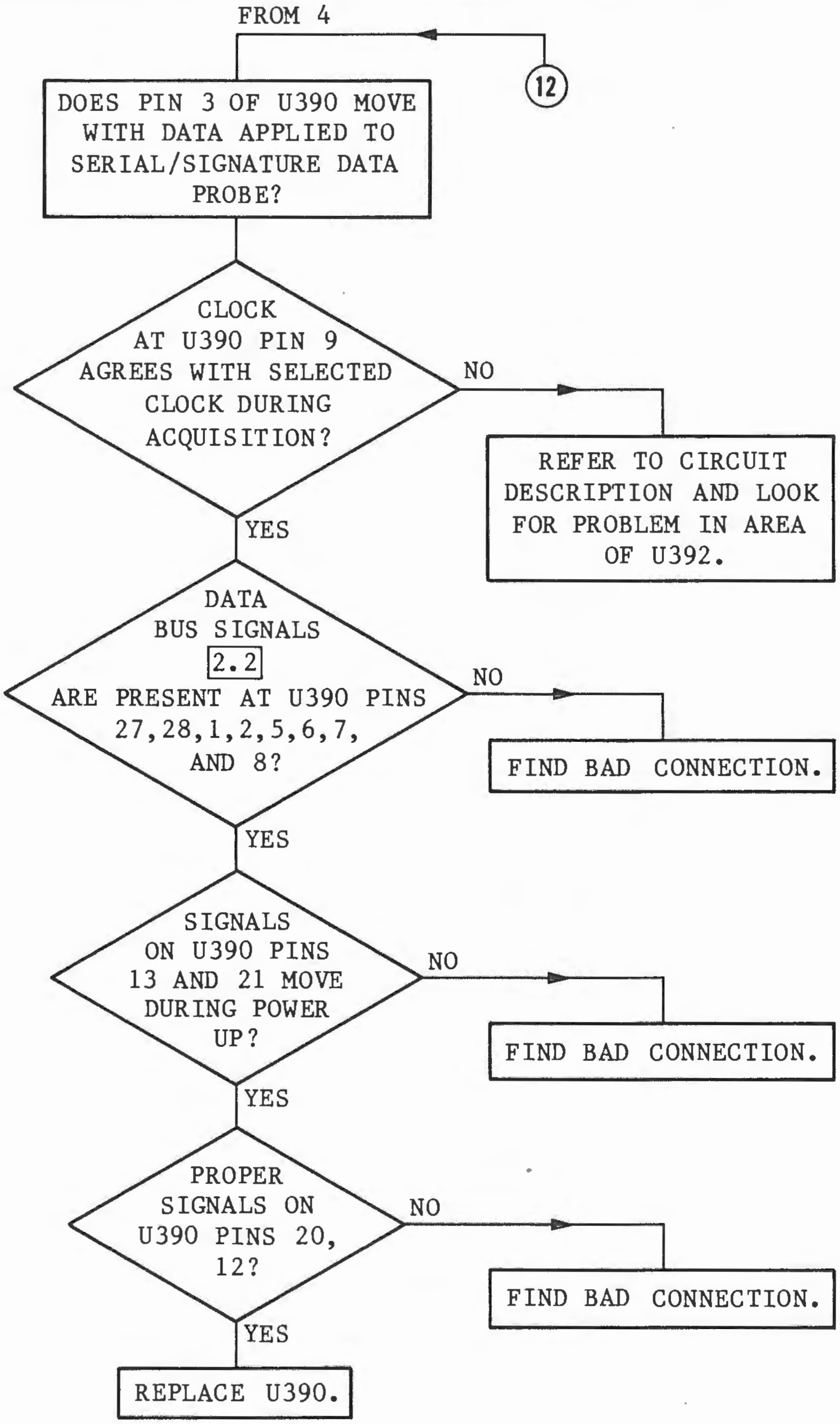


2662-37 (10 of 26)

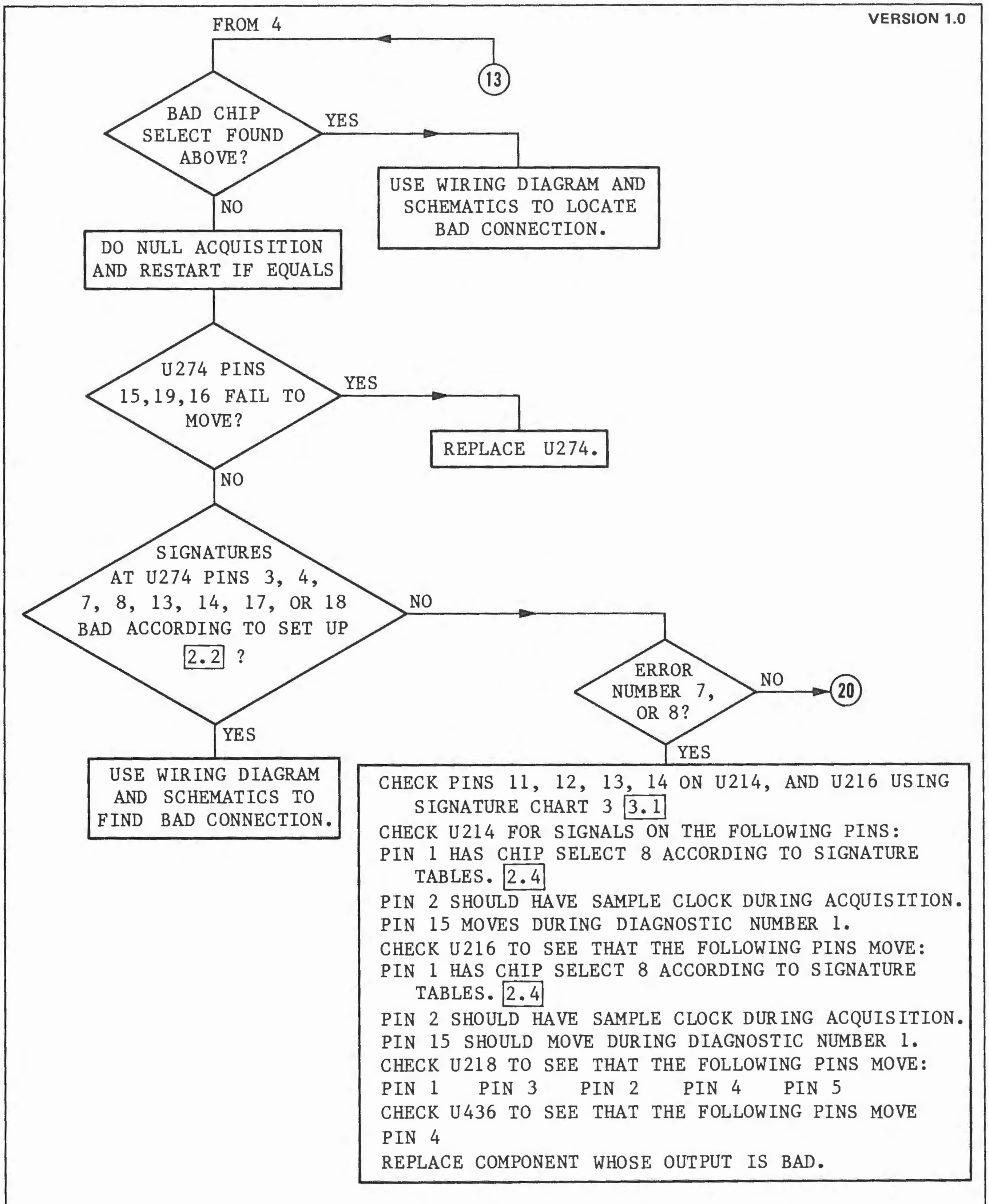


2662-37 (11 of 26)

VERSION 1.0

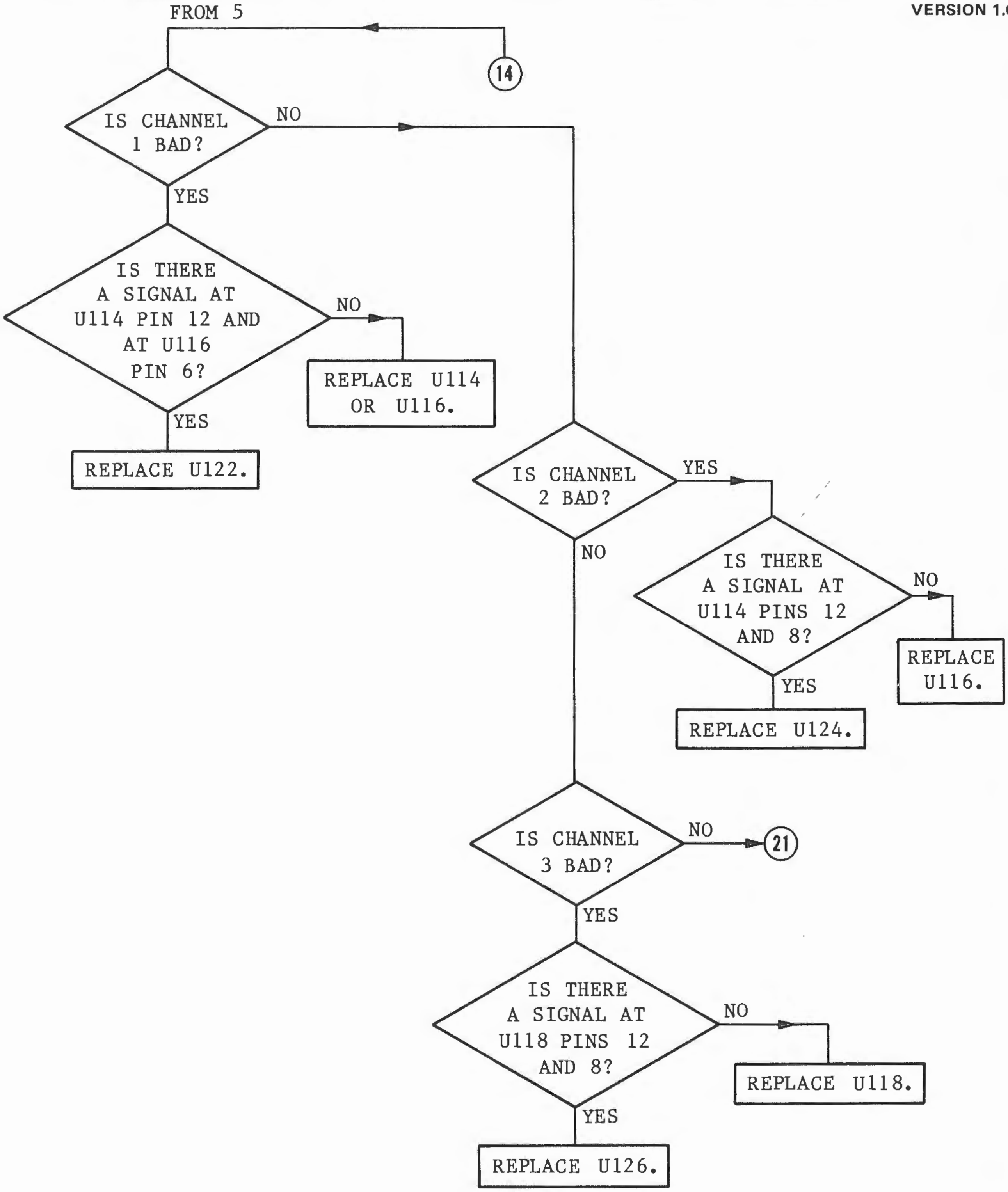


2662-37 (12 of 26)



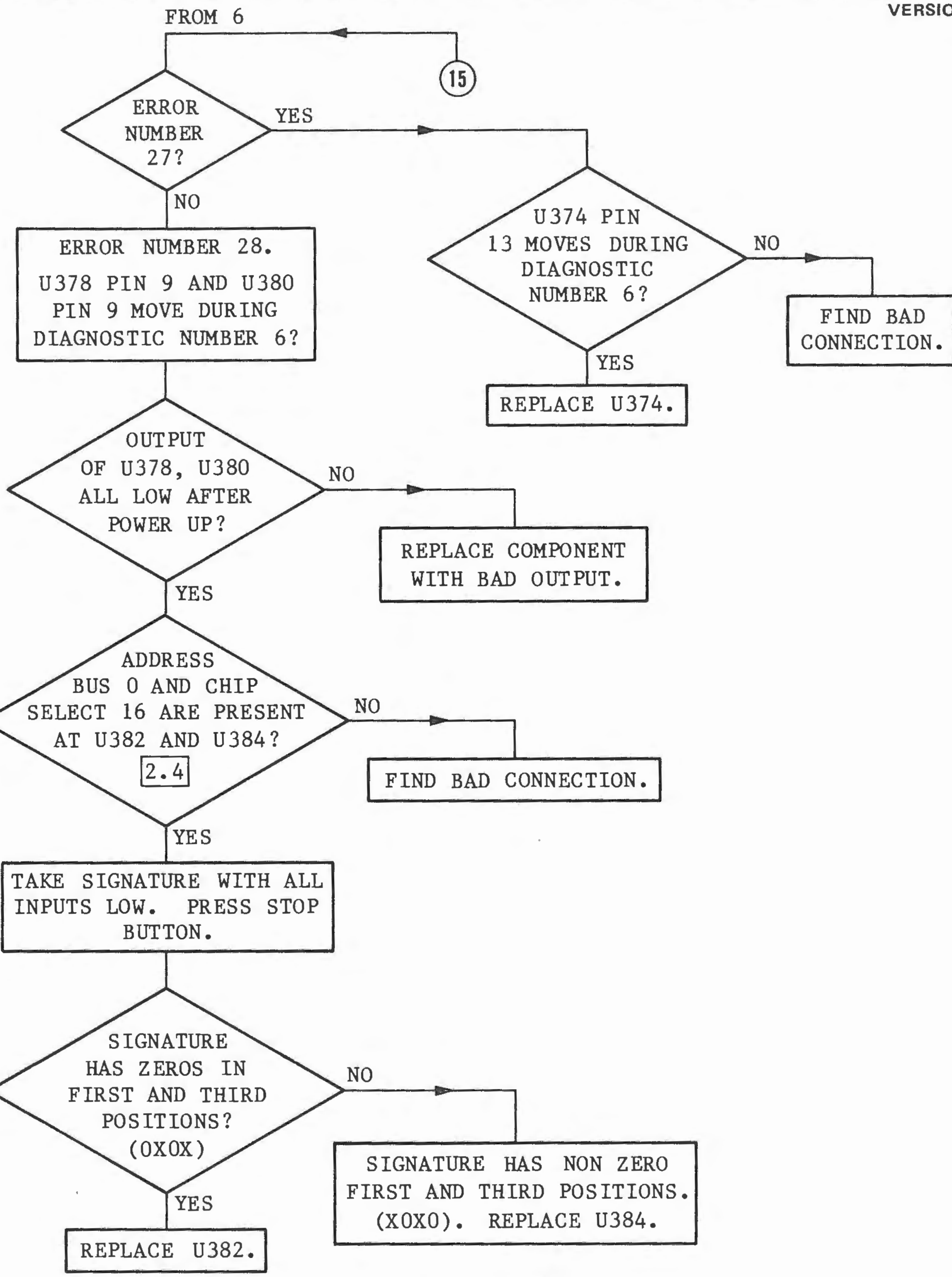
2662-37 (13 of 26)

VERSION 1.0



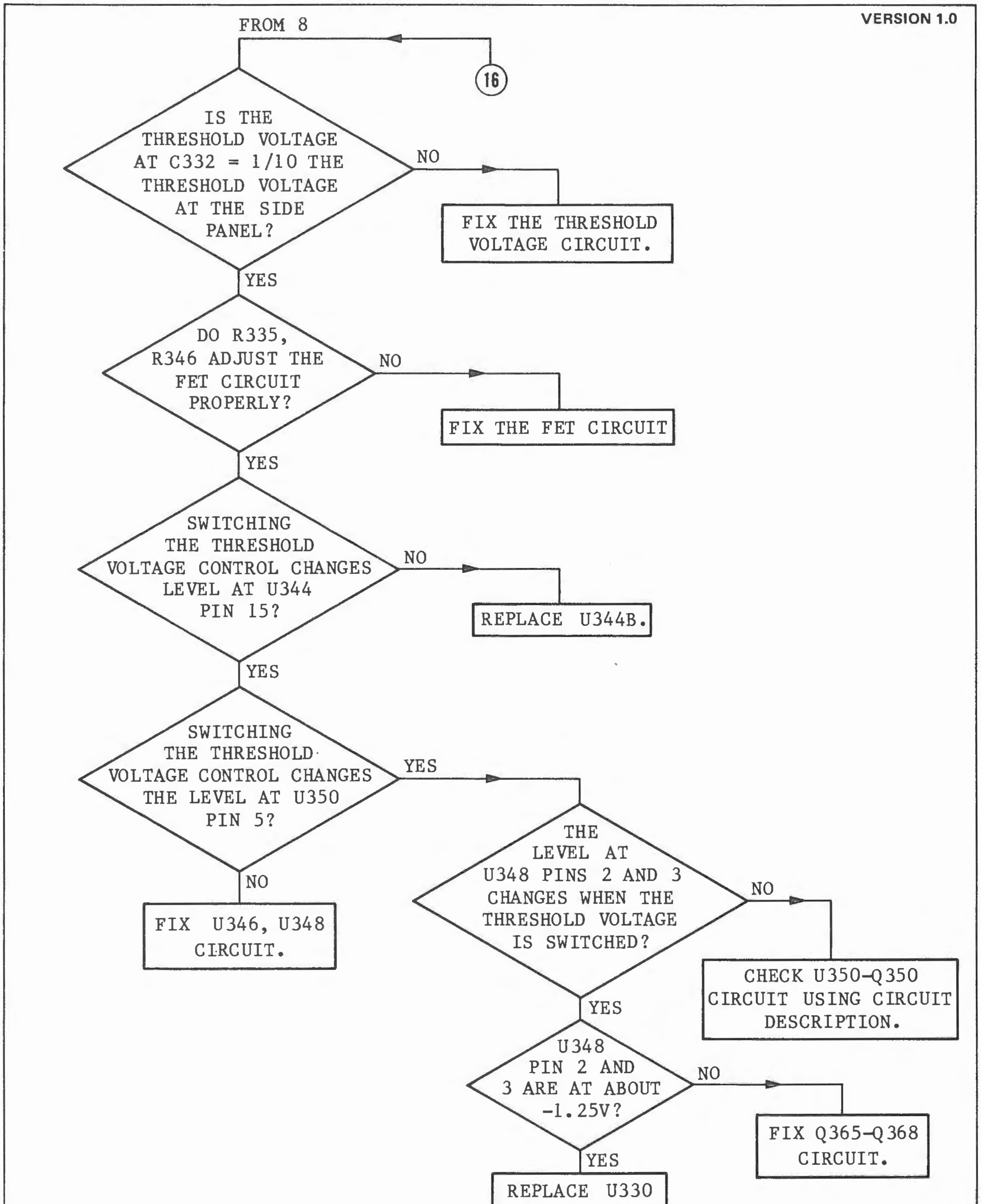
2662-37 (14 of 26)

VERSION 1.0

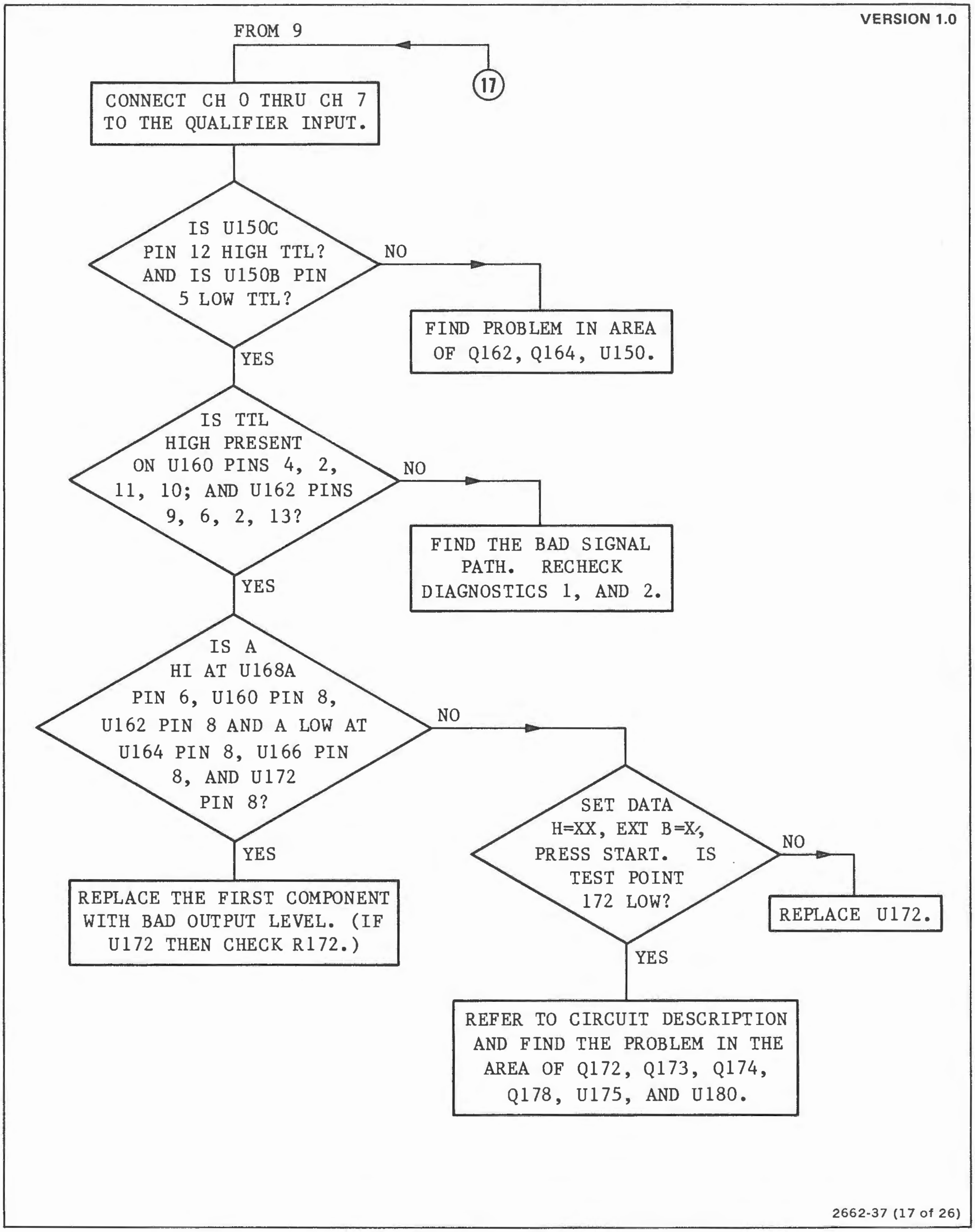


2662-37 (15 of 26)

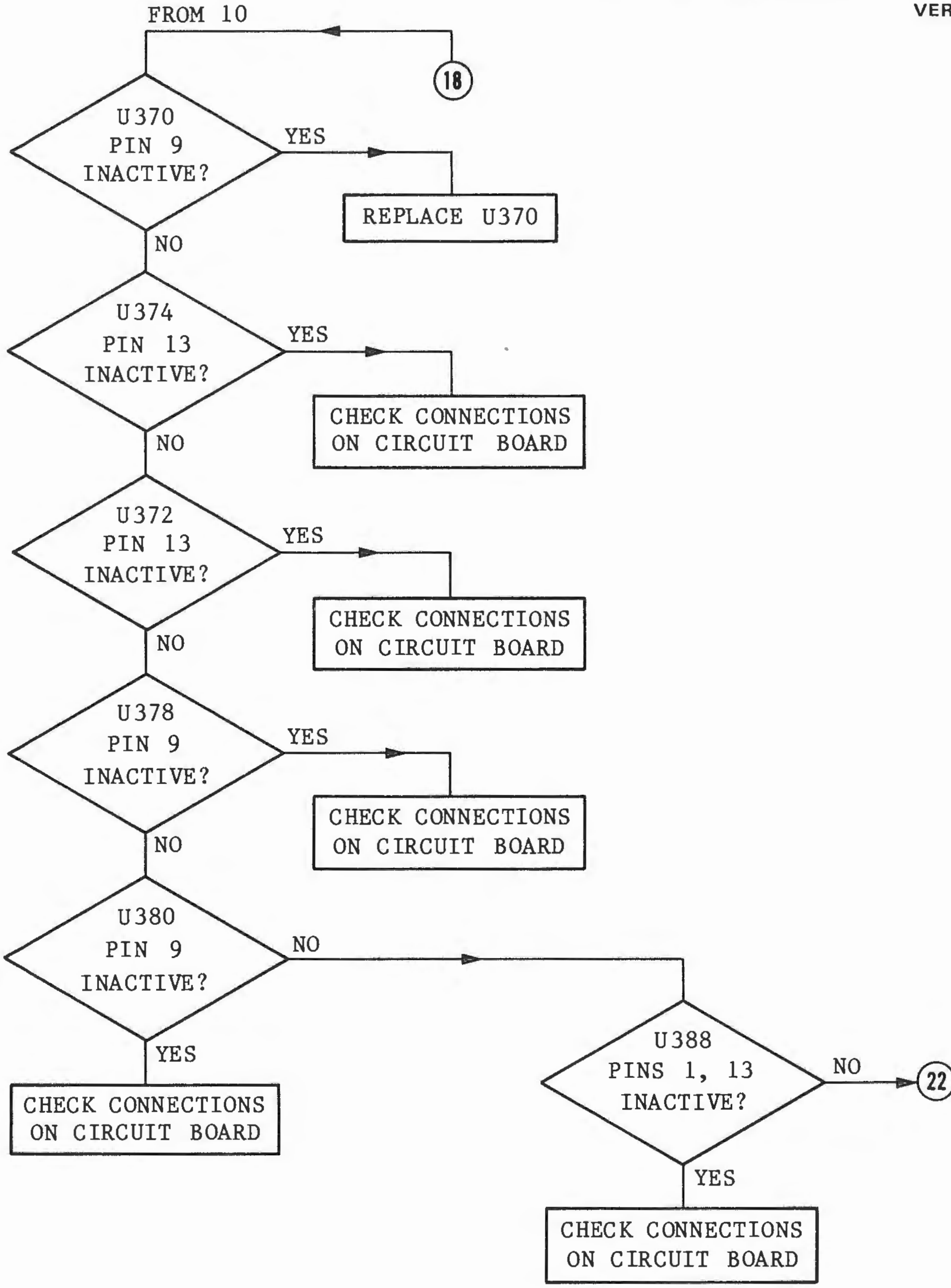
@



2662-37 (16 of 26)

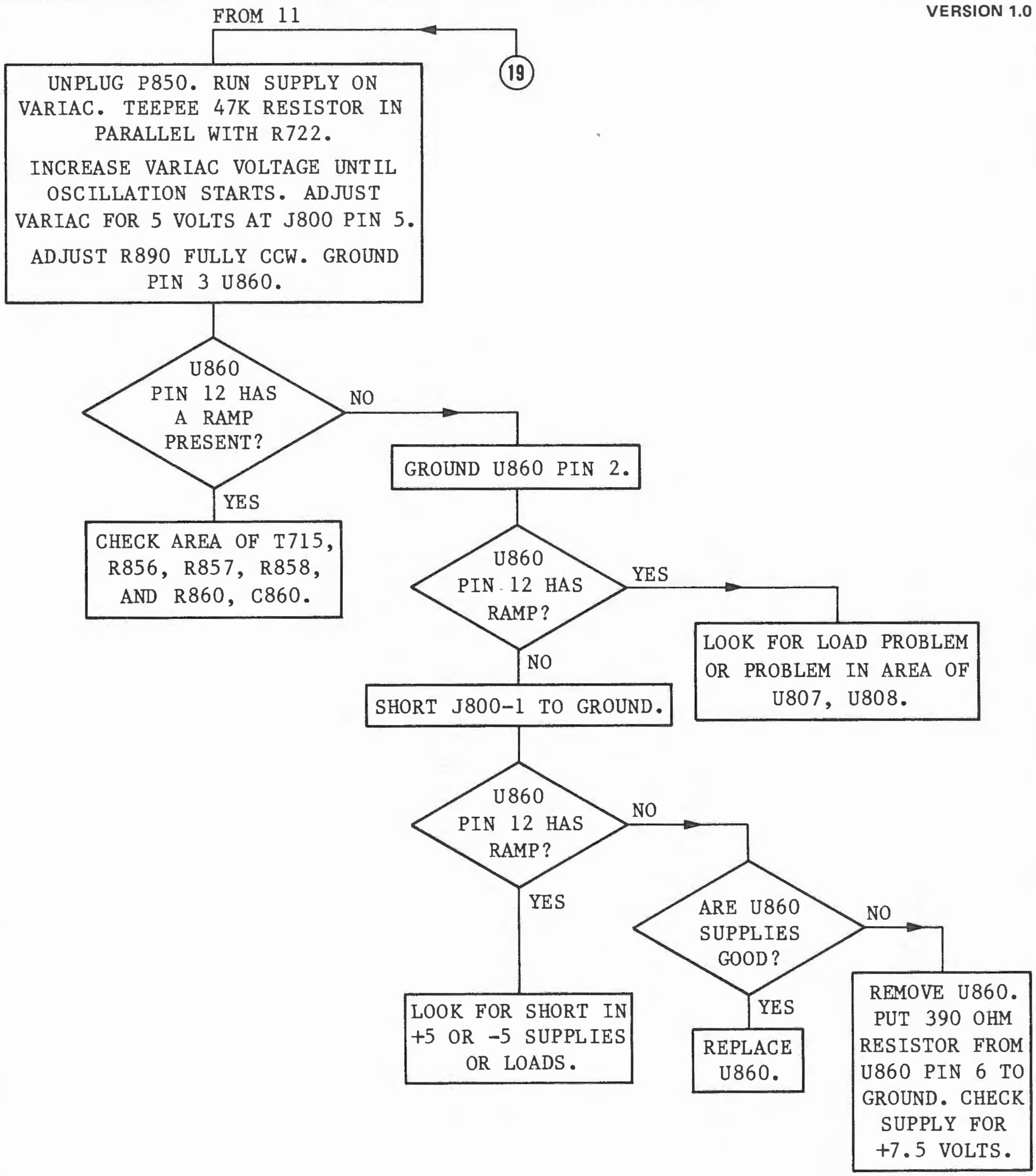

VERSION 1.0
FROM 9
17
CONNECT CH 0 THRU CH 7 TO THE QUALIFIER INPUT.
IS U150C PIN 12 HIGH TTL? AND IS U150B PIN 5 LOW TTL?
NO
FIND PROBLEM IN AREA OF Q162, Q164, U150.
YES
IS TTL HIGH PRESENT ON U160 PINS 4, 2, 11, 10; AND U162 PINS 9, 6, 2, 13?
NO
FIND THE BAD SIGNAL PATH. RECHECK DIAGNOSTICS 1, AND 2.
YES
IS A HI AT U168A PIN 6, U160 PIN 8, U162 PIN 8 AND A LOW AT U164 PIN 8, U166 PIN 8, AND U172 PIN 8?
NO
SET DATA H=XX, EXT B=X/, PRESS START. IS TEST POINT 172 LOW?
NO
REPLACE U172.
YES
REFER TO CIRCUIT DESCRIPTION AND FIND THE PROBLEM IN THE AREA OF Q172, Q173, Q174, Q178, U175, AND U180.
YES
REPLACE THE FIRST COMPONENT WITH BAD OUTPUT LEVEL. (IF U172 THEN CHECK R172.)
2662-37 (17 of 26)

VERSION 1.0



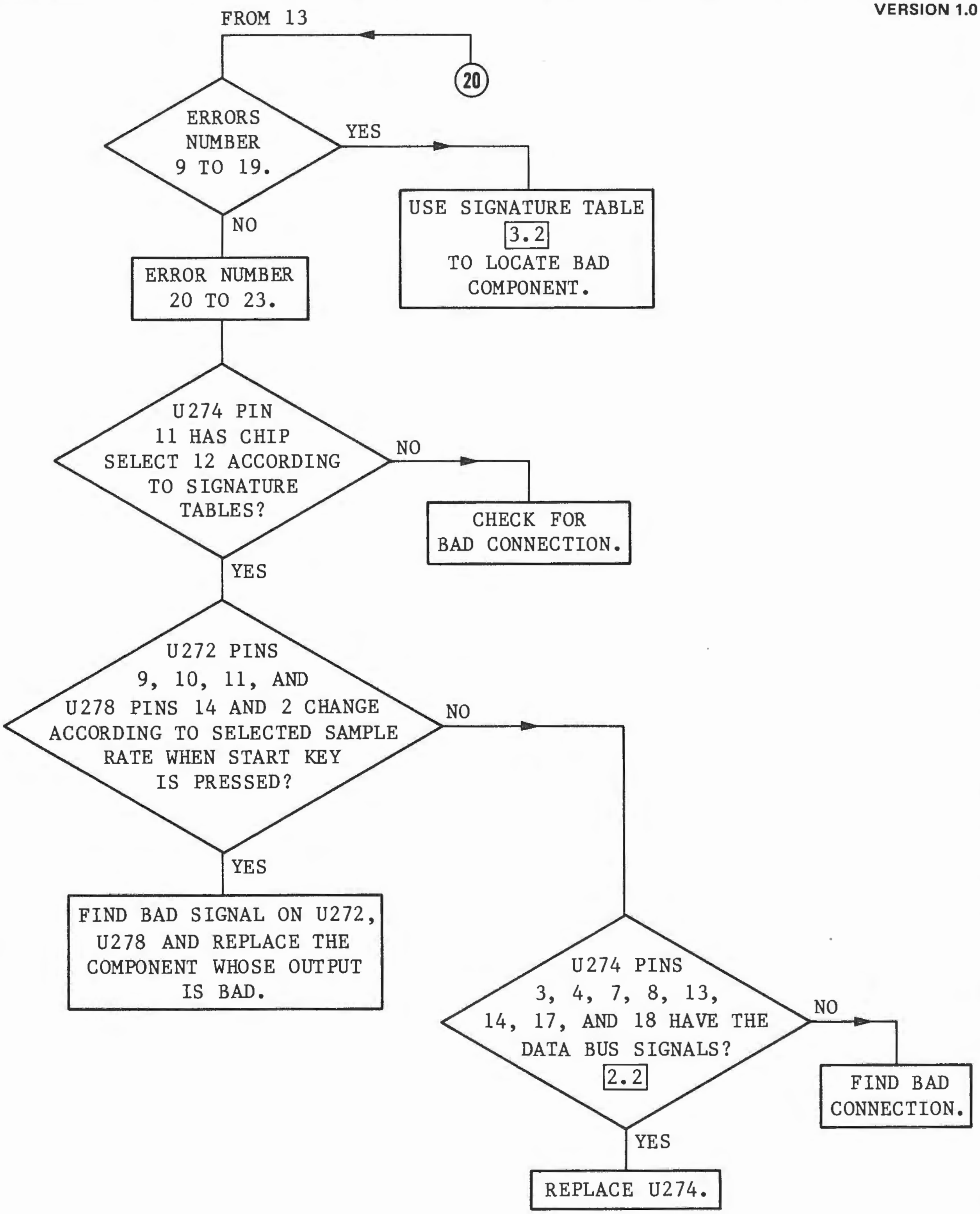
2662-37 (18 of 26)

VERSION 1.0

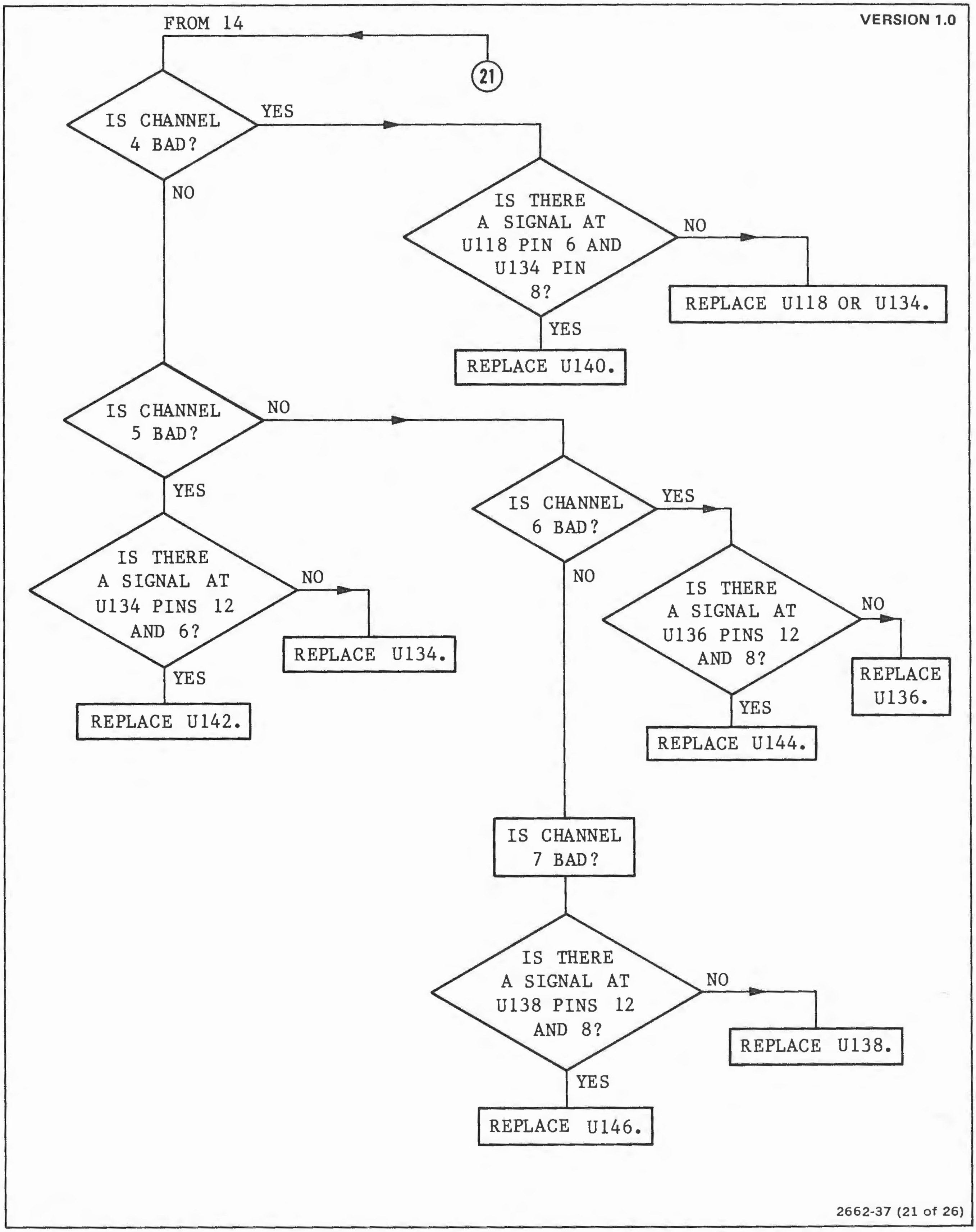


2662-37 (19 of 26)

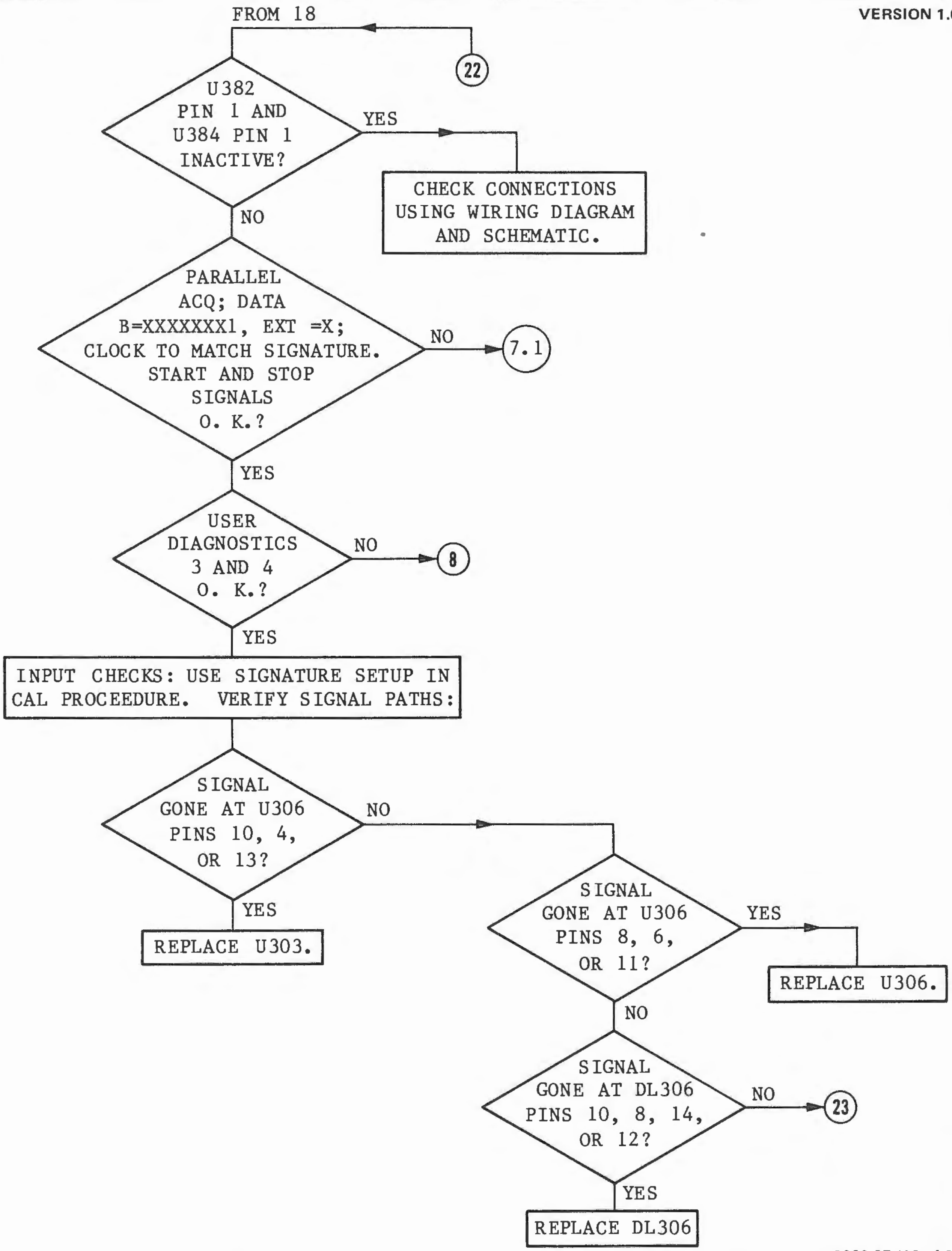
VERSION 1.0



2662-37 (20 of 26)


VERSION 1.0
FROM 14
21
IS CHANNEL 4 BAD?
YES
NO
IS THERE A SIGNAL AT U118 PIN 6 AND U134 PIN 8?
NO
REPLACE U118 OR U134.
YES
REPLACE U140.
IS CHANNEL 5 BAD?
NO
YES
IS CHANNEL 6 BAD?
YES
NO
IS THERE A SIGNAL AT U134 PINS 12 AND 6?
NO
REPLACE U134.
YES
REPLACE U142.
IS THERE A SIGNAL AT U136 PINS 12 AND 8?
NO
REPLACE U136.
YES
REPLACE U144.
IS CHANNEL 7 BAD?
IS THERE A SIGNAL AT U138 PINS 12 AND 8?
NO
REPLACE U138.
YES
REPLACE U146.
2662-37 (21 of 26)

VERSION 1.0



2662-37 (22 of 26)

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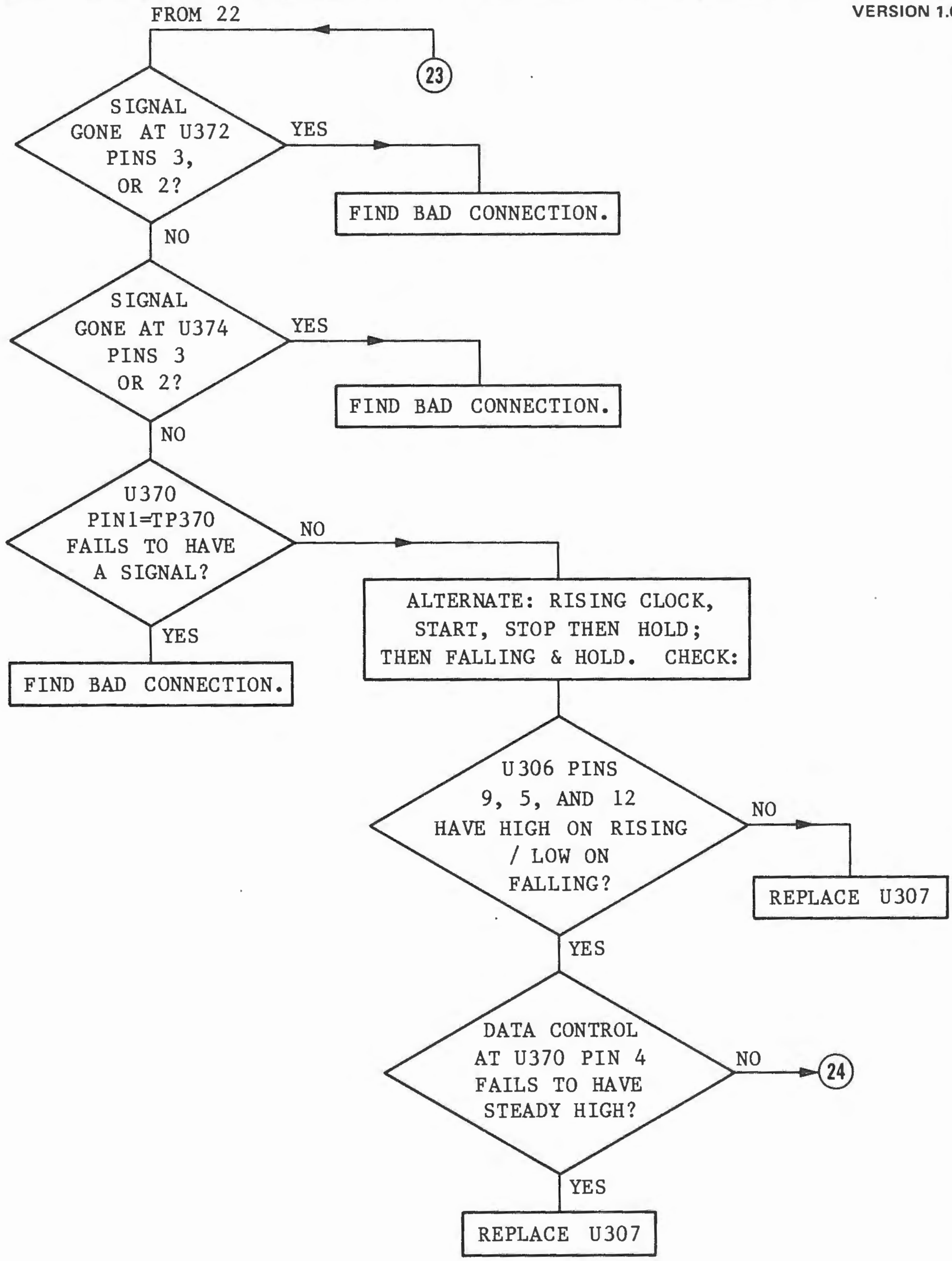
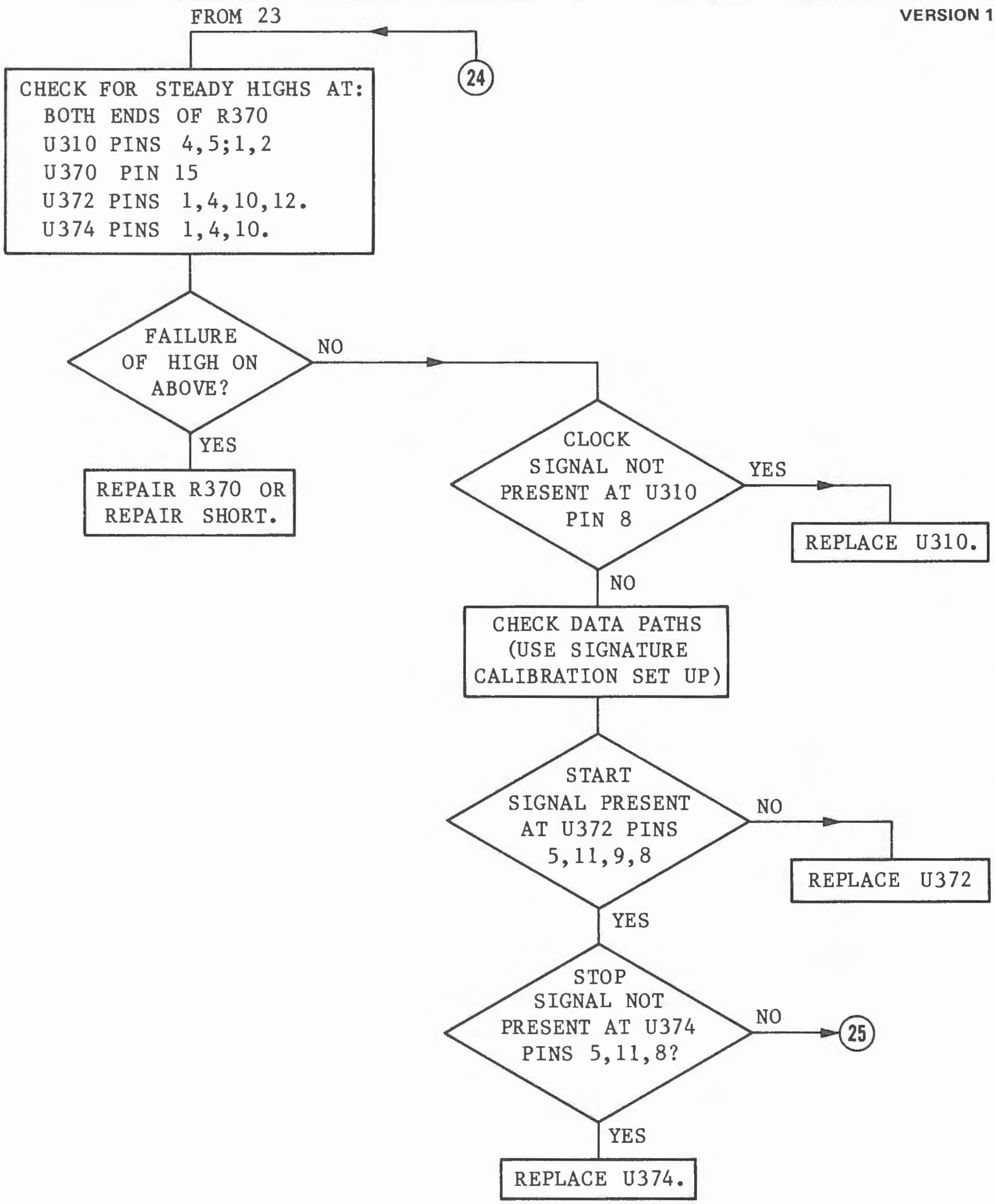
VERSION 1.0

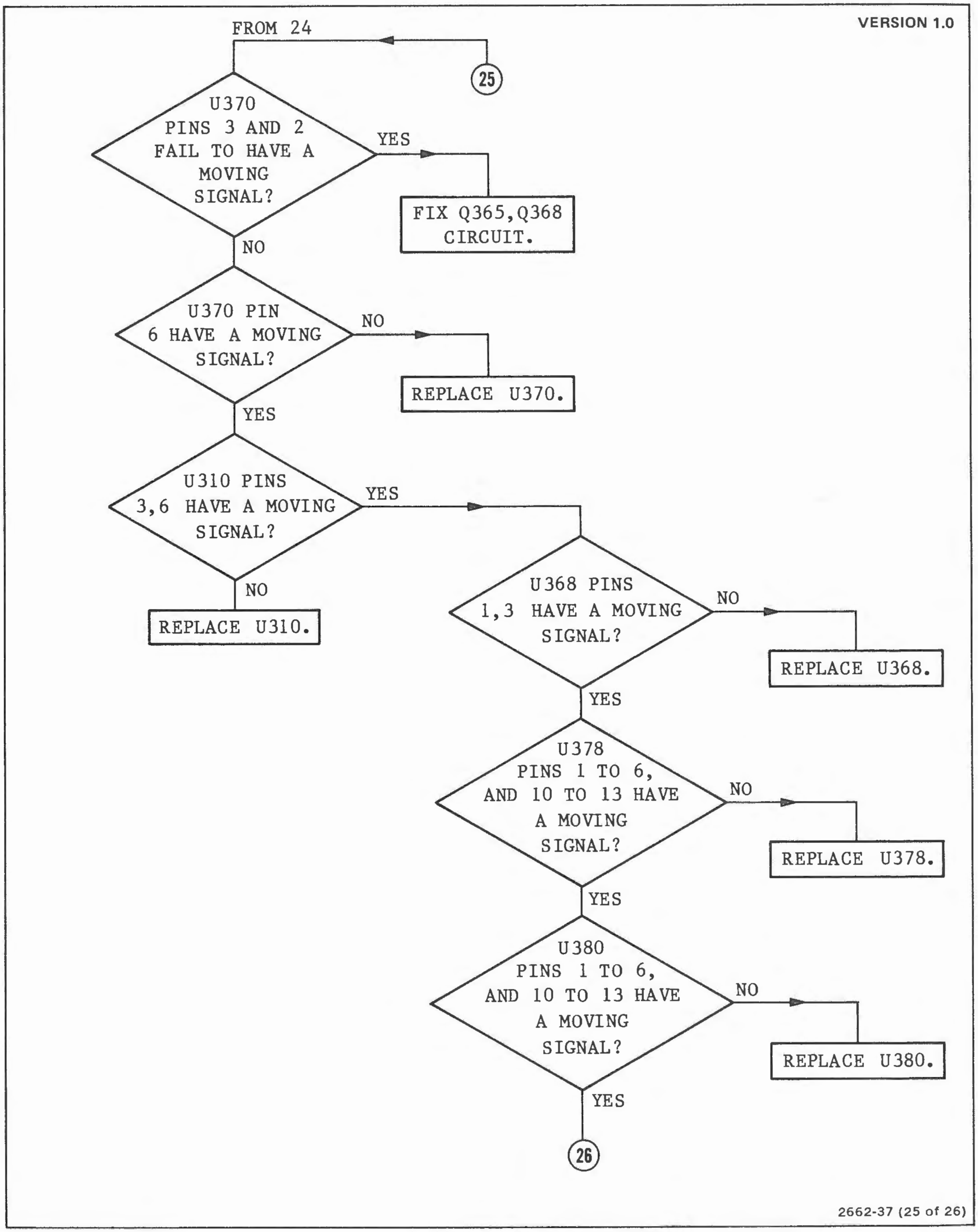


2662-37 (23 of 26)

VERSION 1.0

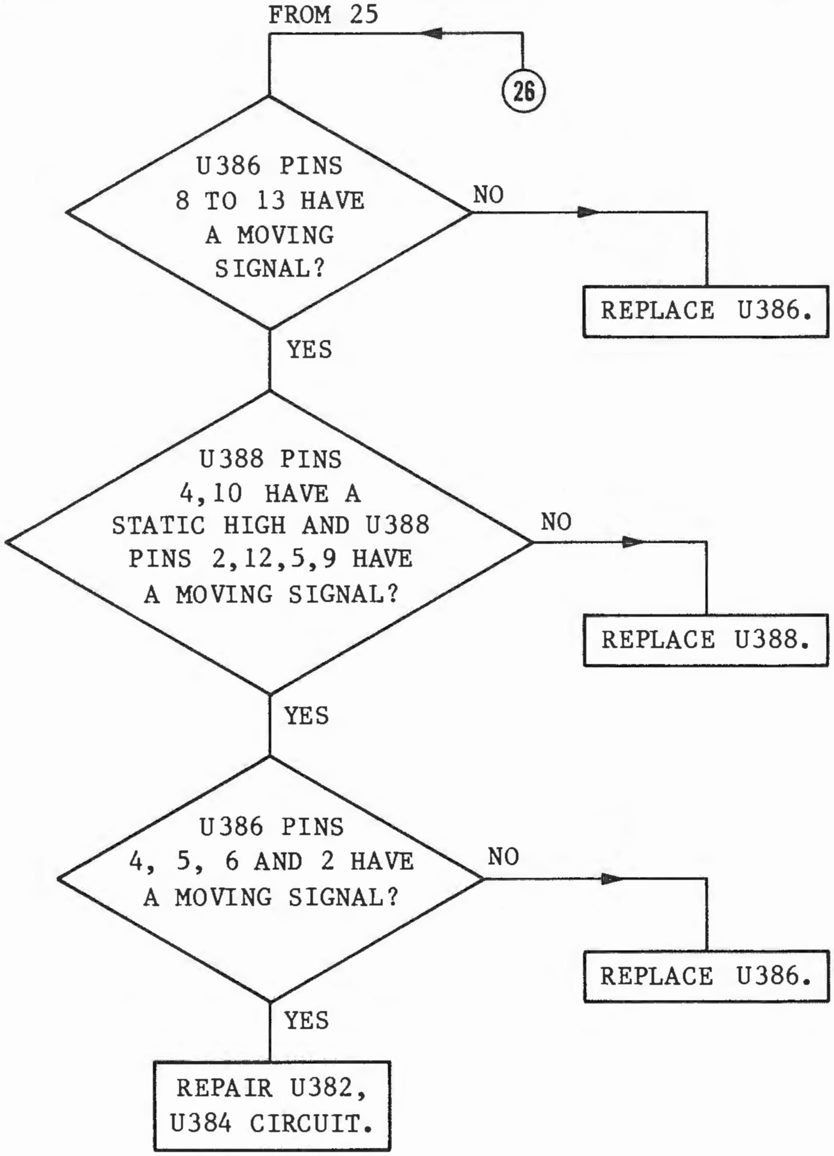


2662-37 (24 of 26)



2662-37 (25 of 26)

VERSION 1.0



2662-37 (26 of 26)

NOTICE

Signature List Introduction

The following Signature List is a historical document and begins with version 1.0. Future firmware or hardware changes to the 308 may require an update to portions of the Signature List. These updated pages (e.g., for versions 1.1, 1.2, and 1.3) should be inserted behind the corresponding earlier versions which should remain in the manual. This allows one manual to support all versions of the 308.

NOTE

Read the Introduction and Use of Signature Lists and Tables before proceeding any farther.

SIGNATURE LISTS AND TABLES

The following troubleshooting information is designed to be used primarily with the Troubleshooting Tree.

The Signature Table reference numbers in Table 8-1 correspond to numbered information in the Troubleshooting Tree. Table 8-1 can be used as a cross-reference with Table 8-2, Device Error List.

Use of Signature Lists and Tables

The following sequence should be followed for correct usage of the tables in this section:

1. Find the number in the left column of Table 8-1 that matches the Signature List reference number given in the Troubleshooting Tree.

2. If necessary cross-reference the alphabetical character in Table 8-1 column two with Table 8-2 column one to verify that the correct device(s) is/are being checked.

3. Read Table 8-1 column four to find the corresponding Signature List table number.

4. Perform the setups on the test 308 and the 308 under test and verify all the signatures listed in that table.

NOTE

There is a setup check signature provided for most Signature List tables. This allows the operator to confirm that all setup conditions for both the test 308 and the 308 under test are functioning properly. This signature is taken from the +5 V at any place in the 308 under test. Signature Table 8-9 has a special setup and Tables 8-14 and 8-15 do not require a setup check signature.

5. An incorrect signature indicates that the component under test or associated circuitry is faulty. If any component is replaced or repaired, retest for all correct signatures.

6. When all correct signatures have been obtained, return to the Troubleshooting Tree and continue troubleshooting if the malfunction has not been corrected.

Table 8-1

Troubleshooting Tree to Signature List Cross-Reference

Version 1.0

Signature List Reference Number	Device Error Reference Number	Test Name	Signature List Table
1.0		Diagnostic Error Information	
1.1	AA	Power-up Diagnostic Error[a]	
1.2	AB	User-Initiated Diagnostics[b]	
2.0		Control System Tests	
2.1	B	Kernel Check	8-5
2.2	A	ROM Check	8-4
2.3	C	Chip Select Test	8-6
2.4	D	Chip Select (Write Only)	8-7
3.0		Parallel Acquisition	
3.1	E	Address Counter	8-8
3.2	F	Delay Counters	8-9
3.3	G	Data Paths	8-10
4.0		Display	
4.1	H	Display Column Counter	8-11
4.2	I	Display Line-Row Counter	8-12
4.3	J	Display Character-Row Counter	8-13
5.0		Latch	
5.1		Baud Rate Test One	8-14
		Baud Rate Test Two	8-15

[a] Reference to Table 8-3 for error numbers and faults.

[b] Refer to Performance Check portion of the Calibration section for detailed instructions on these tests.

Table 8-2

Device Error List

AA	POWER-UP DIAGNOSTIC ERRORS
AB	USER-INITIATED DIAGNOSTICS
A	U430 ROM CHECK
B	U400 KERNEL CHECK
	U410
	U412
C	U396 CHIP SELECT TEST
	U412
	U416
D	U414 CHIP SELECT TEST
E	U214 ADDRESS COUNTER TEST
	U216
F	U226 PARALLEL CONTROL CRT TEST
	U230
	U232
	U234
	U236
	U240
	U242
	U246
	U250
	U252
	U254
	U256
G	DL112 PARALLEL DATA TEST
	U120
	U122
	U124
	U126
	U140
	U142
	U144
	U146
	U168
	U202
	U206
	U220
	U222
H	U464 COLUMN COUNTER
	U468
I	U466 LINE OF ROW COUNTER
J	U452 CHARACTER ROW COUNTER
	U468 SYNC—Z AXIS GATE AND CHARACTER ROM CHECK
	U470
	U490
	U492
	U494

Table 8-3

308 Power-Up Diagnostic Errors

Error No.	Fault
	RAM/ROM ERRORS
1,2	RAM error U480 or U482 is bad (F800—FBFF).
3,4	RAM error U420 or U422 is bad (FC00—FFFF).
5	ROM error U432 is bad (2000—3FFF).
6	ROM error U434 is bad (4000—5FFF).
	PARALLEL SYSTEM ERRORS
7	High Speed Memory Address Counter does not load correctly (U214, U216).
8	High Speed Memory Address Counter does not count correctly (U214, U216).
9	U256A does not reset (Not Store Clock Enable does not reset).
10	U224A or U224B won't reset (Trig'd won't reset).
11	U256B does not reset (Data Position Count Carry does not reset).
12	U256A path bad.
13	U224 path bad.
14	U256B path bad.
15	U256A won't set (Not Store Clock Enable does not set).
16	Data Position Counter does not load (U252, U254).
17	Data Position Counter does not count (U252, U254).
18	Delay Counter does not load (U230, U232, U234, U236).
19	Delay Counter does not count (U230, U232, U234, U236).
20	Parallel Sample Rate error. 2 ms clock too slow.
21	Parallel Sample Rate error. 2 ms clock too fast.
22	Parallel Sample Rate error. 100 ms clock too slow.
23	Parallel Sample Rate error. 100 ms clock too fast.

Table 8-3 (cont)

Error No.	Fault
	SERIAL SYSTEM ERROR
24	8251A will not recognize asynchronous characters.
	KEYBOARD ERROR
25	The keyboard says that a key(s) is being pushed.
	SIGNATURE ERRORS
26	Start flip/flop won't reset (U370B, U372B).
27	Stop flip/flop won't reset (U370B, U374B).
28	CRC generator won't reset (U378, U380, U382, U384).

NOTE

An error in RAM or ROM (errors 1—6) is considered fatal. The error number(s) are displayed, or at least an attempt is made, and then the processor simply halts. If a nonfatal error occurs (errors 7—28) and no fatal errors, the error number(s) is displayed, and the instrument waits for the user to push the START key to cause the instrument to operate despite the errors. If no errors occur, an ***OK*** *message is displayed for about 2 seconds, and then control goes to the main program.*

Table 8-4

Signature List and Setup Conditions for ROM Check

Version 1.0
Reference No. 2.2

Setup Conditions

A. Setup Conditions for Test 308

Signature Mode	Data Acquisition Probe Connections
Clock—↑	Clock—U412 Pin 14
Start—↓	Start—U400 Pin 28
Stop—↑	Stop—U400 Pin 24

B. Setup Conditions for 308 Under Test

1. Remove jumpers from P410
2. Place a jumper on P456
3. After test is complete, return jumpers to original positions

C. Setup Check Signature

Location	Signature
+5 V	7A70

D. Signature

Component Circuit Number	Component Pin Number	Signature	Data Bus Line Number
P410	1	F64P	0
P410	3	4UAA	1
P410	5	F417	7
P410	7	6C3A	6
P410	9	F221	5
P410	11	H908	2
P410	13	CC75	3
P410	15	68C1	4

NOTE

When the Troubleshooting Tree calls for testing a Data Bus Line, use the same Clock, Start, and Stop connections specified in this table. The Data Acquisition probe should be placed on the point described in the Troubleshooting Tree.

Table 8-5

Signature List and Setup Conditions for Kernel Check

Version 1.0
Reference No. 2.1

A. Setup Conditions for Test 308

Signature Mode	Data Acquisition Probe Connections
Clock—↓	Clock—U400 Pin 30
Start—↓	Start—U400 Pin 28
Stop—↓	Stop—U400 Pin 28

B. Setup Conditions for 308 Under Test

1. Remove jumpers from P410
2. Place a jumper on P456
3. After test is complete return jumpers original positions

C. Setup Check Signature

Location	Signature
+5 V	0001

Table 8-5 (cont)

D. Signature

Component Circuit Number	Component Pin Number	Signature	Data Bus Line Number
U400	3	0000	
U400	6	0000	
U400	12	UUUU	
U400	13	5555	
U400	14	CCCC	
U400	15	7F7F	
U400	16	5H21	
U400	17	0AFA	
U400	18	UPFH	
U400	19	52F8	
U400	21	HC89	
U400	22	2H70	
U400	23	HPP0	
U400	24	1293	
U400	25	HAP7	
U400	26	3C96	
U400	27	3827	
U400	31	0001	
U400	32	0001	
U400	35	0001	
U400	36	0001	
U400	38	0000	
U400	39	0000	
U400	40	0001	
U410	2	U4U4	Ø
U410	5	5555	1
U410	6	CCCC	2
U410	9	7F7F	3
U410	12	5H21	4
U410	15	0AFA	5
U410	16	UPFH	6
U410	19	52F8	7
U412	1	0255	
U412	5	U3H5	
U412	6	0996	
U412	7	6H49	

NOTE

When the Troubleshooting Tree calls for testing a Data Bus Line, use the same Clock, Start, and Stop connections specified in this table. The Data Acquisition probe should be placed on the point described in the Troubleshooting Tree.

Table 8-6

Signature List and Setup Conditions for Chip Select Test

Version 1.0 Reference No. 2.3

A. Setup Conditions for Test 308

Signature Mode	Data Acquisition Probe Connections
Clock—↑	Clock—U400 Pin 32
Start—↑	Start—U412 Pin 10
Stop—↑	Stop—U412 Pin 10

B. Setup Conditions for 308 Under Test

1. With instrument on, initiate Diagnostic 6.

C. Setup Check Signature

Location	Signature
+5 V	A77U

Table 8-6 (cont)

D. Signature

Component Circuit Number	Component Pin Number	Signature	Chip Select
U396	2	A3U3	
U396	3	C503	
U396	4	H1PA	
U396	5	9C46	
U396	6	F614	
U396	7	95F1	
U396	8	26A2	
U396	9	8F20	
U396	19	HP2H	
U412	1	0A0H	
U412	2	0000	
U412	3	3C16	
U412	4	6CA3	
U412	5	399F	
U412	6	PFU6	
U412	7	C4F4	5
U412	11	29P7	3
U412	12	40FP	
U412	13	60P5	
U412	15	0A0H	
U416	1	A77U	
U416	2	6CA3	
U416	3	05FP	
U416	4	5640	22
U416	5	U896	21
U416	6	5H1P	
U416	7	3U14	19
U416	9	U13P	15
U416	10	6A26	16
U416	13	A235	
U416	14	40FP	
U416	15	40FP	

NOTE

When the Troubleshooting Tree calls for testing a Chip Select, use the same Clock, Start, and Stop connections specified in this table. The Data Acquisition probe should be placed on the point described in the Troubleshooting Tree.

Table 8-7

Signature List and Setup Conditions for Chip Select Test (Write Only)

Version 1.0 Reference No. 2.4

A. Setup Conditions for Test 308

Signature Mode	Data Acquisition Probe Connections
Clock—↑ Start—↑ Stop—↑	Clock—U400 Pin 31 Start—U400 Pin 27 Stop—U400 Pin 27

B. Setup Conditions for 308 Under Test

1. Perform Diagnostic 1

C. Setup Check Signature

Location	Signature
+5 V	03U9

D. Signature

Component Circuit Number	Component Pin Number	Signature	Chip Select
U414	7	03UH	14
U414	9	03UI	13
U414	10	03P9	12
U414	11	03H9	11
U414	12	03C9	10
U414	13	0378	9
U414	14	02UC	8
U414	15	01UF	7

NOTE

When the Troubleshooting Tree calls for testing a Chip Select, use the same Clock, Start, and Stop connections specified in this table. The Data Acquisition probe should be placed on the point described in the Troubleshooting Tree.

Table 8-8

Signature List and Setup Conditions for Address Counter

Version 1.0 Reference No. 3.1

A. Setup Conditions for Test 308

Signature Mode	Data Acquisition Probe Connections
Clock—↑ Start—↑ Stop—↑	Clock—U214 Pin 2 Start—U214 Pin 1 Stop—U214 Pin 15 (U214 Test) U216 Pin 15 (U216 Test)

B. Setup Conditions for 308 Under Test

Diagnostic 1

Setup Check Signature

Location	Signature
+5 V	7U39 (U214 Test) HH9A (U216 Test)

D. Signature

Component Circuit Number	Component Pin Number	Signature
U214	11	007U
U214	12	078C
U214	13	19A7
U214	14	2AP8
Change Stop signal connection and verify Setup Check Signature for U216 Test.		
U216	11	C75U
U216	12	CCP3
U216	13	42U5
U216	14	3U12

Table 8-9

Signature List and Setup Conditions for Delay Counters

Version 1.0 Reference No. 3.2	

A. Setup Conditions for Test 308

Signature Mode	Data Acquisition Probe Connections
Clock—↑ Start—↑ Stop—↑	Clock—U224 Pin 11 Start—U224 Pin 9 Stop—Use the Stop Lead as test Probe

B. Setup Conditions for 308 Under Test

1. Diagnostic 1
2. Connect Serial/Signature Probe to +5 V

C. Setup Check Signature

Location	Signature
U224 Pin 9	FH15

Table 8-9 (cont)

D. Signature

Component Circuit Number	Component Pin Number	Signature
U226	10	0001
U226	13	9A2A
U230	2	001U
U230	5	0003
U230	9	0007
U230	12	01UF
U232	2	9F32
U232	5	U9FF
U232	9	P545
U232	12	CAU9
U234	2	24AU
U234	5	7668
U234	9	24AU
U234	12	24AU
U236	2	24AU
U236	5	24AU
U236	9	24AU
U236	12	24AU
U240	6	495U
U240	8	0001
U242	8	0001
U246	4	668A
U246	6	11PH
U246	8	7884
U250	2	0007
U250	5	0003
U250	8	0001
U250	9	001U
U250	12	007U
U252	2	59A4
U252	5	3951
U252	9	UP73
U252	12	CAUH
U254	8	11PH
U256	5	11PH
U256	6	7884
U256	9	11PH

Table 8-10

Signature List and Setup Conditions for Data Paths

Version 1.0 Reference No. 3.3

A. Setup Conditions for Test 308

Signature Mode	Data Acquisition Probe Connections
Clock—↑ Start—↑ Stop—↑	Clock—U222 Pin 20 Start—U224 Pin 9 Stop—U256 Pin 5

B. Setup Conditions for 308 Under Test

Place Data Probe Channels 0—7 to U220 Pins 4, 3, 2, 1, 21, 5, 6, and 7 respectively.
Set Sample rate to 1 μs, Data [H] =8Ø, connect Data probe clock line to U222 Pin 4.[a]
Delay [H] = 0000

C. Setup Check Signature

Location	Signature
+5 V	11HP

Table 8-10 (cont)

D. Signature

Component Circuit Number	Component Pin Number	Signature
DL112	6	U592
DL112	14	AC10
DL112	15	CPHC
DL112	17	5HUP
DL112	18	H814
DL112	20	U592
DL112	21	1PC6
DL112	23	9C85
DL112	24	A380
U120	9	1PC6
U120	12	0U5C
U122	9	P47U
U122	12	UAF9
U124	9	7UUA
U124	12	FHF2
U126	9	U1UC
U126	12	H1F0
U140	9	8P64
U140	12	2PUU
U142	9	AU1P
U142	12	6F0A
U144	9	76AH
U144	12	HU6H
U146	9	6649
U146	12	FF93
U168	1	1PC6
U168	8	11PH
U168	10	0U5C
U202	9	0U5C
U202	13	1PC6
U206	6	11PH
U206	8	11PH
U220	9	1PC6
U220	11	P47U
U220	13	7UUA
U220	15	U1UC
U222	9	8P64
U222	11	AU1P
U222	13	76AH
U222	15	6649

[a] Put into Free Run by doing acquisition in SERIAL with no data probe, Store Data → REF, Return to Parallel timing, press RESTART IF DATA = REF key.

Table 8-11

Signature List and Setup conditions for Display Column Counter

Version 1.0 Reference No. 4.1	

A. Setup Conditions for Test 308

Signature Mode	Data Acquisition Probe Connections
Clock—↑	Clock—U400 Pin 37
Start—↑	Start—U464 Pin 10
Stop—↑	Stop—U464 Pin 10

B. Setup Conditions for 308 Under Test

None

C. Setup Check Signature

Location	Signature
+5 V	4566

D. Signature

Component Circuit Number	Component Pin Number	Signature
U464	3	F322
U464	4	784U
U464	5	P7P9
U464	6	51A0
U464	10	7F37
U464	11	UP73

Table 8-12

Signature List and Setup Conditions for Display Row. Line Counter

Version 1.0 Reference No. 4.2	

A. Setup Conditions for Test 308

Signature Mode	Data Acquisition Probe Connections
Clock—↑	Clock—U400 Pin 37
Start—↑	Start—U466 Pin 8
Stop—↑	Stop—U466 Pin 8

B. Setup Conditions for 308 Under Test

None

C. Setup Check Signature

Location	Signature
+5 V	CHPU

D. Signature

Component Circuit Number	Component Pin Number	Signature
U466	4	CH5H
U466	5	7634
U466	8	A122
U466	9	57P4

Table 8-13

Signature List and Setup Conditions for Display Character Row Counter

Version 1.0 Reference No. 4.3

A. Setup Conditions for Test 308

Signature Mode	Data Acquisition Probe Connections
Clock—↑	Clock—U400 Pin 37
Start—↑	Start—U405 Pin 5
Stop—↑	Stop—U470 Pin 13

B. Setup Conditions for 308 Under Test

Setup required only at places footnoted

C. Setup Check Signature

Location	Signature
+5 V	UF3A

Table 8-13 (cont)

D. Signature

Component Circuit Number	Component Pin Number	Signature
P492	1	98U3
P492	2	P40U
P492	4	H063[a]
U468	3	A6H8
U468	4	U363
U468	5	5F35
U468	6	6076
U468	11	3U64
U470	6	9140
U490	7	4H45[a]
U492	1	HC53[a]
U492	3	HC53[a]
U492	4	2FHP
U492	5	A2C2
U492	6	35A9
U492	7	35A9
U492	10	98U3
U492	13	9140
U492	14	P40U
U492	15	P40U
U494	6	A7H0[b]
U494	6	H063[a]

[a] Instrument is displaying Timing Menu as when first powered up.

[b] 1. Instrument is powered up.
2. Display appears as in Figure 8-16.
3. Jumper is inserted on P406 and P407 to hold the MPU with that display.

Table 8-14

Baud Rate Test One

Version 1.0
Reference Number 5.1

A. Setup Conditions for Test 308

1. Any mode
2. Use clock lead of Data Acquisition probe for test probe. The EXT CLOCK LED will illuminate when this lead is connected to a TTL logic High and will remain Off when connected to a TTL logic Low.[a]

B. Setup Conditions for 308 Under Test

1. Serial State mode
2. Baud Rate set as indicated
3. Static dc levels at U394 correspond to Baud Rate setting.[b]

Baud Rate Hz	U394 Pins 15	10	7	2
EXT ↓	0	0	0	0
EXT ↑	0	0	0	1
50	0	0	1	0
75	0	0	1	1
110	1	1	1	1
134.5	0	1	0	0
150	1	1	1	0
200	0	1	0	1
300	1	1	0	1
600	0	1	1	0
1200	1	0	1	1
1800	1	0	1	0
2400	0	1	1	1
4800	1	0	0	1
9600	1	0	0	0

[a] **Any measurement device capable of measuring TTL logic levels may be used.**

[b] **Test in Table 8-15 must be performed after tests in Table 8-14 have been completed.**

Table 8-15

Baud Rate Test Two

Version 1.0
Reference No. 5.1

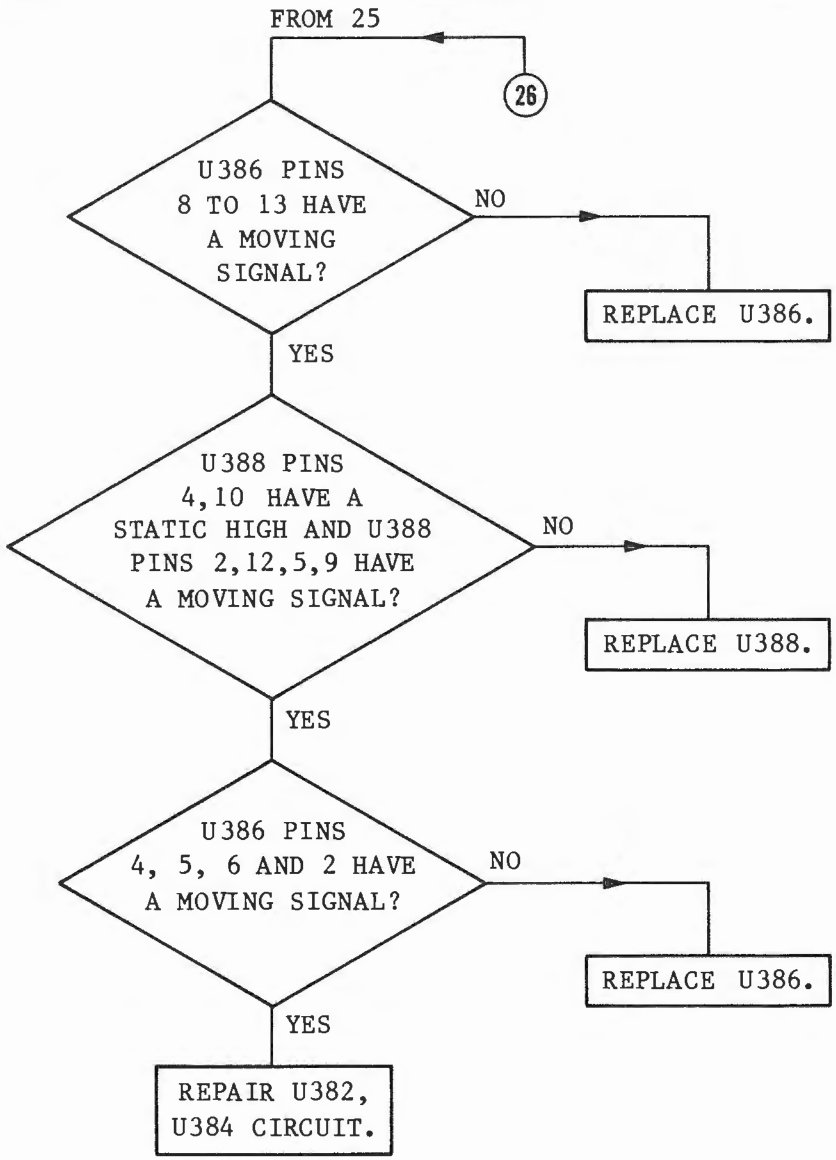
A. Equipment Required: Oscilloscope such as item 3 in Table 4-1.

B. Setup Conditions for 308 Under Test

1. Serial State mode
2. Baud Rate set as indicated
3. Clock period measured at U392 pin 10 correspond to Baud Rate setting

Baud Rate Hz	Clock Period
50	1.2 ms
75	833 μs
110	568 μs
134.5	465 μs
150	417 μs
200	313 μs
300	208 μs
600	104 μs
1200	52 μs
1800	34.7 μs
2400	26 μs
4800	13 μs
9600	6.5 μs

VERSION 1.0



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NOTICE

Signature List Introduction

The following Signature List is a historical document and begins with version 1.0. Future firmware or hardware changes to the 308 may require an update to portions of the Signature List. These updated pages (e.g., for versions 1.1, 1.2, and 1.3) should be inserted behind the corresponding earlier versions which should remain in the manual. This allows one manual to support all versions of the 308.

NOTE

Read the Introduction and Use of Signature Lists and Tables before proceeding any farther.

SIGNATURE LISTS AND TABLES

The following troubleshooting information is designed to be used primarily with the Troubleshooting Tree.

The Signature Table reference numbers in Table 8-1 correspond to numbered information in the Troubleshooting Tree. Table 8-1 can be used as a cross-reference with Table 8-2, Device Error List.

Use of Signature Lists and Tables

The following sequence should be followed for correct usage of the tables in this section:

1. Find the number in the left column of Table 8-1 that matches the Signature List reference number given in the Troubleshooting Tree.

2. If necessary cross-reference the alphabetical character in Table 8-1 column two with Table 8-2 column one to verify that the correct device(s) is/are being checked.

3. Read Table 8-1 column four to find the corresponding Signature List table number.

4. Perform the setups on the test 308 and the 308 under test and verify all the signatures listed in that table.

NOTE

There is a setup check signature provided for most Signature List tables. This allows the operator to confirm that all setup conditions for both the test 308 and the 308 under test are functioning properly. This signature is taken from the +5 V at any place in the 308 under test. Signature Table 8-9 has a special setup and Tables 8-14 and 8-15 do not require a setup check signature.

5. An incorrect signature indicates that the component under test or associated circuitry is faulty. If any component is replaced or repaired, retest for all correct signatures.

6. When all correct signatures have been obtained, return to the Troubleshooting Tree and continue troubleshooting if the malfunction has not been corrected.

Table 8-1

Troubleshooting Tree to Signature List Cross-Reference

Version 1.0

Signature List Reference Number	Device Error Reference Number	Test Name	Signature List Table
1.0		Diagnostic Error Information	
1.1	AA	Power-up Diagnostic Error[a]	
1.2	AB	User-Initiated Diagnostics[b]	
2.0		Control System Tests	
2.1	B	Kernel Check	8-5
2.2	A	ROM Check	8-4
2.3	C	Chip Select Test	8-6
2.4	D	Chip Select (Write Only)	8-7
3.0		Parallel Acquisition	
3.1	E	Address Counter	8-8
3.2	F	Delay Counters	8-9
3.3	G	Data Paths	8-10
4.0		Display	
4.1	H	Display Column Counter	8-11
4.2	I	Display Line-Row Counter	8-12
4.3	J	Display Character-Row Counter	8-13
5.0		Latch	
5.1		Baud Rate Test One	8-14
		Baud Rate Test Two	8-15

[a] Reference to Table 8-3 for error numbers and faults.

[b] Refer to Performance Check portion of the Calibration section for detailed instructions on these tests.

Table 8-2

Device Error List

AA	POWER-UP DIAGNOSTIC ERRORS
AB	USER-INITIATED DIAGNOSTICS
A	U430 ROM CHECK
B	U400 KERNEL CHECK U410 U412
C	U396 CHIP SELECT TEST U412 U416
D	U414 CHIP SELECT TEST
E	U214 ADDRESS COUNTER TEST U216
F	U226 PARALLEL CONTROL CRT TEST U230 U232 U234 U236 U240 U242 U246 U250 U252 U254 U256
G	DL112 PARALLEL DATA TEST U120 U122 U124 U126 U140 U142 U144 U146 U168 U202 U206 U220 U222
H	U464 COLUMN COUNTER U468
I	U466 LINE OF ROW COUNTER
J	U452 CHARACTER ROW COUNTER
	U468 SYNC—Z AXIS GATE AND CHARACTER ROM CHECK U470 U490 U492 U494

Table 8-3

308 Power-Up Diagnostic Errors

Error No.	Fault
	RAM/ROM ERRORS
1,2	RAM error U480 or U482 is bad (F800—FBFF).
3,4	RAM error U420 or U422 is bad (FC00—FFFF).
5	ROM error U432 is bad (2000—3FFF).
6	ROM error U434 is bad (4000—5FFF).
	PARALLEL SYSTEM ERRORS
7	High Speed Memory Address Counter does not load correctly (U214, U216).
8	High Speed Memory Address Counter does not count correctly (U214, U216).
9	U256A does not reset (Not Store Clock Enable does not reset).
10	U224A or U224B won't reset (Trig'd won't reset).
11	U256B does not reset (Data Position Count Carry does not reset).
12	U256A path bad.
13	U224 path bad.
14	U256B path bad.
15	U256A won't set (Not Store Clock Enable does not set).
16	Data Position Counter does not load (U252, U254).
17	Data Position Counter does not count (U252, U254).
18	Delay Counter does not load (U230, U232, U234, U236).
19	Delay Counter does not count (U230, U232, U234, U236).
20	Parallel Sample Rate error. 2 ms clock too slow.
21	Parallel Sample Rate error. 2 ms clock too fast.
22	Parallel Sample Rate error. 100 ms clock too slow.
23	Parallel Sample Rate error. 100 ms clock too fast.

Table 8-3 (cont)

Error No.	Fault
	SERIAL SYSTEM ERROR
24	8251A will not recognize asynchronous characters.
	KEYBOARD ERROR
25	The keyboard says that a key(s) is being pushed.
	SIGNATURE ERRORS
26	Start flip/flop won't reset (U370B, U372B).
27	Stop flip/flop won't reset (U370B, U374B).
28	CRC generator won't reset (U378, U380, U382, U384).

NOTE

An error in RAM or ROM (errors 1—6) is considered fatal. The error number(s) are displayed, or at least an attempt is made, and then the processor simply halts. If a nonfatal error occurs (errors 7—28) and no fatal errors, the error number(s) is displayed, and the instrument waits for the user to push the START key to cause the instrument to operate despite the errors. If no errors occur, an **OK** *message is displayed for about 2 seconds, and then control goes to the main program.*

Table 8-4

Signature List and Setup Conditions for ROM Check

Version 1.0
Reference No. 2.2

Setup Conditions

A. Setup Conditions for Test 308

Signature Mode	Data Acquisition Probe Connections
Clock—↑	Clock—U412 Pin 14
Start—↓	Start—U400 Pin 28
Stop—↑	Stop—U400 Pin 24

B. Setup Conditions for 308 Under Test

1. Remove jumpers from P410
2. Place a jumper on P456
3. After test is complete, return jumpers to original positions

C. Setup Check Signature

Location	Signature
+5 V	7A70

D. Signature

Component Circuit Number	Component Pin Number	Signature	Data Bus Line Number
P410	1	F64P	0
P410	3	4UAA	1
P410	5	F417	7
P410	7	6C3A	6
P410	9	F221	5
P410	11	H908	2
P410	13	CC75	3
P410	15	68C1	4

NOTE

When the Troubleshooting Tree calls for testing a Data Bus Line, use the same Clock, Start, and Stop connections specified in this table. The Data Acquisition probe should be placed on the point described in the Troubleshooting Tree.

Table 8-5

Signature List and Setup Conditions for Kernel Check

Version 1.0 Reference No. 2.1	

A. Setup Conditions for Test 308

Signature Mode	Data Acquisition Probe Connections
Clock—↓ Start—↓ Stop—↓	Clock—U400 Pin 30 Start—U400 Pin 28 Stop—U400 Pin 28

B. Setup Conditions for 308 Under Test

1. Remove jumpers from P410
2. Place a jumper on P456
3. After test is complete return jumpers original positions

C. Setup Check Signature

Location	Signature
+5 V	0001

Table 8-5 (cont)

D. Signature

Component Circuit Number	Component Pin Number	Signature	Data Bus Line Number
U400	3	0000	
U400	6	0000	
U400	12	UUUU	
U400	13	5555	
U400	14	CCCC	
U400	15	7F7F	
U400	16	5H21	
U400	17	0AFA	
U400	18	UPFH	
U400	19	52F8	
U400	21	HC89	
U400	22	2H70	
U400	23	HPP0	
U400	24	1293	
U400	25	HAP7	
U400	26	3C96	
U400	27	3827	
U400	31	0001	
U400	32	0001	
U400	35	0001	
U400	36	0001	
U400	38	0000	
U400	39	0000	
U400	40	0001	
U410	2	U4U4	Ø
U410	5	5555	1
U410	6	CCCC	2
U410	9	7F7F	3
U410	12	5H21	4
U410	15	0AFA	5
U410	16	UPFH	6
U410	19	52F8	7
U412	1	0255	
U412	5	U3H5	
U412	6	0996	
U412	7	6H49	

NOTE

When the Troubleshooting Tree calls for testing a Data Bus Line, use the same Clock, Start, and Stop connections specified in this table. The Data Acquisition probe should be placed on the point described in the Troubleshooting Tree.

Table 8-6

Signature List and Setup Conditions for Chip Select Test

Version 1.0 Reference No. 2.3	

A. Setup Conditions for Test 308

Signature Mode	Data Acquisition Probe Connections
Clock—↑ Start—↑ Stop—↑	Clock—U400 Pin 32 Start—U412 Pin 10 Stop—U412 Pin 10

B. Setup Conditions for 308 Under Test

1. With instrument on, initiate Diagnostic 6.

C. Setup Check Signature

Location	Signature
+5 V	A77U

Table 8-6 (cont)

D. Signature

Component Circuit Number	Component Pin Number	Signature	Chip Select
U396	2	A3U3	
U396	3	C503	
U396	4	H1PA	
U396	5	9C46	
U396	6	F614	
U396	7	95F1	
U396	8	26A2	
U396	9	8F20	
U396	19	HP2H	
U412	1	0A0H	
U412	2	0000	
U412	3	3C16	
U412	4	6CA3	
U412	5	399F	
U412	6	PFU6	
U412	7	C4F4	5
U412	11	29P7	3
U412	12	40FP	
U412	13	60P5	
U412	15	0A0H	
U416	1	A77U	
U416	2	6CA3	
U416	3	05FP	
U416	4	5640	22
U416	5	U896	21
U416	6	5H1P	
U416	7	3U14	19
U416	9	U13P	15
U416	10	6A26	16
U416	13	A235	
U416	14	40FP	
U416	15	40FP	

NOTE

When the Troubleshooting Tree calls for testing a Chip Select, use the same Clock, Start, and Stop connections specified in this table. The Data Acquisition probe should be placed on the point described in the Troubleshooting Tree.

Table 8-7

Signature List and Setup Conditions for Chip Select Test (Write Only)

Version 1.0 Reference No. 2.4

A. Setup Conditions for Test 308

Signature Mode	Data Acquisition Probe Connections
Clock—↑ Start—↑ Stop—↑	Clock—U400 Pin 31 Start—U400 Pin 27 Stop—U400 Pin 27

B. Setup Conditions for 308 Under Test

1. Perform Diagnostic 1

C. Setup Check Signature

Location	Signature
+5 V	03U9

D. Signature

Component Circuit Number	Component Pin Number	Signature	Chip Select
U414	7	03UH	14
U414	9	03UI	13
U414	10	03P9	12
U414	11	03H9	11
U414	12	03C9	10
U414	13	0378	9
U414	14	02UC	8
U414	15	01UF	7

NOTE

When the Troubleshooting Tree calls for testing a Chip Select, use the same Clock, Start, and Stop connections specified in this table. The Data Acquisition probe should be placed on the point described in the Troubleshooting Tree.

Table 8-8

Signature List and Setup Conditions for Address Counter

Version 1.0 Reference No. 3.1

A. Setup Conditions for Test 308

Signature Mode	Data Acquisition Probe Connections
Clock—↑ Start—↑ Stop—↑	Clock—U214 Pin 2 Start—U214 Pin 1 Stop—U214 Pin 15 (U214 Test) U216 Pin 15 (U216 Test)

B. Setup Conditions for 308 Under Test

Diagnostic 1

Setup Check Signature

Location	Signature
+5 V	7U39 (U214 Test) HH9A (U216 Test)

D. Signature

Component Circuit Number	Component Pin Number	Signature
U214	11	007U
U214	12	078C
U214	13	19A7
U214	14	2AP8
Change Stop signal connection and verify Setup Check Signature for U216 Test.		
U216	11	C75U
U216	12	CCP3
U216	13	42U5
U216	14	3U12

Table 8-9

Signature List and Setup Conditions for Delay Counters

Version 1.0 Reference No. 3.2	

A. Setup Conditions for Test 308

Signature Mode	Data Acquisition Probe Connections
Clock—↑ Start—↑ Stop—↑	Clock—U224 Pin 11 Start—U224 Pin 9 Stop—Use the Stop Lead as test Probe

B. Setup Conditions for 308 Under Test

1. Diagnostic 1
2. Connect Serial/Signature Probe to +5 V

C. Setup Check Signature

Location	Signature
U224 Pin 9	FH15

Table 8-9 (cont)

D. Signature

Component Circuit Number	Component Pin Number	Signature
U226	10	0001
U226	13	9A2A
U230	2	001U
U230	5	0003
U230	9	0007
U230	12	01UF
U232	2	9F32
U232	5	U9FF
U232	9	P545
U232	12	CAU9
U234	2	24AU
U234	5	7668
U234	9	24AU
U234	12	24AU
U236	2	24AU
U236	5	24AU
U236	9	24AU
U236	12	24AU
U240	6	495U
U240	8	0001
U242	8	0001
U246	4	668A
U246	6	11PH
U246	8	7884
U250	2	0007
U250	5	0003
U250	8	0001
U250	9	001U
U250	12	007U
U252	2	59A4
U252	5	3951
U252	9	UP73
U252	12	CAUH
U254	8	11PH
U256	5	11PH
U256	6	7884
U256	9	11PH

Table 8-10

Signature List and Setup Conditions for Data Paths

Version 1.0 Reference No. 3.3	

A. Setup Conditions for Test 308

Signature Mode	Data Acquisition Probe Connections
Clock—↑ Start—↑ Stop—↑	Clock—U222 Pin 20 Start—U224 Pin 9 Stop—U256 Pin 5

B. Setup Conditions for 308 Under Test

Place Data Probe Channels 0—7 to U220 Pins 4, 3, 2, 1, 21, 5, 6, and 7 respectively.
Set Sample rate to 1 μs, Data $\boxed{H}$ =8Ø, connect Data probe clock line to U222 Pin 4.[a]
Delay $\boxed{H}$ = 0000

C. Setup Check Signature

Location	Signature
+5 V	11HP

Table 8-10 (cont)

D. Signature

Component Circuit Number	Component Pin Number	Signature
DL112	6	U592
DL112	14	AC10
DL112	15	CPHC
DL112	17	5HUP
DL112	18	H814
DL112	20	U592
DL112	21	1PC6
DL112	23	9C85
DL112	24	A380
U120	9	1PC6
U120	12	0U5C
U122	9	P47U
U122	12	UAF9
U124	9	7UUA
U124	12	FHF2
U126	9	U1UC
U126	12	H1F0
U140	9	8P64
U140	12	2PUU
U142	9	AU1P
U142	12	6F0A
U144	9	76AH
U144	12	HU6H
U146	9	6649
U146	12	FF93
U168	1	1PC6
U168	8	11PH
U168	10	0U5C
U202	9	0U5C
U202	13	1PC6
U206	6	11PH
U206	8	11PH
U220	9	1PC6
U220	11	P47U
U220	13	7UUA
U220	15	U1UC
U222	9	8P64
U222	11	AU1P
U222	13	76AH
U222	15	6649

[a] Put into Free Run by doing acquisition in SERIAL with no data probe, Store Data → REF, Return to Parallel timing, press RESTART IF DATA = REF key.

Table 8-11

Signature List and Setup conditions for Display Column Counter

Version 1.0 Reference No. 4.1	

A. Setup Conditions for Test 308

Signature Mode	Data Acquisition Probe Connections
Clock—↑	Clock—U400 Pin 37
Start—↑	Start—U464 Pin 10
Stop—↑	Stop—U464 Pin 10

B. Setup Conditions for 308 Under Test

None

C. Setup Check Signature

Location	Signature
+5 V	4566

D. Signature

Component Circuit Number	Component Pin Number	Signature
U464	3	F322
U464	4	784U
U464	5	P7P9
U464	6	51A0
U464	10	7F37
U464	11	UP73

Table 8-12

Signature List and Setup Conditions for Display Row.Line Counter

Version 1.0 Reference No. 4.2	

A. Setup Conditions for Test 308

Signature Mode	Data Acquisition Probe Connections
Clock—↑	Clock—U400 Pin 37
Start—↑	Start—U466 Pin 8
Stop—↑	Stop—U466 Pin 8

B. Setup Conditions for 308 Under Test

None

C. Setup Check Signature

Location	Signature
+5 V	CHPU

D. Signature

Component Circuit Number	Component Pin Number	Signature
U466	4	CH5H
U466	5	7634
U466	8	A122
U466	9	57P4

Table 8-13

Signature List and Setup Conditions for Display Character Row Counter

Version 1.0 Reference No. 4.3

A. Setup Conditions for Test 308

Signature Mode	Data Acquisition Probe Connections
Clock—↑ Start—↑ Stop—↑	Clock—U400 Pin 37 Start—U405 Pin 5 Stop—U470 Pin 13

B. Setup Conditions for 308 Under Test

Setup required only at places footnoted

C. Setup Check Signature

Location	Signature
+5 V	UF3A

Table 8-13 (cont)

D. Signature

Component Circuit Number	Component Pin Number	Signature
P492	1	98U3
P492	2	P40U
P492	4	H063[a]
U468	3	A6H8
U468	4	U363
U468	5	5F35
U468	6	6076
U468	11	3U64
U470	6	9140
U490	7	4H45[a]
U492	1	HC53[a]
U492	3	HC53[a]
U492	4	2FHP
U492	5	A2C2
U492	6	35A9
U492	7	35A9
U492	10	98U3
U492	13	9140
U492	14	P40U
U492	15	P40U
U494	6	A7H0[b]
U494	6	H063[a]

[a] Instrument is displaying Timing Menu as when first powered up.

[b] 1. Instrument is powered up.
2. Display appears as in Figure 8-16.
3. Jumper is inserted on P406 and P407 to hold the MPU with that display.

Table 8-14

Baud Rate Test One

Version 1.0 Reference Number 5.1

A. Setup Conditions for Test 308

1. Any mode

2. Use clock lead of Data Acquisition probe for test probe. The EXT CLOCK LED will illuminate when this lead is connected to a TTL logic High and will remain Off when connected to a TTL logic Low.[a]

B. Setup Conditions for 308 Under Test

1. Serial State mode

2. Baud Rate set as indicated

3. Static dc levels at U394 correspond to Baud Rate setting.[b]

Baud Rate Hz	U394 Pins 15	10	7	2
EXT ↓	0	0	0	0
EXT ↑	0	0	0	1
50	0	0	1	0
75	0	0	1	1
110	1	1	1	1
134.5	0	1	0	0
150	1	1	1	0
200	0	1	0	1
300	1	1	0	1
600	0	1	1	0
1200	1	0	1	1
1800	1	0	1	0
2400	0	1	1	1
4800	1	0	0	1
9600	1	0	0	0

[a] **Any measurement device capable of measuring TTL logic levels may be used.**

[b] **Test in Table 8-15 must be performed after tests in Table 8-14 have been completed.**

Table 8-15

Baud Rate Test Two

Version 1.0 Reference No. 5.1

A. Equipment Required: Oscilloscope such as item 3 in Table 4-1.

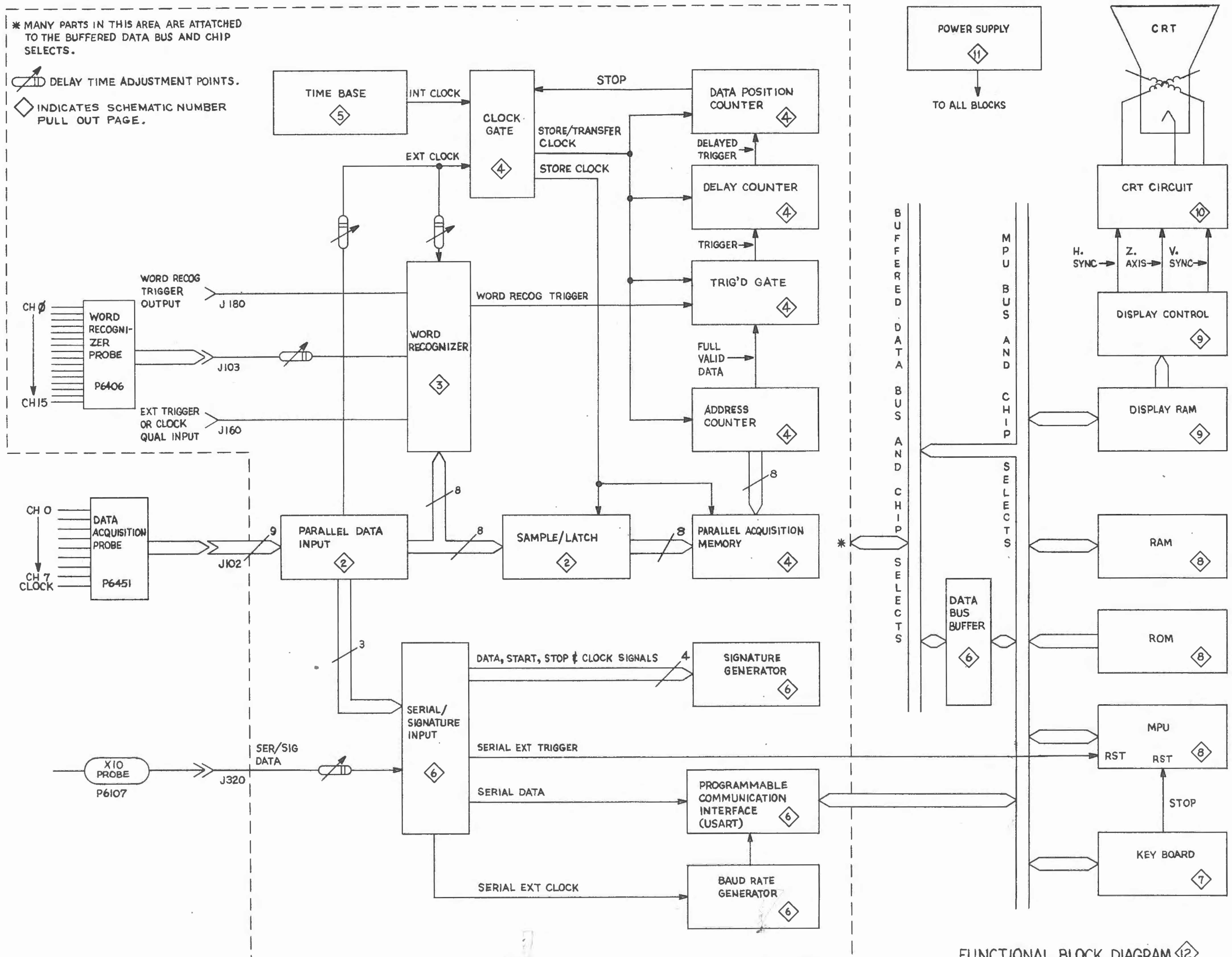
B. Setup Conditions for 308 Under Test

1. Serial State mode

2. Baud Rate set as indicated

3. Clock period measured at U392 pin 10 correspond to Baud Rate setting

Baud Rate Hz	Clock Period
50	1.2 ms
75	833 μs
110	568 μs
134.5	465 μs
150	417 μs
200	313 μs
300	208 μs
600	104 μs
1200	52 μs
1800	34.7 μs
2400	26 μs
4800	13 μs
9600	6.5 μs



FUNCTIONAL BLOCK DIAGRAM 12

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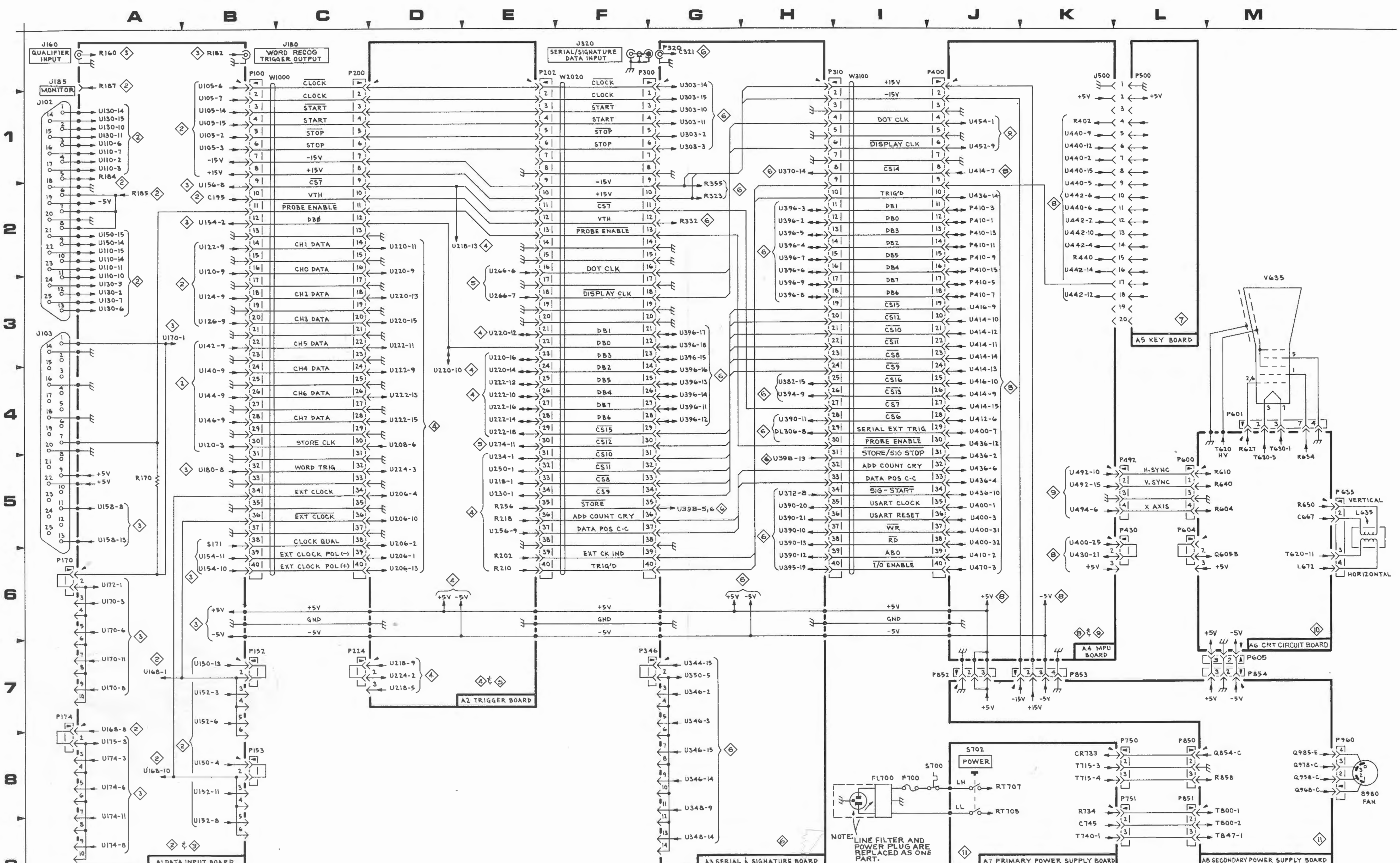
CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM NUMBER	SCHEM LOCATION	CIRCUIT NUMBER	SCHEM NUMBER	SCHEM LOCATION
B980	11	7K			
			L635	10	5I
F700	11	5A			
FL700	11	5A	S700	11	2A
J320	6	1A			



2662-01

WIRING DIAGRAM 1

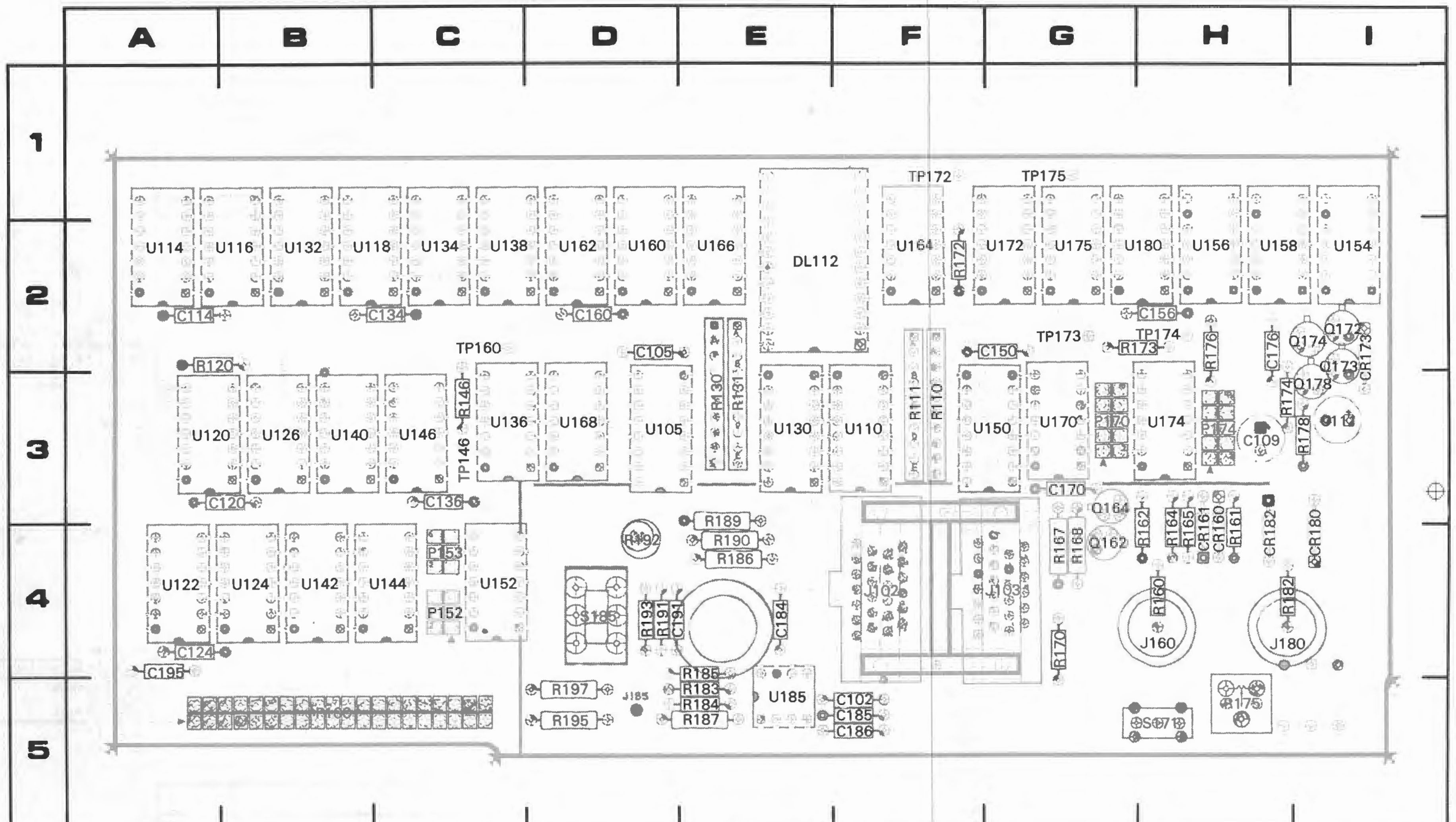
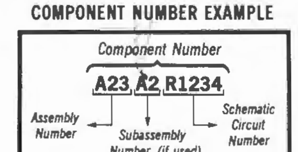


Figure 8-2. A1 Data Input board component locations.

2662-93

Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

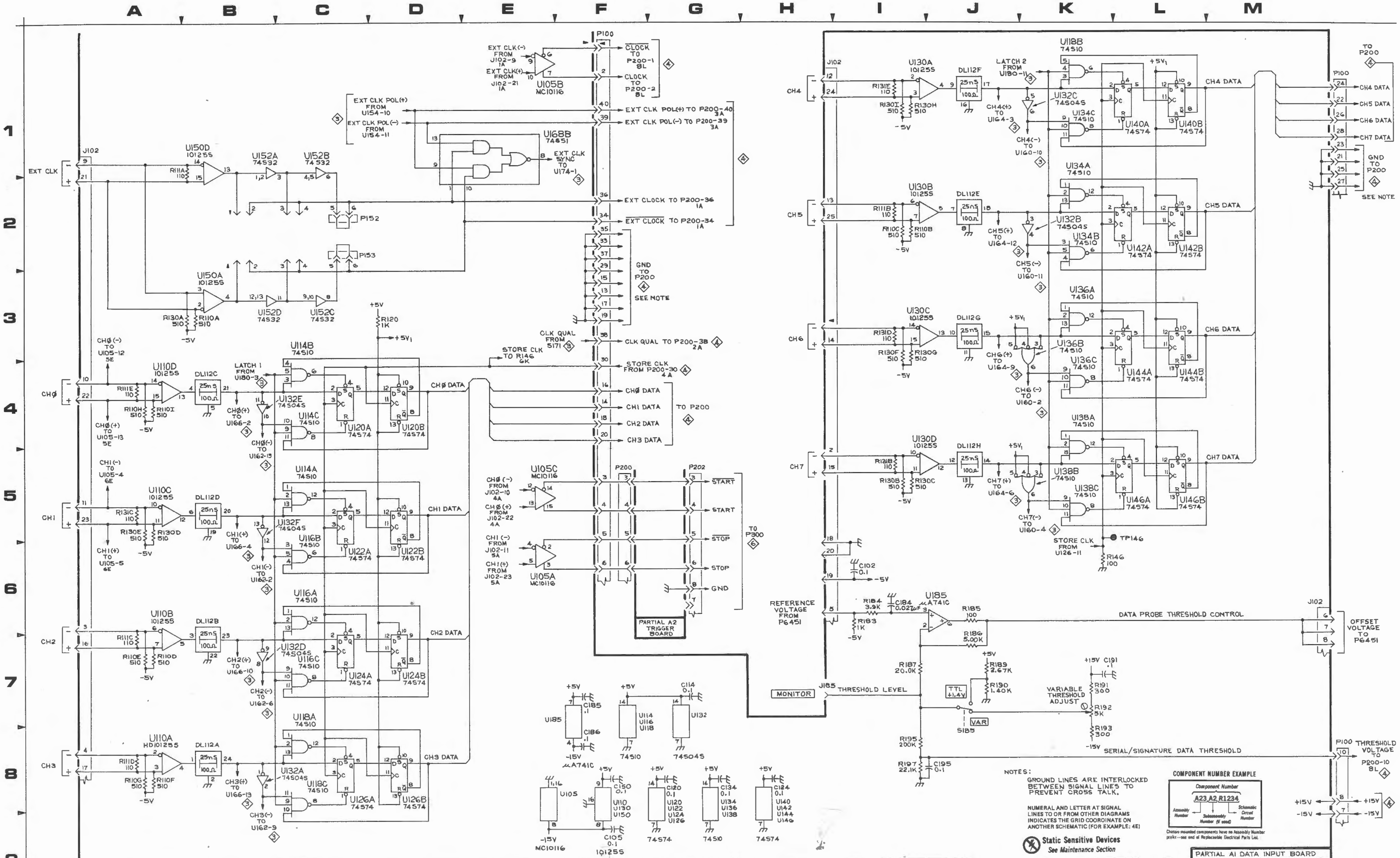
A1 DATA INPUT BOARD

DATA INPUT DIAGRAM ⟨2⟩

PARTIAL A1 ASSY

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C102	6I	5F	R111E	4A	3F	U118A	7C	2B
C105	8H	2D	R120	9C	2A	U118B	1K	2B
C114	7G	2A	R130A	3A	3E	U118C	8C	2B
C120	8G	3B	R130B	5I	3E	U120A	4C	3A
C124	8H	4A	R130C	5I	3E	U120B	4D	3A
C134	8G	2C	R130D	5A	3E	U122A	6C	4A
C150	7H	2G	R130E	5A	3E	U122B	6D	4A
C184	6I	4E	R130F	3I	3E	U124A	7C	4B
C185	7F	5F	R130G	3I	3E	U124B	7D	4B
C186	8F	5F	R130H	1I	3E	U126A	8C	3B
C191	7K	4D	R130I	1I	3E	U126B	8D	3B
C195	8J	4A	R131B	5I	3E	U130A	1I	3E
			R131C	5A	3E	U130B	2I	3E
DL112A	8B	2E	R131D	3I	3E	U130C	3I	3E
DL112B	6B	2E	R131E	1I	3E	U130D	4I	3E
DL112C	4B	2E	R146	6K	3C	U132A	8C	2B
DL112D	5B	2E	R183	6I	5E	U132B	2K	2B
DL112E	2J	2E	R184	6I	5E	U132C	1K	2B
DL112F	1J	2E	R185	6J	4E	U132D	7C	2B
DL112G	3J	2E	R186	7J	4E	U132E	4C	2B
DL112H	5J	2E	R187	7I	5E	U132F	5C	2E
			R189	7J	3E	U134A	1K	2C
J102	1A	4F	R190	7J	4E	U134B	2K	2C
J102	1H	4F	R191	7K	4D	U134C	1K	2C
J102	6N	4F	R192	7K	4D	U136A	3K	3C
J185	7N	5D	R193	7K	4D	U136B	3K	3C
			R195	8I	5D	U136C	4K	3C
P100	1F	5B	R197	8I	5D	U138A	4K	2C
P100	1N	5B				U138B	5K	2C
P100	8N	5B	S185	8J	4D	U138C	5K	2C
P152	2C	4C				U140A	1L	3B
P153	2C	4C	TP146	5L	3C	U140B	1L	3B
						U142A	2L	4B
R110A	3B	3F	U105A	6E	3D	U142B	2L	4B
R110B	2I	3F	U105B	1E	3D	U144A	4L	4C
R110C	2I	3F	U105C	5E	3D	U144B	4L	4C
R110D	7A	3F	U110A	8A	3F	U146A	5L	3C
R110E	7A	3F	U110B	6A	3F	U146B	5L	3C
R110F	8A	3F	U110C	5A	3F	U150A	3B	3G
R110G	8A	3F	U110D	4A	3F	U150D	1B	3G
R110H	4A	3F	U114A	5C	2A	U152A	1B	4C
R110I	4A	3F	U114B	3C	2A	U152B	1C	4C
R111A	1A	3F	U114C	4C	2A	U152C	3C	4C
R111B	2I	3F	U116A	6C	2B	U152D	3B	4C
R111C	7A	3F	U116B	5C	2B	U168B	1E	3D
R111D	8A	3F	U116C	7C	2B	U185	6J	5E

Partial A1 ASSY also shown on diagram 3.



308

2662-02

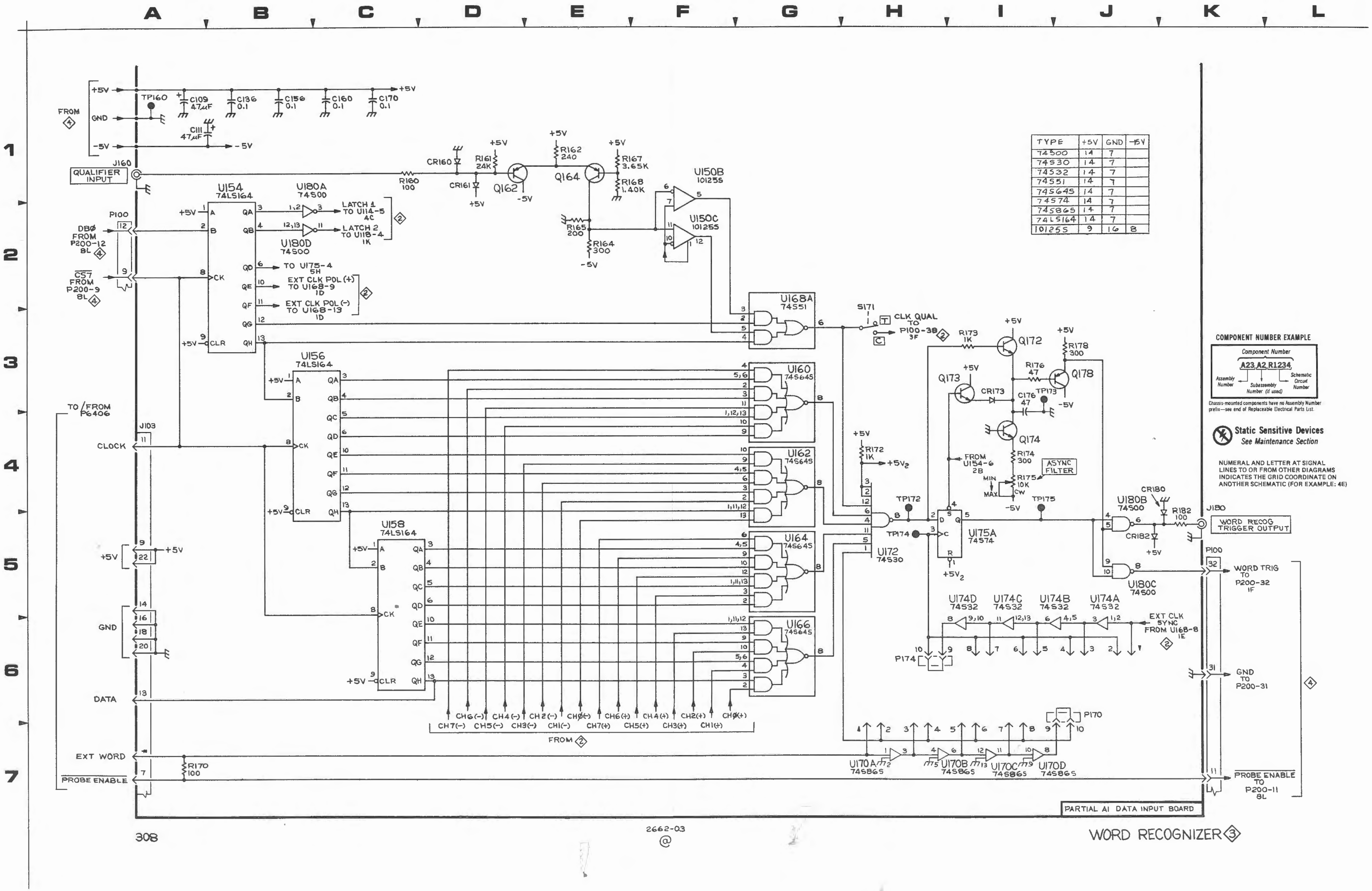
DATA INPUT ②

WORD RECOGNIZER DIAGRAM ③

PARTIAL A1 ASSY

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C109	1A	3H	R173	3I	2H
C111	1A	3I	R174	4I	3H
C136	1B	3C	R175	4I	5H
C156	1B	2H	R176	3I	2H
C160	1C	2D	R178	3J	3I
C170	1C	3G	R182	4K	4H
C176	3I	2H			
			S171	2H	5H
CR160	1D	4H			
CR161	1D	4H	TP160	1A	2C
CR173	3I	2I	TP172	4H	1F
CR180	4J	4I	TP173	3I	2G
CR182	5J	4H	TP174	5H	2H
			TP175	4I	1G
J103	4A	4G			
J160	1A	4H	U150B	1F	3G
J180	4K	4H	U150C	2F	3G
			U154	1B	2I
P100	2A	5B	U156	3C	2H
P100	5K	5B	U158	5C	2H
P170	6J	3G	U160	3G	2D
P174	6H	3H	U162	4G	2D
			U164	5G	2F
Q162	1D	4G	U166	6G	2E
Q164	1E	3G	U168A	2G	3D
Q172	3I	2I	U170A	7H	3G
Q173	3I	2I	U170B	7I	3G
Q174	4I	2I	U170C	7I	3G
Q178	3J	2I	U170D	7J	3G
			U172	5H	2G
R160	1C	4H	U174A	5J	3H
R161	1D	4H	U174B	5J	3H
R162	1E	4H	U174C	5I	3H
R164	2E	4H	U174D	5I	3H
R165	2E	4H	U175	5I	2G
R167	1E	4G	U180A	1B	2H
R168	1E	4G	U180B	4J	2H
R170	7A	4G	U180C	5J	2H
R172	4H	2F	U180D	2B	2H

Partial A1 ASSY also shown on diagram 2.



TYPE	+5V	GND	-5V
74S00	14	7	
74S30	14	7	
74S32	14	7	
74S51	14	7	
74S645	14	7	
74S74	14	7	
74S86S	14	7	
74LS164	14	7	
101255	9	16	8

2662-03
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WORD RECOGNIZER 3

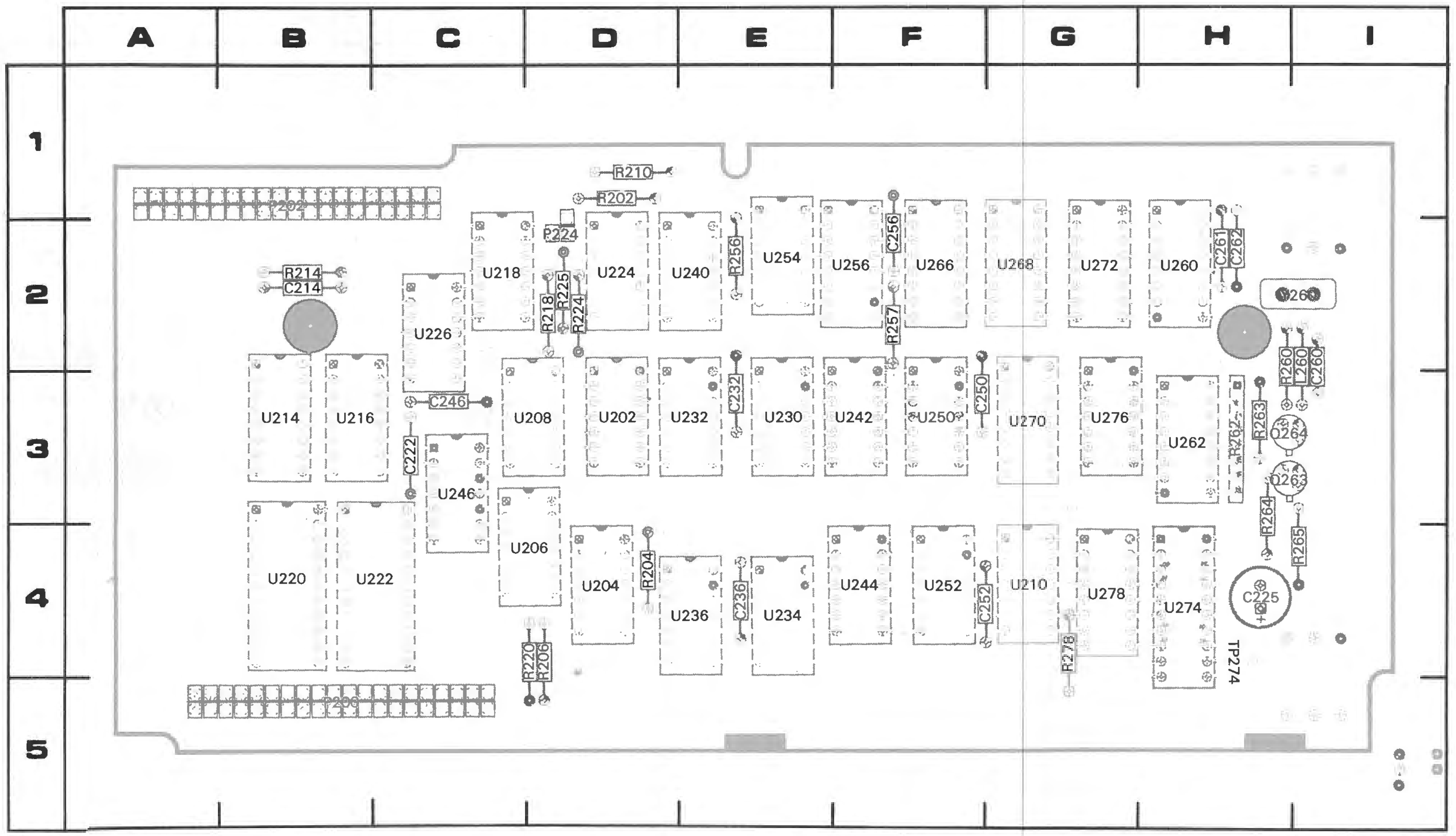


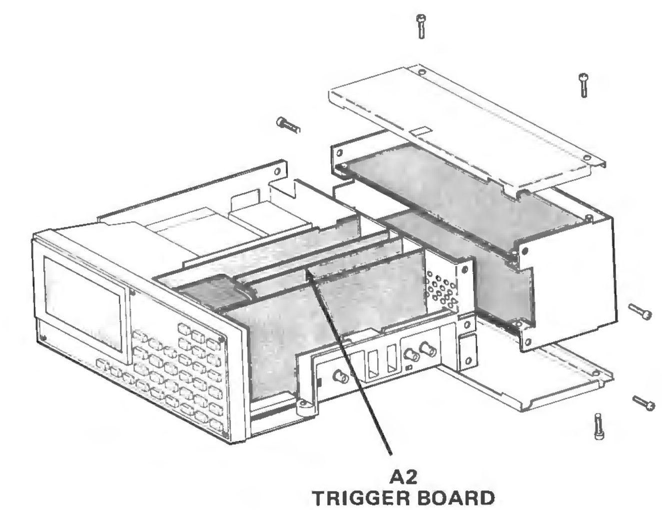
Figure 8-3. A2 Trigger board component locations.

Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE

Component Number	
A23 A2 R1234	
Assembly Number	Subassembly Number (if used)	Schematic Circuit Number

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.



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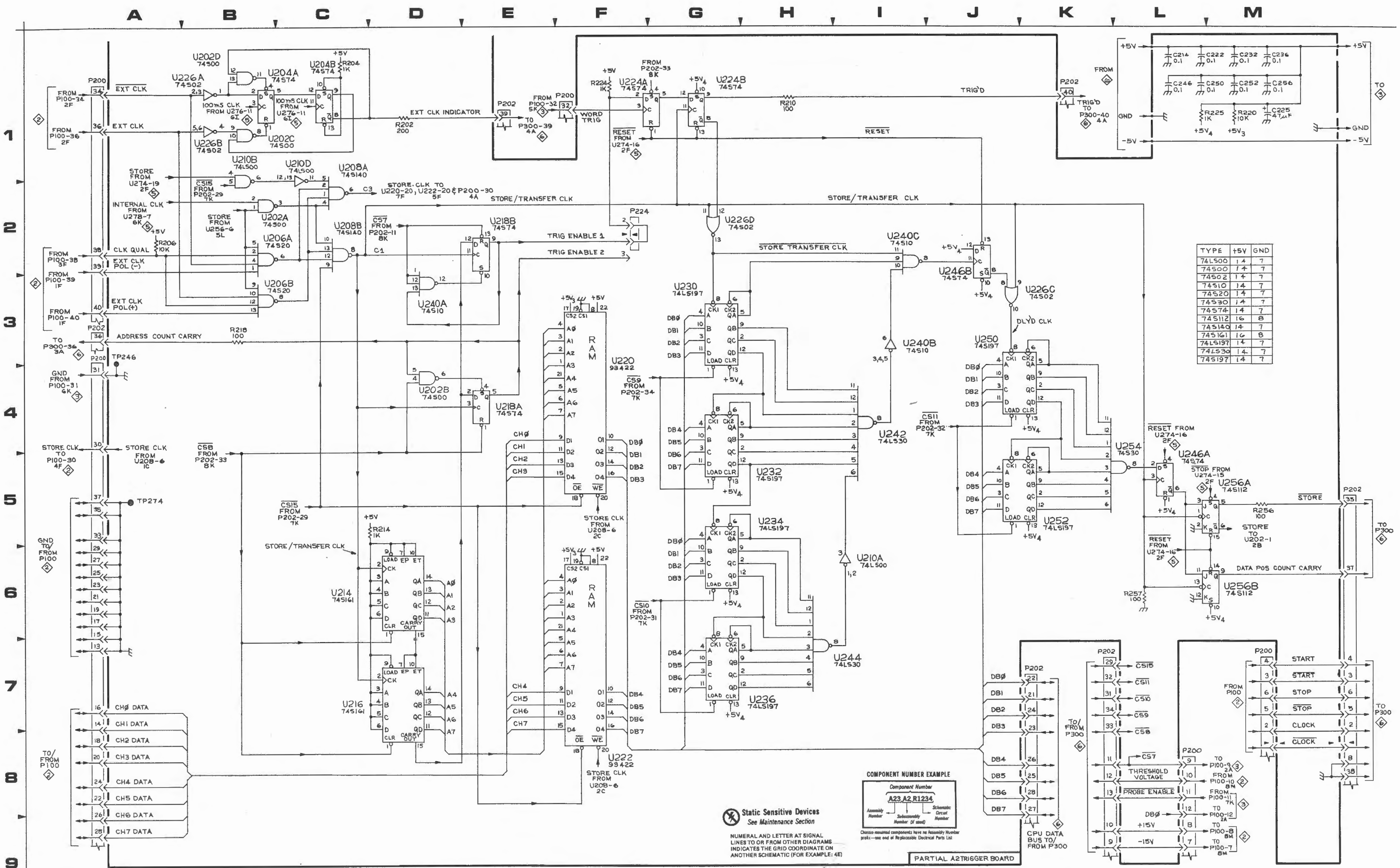
ACQUISITION MEMORY & TRIGGER DELAY — DIAGRAM 4

PARTIAL A2 ASSY

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C214	1L	2B	U202D	1B	3D
C222	1M	3C	U204A	1B	4D
C225	1M	4H	U204B	1C	4D
C232	1M	3E	U206A	2B	4D
C236	1M	4E	U206B	3B	4D
C246	1L	3C	U208A	1C	3D
C250	1M	3F	U208B	2C	3D
C252	1M	4F	U210A	6I	4G
C256	1M	2F	U210B	1B	4G
			U210D	1C	4G
P200	1A	5B	U214	6C	3B
P200	1F	5B	U216	7C	3B
P200	7M	5B	U218A	4E	2C
P200	8L	5B	U218B	2E	2C
P202	1E	1B	U220	8F	4B
P202	1K	1B	U222	3F	4C
P202	5M	1B	U224A	1F	2D
P202	7K	1B	U224B	1G	2D
P202	7K	1B	U226A	1B	2C
P224	2F	2D	U226B	1B	2C
			U226C	3K	2C
R202	1D	1D	U226D	2G	2C
R204	1C	4D	U230	3G	3E
R206	2A	4D	U232	5H	3E
R210	1H	1D	U234	5H	4E
R214	5D	2B	U236	7H	4E
R218	3B	2D	U240A	3D	2E
R220	1M	4D	U240B	3I	2E
R224	1F	2D	U240C	2I	2E
R225	1M	2D	U242	4I	3F
R256	5M	2E	U244	7I	4F
R257	6L	2F	U246A	5L	3C
			U246B	2J	3C
TP274	5A	4H	U250	3J	3F
			U252	5K	4F
U202A	2B	3D	U254	4L	2E
U202B	4D	3D	U256A	5M	2F
U202C	1B	3D	U256B	6M	2F

Partial A2 ASSY also shown on diagram 5.



TYPE	+5V	GND
74LS00	14	7
74S00	14	7
74S02	14	7
74S10	14	7
74S20	14	7
74S30	14	7
74S74	14	7
74S112	16	8
74S140	14	7
74S161	16	8
74LS197	14	7
74LS30	14	7
74S197	14	7

2662-04

ACQUISITION MEMORY & TRIGGER DELAY 4

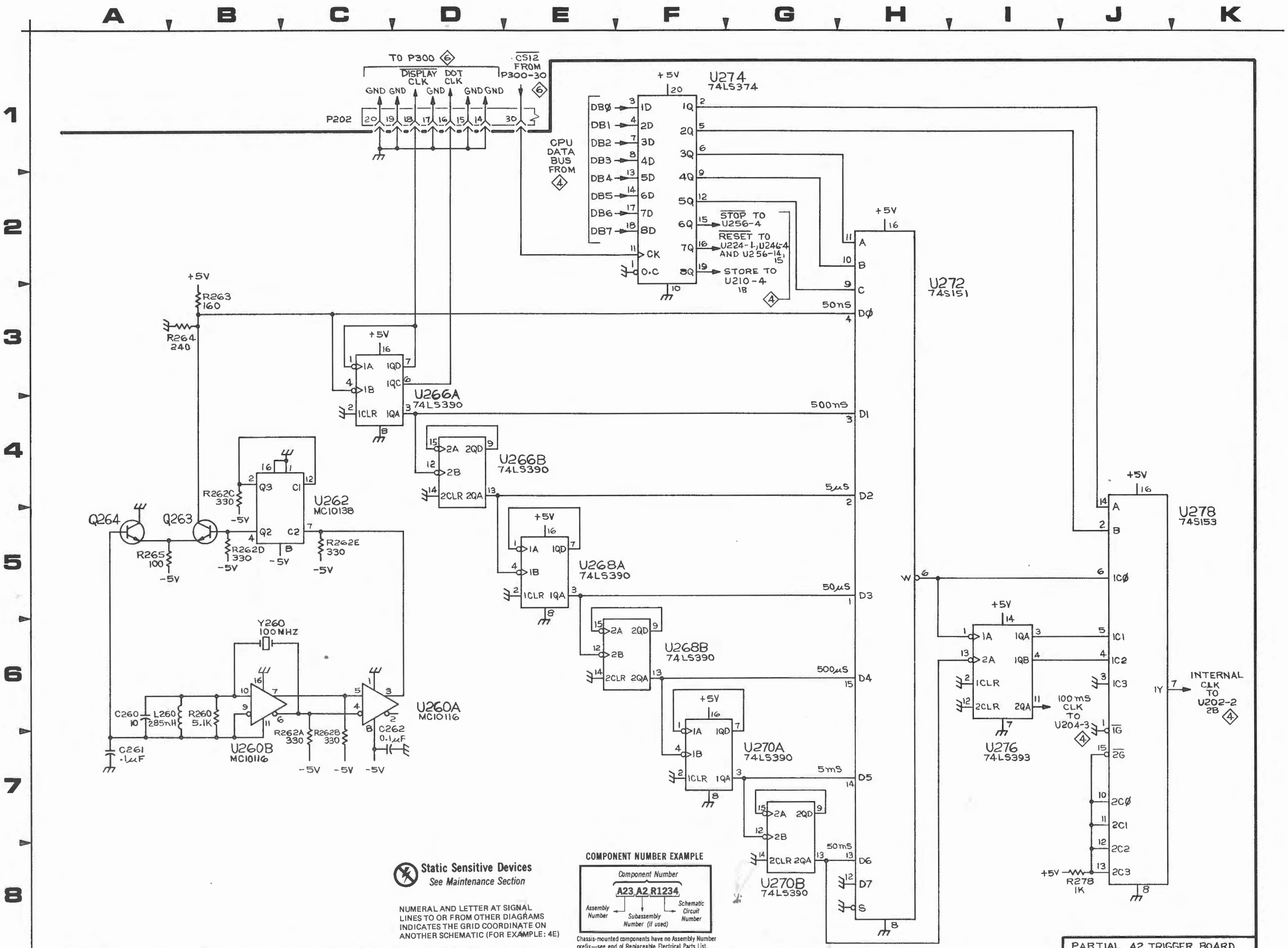
TIME BASE

DIAGRAM 5

PARTIAL A2 ASSY

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C260	6A	2I
C261	7A	2H
C262	7C	2H
L260	6B	2I
P202	1C	1B
Q263	5B	3I
Q264	5A	3I
R260	6B	2H
R262A	7C	3H
R262B	7C	3H
R262C	4B	3H
R262D	5B	3H
R262E	5C	3H
R263	3B	3H
R264	3B	3H
R265	5A	4I
R278	8J	4G
U260A	6D	2H
U260B	7B	2H
U262	4C	3H
U266A	3D	2F
U266B	4D	2F
U268A	5E	2G
U268B	6F	2G
U270A	7G	3G
U270B	8G	3G
U272	2H	2G
U274	1F	4H
U276	7I	3G
U278	5K	4G
Y260	6B	2I

Partial A2 ASSY also shown on diagram 4.



Static Sensitive Devices
See Maintenance Section

NUMERAL AND LETTER AT SIGNAL LINES TO OR FROM OTHER DIAGRAMS INDICATES THE GRID COORDINATE ON ANOTHER SCHEMATIC (FOR EXAMPLE: 4E)

COMPONENT NUMBER EXAMPLE

Component Number: A23 A2 R1234 — Assembly Number; Subassembly Number (if used); Schematic Circuit Number

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

PARTIAL A2 TRIGGER BOARD

A3 SERIAL & SIGNATURE DATA ACQUISITION BOARD

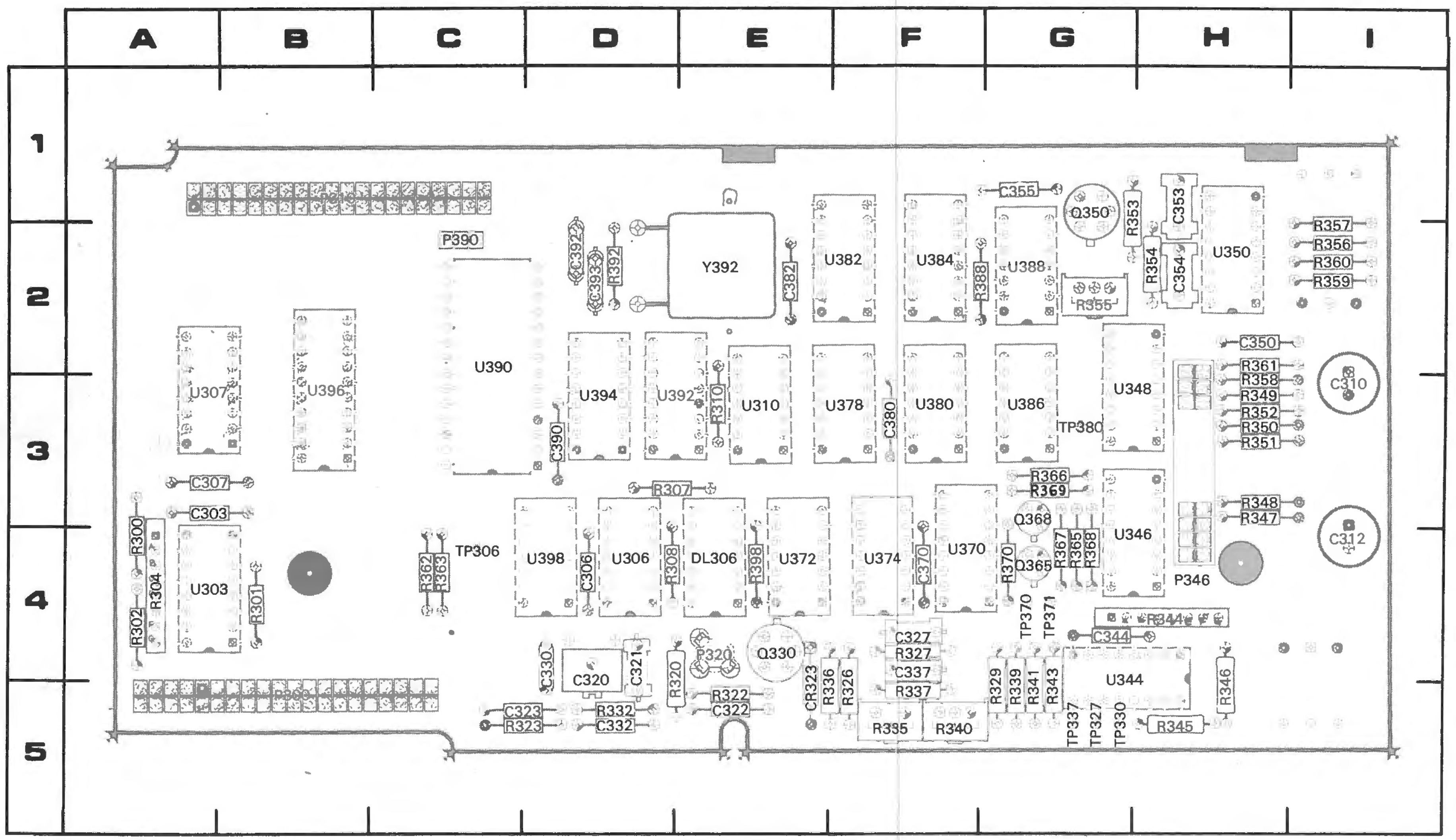
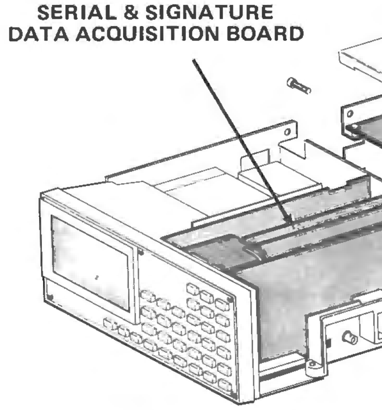


Figure 8-4. A3 Serial and Signature Data Acquisition board component locations.

2662-95



Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE

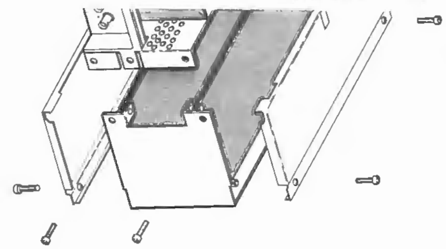
Component Number

A23 A2 R1234

Assembly Number — *Subassembly Number (if used)* — *Schematic Circuit Number*

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

A3 SERIAL & SIGNATURE
DATA ACQUISITION BOARD



SERIAL & SIGNATURE DATA ACQUISITION DIAGRAM ⟨6⟩

PARTIAL A3 ASSY

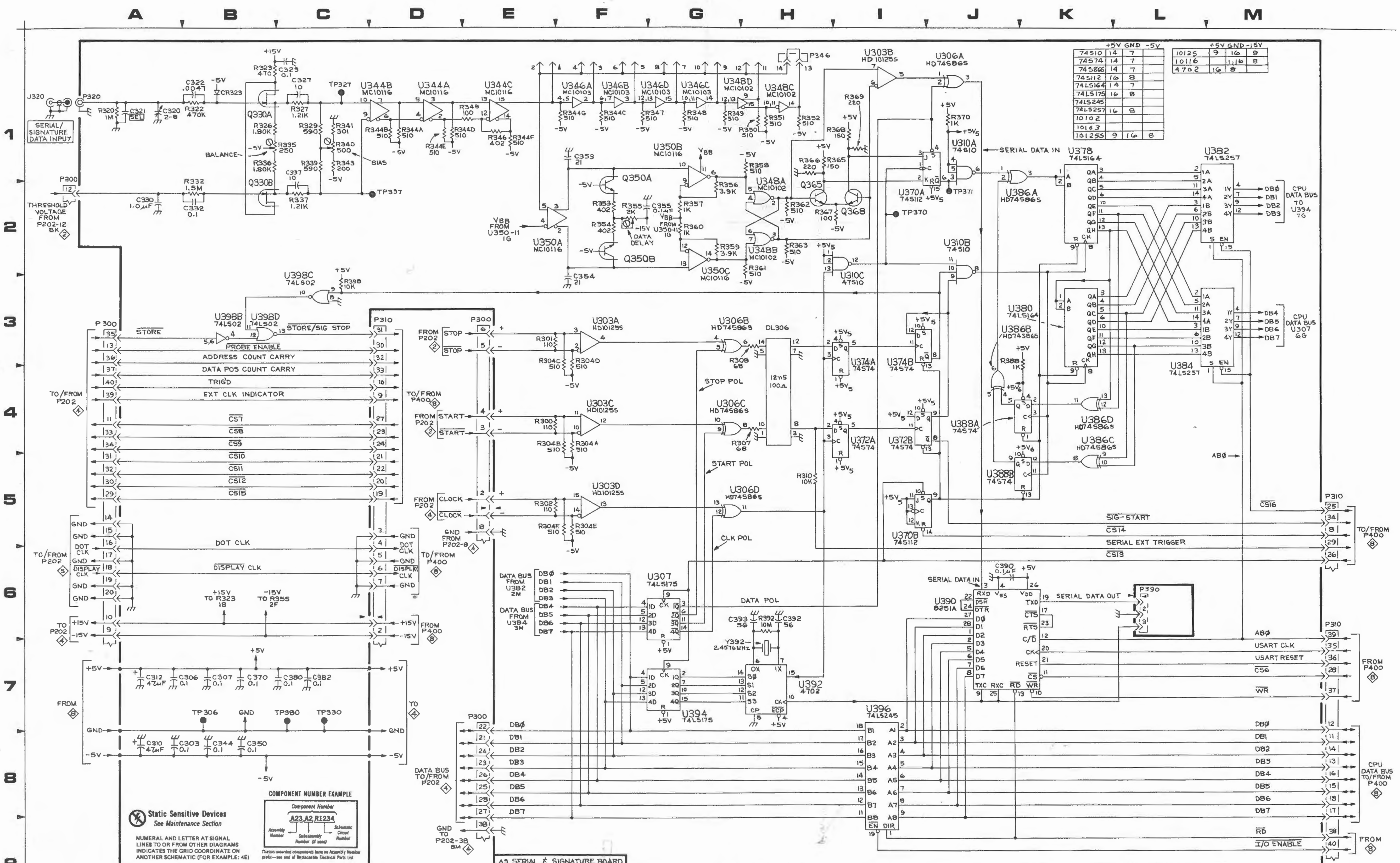
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C303	8B	3A
C306	7B	4D
C307	7B	3A
C310	8A	3I
C312	7A	4I
C320	1A	4D
C321	1A	4D
C322	1B	5E
C323	1C	5D
C327	1C	4F
C330	2A	4D
C332	2B	5D
C337	1C	4F
C344	8B	4G
C350	8B	2H
C353	1F	1H
C354	2F	2H
C355	2G	1G
C370	7B	4F
C380	7C	3F
C382	7C	2E
C390	7C	3D
C392	6H	2D
C393	6H	2D
CR323	1B	5E
DL306	3H	4E
P300	1A	5B
P300	3A	5B
P300	3E	5B
P300	7E	5B
P310	3D	1B
P310	5M	1B
P320	1A	4E
P346	1H	4H
P390	6L	2C
Q330A	1B	4E
Q330B	1B	4E
Q350A	1F	1G
Q350B	2F	1G
Q365	2H	4G
Q368	2I	3G
R300	4E	4A
R301	3E	4B
R302	5E	4A
R304A	4E	4A
R304B	4F	4A
R304C	3F	4A
R304D	3F	4A
R304E	5E	4A
R304F	5F	4A
R307	4H	3D

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
R308	3H	4D
R310	5H	3E
R320	1A	4D
R322	1B	5E
R323	1B	5B
R326	1B	5F
R327	1C	4F
R329	1C	5G
R332	1B	5D
R335	1C	5F
R336	1B	5F
R337	2C	5F
R339	1C	5G
R340	1C	5F
R341	1C	5G
R343	1C	5G
R344A	1D	4H
R344B	1D	4H
R344C	1F	4H
R344D	1D	4H
R344E	1D	4H
R344F	1E	4H
R344G	1F	4H
R345	1E	5H
R346	1E	5H
R347	1F	3H
R348	1G	3H
R349	1G	3H
R350	1H	3H
R351	1H	3H
R352	1H	3H
R353	2F	1G
R354	2F	2H
R355	2F	2G
R356	2G	2I
R357	2G	2I
R358	1H	3H
R359	2G	2I
R360	2G	2I
R361	2H	2H
R362	2H	4C
R363	2H	4C
R365	1H	4G
R366	1H	3G
R367	2H	4G
R368	1I	4G
R369	1I	3G
R370	1J	3G
R388	3J	2G
R392	6H	2D
R398	3C	4E
TP306	7B	4C
TP327	1C	5G
TP330	7C	5G
TP337	2D	5G

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
TP370	2I	4G
TP371	2J	4G
TP380	7C	3G
U303A	3F	4A
U303C	4F	4A
U303D	5F	4A
U306A	1I	4D
U306B	3G	4D
U306C	4G	4D
U306D	5G	4D
U307	6G	3A
U310A	2J	3E
U310B	2J	3E
U310C	2I	3E
U344A	1D	4G
U344B	1D	4G
U344C	1E	4G
U346A	1F	4H
U346B	1F	4H
U346C	1G	4H
U346D	1G	4H
U348A	1H	3G
U348B	2H	3G
U348C	1H	3G
U348D	1G	3G
U350A	2E	2H
U350B	1G	2H
U350C	2G	2H
U370A	1I	4F
U370B	5I	4F
U372A	4I	4E
U372B	4I	4E
U374A	3I	4F
U374B	3I	4F
U378	1K	3F
U380	3K	3F
U382	1M	2F
U384	3L	2F
U386A	1K	3G
U386B	3J	3G
U386C	4K	3F
U386D	4K	3G
U388A	4J	2G
U388B	5J	2G
U390	6J	2C
U392	7H	3D
U394	7G	3D
U396	7I	3B
U398B	3B	4D
U398C	3C	4D
U398D	3B	4D
Y392	7H	2E

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
J320	1A	CHASSIS



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SERIAL & SIGNATURE DATA ACQUISITION ⑥

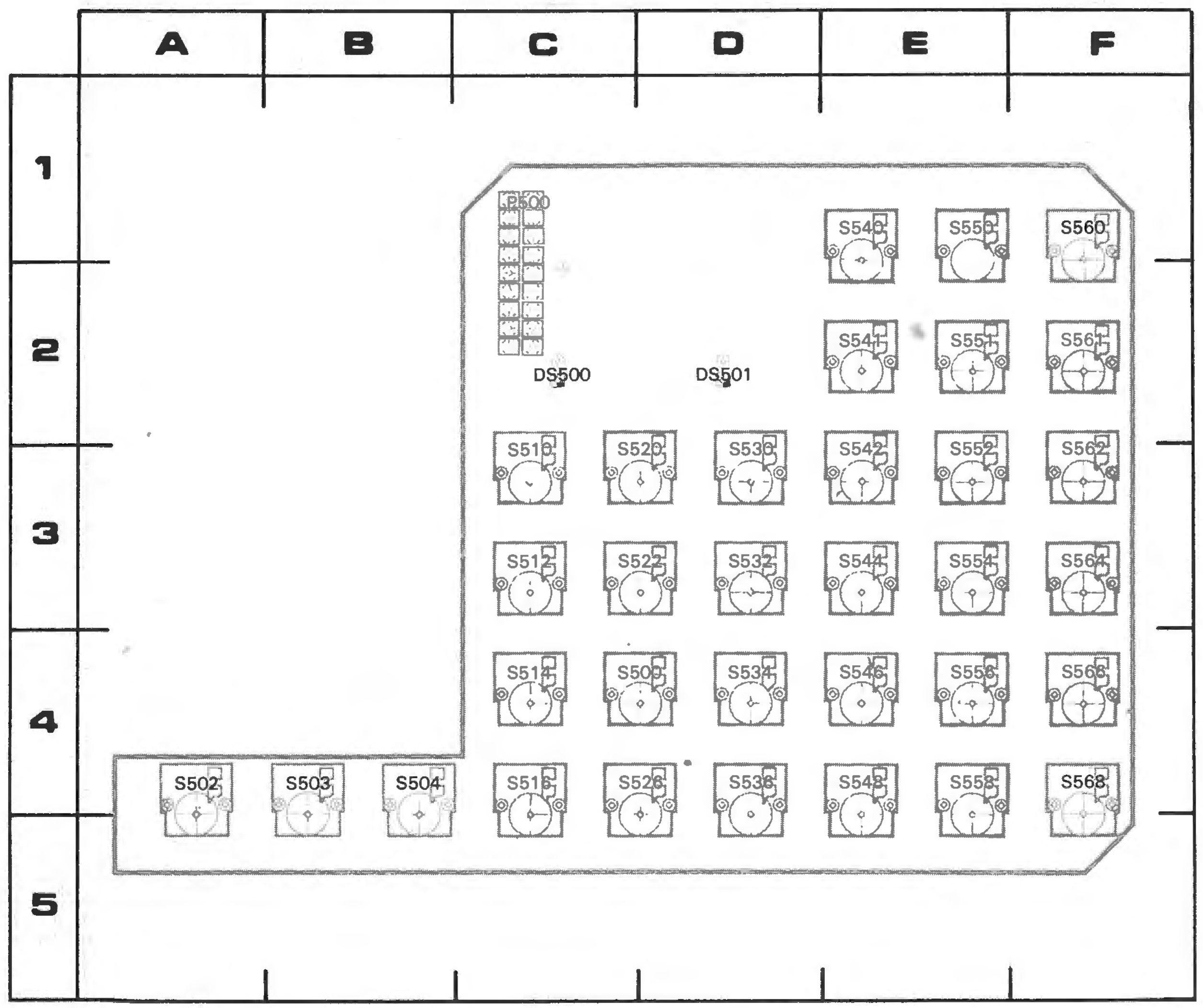

Figure 8-5. A5 Key board component locations.

2662-96

Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE

Component Number

A23 A2 R1234

Assembly Number — *Subassembly Number (if used)* — *Schematic Circuit Number*

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

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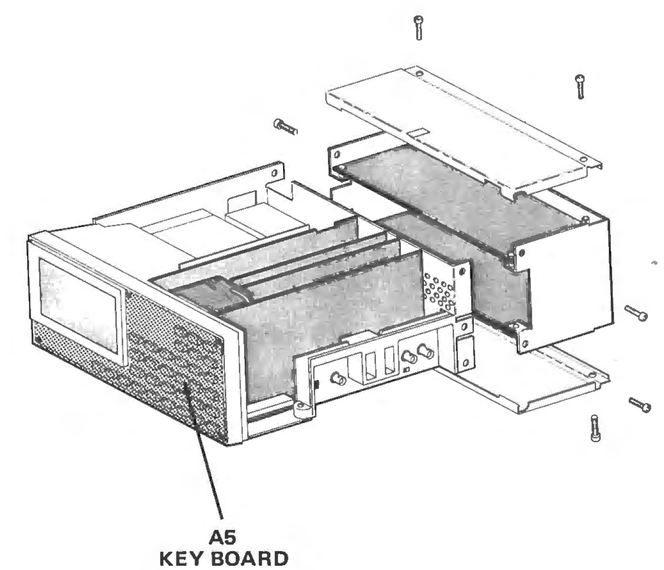
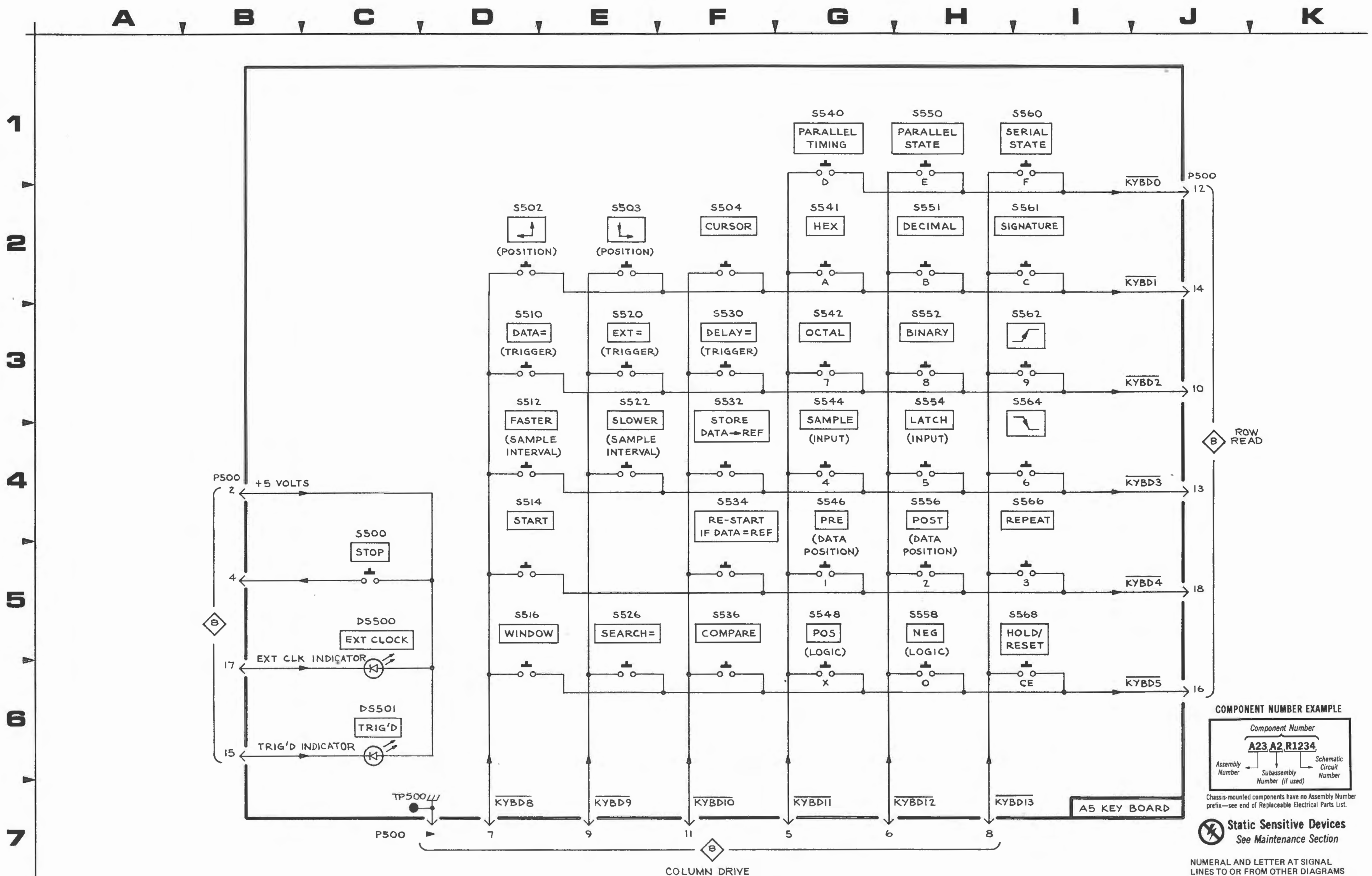


KEYBOARD

DIAGRAM 7

PARTIAL A5 ASSY		
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
DS500	5C	2C
DS501	6C	2D
P500	1J	1C
P500	4B	1C
P500	7C	1C
S500	4C	4D
S502	2D	4A
S503	2E	4B
S504	2F	4B
S510	3D	3C
S512	3D	3C
S514	4D	4C
S516	5D	4C
S520	3E	3D
S522	3E	3D
S526	5E	4D
S530	3F	3D
S532	3F	3D
S534	4F	4D
S536	5F	4D
S540	1G	1E
S541	2G	2E
S542	3G	3E
S544	3G	3E
S546	4G	4E
S548	5G	4E
S550	1H	1E
S551	2H	2E
S552	3H	3E
S554	3H	3E
S556	4H	4E
S558	5H	4E
S560	1I	1E
S561	2I	2F
S562	3I	3E
S564	3I	3F
S566	4I	4F
S568	5I	4F



COMPONENT NUMBER EXAMPLE

Component Number

A23 A2 R1234

Assembly Number — Subassembly Number (if used) — Schematic Circuit Number

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

Static Sensitive Devices
See Maintenance Section

NUMERAL AND LETTER AT SIGNAL LINES TO OR FROM OTHER DIAGRAMS INDICATES THE GRID COORDINATE ON ANOTHER SCHEMATIC (FOR EXAMPLE: 4E)

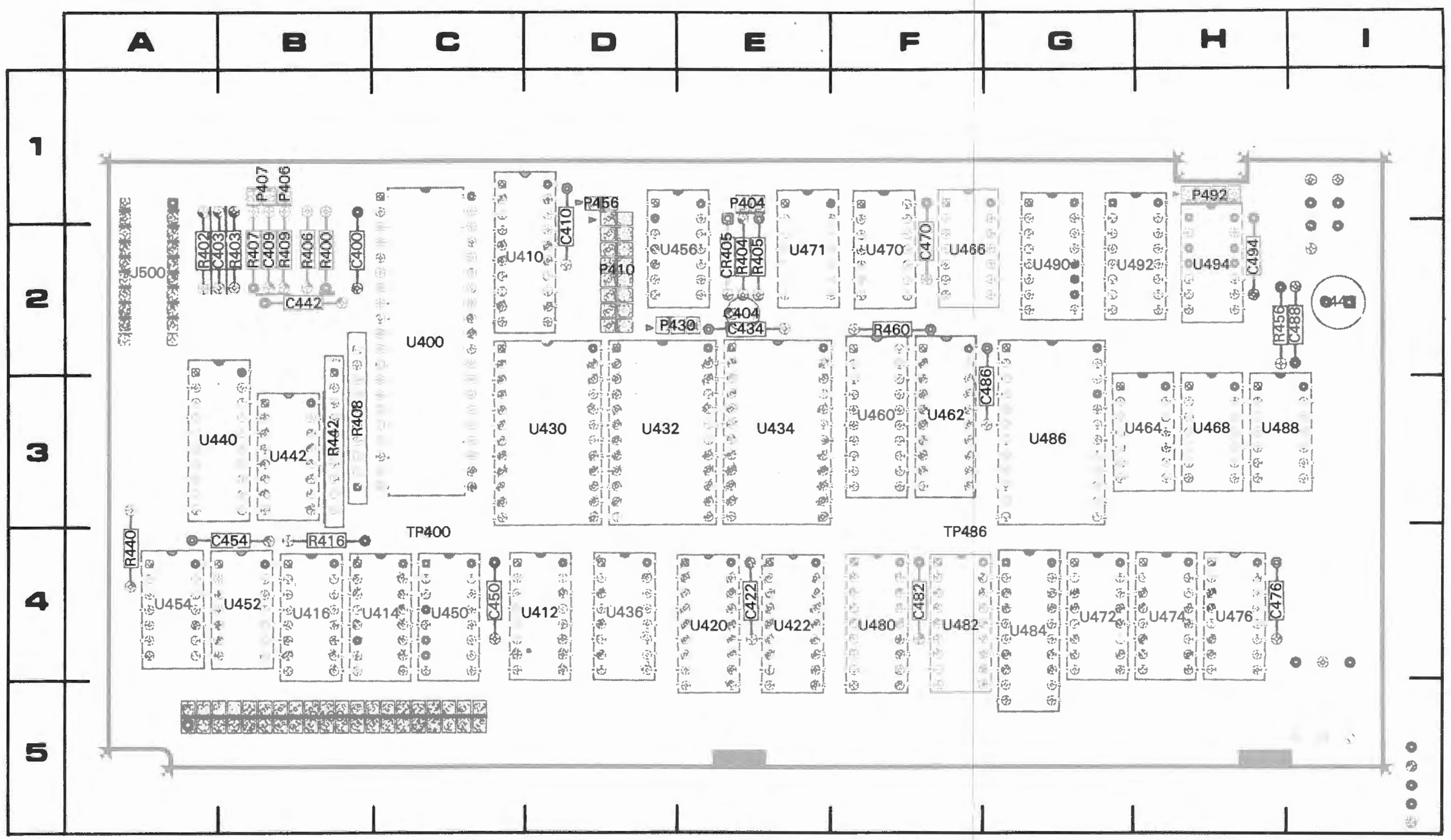
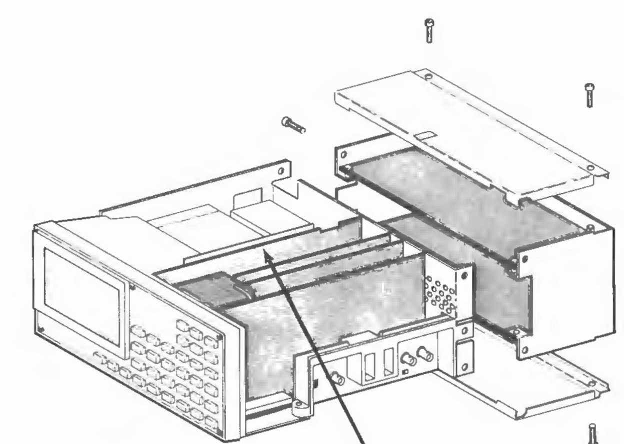


Figure 8-6. A4 MPU board component locations.

2662-97



Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE

Component Number

A23 A2 R1234

Assembly Number — *Subassembly Number (if used)* — *Schematic Circuit Number*

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

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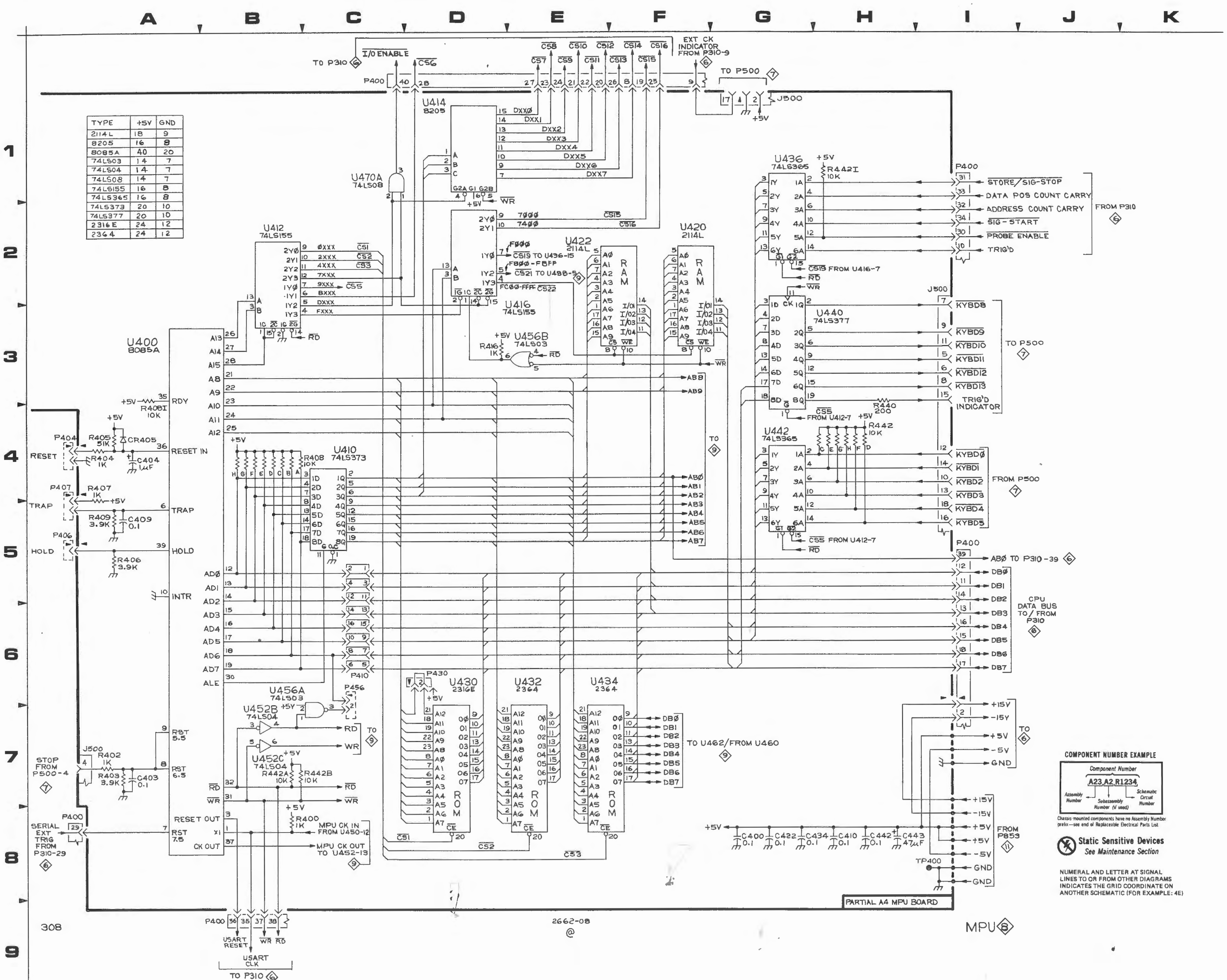
MPU DIAGRAM 8

PARTIAL A4 ASSY

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C400	8G	2B	R406	5A	2B
C403	7A	2B	R407	4A	2B
C404	4A	2E	R408	4C	3B
C409	5A	2B	R408I	4A	3B
C410	8H	2D	R409	5A	2B
C422	8G	4E	R416	3D	4B
C434	8G	2E	R440	4H	4A
C442	8H	2B	R442	4H	3B
C443	8H	2I	R442A	7B	3B
			R442B	7C	3B
CR405	4A	2E	R442I	1H	3B
J500	1G	2A	TP400	8I	4C
J500	2I	2A			
J500	7A	2A	U400	3A	2C
			U410	4C	2D
P400	1C	5B	U412	2B	4D
P400	1I	5B	U414	1D	4C
P400	5I	5B	U416	2E	4B
P400	8A	5B	U420	2F	4E
P400	9B	5B	U422	2E	3B
P404	4A	1E	U430	6D	3D
P406	5A	1B	U432	6E	3D
P407	4A	1B	U434	6E	3E
P410	6C	2B	U436	1G	4D
P430	6D	2D	U440	3H	3A
P456	6C	1D	U442	4G	3B
			U452A	7B	4B
R400	8C	2B	U452B	7B	4B
R402	7A	2A	U456A	6B	2E
R403	7A	2B	U456B	3E	2E
R404	4A	2E	U470A	1C	2F
R405	4A	2E			

Partial A4 ASSY also shown on diagram 9.



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2662-08

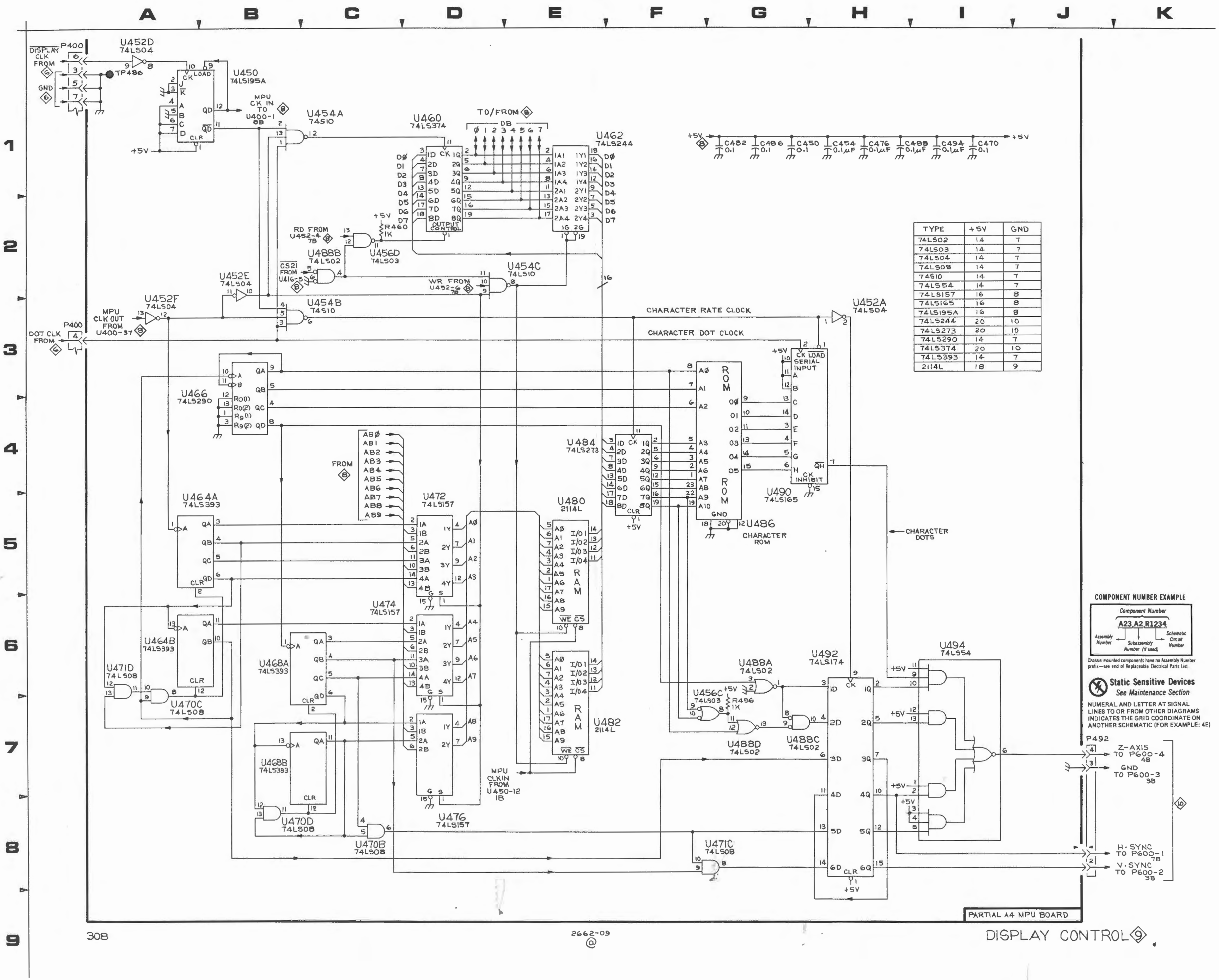
MPU 8

DISPLAY CONTROL DIAGRAM ⟨9⟩

PARTIAL A4 ASSY

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C450	1G	4C	U456D	2C	2E
C454	1H	4B	U460	1D	3F
C470	1I	2F	U462	1E	3F
C476	1H	4H	U464A	5A	3H
C482	1G	4F	U464B	6A	3H
C486	1G	3G	U466	3B	2F
C488	1H	2I	U468A	6B	3H
C494	1I	2H	U468B	7B	3H
			U470B	8C	2F
P400	1A	5B	U470C	7A	2F
P400	3A	5B	U470D	8B	2F
P492	7J	1H	U471C	8G	2E
			U471D	6A	2E
R456	6G	2H	U472	5D	4G
R460	2C	2F	U474	6C	4H
			U476	8D	4H
TP486	1A	4F	U480	5E	4F
			U482	7E	4F
U450	1B	4C	U484	4E	4G
U452A	3H	4B	U486	5G	3G
U452D	1A	4B	U488A	6G	3H
U452E	2B	4B	U488B	2C	3H
U452F	3A	4B	U488C	7G	3H
U454A	1C	4A	U488D	7G	3H
U454B	3C	4A	U490	4G	2G
U454C	2E	4A	U492	6H	2H
U456C	7F	2E	U494	6I	2H

Partial A4 ASSY also shown on diagram 8.



TYPE	+5V	GND
74LS02	14	7
74LS03	14	7
74LS04	14	7
74LS08	14	7
74S10	14	7
74LS54	14	7
74LS157	16	8
74LS165	16	8
74LS195A	16	8
74LS244	20	10
74LS273	20	10
74LS290	14	7
74LS374	20	10
74LS393	14	7
2114L	18	9

COMPONENT NUMBER EXAMPLE

Component Number: A23 A2 R1234 — Assembly Number; Subassembly Number (if used); Schematic Circuit Number

Chassis mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List

Static Sensitive Devices
See Maintenance Section

NUMERAL AND LETTER AT SIGNAL LINES TO OR FROM OTHER DIAGRAMS INDICATES THE GRID COORDINATE ON ANOTHER SCHEMATIC (FOR EXAMPLE: 4E)

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DISPLAY CONTROL 9

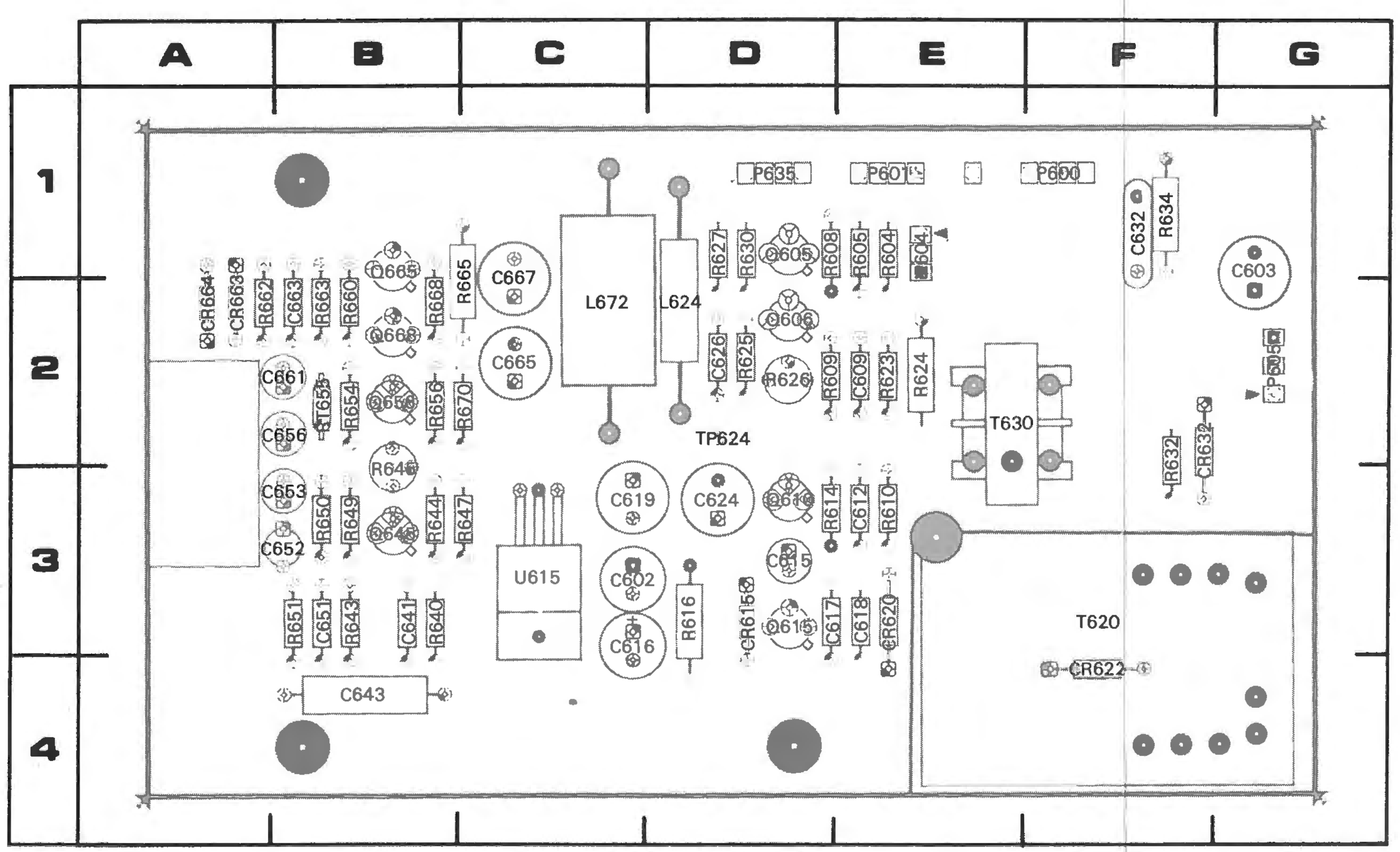


Figure 8-7. A6 CRT board component locations.

2662-98

Static Sensitive Devices
See Maintenance Section

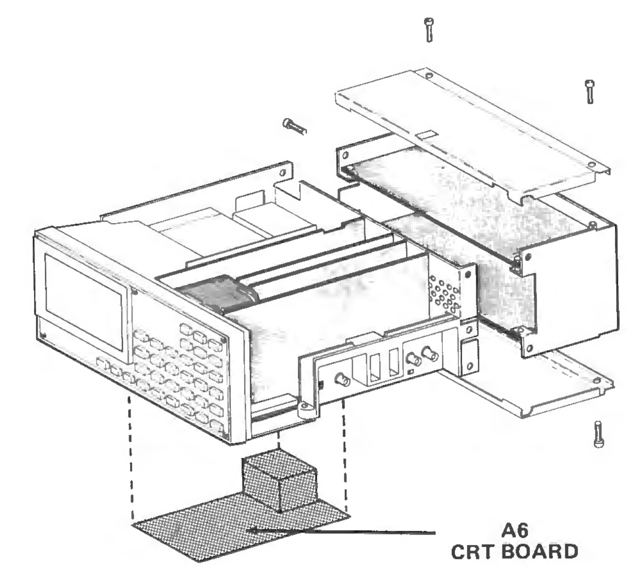
COMPONENT NUMBER EXAMPLE

Component Number

A23 A2 R1234

Assembly Number — *Subassembly Number (if used)* — *Schematic Circuit Number*

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.



A6 CRT BOARD

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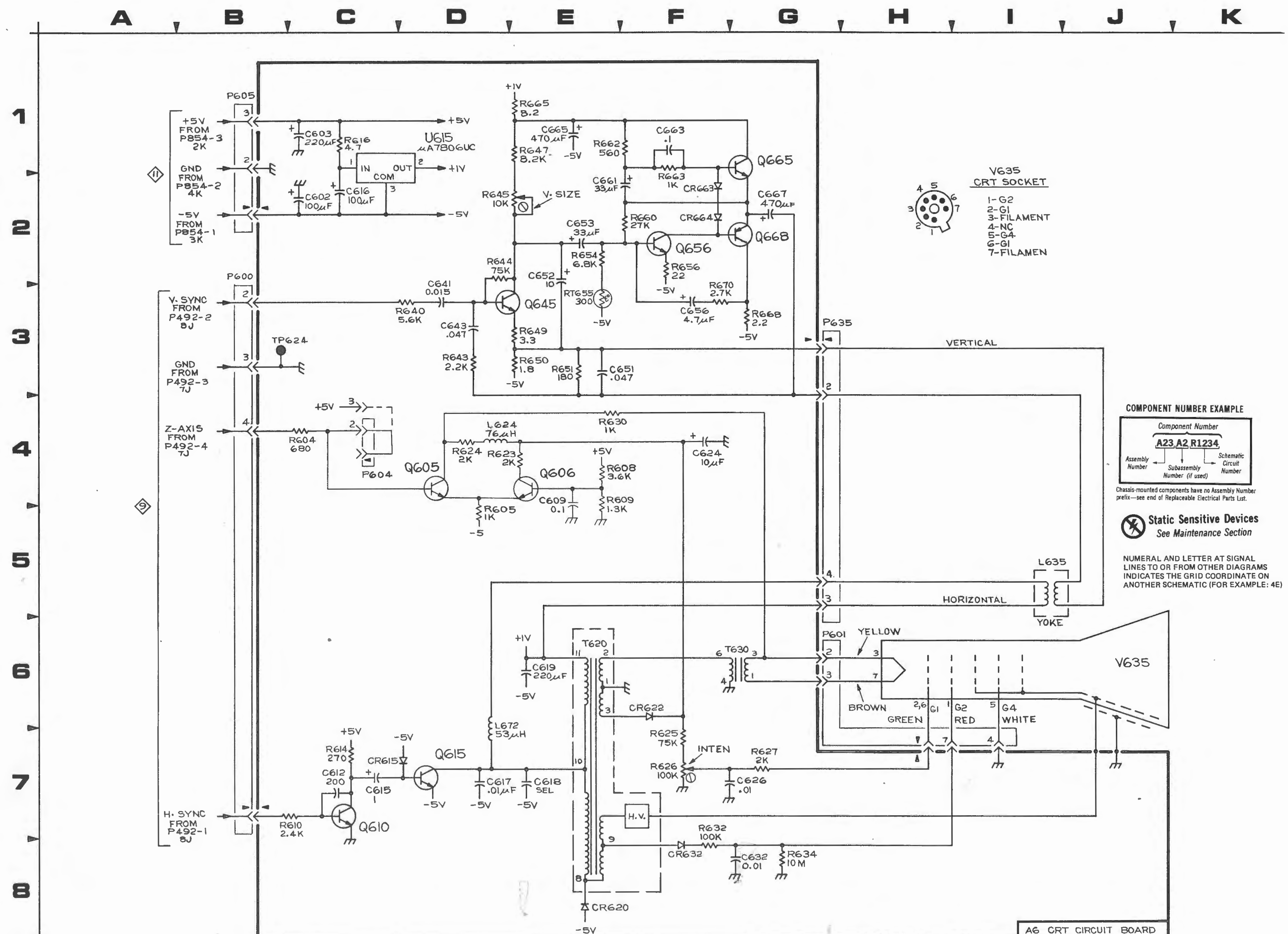
CRT CIRCUIT DIAGRAM 10

PARTIAL A6 ASSY

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C602	2C	3C	Q656	2F	2B
C603	1C	1G	Q665	1G	1B
C609	4E	2E	Q668	2G	2B
C612	7C	3E			
C615	7C	3D	R604	4C	1E
C616	2C	3C	R605	5D	1E
C617	7D	3D	R608	4E	1D
C618	7E	3E	R609	4E	2D
C619	6E	3C	R610	7B	3E
C624	4F	3D	R614	7C	3D
C626	7G	2D	R616	1C	3D
C632	8G	1F	R623	4D	2E
C641	3D	3B	R624	4D	2E
C643	3D	4B	R625	7F	2D
C651	3E	3B	R626	7F	2D
C652	2E	3B	R627	7G	1D
C653	2E	3B	R630	4E	1D
C656	3F	2B	R632	7F	2F
C661	2E	2B	R634	8G	1F
C663	1F	2B	R640	3D	3B
C665	1E	2C	R643	3D	3B
C667	2G	1C	R644	2D	3B
			R645	2D	3B
CR615	7C	3D	R647	1E	3C
CR620	8E	3E	R649	3E	3B
CR622	6F	4F	R650	3E	3B
CR632	8F	2F	R651	3E	3B
CR663	2F	2A	R654	2E	2B
CR664	2F	2A	R656	2F	2B
			R660	2F	2B
L624	4D	2D	R662	1E	2A
L672	7D	2C	R663	2F	2B
			R665	1E	2C
P600	2B	1F	R668	3G	2B
P601	6G	1E	R670	3F	2C
P604	4C	1E			
P605	1B	2G	RT655	3E	2B
P635	3G	1D			
			T620	6E	3F
Q605	4D	1D	T630	6G	2E
Q606	4E	2D			
Q610	7C	3D	TP624	3B	2D
Q615	7D	3D			
Q645	3E	3B	U615	1D	3C

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
L635	5I	CHASSIS	V635	6J	CHASSIS



2662-10

CRT CIRCUIT 10

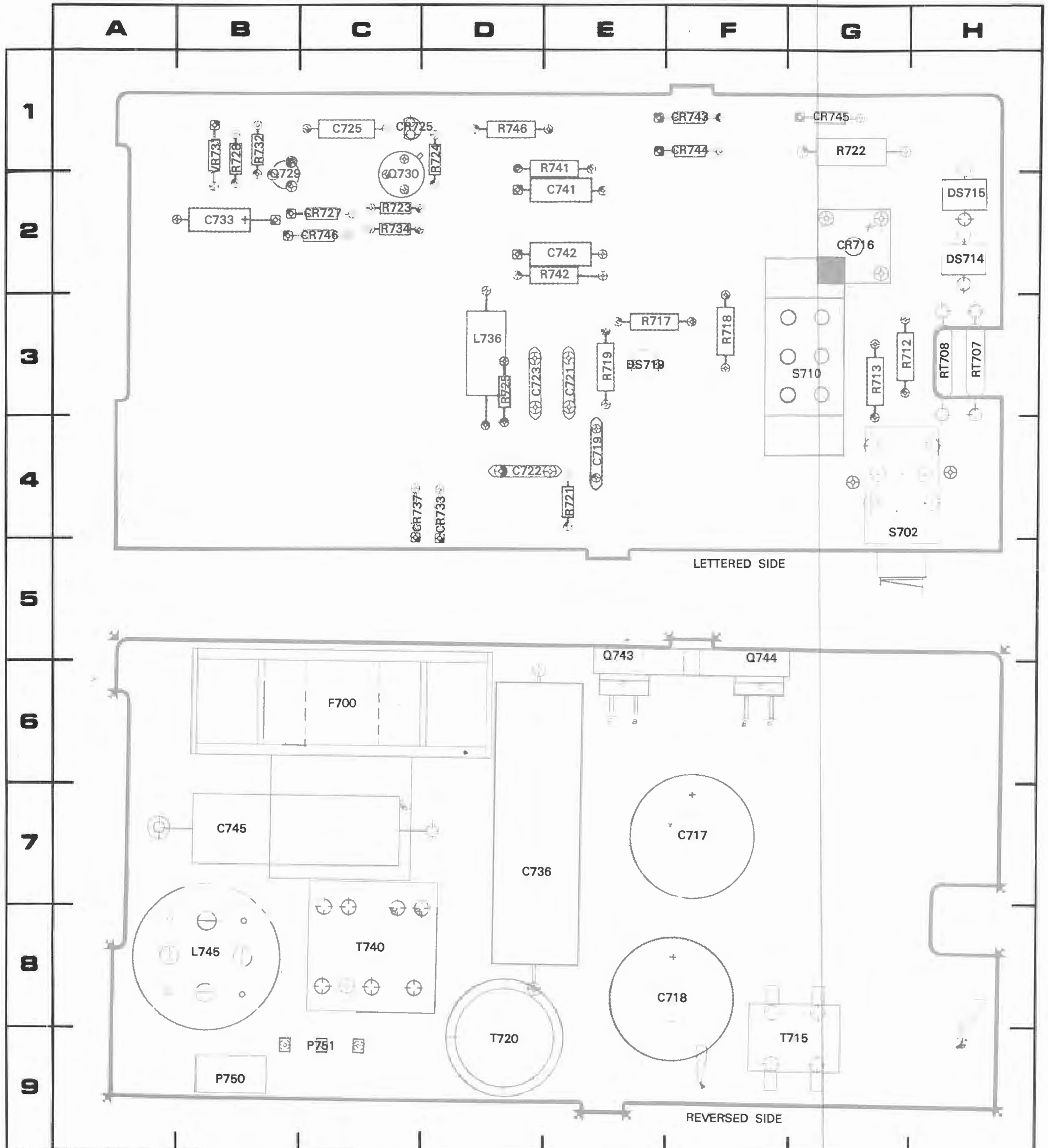


Figure 8-8. A7 Primary Power Supply board component locations.

2662-99

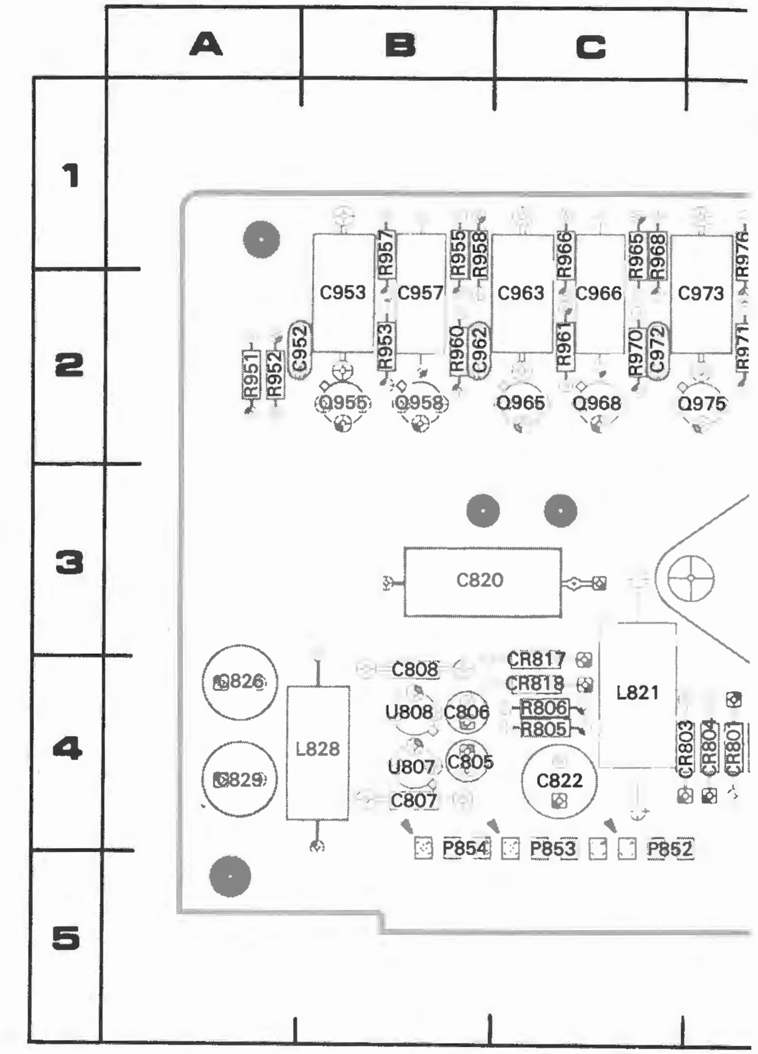
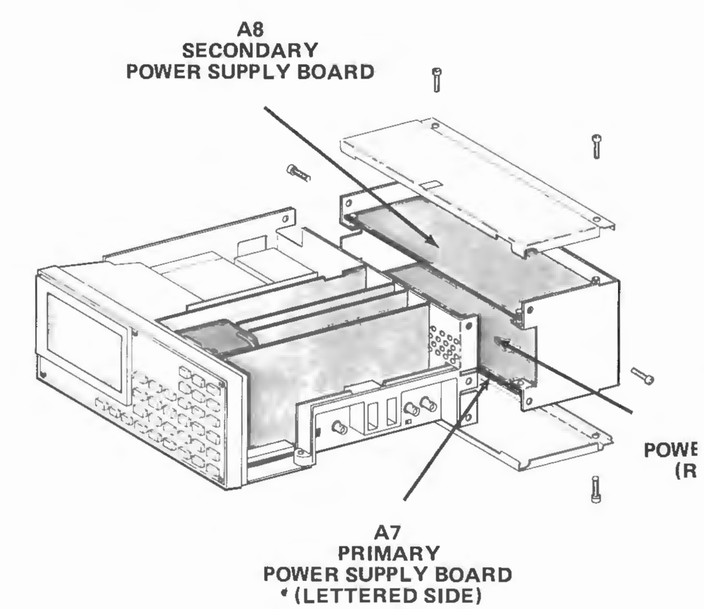


Figure 8-9. A8 Secondary Po



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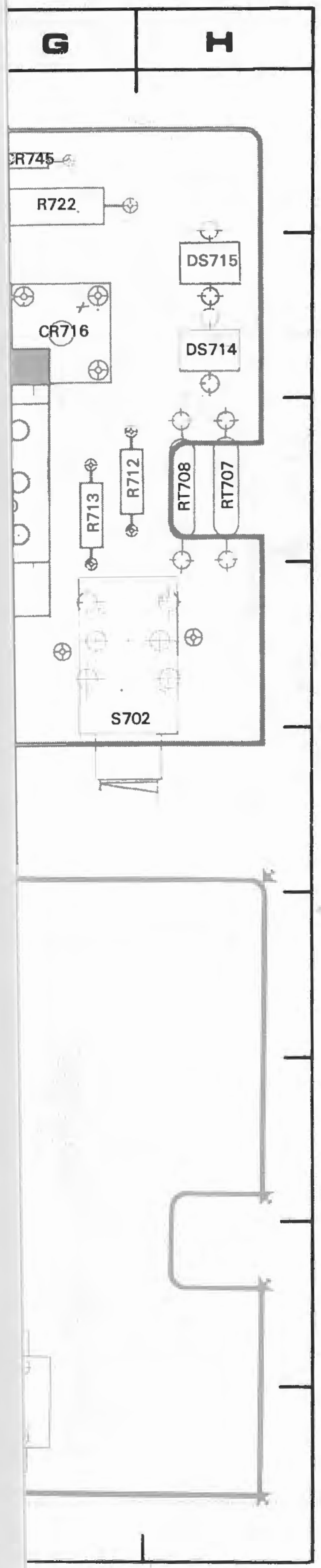


2662-99

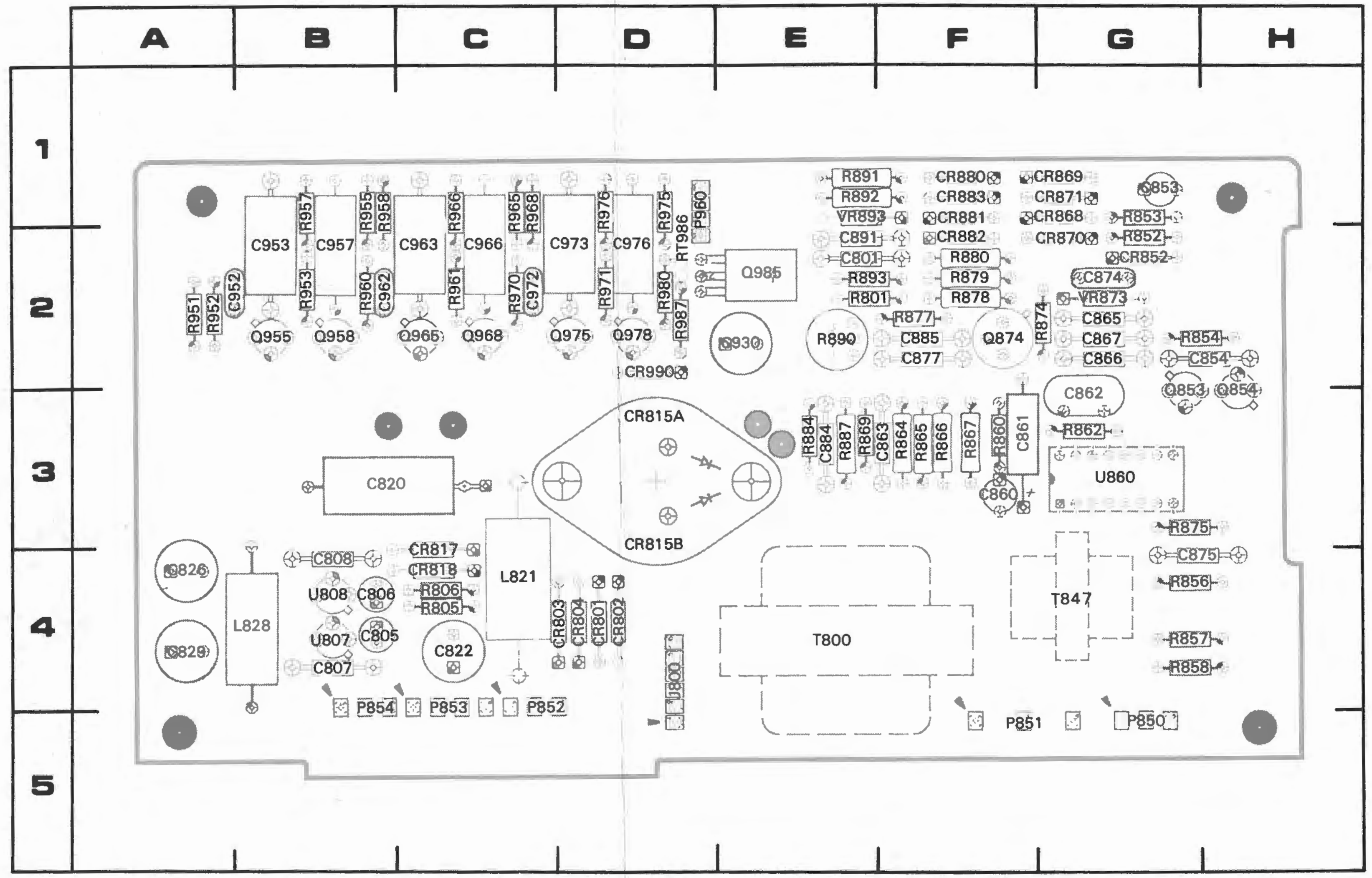
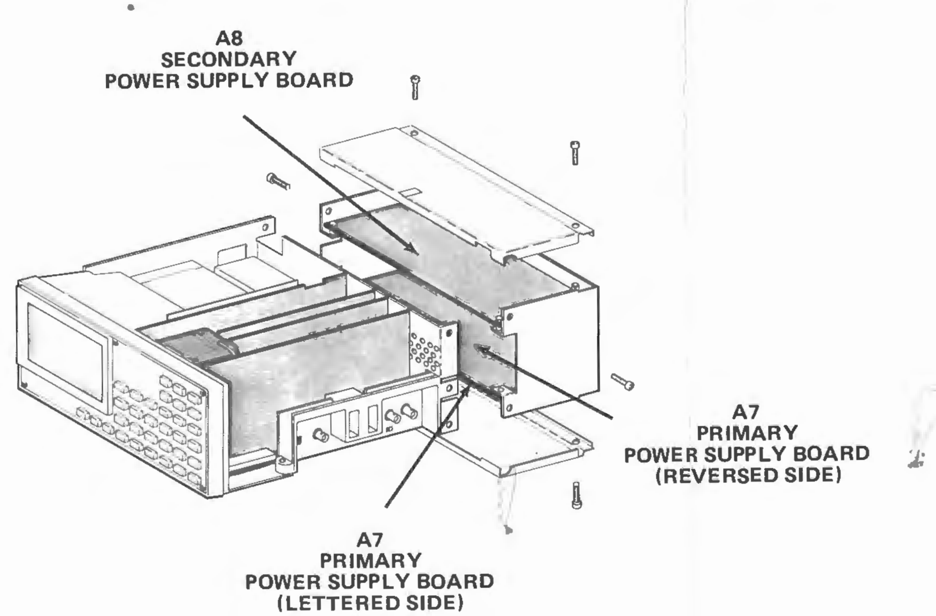


Figure 8-9. A8 Secondary Power Supply board component locations.

2662-100



Static Sensitive Devices
See Maintenance Section

COMPONENT NUMBER EXAMPLE

Component Number

A23 A2 R1234

Assembly Number — *Subassembly Number (if used)* — *Schematic Circuit Number*

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

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POWER SUPPLY & FAN DIAGRAM ⟨11⟩

PARTIAL A7 ASSY

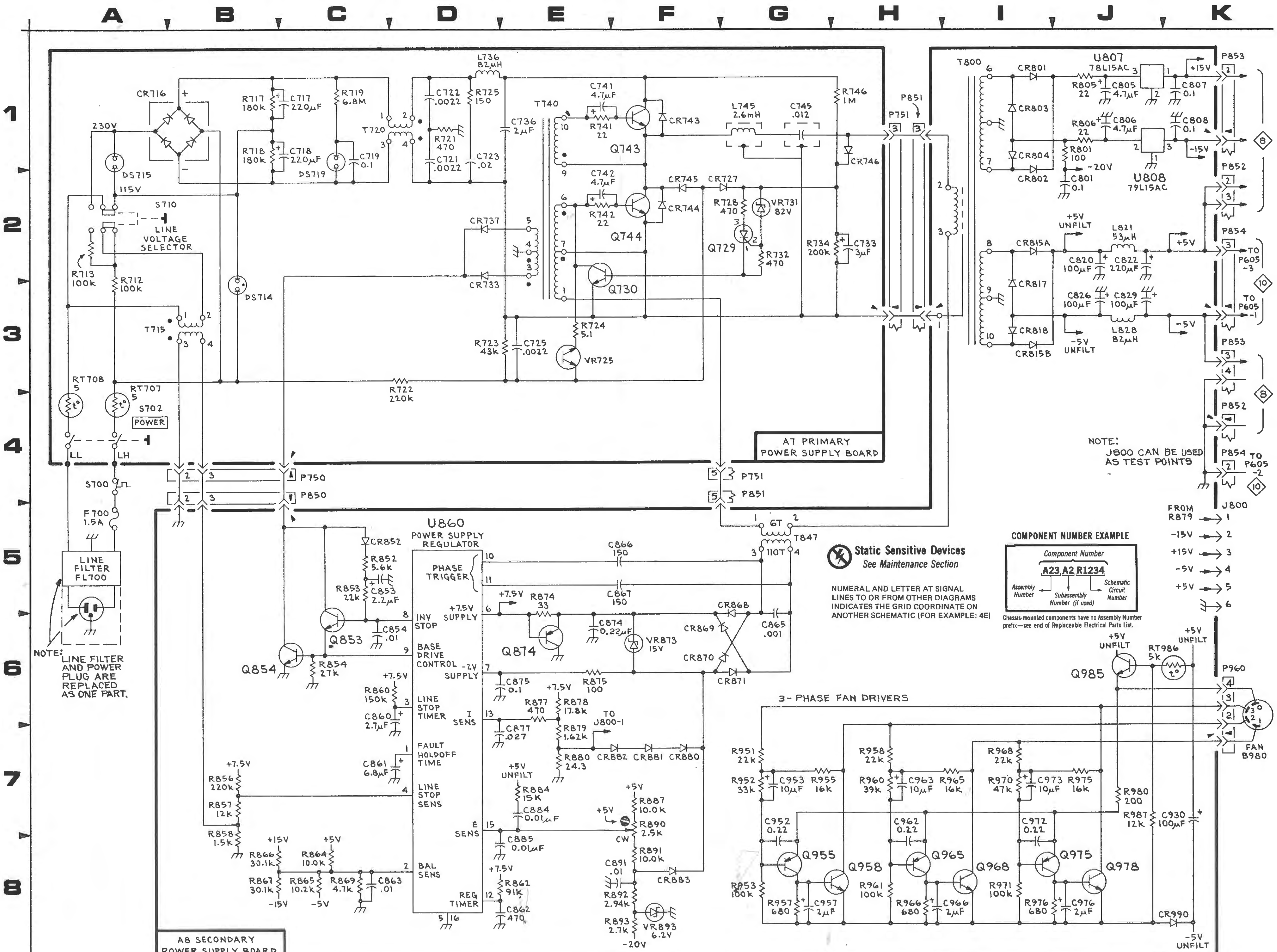
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C717	1C	1F	CR737	2D	4C	Q730	3F	2C	R741	1E	2E
C718	1C	BF	CR743	1F	1F	Q743	1F	5E	R742	2E	2E
C719	1C	4E	CR744	2F	1F	Q744	2F	5F	R746	1H	1D
C721	1D	3E	CR745	2F	7B						
C722	1D	4D	CR746	1H	2C	R712	2A	3G	RT707	3A	3M
C723	1D	3D				R713	2A	3G	RT708	3A	3M
C725	3E	1C	DS714	3B	2M	R717	1B	3E			
C733	2H	2B	DS715	2A	2H	R718	1B	3F	S702	4A	5G
C736	1E	7D	DS719	1C	3E	R719	1C	3E	S710	2A	3G
C741	1E	2E				R721	1D	4E			
C742	2E	2E	L736	1D	3D	R722	3D	1G	T715	3A	8F
C745	1G	3J	L745	1G	8B	R723	3D	2C	T720	1C	9D
						R724	3E	1C	T740	1E	8C
CR716	1A	2G	P750	4C	9B	R725	1D	3D			
CR725	3E	1C	P751	1H	9B	R728	2G	1B	VR731	2G	1B
CR727	2G	2C				R732	2G	1B			
CR733	3D	4D	Q729	2G	2B	R734	2G	2C			

PARTIAL A8 ASSY

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C801	2J	2E	CR801	1I	4D	Q853	6C	3G	R890	7F	2E
C805	1J	4B	CR802	2I	4D	Q854	6B	3H	R891	8F	1E
C806	1J	4B	CR803	1I	4D	Q874	6E	2F	R892	8F	1E
C807	1K	4B	CR804	1I	4D	Q955	8G	2B	R893	8F	2E
C808	1K	4B	CR815A	2I	3D	Q958	8H	2B	R951	7G	2A
C820	2J	3B	CR815B	3I	3D	Q965	8H	2C	R952	7G	2A
C822	2J	4C	CR817	3I	4C	Q968	8I	2C	R953	8G	2B
C826	3J	4A	CR818	3I	4C	Q975	8J	2D	R955	7G	1B
C829	3J	4A	CR852	5C	2G	Q978	8J	2D	R957	8G	1B
C853	5C	1G	CR868	5G	1G	Q985	6J	2E	R958	7H	1B
C854	6C	2H	CR869	6F	1G				R960	7H	2B
C860	6C	3F	CR870	6F	2G	R801	1J	2E	R961	8H	2C
C861	7C	3F	CR871	6G	1G	R805	1J	4C	R965	7I	1C
C862	8E	3G	CR880	7F	1F	R806	1J	4C	R966	8H	1C
C863	8C	3F	CR881	7F	2F	R852	5C	2G	R968	7I	1C
C865	6G	2G	CR882	7F	2F	R853	5C	1G	R970	7I	2C
C866	5F	2G	CR883	8F	1F	R854	6C	2H	R971	8I	2D
C867	5F	2G	CR990	8K	2D	R856	7B	4G	R975	7J	1D
C874	6E	2G				R857	7B	4G	R976	8I	1D
C875	6E	4H	J800	5K	4D	R858	7B	4G	R980	7J	2D
C877	7E	2F				R860	6C	3F	R987	7J	2D
C884	7E	2E	L821	2J	4C	R862	8E	3G			
C885	8E	2F	L828	3J	4B	R864	8C	3F	RT986	6J	2D
C891	8F	2E				R865	8C	3F			
C930	7K	2E	P850	4C	5G	R866	88	3F	T800	1I	4F
C952	7G	2A	P851	1H	5F	R867	8B	3F	T847	5G	4G
C953	7G	2B	P851	4G	5F	R869	8C	3E			
C957	8G	2B	PB52	1K	5C	R874	5E	2G	U807	1J	4B
C962	7H	2B	P852	4K	5C	R875	6E	3G	U808	2J	4B
C963	7H	2C	P853	1K	5C	R877	6E	2F	U860	5D	3G
C966	8I	2C	P853	3K	5C	R878	6E	2F			
C972	7I	2C	P854	2K	4B	R879	7E	2F	VR873	6F	2G
C973	7I	2D	P854	4K	4B	R880	7E	2F	VR893	8F	1E
C976	8J	2D	P960	6K	1D	R884	7E	3E			
						R887	7F	3E			

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
B980	7K	CHASSIS	F700	5A	CHASSIS	FL700	5A	CHASSIS	S700	2A	CHASSIS



NOTE: LINE FILTER AND POWER PLUG ARE REPLACED AS ONE PART.

Static Sensitive Devices
See Maintenance Section

NUMERAL AND LETTER AT SIGNAL LINES TO OR FROM OTHER DIAGRAMS INDICATES THE GRID COORDINATE ON ANOTHER SCHEMATIC (FOR EXAMPLE: 4E)

COMPONENT NUMBER EXAMPLE

Component Number
A23 A2 R1234
Assembly Number — Subassembly Number (if used) — Schematic Circuit Number

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

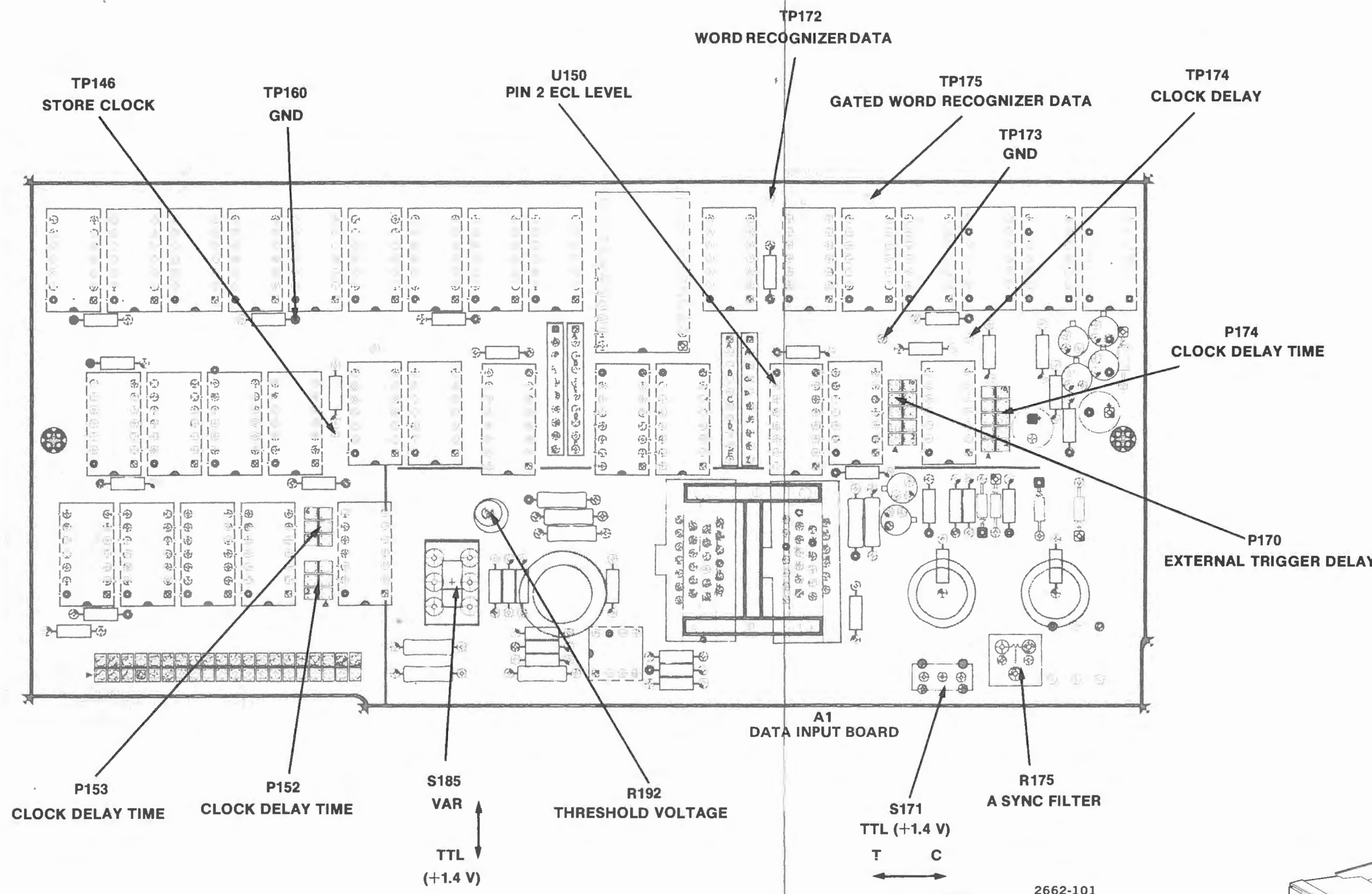
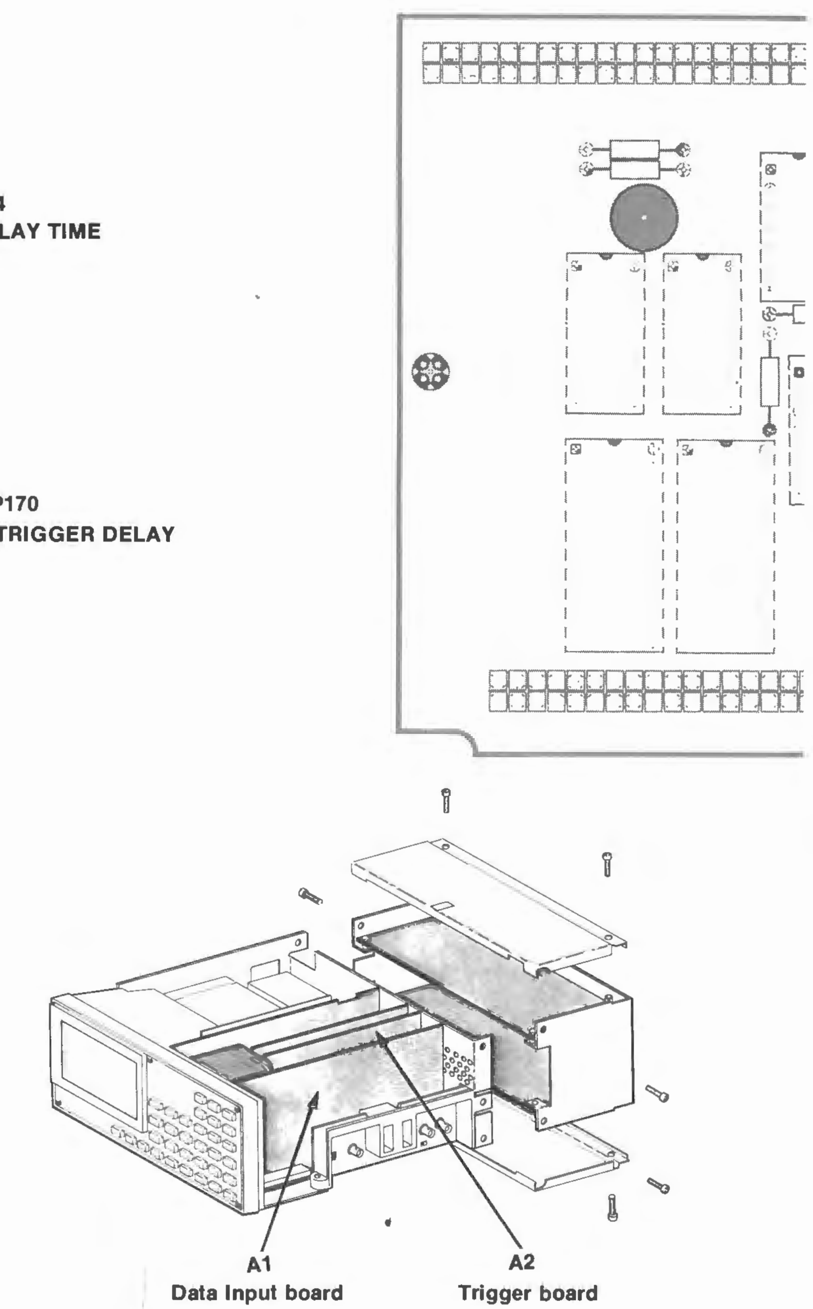
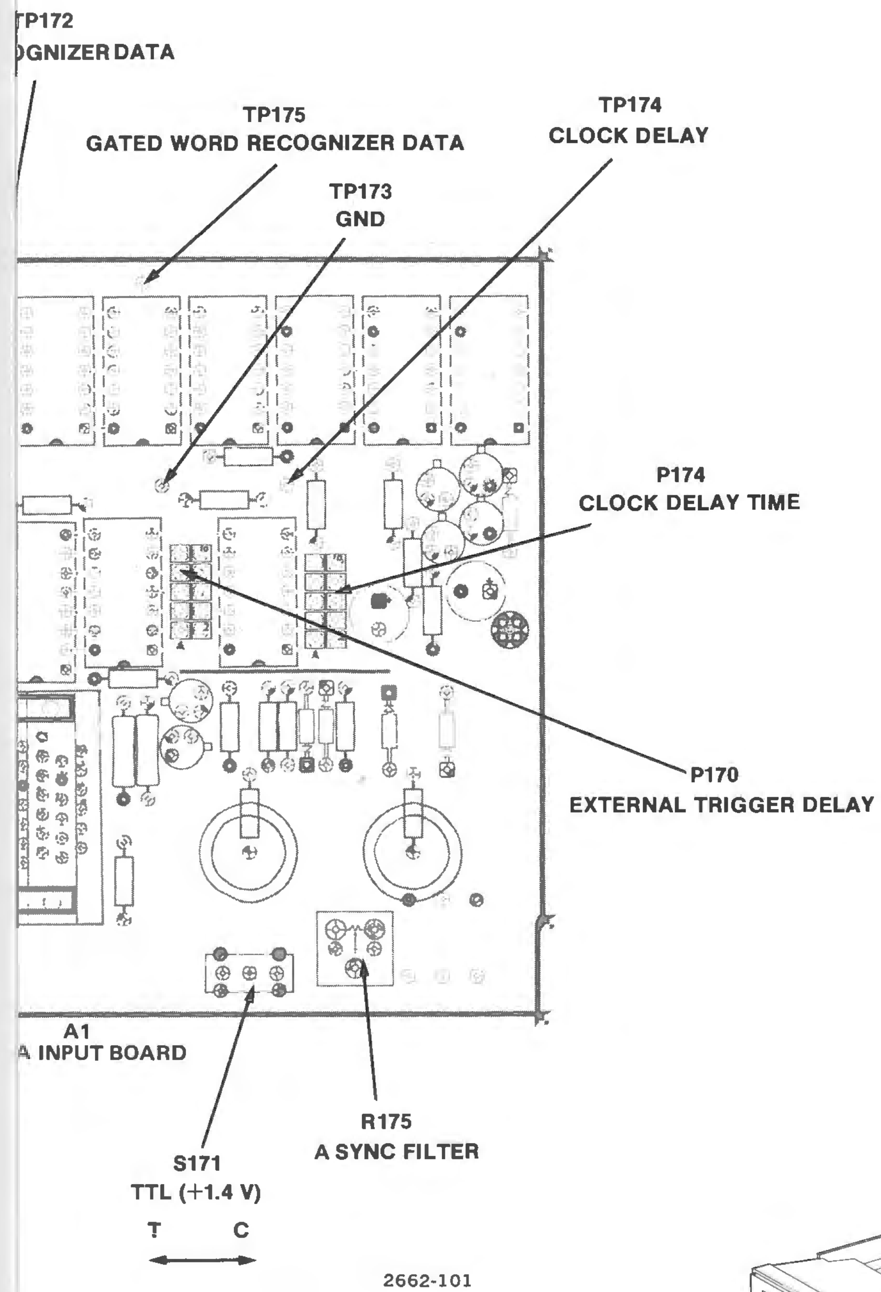
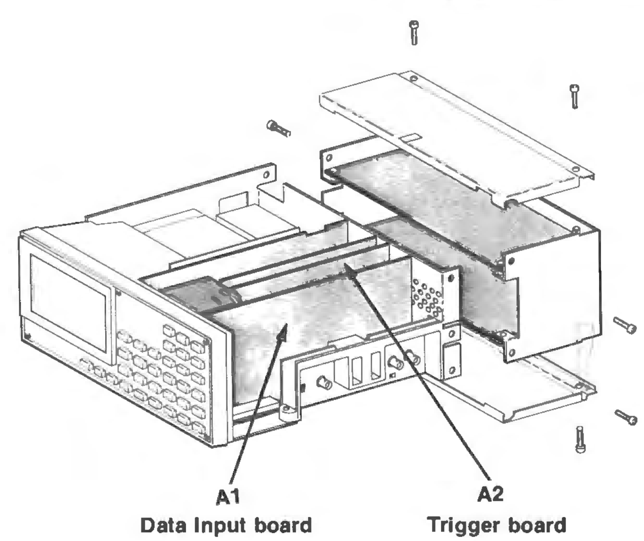


Figure 8-10. A1 Data Input board test point and adjustment locations.





ons.



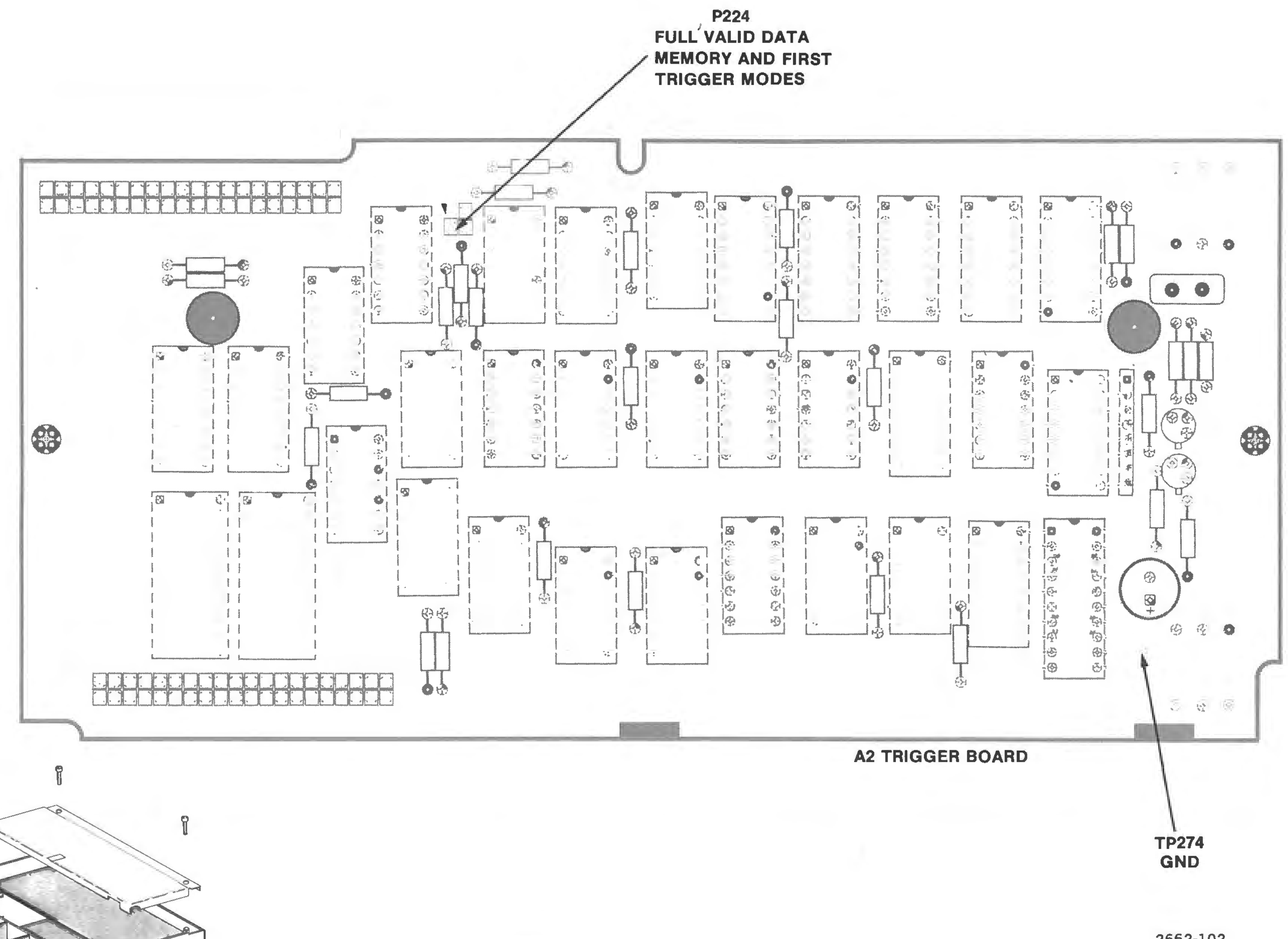


Figure 8-11. A2 Trigger board test point and adjustment locations.

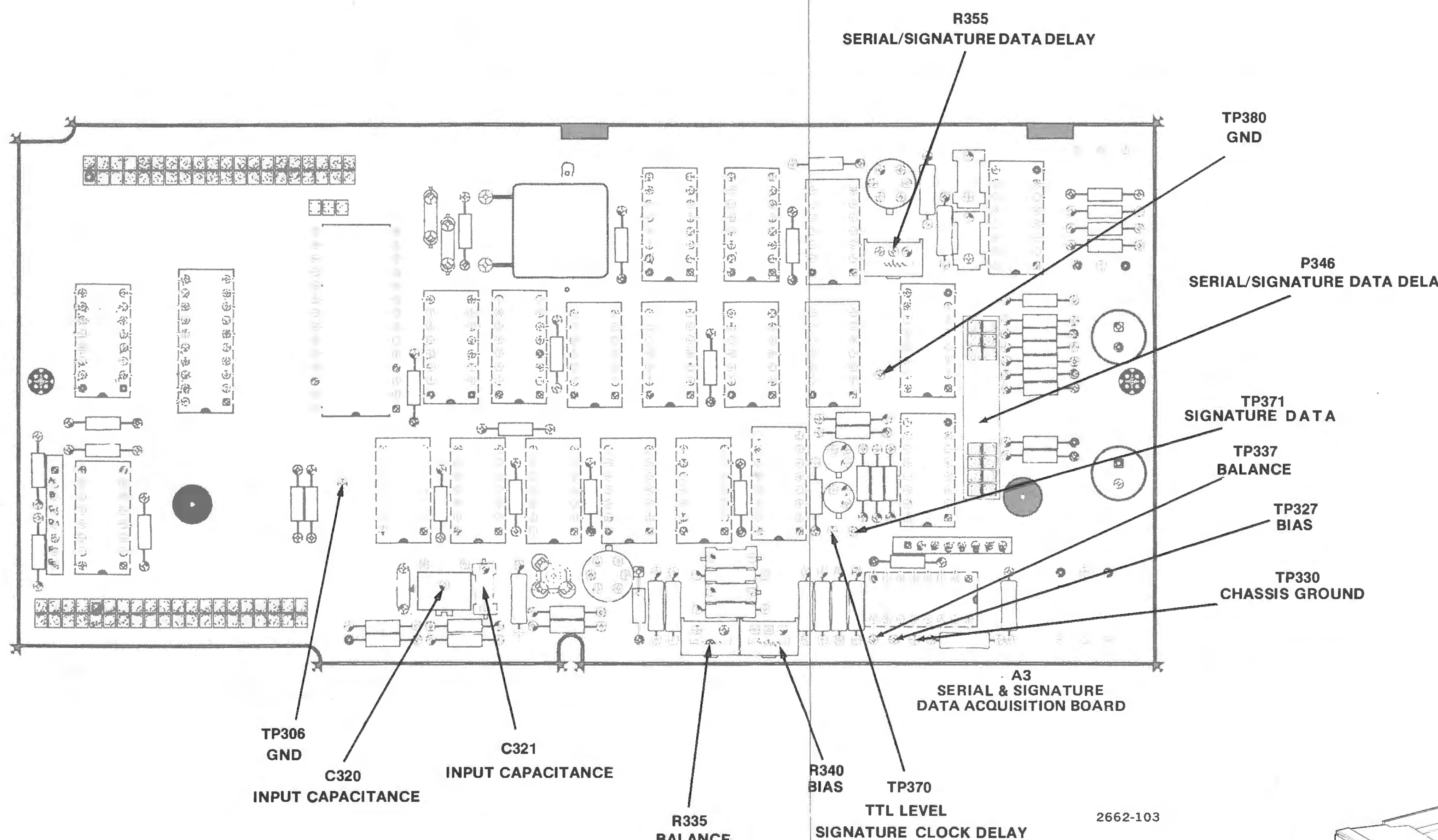
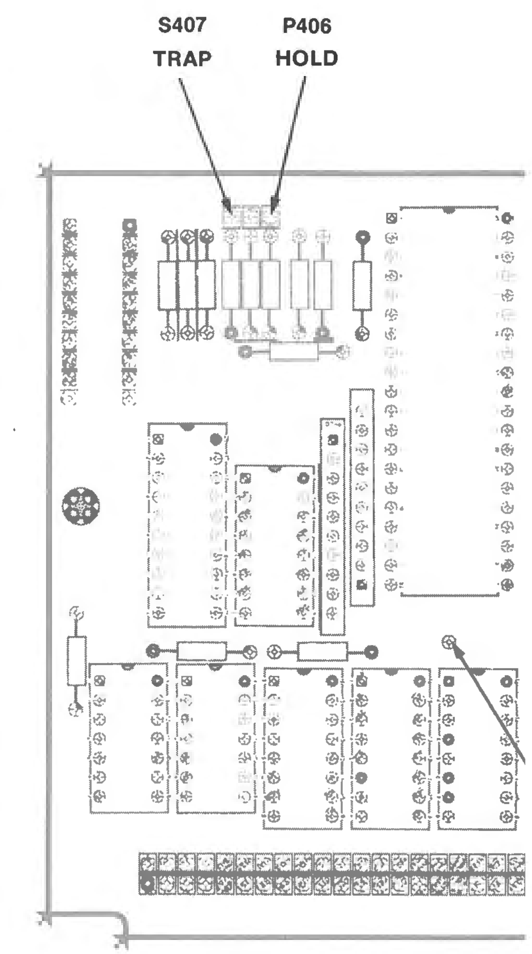
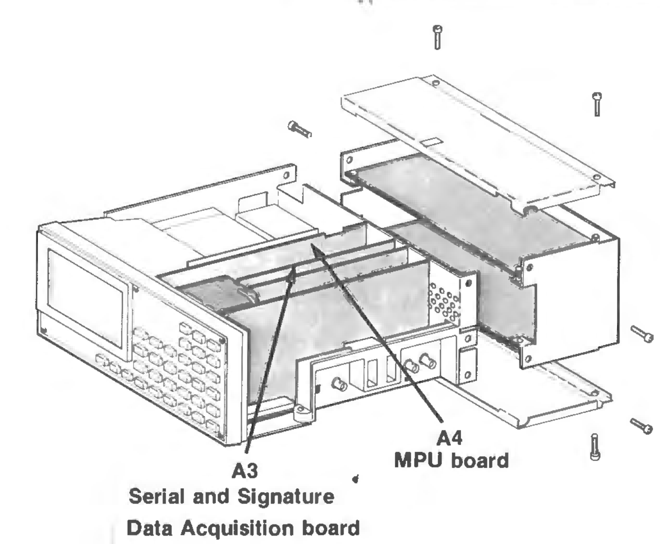
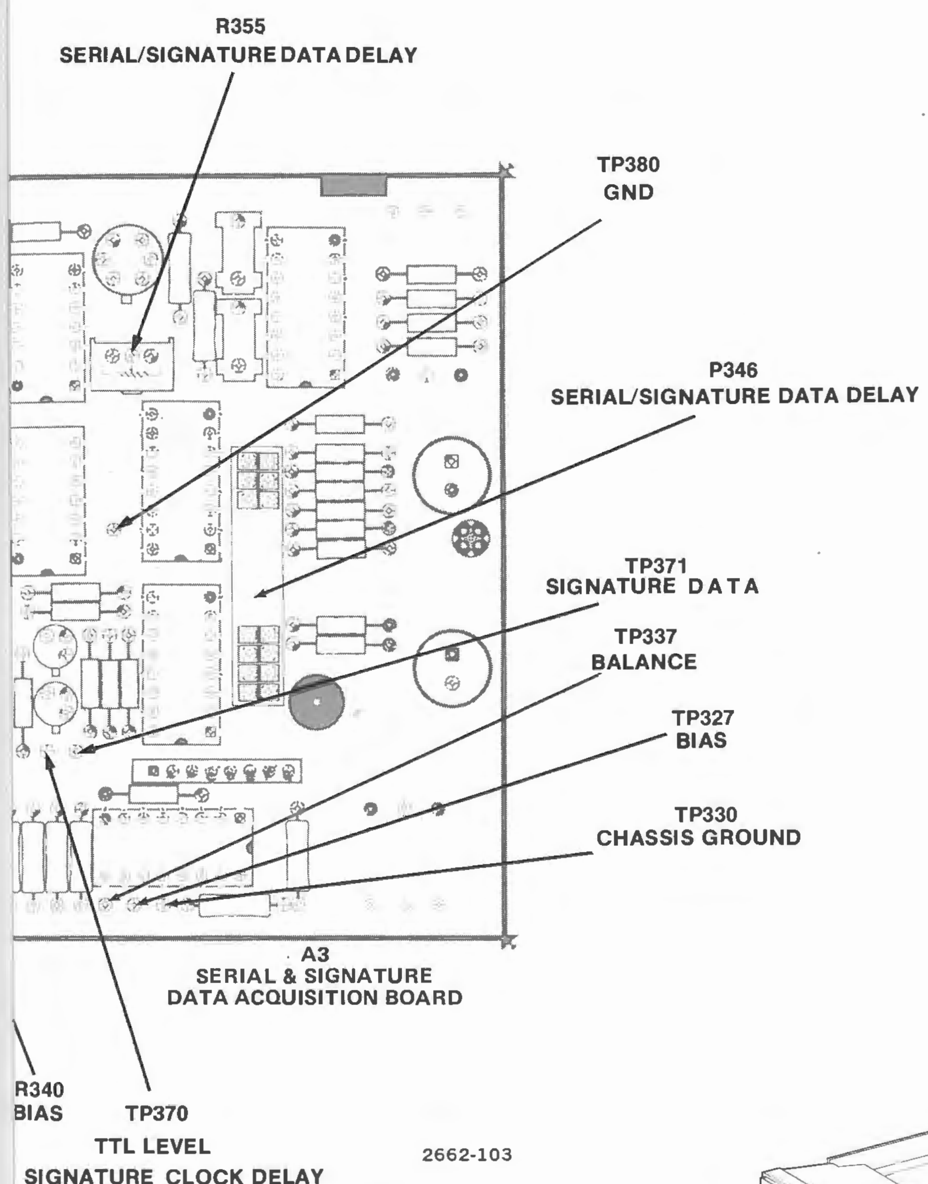


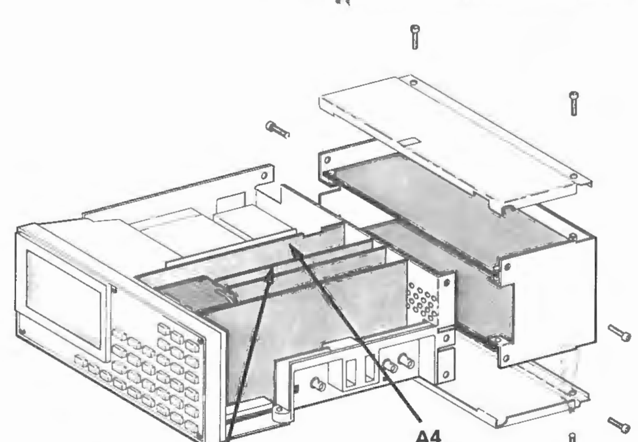
Figure 8-12. A3 Serial and Signature Data Acquisition board test point and adjustment locations.







d adjustment locations.



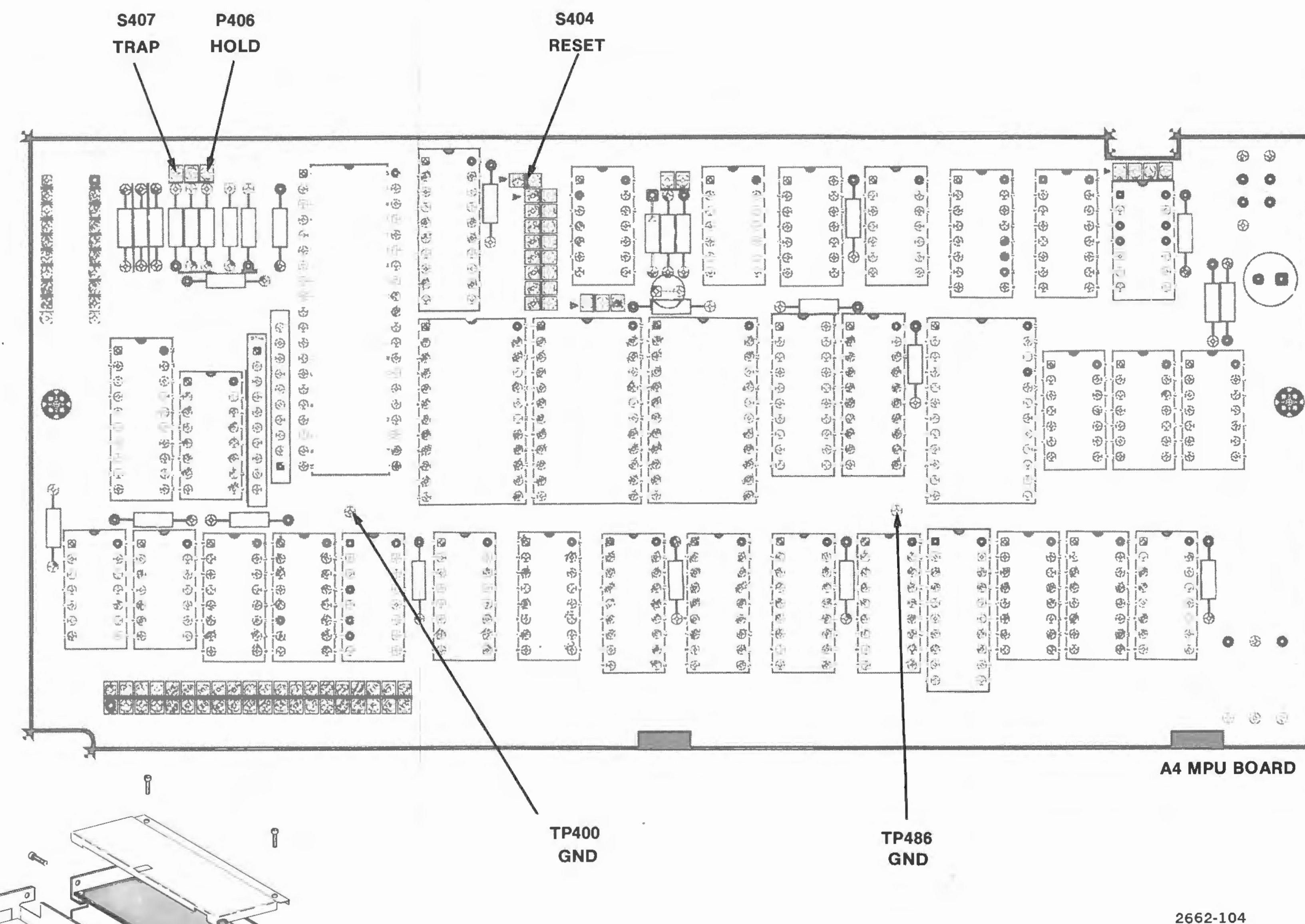
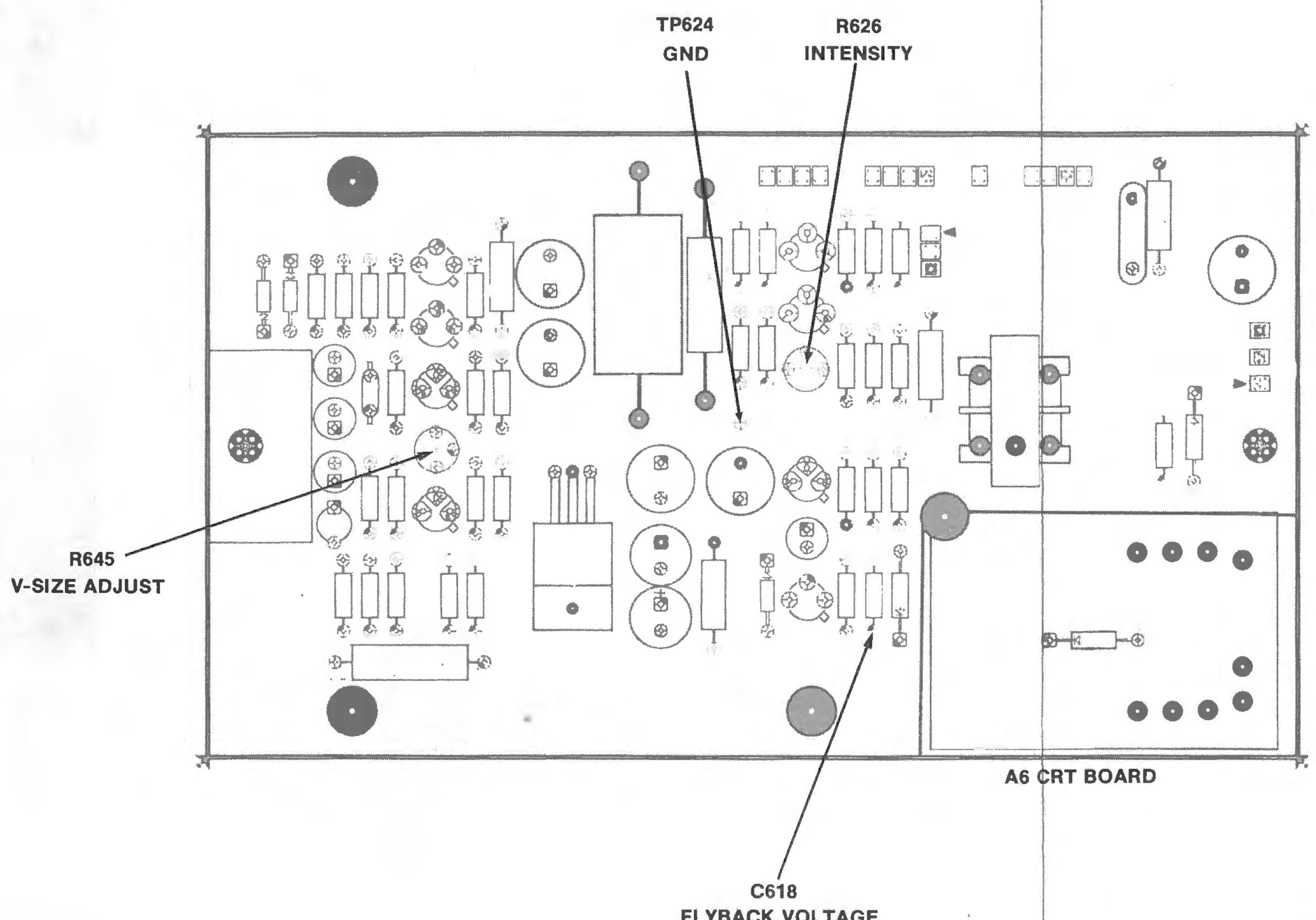
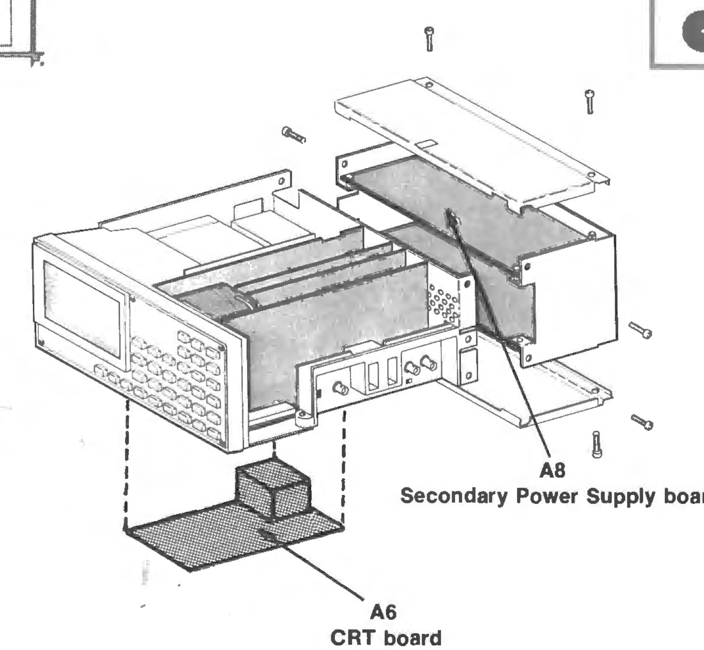


Figure 8-13. A4 MPU board test point and adjustment locations.



2662-105

Figure 8-14. A6 CRT board test point and adjustment locations.



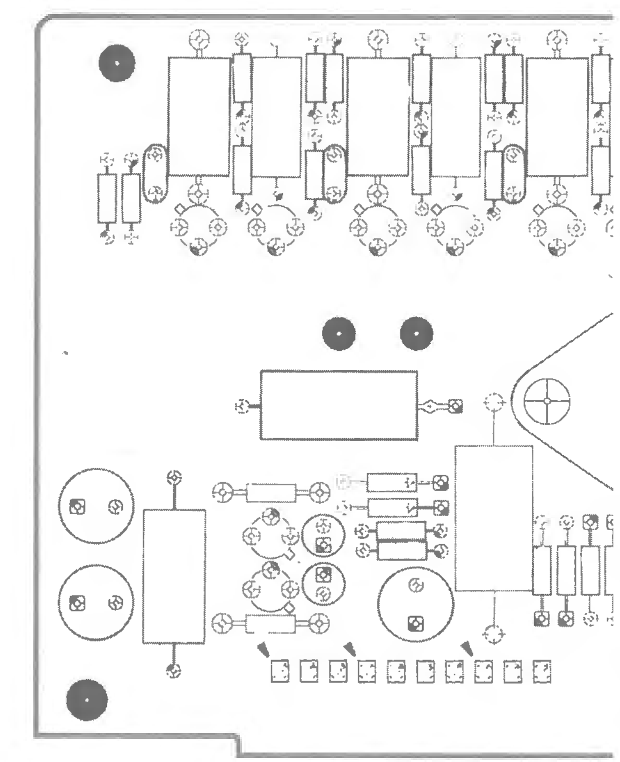
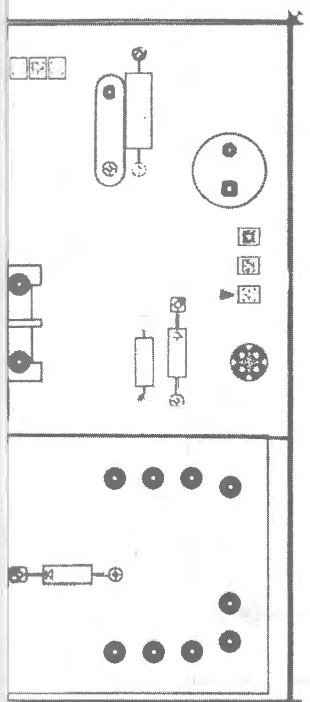
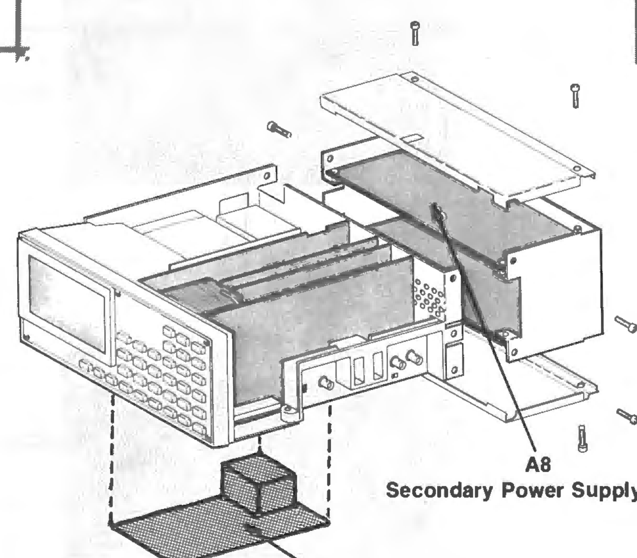
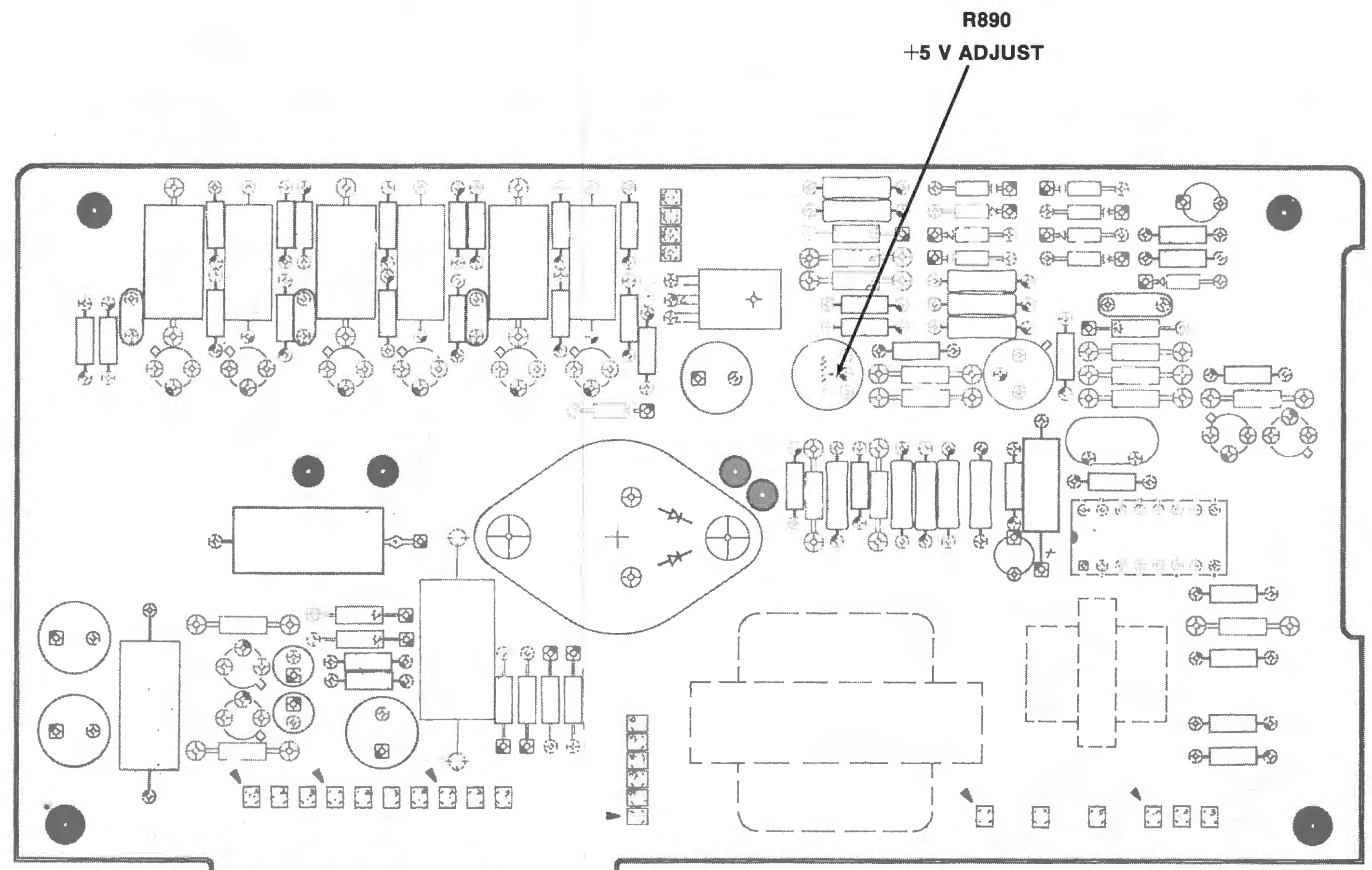


Figure 8-15. A8 Se



2662-105





2662-106

Figure 8-15. A8 Secondary Power Supply board test and adjustment locations.

CONTROL CHART AND CHARACTER DISPLAY

Fig. 8-16. Character Display.

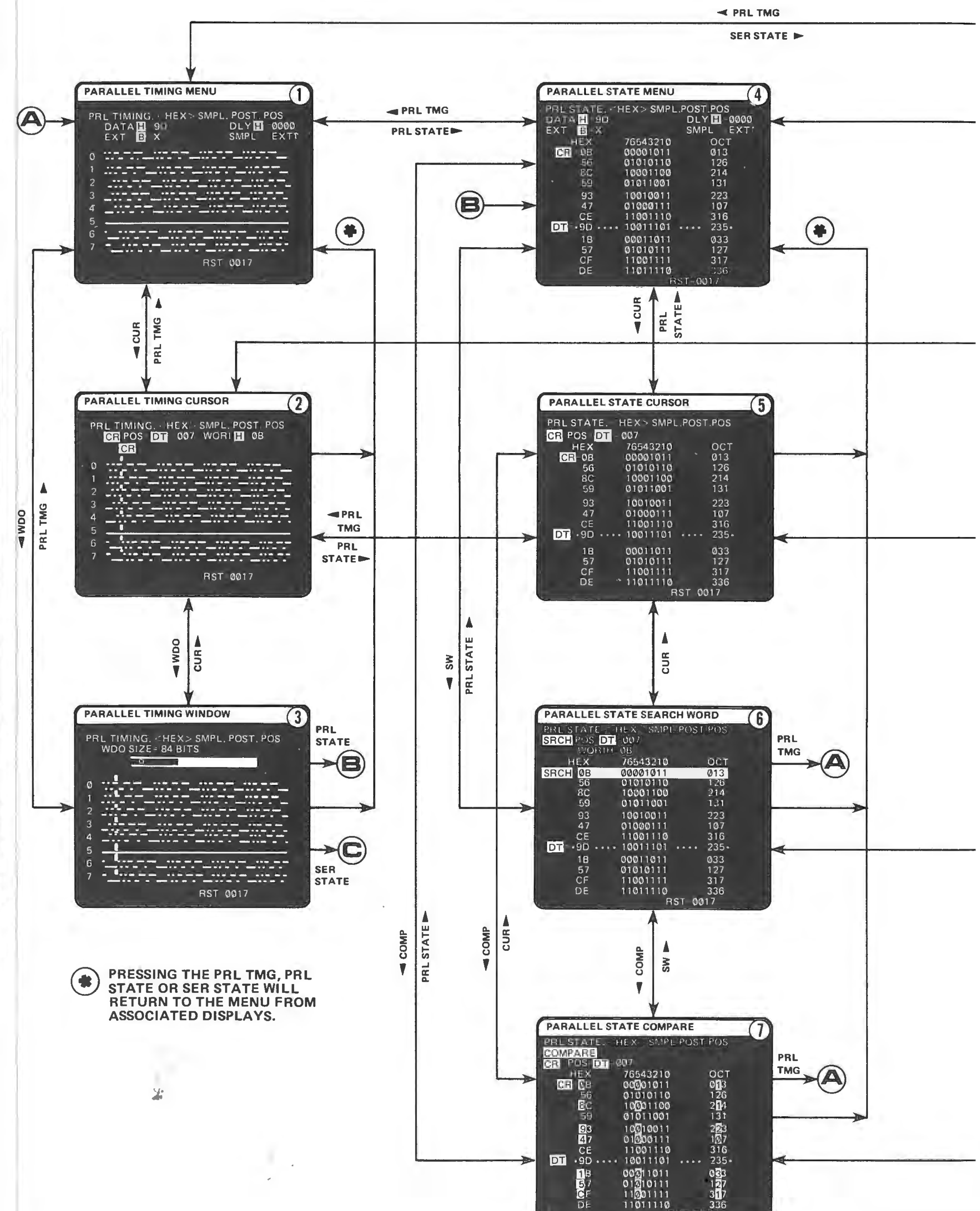


Figure 8-17. Con

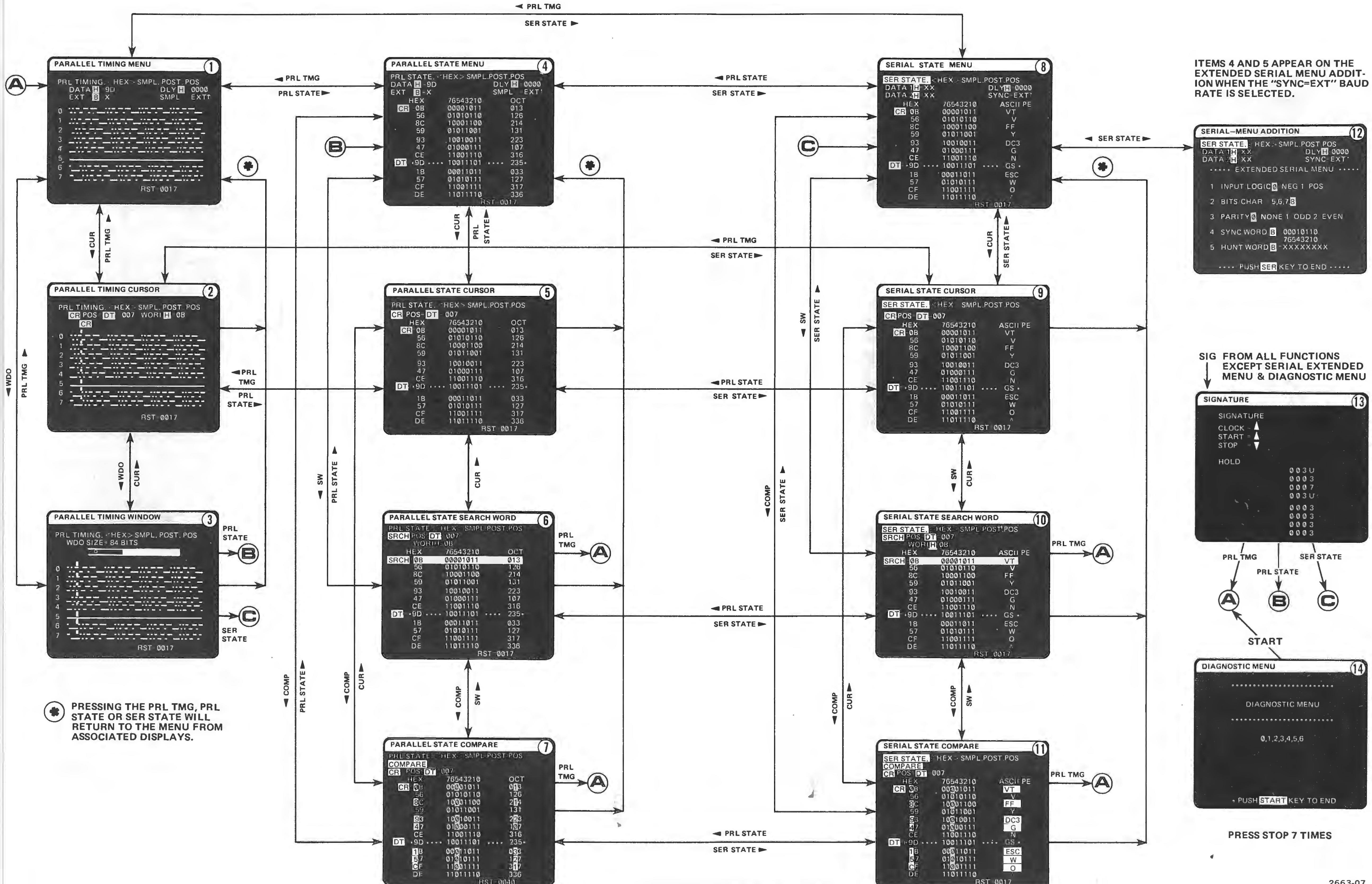


Figure 8-17. Control function access chart.

REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

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

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

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

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

SPECIAL NOTES AND SYMBOLS

X000 Part first added at this serial number

00X Part removed after this serial number

FIGURE AND INDEX NUMBERS

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

INDENTATION SYSTEM

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

1 2 3 4 5 Name & Description

Assembly and/or Component
Attaching parts for Assembly and/or Component
- - - * - - -
Detail Part of Assembly and/or Component
Attaching parts for Detail Part
- - - * - - -
Parts of Detail Part
Attaching parts for Parts of Detail Part
- - - * - - -

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

Attaching parts must be purchased separately, unless otherwise specified.

ITEM NAME

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

ABBREVIATIONS

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

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
000FU	WRIGHT ENGINEERED PLASTICS	10350 OLD REDWOOD HIGHWAY	WINDSOR, CA 95492
0000M	SONY/TEKTRONIX CORPORATION	P O BOX 14, HANEDA AIRPORT	TOKYO 149, JAPAN
00779	AMP, INC.	P O BOX 3608	HARRISBURG, PA 17105
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P O BOX 5012, 13500 N CENTRAL EXPRESSWAY	DALLAS, TX 75222
08261	SPECTRA-STRIP CORP.	7100 LAMPSON AVE.	GARDEN GROVE, CA 92642
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
24931	SPECIALTY CONNECTOR CO., INC.	3560 MADISON AVE.	INDIANAPOLIS, IN 46227
71785	TRW, CINCH CONNECTORS	1501 MORSE AVENUE	ELK GROVE VILLAGE, IL 60007
72041	EAGLE ELECTRIC MFG. CO.	23-10 BRIDGE PLAZA S	LONG ISLAND CITY, NY 11101
73803	TEXAS INSTRUMENTS, INC., METALLURGICAL MATERIALS DIV.	34 FOREST STREET	ATTLEBORO, MA 02703
75915	LITTELFUSE, INC.	800 E. NORTHWEST HWY	DES PLAINES, IL 60016
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
82647	TEXAS INSTRUMENTS, INC., CONTROL PRODUCTS DIV.	34 FOREST ST.	ATTLEBORO, MA 02703
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
86445	PENN FIBRE AND SPECIALTY CO., INC.	2032 E. WESTMORELAND ST.	PHILADELPHIA, PA 19134
86928	SEASTROM MFG. COMPANY, INC.	701 SONORA AVENUE	GLENDALE, CA 91201
88245	LITTON SYSTEMS, INC., USECO DIV.	13536 SATICOY ST.	VAN NUYS, CA 91409
95712	BENDIX CORP., THE ELECTRICAL COMPONENTS DIV., MICROWAVE DEVICES PLANT	HURRICANE ROAD	FRANKLIN, IN 46131
95987	WECKESSER CO., INC.	4444 WEST IRVING PARK RD.	CHICAGO, IL 60641
98159	RUBBER TECK, INC.	19115 HAMILTON AVE., P O BOX 389	GARDENA, CA 90247
98291	SEALECTRO CORP.	225 HOYT	MAMARONECK, NY 10544

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-1	333-2508-00			1	PANEL,FRONT:	80009	333-2508-00
					(ATTACHING PARTS)		
-2	211-0108-00			4	SCREW,MACHINE:2-56 X 0.156 INCH,PNH STL	83385	OBD
					- - - * - - -		
-3	210-0202-00			1	TERMINAL,LUG:0.146 ID,LOCKING,BRZ TINNED	78189	2104-06-00-2520N
					(ATTACHING PARTS)		
-4	211-0503-00			1	SCREW,MACHINE:6-32 X 0.188 INCH,PNH STL	83385	OBD
					- - - * - - -		
-5	343-0787-00			1	RETAINER,CRT:	0000M	343-0787-00
					(ATTACHING PARTS)		
-6	211-0661-00			2	SCREW,MACHINE:4-40 X 0.25 INCH,PNH,STL	83385	OBD
					- - - * - - -		
-7	337-2600-00			1	SHIELD,CRT:	0000M	337-2600-00
-8	366-1770-02			1	PUSH BUTTON:GRAY,1	000FU	OBD
	366-1770-03			1	PUSH BUTTON:GRAY,2	000FU	OBD
	366-1770-04			1	PUSH BUTTON:GRAY,3	000FU	OBD
	366-1770-05			1	PUSH BUTTON:GRAY,4	000FU	OBD
	366-1770-06			1	PUSH BUTTON:GRAY,5	000FU	OBD
	366-1770-07			1	PUSH BUTTON:GRAY,6	000FU	OBD
	366-1770-08			1	PUSH BUTTON:GRAY,7	000FU	OBD
	366-1770-09			1	PUSH BUTTON:GRAY,8	000FU	OBD
	366-1770-10			1	PUSH BUTTON:GRAY,9	000FU	OBD
	366-1770-11			1	PUSH BUTTON:GRAY,0	000FU	OBD
	366-1770-12			1	PUSH BUTTON:GRAY,A	000FU	OBD
	366-1770-13			1	PUSH BUTTON:GRAY,B	000FU	OBD
	366-1770-14			1	PUSH BUTTON:GRAY,C	000FU	OBD
	366-1770-15			1	PUSH BUTTON:GRAY,D	000FU	OBD
	366-1770-16			1	PUSH BUTTON:GRAY,E	000FU	OBD
	366-1770-17			1	PUSH BUTTON:GRAY,F	000FU	OBD
	366-1770-18			1	PUSH BUTTON:GRAY,X	000FU	OBD
	366-1770-19			1	PUSH BUTTON:GRAY,CE	000FU	OBD
	366-1770-00			4	PUSH BUTTON:GY,0.225 X 0.4 X 0.17	000FU	OBD
	366-1784-00			2	PSUH BUTTON:GRAY,0.4 X 0.225 X 0.21	000FU	OBD
	366-1785-00			9	PUSH BUTTON:TV GRAY,1 SILVER GRAY LEGEND	000FU	OBD
-9	----- -----			1	CKT BOARD ASSY:KEY(SEE A5 EPL)		
					(ATTACHING PARTS)		
-10	211-0207-00			4	SCR,ASSEM WSHR:4-40 X 0.312 DOUBLE SEMS	83385	OBD
					- - - * - - -		
	----- -----			-	. CKT BOARD ASSY INCLUDES:		
-11	131-0590-00			18	. CONTACT,ELEC:0.71 INCH LONG	22526	47351
-12	214-0579-00			1	. TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-13	263-0019-09			33	. SWITCH PB ASSY:MOMENTARY	80009	263-0019-09
-14	----- -----			1	CKT BOARD ASSY:DATA INPUT(SEE A1 EPL)		
					(ATTACHING PARTS)		
-15	211-0166-00			2	SCREW,MACHINE:4-40 X 1.750,PNH,STL,CD PL	83385	OBD
-16	210-0054-00			2	WASHER,LOCK:SPLIT,0.118 ID X 0.212"OD STL	83385	OBD
-17	210-0994-00			2	WASHER,FLAT:0.125 ID X 0.25" OD,STL	86928	5714-147-20N
-18	211-0109-00			1	SCREW,MACHINE:4-40 X 0.875"100 DEG,FLH STL	83385	OBD
					- - - * - - -		
	----- -----			-	. CKT BOARD ASSY INCLUDES:		
-19	131-0608-00			72	. TERMINAL,PIN:0.365 L X 0.25 PH,BRZ,GOLD PL	22526	47357
-20	131-0993-00			4	. BUS,CONDUCTOR:2 WIRE BLACK	00779	530153-2
-21	214-0579-00			6	. TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-22	136-0578-00			1	. SOCKET,PLUG-IN:24 DIP,LOW PROFILE	73803	CS9002-24
-23	136-0269-02			3	. SOCKET,PLUG-IN:14 CONTACT,LOW CLEARANCE	01295	C95140
-24	131-1897-00			2	. CONNECTOR,RCPT,:25 MALE CONTACT	71785	2805125002
-25	361-0955-00			1	. SPACER,CONN:0.433 THK,POLYCARBONATE	0000M	361-0955-00
	650-0561-00			1	PNL ASSY,SIDE:	0000M	650-0561-00
					(ATTACHING PARTS)		
-26	211-0121-00			3	SCR,ASSEM WSHR:4-40 X 0.438 INCH,PNH BRS	83385	OBD
					- - - * - - -		
	----- -----			-	. PNL ASSY,SIDE INCLUDES:		
-27	131-0106-01			2	. CONN,RCPT,ELEC:BNC FEMALE	95712	33148-1
-28	210-0012-00			2	. WASHER,LOCK:INTL,0.375 ID X 0.50" OD STL	78189	1220-02-00-0541C
-29	131-1315-01			1	. CONN,RCPT,ELEC:BNC FEMALE	24931	28JR235-1

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-30	386-4060-00			1	. PANEL,SIDE:	80009	386-4060-00
-31	131-0779-00			1	. JACK,TIP:FOR 0.08 INCH DIA TEST POINT	98291	016-8010-00-0208
-32	200-1480-07			1	. COVER,ELEC SW:SILVER GRAY	0000M	200-1480-07
-33	386-4061-00			1	. SUBPANEL,SIDE:	0000M	386-4061-00
-34	386-4167-00			1	. PLATE,ELEC SHLD:ALUMINUM	0000M	386-4167-00
-35	175-2434-00			1	CABLE,SP,ELEC:7,28 AWG,STRD W/PVC JACKET	0000M	175-2434-00
-36	361-0951-00			2	SPACER,SLEEVE:1.355 L X 0.157 ID,BRS	0000M	361-0951-00
					(ATTACHING PARTS FOR EACH)		
-37	129-0780-00			1	SPACER,POST:9.9ML,W/10-32 THD ONE END,BRS	0000M	129-0780-00
					- - - * - - -		
-38	343-0001-00			1	CLAMP,LOOP:0.15 INCH DIA,PLASTIC	95987	1-8-6B
					(ATTACHING PARTS)		
-39	211-0661-00			1	SCREW,MACHINE:4-40 X 0.25 INCH,PNH,STL	83385	OBD
-40	210-0551-00			1	NUT,PLAIN,HEX.:4-40 X 0.25 INCH,STL	83385	OBD
					- - - * - - -		
-41	----- -----			1	CKT BOARD ASSY:TRIGGER(SEE A2 EPL)		
-42	214-0579-00			2	. TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-43	131-0608-00			83	. TERMINAL,PIN:0.365 L X 0.25 PH,BRZ,GOLD PL	22526	47357
-44	131-0993-00			1	. BUS,CONDUCTOR:2 WIRE BLACK	00779	530153-2
-45	136-0621-00			2	. SOCKET,PLUG-IN:22 CONTACT	73803	CS9002-22
-46	175-2435-00			1	CABLE,SP,ELEC:7,28 AWG,STRD,W/PVC JACKET	0000M	175-2435-00
-47	----- -----			1	CKT BOARD ASSY:SERIAL & SIGNATURE(SEE A3 EPL)		
-48	131-0608-00			97	. TERMINAL,PIN:0.365 L X 0.25 PH,BRZ,GOLD PL	22526	47357
-49	131-0993-00			1	. BUS,CONDUCTOR:2 WIRE BLACK	00779	530153-2
-50	214-0579-00			7	. TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-51	136-0252-04			1	. SOCKET,PIN TERM:0.188 INCH LONG	22526	75060-007
-52	131-1003-00			1	. CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
-53	346-0032-00			1	. STRAP,RETAINING:0.075 DIA X 4.0 L,MLD RBR	98159	2859-75-4
-54	136-0694-00			1	. SKT,PL-IN ELEK:MICROCIRCUIT,28 CONTACT	73803	CS9002-28
-55	175-2433-00			1	CABLE,SP,ELEC:7,28 AWG,STRD,W/PVC JACKET	0000M	175-2433-00
-56	----- -----			1	CKT BOARD ASSY:MPU(SEE A4 EPL)		
					(ATTACHING PARTS)		
-57	129-0457-00			2	SPACER,POST:1.07L,W/4-40 TAP 1 END	80009	129-0457-00
-58	211-0207-00			2	SCR,ASSEM WSHR:4-40 X 0.312 DOUBLE SEMS	83385	OBD
					- - - * - - -		
	----- -----			-	. CKT BOARD ASSY INCLUDES:		
-59	214-0579-00			2	. TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-60	131-0608-00			73	. TERMINAL,PIN:0.365 L X 0.25 PH,BRZ,GOLD PL	22526	47357
-61	131-0993-00			10	. BUS,CONDUCTOR:2 WIRE BLACK	00779	530153-2
-62	136-0578-00			4	. SOCKET,PLUG-IN:24 DIP,LOW PROFILE	73803	CS9002-24
-63	136-0670-00			4	. SKT,PL-IN ELEK:MICROCKT,18 PIN,LOW PROFILE	73803	CS9002-18
-64	136-0623-00			1	. SOCKET,PLUG-IN:40 DIP,LOW PROFILE	73803	CS9002-40
-65	131-2183-00			1	. CONN,RCPT,ELEC:CKT CD,2 X 10FEM,SIDE ENTR	00779	5-87729-6
-66	386-4059-00			1	SUPPORT,CRT:BLACK PLASTIC	0000M	386-4059-00
-67	----- -----			1	ELECRON TUBE:CRT(SEE V635 EPL)		
	198-4231-00			1	WIRE SET,ELEC:	0000M	198-4231-00
-68	136-0711-00			1	. SKT,PL-IN ELEK:	0000M	136-0711-00
-69	175-0827-00			FT	. WIRE,ELECTRICAL:4 WIRE RIBBON	08261	SS-0426-710610C
	175-0861-00			FT	. WIRE,ELECTRICAL:4 WIRE RIBBON	08261	SS-0422-1910610C
	175-0862-00			FT	. WIRE,ELECTRICAL:3 WIRE RIBBON	08261	SS-0322-1910610C
-70	352-0162-00			1	. HLDR,TERM CONN:4 WIRE BLACK	80009	352-0162-00
	352-0162-02			1	. CONN BODY,PL,EL:4 WIRE RED	80009	352-0162-02
-71	352-0162-05			1	. CONN BODY,PL,EL:4 WIRE GREEN	80009	352-0162-05
	352-0200-03			1	. HLDR,TERM CONN:4 WIRE ORANGE	80009	352-0200-03
	352-0165-01			1	. CONN BODY,PL,EL:7 WIRE BROWN	80009	352-0165-01
-72	352-0199-02			1	. CONN BODY,PL,EL:3 WIRE RED	80009	352-0199-02
	352-0199-04			1	. CONN BODY,PL,EL:3 WIRE YELLOW	80009	352-0199-04
	352-0199-05			1	. CONN BODY,PL,EL:3 WIRE GREEN	80009	352-0199-05
-73	334-3360-00			1	MARKER,IDENT:MARKED WARNING	0000M	334-3360-00
-74	386-4062-00			1	SUBPANEL,FRONT:	0000M	386-4062-00
					(ATTACHING PARTS)		
-75	211-0538-00			6	SCREW,MACHINE:6-32 X 0.312"100 DEG,FLH STL	83385	OBD
-76	211-0101-00			1	SCREW,MACHINE:4-40 X 0.25" 100 DEG,FLH STL	83385	OBD
-77	210-0586-00			1	NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	211-041800-00
					- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-78	337-2599-00			1	SHIELD,CRT:	0000M	337-2599-00
-79	----- -----			1	CKT BOARD ASSY:CRT CIRCUIT(SEE A6 EPL)		
					(ATTACHING PARTS)		
-80	211-0207-00			4	SCR,ASSEM WSHR:4-40 X 0.312 DOUBLE SEMS	83385	OBD
					- - - * - - -		
	----- -----			-	. CKT BOARD ASSY INCLUDES:		
-81	131-0589-00			3	. TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL	22526	47350
-82	131-0608-00			16	. TERMINAL,PIN:0.365 L X 0.25 PH,BRZ,GOLD PL	22526	47357
-83	131-0993-00			1	. BUS,CONDUCTOR:2 WIRE BLACK	00779	530153-2
-84	----- -----			1	. TRANSFORMER,RF:(SEE T620 EPL)		
-85	----- -----			1	. MICROCIRCUIT,LI:(SEE U615 EPL)		
					(ATTACHING PARTS)		
-86	211-0244-00			1	. SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL	78189	OBD
-87	210-0551-00			1	. NUT,PLAIN,HEX.:4-40 X 0.25 INCH,STL	83385	OBD
					- - - * - - -		
-88	131-2272-00			1	. CONTACT,ELEC:GROUNDING,PHOS-BRONZE	0000M	131-2272-00
-89	214-0579-00			1	. TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-90	384-1548-00			1	EXTENSION SHAFT:215.3MM L X 4.75MM SQ,NYLON	0000M	384-1548-00
-91	366-1767-01			1	PUSH BUTTON:BLACK,YELLOW INDICATOR	0000M	366-1767-00
-92	441-1460-00			1	CHAS,DATA ANALY:LEFT	0000M	441-1460-00
					(ATTACHING PARTS)		
-93	211-0101-00			4	SCREW,MACHINE:4-40 X 0.25" 100 DEG,FLH STL	83385	OBD
					- - - * - - -		
-94	386-1556-00			1	SUPPORT,CKT BD:0.215 H,ACETAL	80009	386-1556-00
-95	441-1459-00			1	CHAS,DATA ANALY:RIGHT	0000M	441-1459-00
					(ATTACHING PARTS)		
-96	211-0661-00			3	SCREW,MACHINE:4-40 X 0.25 INCH,PNH,STL	83385	OBD
					- - - * - - -		
-97	200-2293-00			1	COVER,PWR SPLY:TOP	0000M	200-2293-00
					(ATTACHING PARTS)		
-98	211-0007-00			2	SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
					- - - * - - -		
-99	----- -----			1	CKT BOARD ASSY:SECONDARY PWR SPLY(SEE A8 EPL)		
					(ATTACHING PARTS)		
-100	129-0743-00			2	SPACER,POST:0.868 L,W/4-40 INT/EXT THD,BRS	0000M	129-0743-00
-101	211-0207-00			2	SCR,ASSEM WSHR:4-40 X 0.312 DOUBLE SEMS	83385	OBD
					- - - * - - -		
	----- -----			-	. CKT BOARD ASSY INCLUDES:		
-102	131-0787-00			10	. CONTACT,ELEC:0.64 INCH LONG	22526	47359
-103	131-0608-00			6	. TERMINAL,PIN:0.365 L X 0.25 PH,BRZ,GOLD PL	22526	47357
-104	131-0589-00			10	. TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL	22526	47350
-105	136-0260-02			1	. SOCKET,PLUG-IN:16 CONTACT,LOW CLEARANCE	82647	C9316-18
-106	----- -----			1	. TRANSISTOR:(SEE Q985 EPL)		
					(ATTACHING PARTS)		
-107	211-0244-00			1	. SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL	78189	OBD
-108	210-0551-00			1	. NUT,PLAIN,HEX.:4-40 X 0.25 INCH,STL	83385	OBD
					- - - * - - -		
-109	----- -----			1	. SEMICOND DEVICE:(SEE CR815A,B EPL)		
					(ATTACHING PARTS)		
-110	210-0244-00			2	. TERMINAL,LUG:#10,RING,SOLDERLESS,CU TIN PL	86928	A373-148-1
-111	210-0551-00			2	. NUT,PLAIN,HEX.:4-40 X 0.25 INCH,STL	83385	OBD
					- - - * - - -		
-112	210-0202-00			1	TERMINAL,LUG:0.146 ID,LOCKING,BRZ TINNED	78189	2104-06-00-2520N
					(ATTACHING PARTS)		
-113	210-0457-00			1	NUT,PLAIN,EXT W:6-32 X 0.312 INCH,STL	83385	OBD
					- - - * - - -		
-114	----- -----			1	FILTER,RFI:(SEE FL700 EPL)		
					(ATTACHING PARTS)		
-115	210-0586-00			2	NUT,PLAIN,EXT W:4-40 X 0.25 INCH,STL	78189	211-041800-00
					- - - * - - -		
-116	361-0952-00			1	SPACER,FILTER:0.5 THK,ALUMINUM	0000M	361-0952-00
-117	----- -----			1	SW,THERMOSTATIC:(SEE S700 EPL)		
					(ATTACHING PARTS)		
-118	210-0478-00			2	INSERT,SCR THD:0.66" L,W/HEX FLG ONE END	80009	210-0478-00
					- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-119	214-2740-00			1	HEAT SINK,XSTR:(2) TO-220,PORCELAIN	0000M	214-2740-00
					(ATTACHING PARTS)		
-120	211-0086-00			1	SCREW,MACHINE:4-40 X 0.75 100" DEG,FLH STL	83385	OBD
					- - - * - - -		
-121	407-2244-00			1	BRACKET,HEAT SK:PLASTIC	0000M	407-2244-00
					(ATTACHING PARTS)		
-122	211-0102-00			2	SCREW,MACHINE:4-40 X 0.500",FLH,STL	83385	OBD
					- - - * - - -		
-123	----- -----			2	TRANSISTOR:(SEE Q743 & Q744 EPL)		
-124	352-0362-01			1	FUSEHOLDER:W/HARDWARE	75915	345002
-125	----- -----			1	FAN,TUBE AXIAL:(SEE B980 EPL)		
					(ATTACHING PARTS)		
-126	211-0020-00			4	SCREW,MACHINE:4-40 X 1.125 INCH,PNH STL	83385	OBD
-127	210-0004-00			4	WASHER,LOCK:#4 INTL,0.015THK,STL CD PL	78189	1204-00-00-0541C
					- - - * - - -		
-128	200-2285-00			1	COVER,PWR SPLY:BOTTOM	0000M	200-2285-00
					(ATTACHING PARTS)		
-129	211-0007-00			2	SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
					- - - * - - -		
-130	----- -----			1	CKT BOARD ASSY:PRIMARY PWR SPLY(SEE A7 EPL)		
					(ATTACHING PARTS)		
-131	129-0742-00			2	SPACER,POST:0.711 L,W/4-40 INT/EXT THD,BRS	0000M	129-0742-00
-132	211-0207-00			2	SCR,ASSEM WSHR:4-40 X 0.312 DOUBLE SEMS	83385	OBD
					- - - * - - -		
	----- -----			-	. CKT BOARD ASSY INCLUDES:		
-133	----- -----			1	. SWITCH,PUSH:(SEE S702 EPL)		
-134	131-0589-00			6	. TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL	22526	47350
-135	131-0344-00			1	. TERMINAL,STUD:BIFURCATED	88245	421837-9
-136	358-0135-00			1	. INSULATOR,BSHG:0.075 ID X 0.141 OD	86928	OBD
	210-0917-00			1	. WASHER,NONMETAL:0.191 ID X 0.625 INCH OD	86445	OBD
	346-0032-00			1	. STRAP,RETAINING:0.075 DIA X 4.0 L,MLD RBR	98159	2859-75-4
-137	441-1461-00			1	CHAS,PWR SPLY:	0000M	441-1461-00
-138	334-3447-00			1	MARKER,IDENT:MARKED CAUTION	80009	334-3447-00
	334-2063-00			1	MARKER,IDENT:MKD CALIB SEAL	80009	334-2063-00
	334-3379-00			1	MARKER,IDENT:MARKED GROUNDSYMBOL	80009	334-3379-00
	334-3468-00			1	MARKER,IDENT:MARKED INPUT IDENTIFICATION	80009	334-3468-00
-139	333-2509-00			1	PANEL,REAR:	0000M	333-2509-00
					(ATTACHING PARTS)		
-140	211-0507-00			2	SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
					- - - * - - -		
	198-4232-00			1	WIRE SET,ELEC:	0000M	198-4232-00
-141	131-0621-00			12	. CONNECTOR,TERM:22-26 AWG,BRS& CU BE GOLD	22526	46231
	131-0707-00			4	. CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-142	175-0862-00			FT	. WIRE,ELECTRICAL:3 WIRE RIBBON	08261	SS-0322-1910610C
-143	175-0827-00			FT	. WIRE,ELECTRICAL:4 WIRE RIBBON	08261	SS-0426-710610C
-144	352-0199-00			2	. CONN BODY,PL,EL:3 WIRE BLACK	80009	352-0199-00
-145	352-0162-00			1	. HLDR,TERM CONN:4 WIRE BLACK	80009	352-0162-00
-146	352-0201-00			2	. CONN BODY,PL,EL:5 WIRE BLACK	80009	352-0201-00

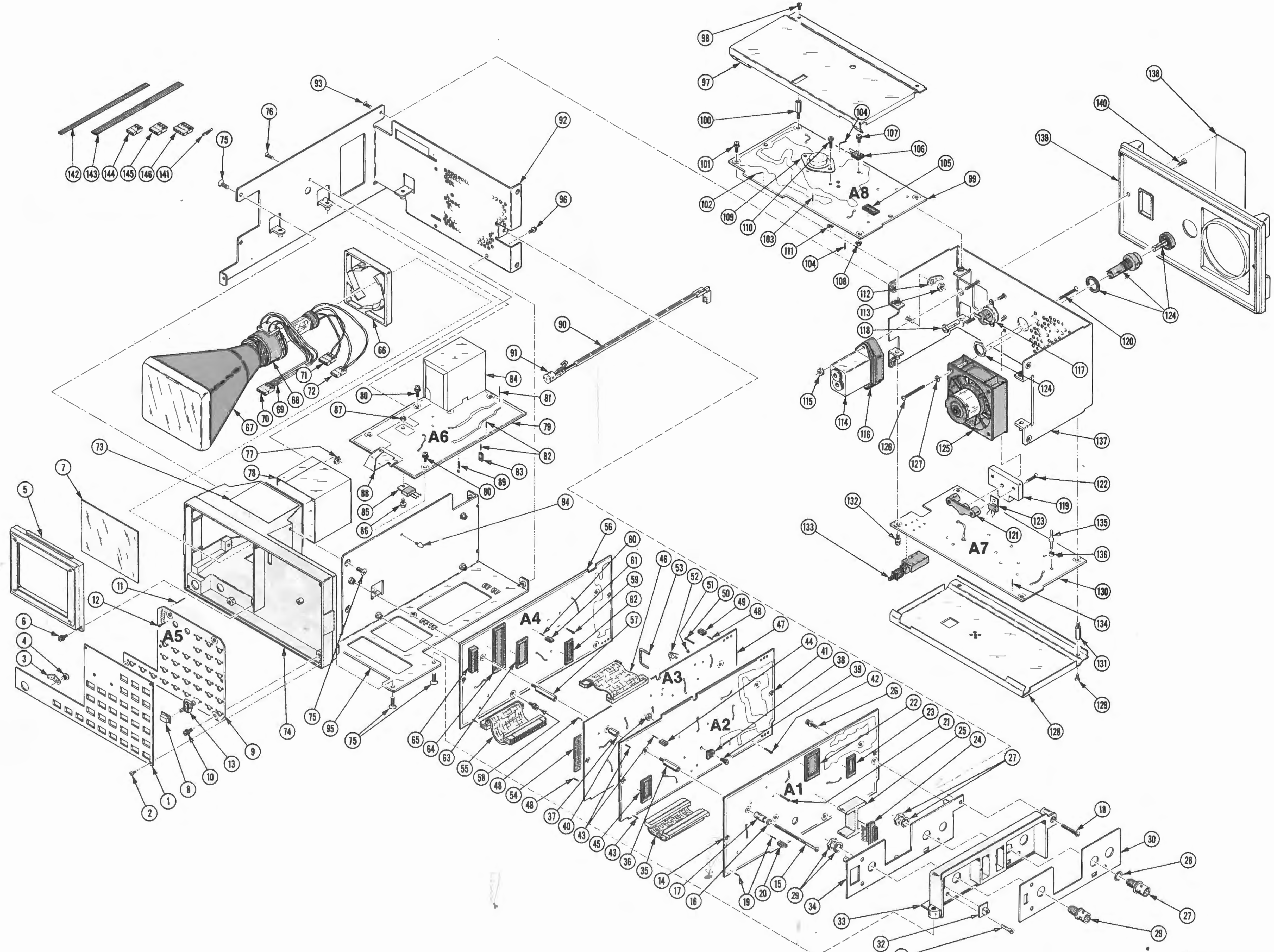

A1
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FIG. 2 CABINET

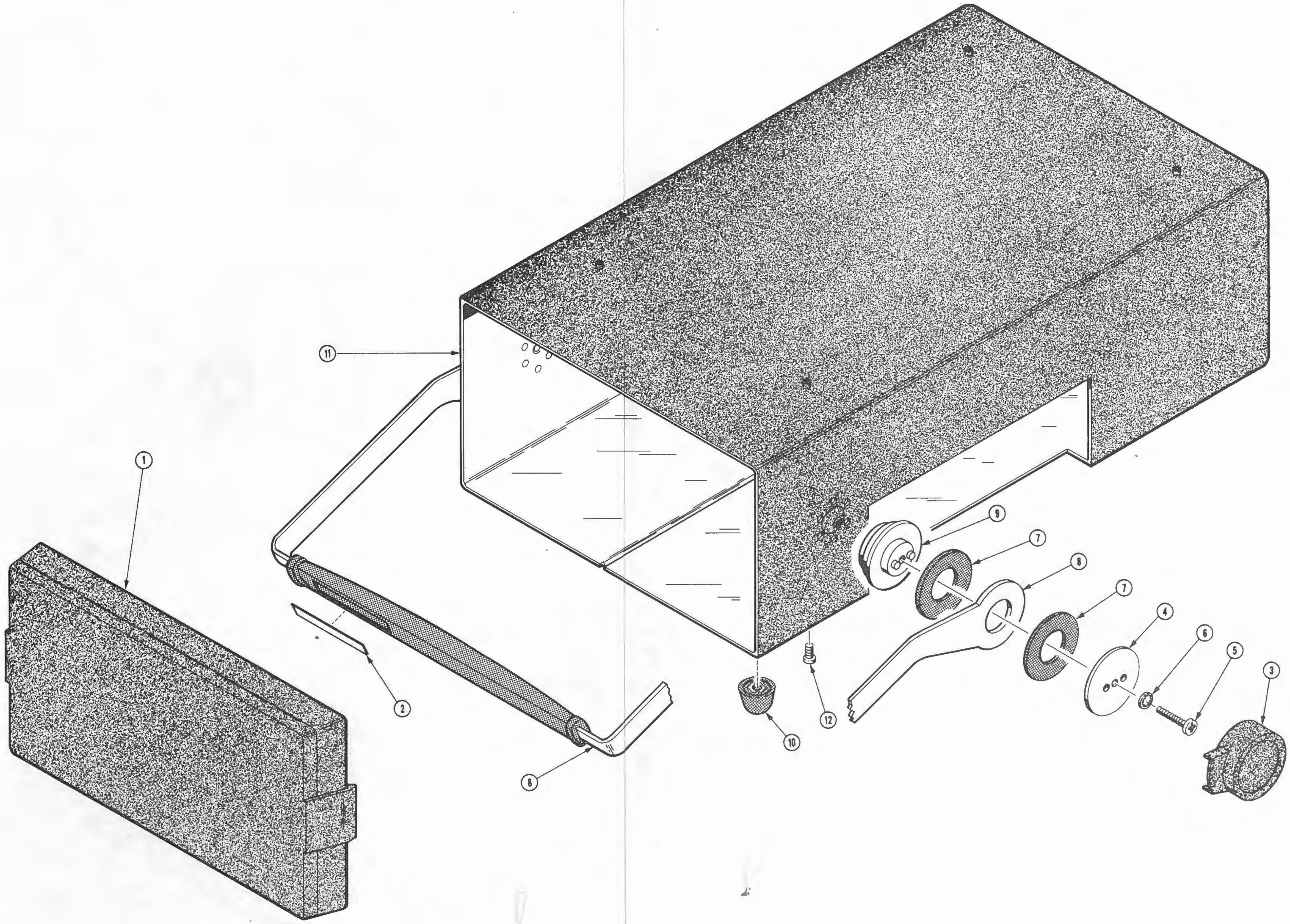

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-1	016-0408-00			1	COVER,PROT:FRONT PANEL	0000M	016-0408-00
-2	334-3480-00			1	MARKER,IDENT:MARKED SONY/TEKTRONIX 308	80009	334-3480-00
-3	200-1342-00			2	COVER,HANDLE:35.5MM OD X 14MM H,PLASTIC	0000M	200-1342-00
-4	386-3936-00			2	PLATE,MOUNTING:HANDLE,STEEL	0000M	386-3936-00
					(ATTACHING PARTS)		
-5	212-0033-00			2	SCREW,MACHINE:8-32 X 0.750 INCH,PNH STL	83385	OBD
					- - - * - - -		
-6	210-0008-00			2	WASHER,LOCK:INTL,0.172 ID X 0.331"OD,STL	78189	1208-00-00-0541C
-7	386-2182-00			4	PLATE,FRICTION:	0000M	386-2182-00
-8	367-0203-00			1	HANDLE,CARRYING:BLACK VINYL	0000M	367-0203-00
-9	343-0757-00			2	RETAINER,HANDLE:	0000M	343-0757-00
-10	348-0080-01			4	FOOT,CABINET:BOTTOM	80009	348-0080-01
-11	390-0634-00			1	CABINET,SIDE:RIGHT,14.716 L	80009	390-0634-00
					(ATTACHING PARTS)		
-12	211-0503-00			1	SCREW,MACHINE:6-32 X 0.188 INCH,PNH STL	83385	OBD
					- - - * - - -		

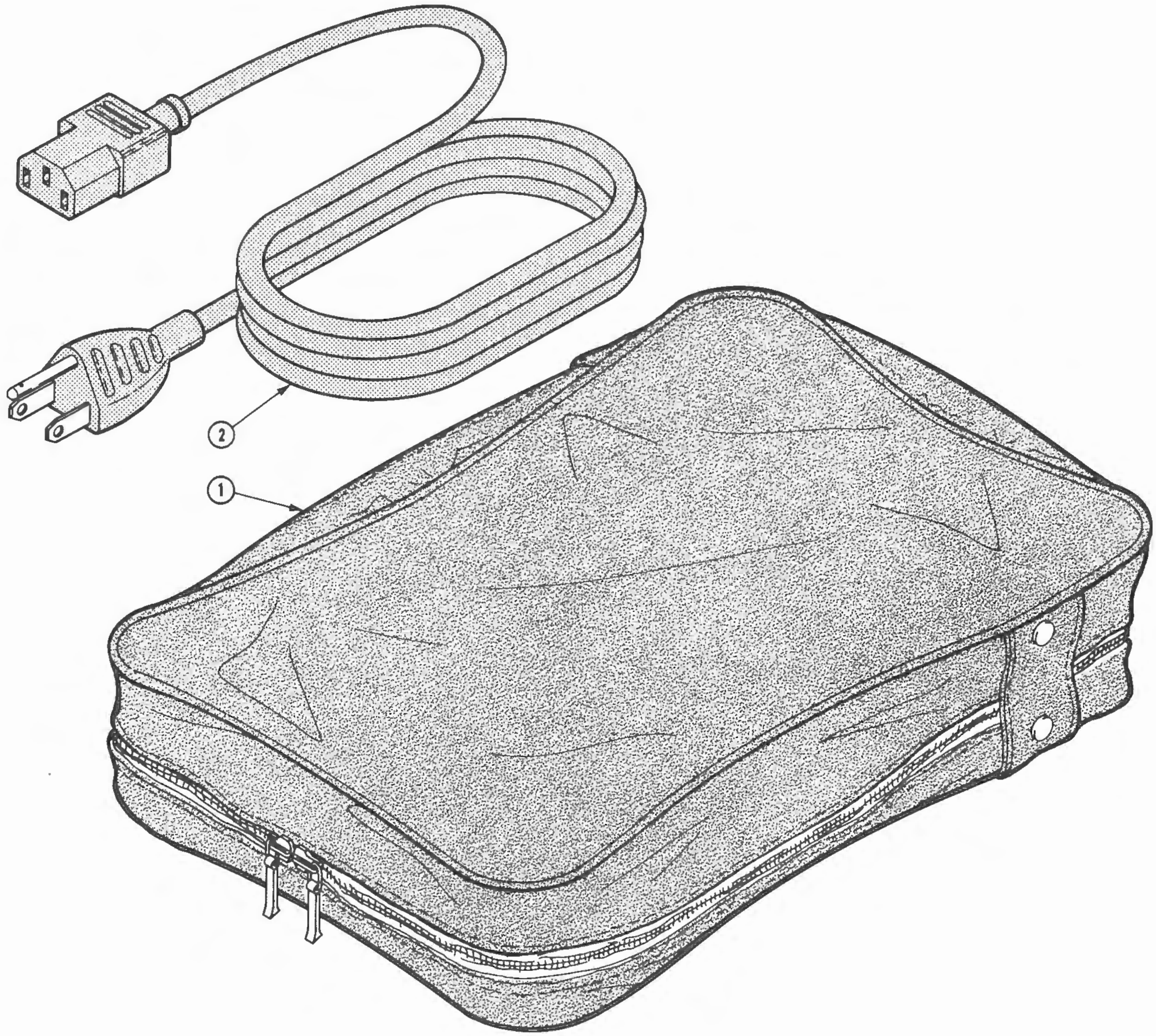

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
3-1	016-0654-00			1	POUCH,ACCESSORY:	0000M	016-0654-00
-2	161-0104-00			1	CABLE ASSY,PWR,:3 WIRE,98.0" LONG	80009	161-0104-00
	010-6107-03			1	PROBE,VOLTAGE:10 X,2 METER	80009	010-6107-03
	010-6406-01			1	PROBE,WORD REC:MULTILEAD,W/ACCESS	80009	010-6406-01
	010-6451-05			1	PROBE,DATA ACQ:MULTILEAD,W/ACCESS	80009	010-6451-05
	103-0013-00			1	ADAPTER,CONN:3 WIRE TO 2 WIRE	72041	419
	070-2662-00			1	MANUAL,TECH:SERVICE	80009	070-2662-00
	070-2663-00			1	MANUAL,TECH:OPERATORS	80009	070-2663-00
	070-2748-00			1	MANUAL,TECH:INSTRUCTION,JAPANESE	0000M	070-2748-00

MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages.

A single change may affect several sections. Since the change information sheets are carried in the manual until all changes are permanently entered, some duplication may occur. If no such change pages appear following this page, your manual is correct as printed.

SERVICE NOTE

Because of the universal parts procurement problem, some electrical parts in your instrument may be different from those described in the Replaceable Electrical Parts List. The parts used will in no way alter or compromise the performance or reliability of this instrument. They are installed when necessary to ensure prompt delivery to the customer. Order replacement parts from the Replaceable Electrical Parts List.

CALIBRATION TEST EQUIPMENT REPLACEMENT

Calibration Test Equipment Chart

This chart compares TM 500 product performance to that of older Tektronix equipment. Only those characteristics where significant specification differences occur, are listed. In some cases the new instrument may not be a total functional replacement. Additional support instrumentation may be needed or a change in calibration procedure may be necessary.

Comparison of Main Characteristics

DM 501 replaces 7D13		
PG 501 replaces 107	PG 501 - Risetime less than 3.5 ns into 50 Ω.	107 - Risetime less than 3.0 ns into 50 Ω.
108	PG 501 - 5 V output pulse; 3.5 ns Risetime	108 - 10 V output pulse 1 ns Risetime
PG 502 replaces 107		
108	PG 502 - 5 V output	108 - 10 V output
111	PG 502 - Risetime less than 1 ns; 10 ns Pretrigger pulse delay	111 - Risetime 0.5 ns; 30 to 250 ns Pretrigger pulse delay
PG 508 replaces 114 115 2101	Performance of replacement equipment is the same or better than equipment being replaced.	
PG 506 replaces 106	PG 506 - Positive-going trigger output signal at least 1 V; High Amplitude output, 60 V.	106 - Positive and Negative-going trigger output signal, 50 ns and 1 V; High Amplitude output, 100 V.
067-0502-01	PG 506 - Does not have chopped feature.	0502-01 - Comparator output can be alternately chopped to a reference voltage.
SG 503 replaces 190, 190A, 190B	SG 503 - Amplitude range 5 mV to 5.5 V p-p.	190B - Amplitude range 40 mV to 10 V p-p.
191		
067-0532-01	SG 503 - Frequency range 250 kHz to 250 MHz.	0532-01 - Frequency range 65 MHz to 500 MHz.
SG 504 replaces 067-0532-01	SG 504 - Frequency range 245 MHz to 1050 MHz.	0532-01 - Frequency range 65 MHz to 500 MHz.
067-0650-00		
TG 501 replaces 180, 180A	TG 501 - Trigger output-slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	180A - Trigger pulses 1, 10, 100 Hz; 1, 10, and 100 kHz. Multiple time-marks can be generated simultaneously.
181		181 - Multiple time-marks
184	TG 501 - Trigger output-slaved to market output from 5 sec through 100 ns. One time-mark can be generated at a time.	184 - Separate trigger pulses of 1 and 0.1 sec; 10, 1, and 0.1 ms; 10 and 1 μs.
2901	TG 501 - Trigger output-slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	2901 - Separate trigger pulses, from 5 sec to 0.1 μs. Multiple time-marks can be generated simultaneously.

NOTE: All TM 500 generator outputs are short-proof. All TM 500 plug-in instruments require TM 500-Series Power Module.

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MANUAL CHANGE INFORMATION

Date: 1-3-80 Change Reference: C1/180

Product: 308 SERVICE ALL SERIAL NUMBERS Manual Part No.: 070-2662-00

DESCRIPTION

This Change Information Insert contains details for circuitry changes added by Pilot Change #33, and unrelated corrections to the original manual text and diagrams section. Pilot Change 33 adds Qualifier circuit components U205 and capacitor C205 to the existing circuitry shown in diagram 4 and the A2 Trigger board illustration Figure 8-3. In early serial numbers these components were added directly on the A2 board. In later serial numbers these components and U206 are relocated on an added A9 Qualifier board and the item shown as U206 in Figure 8-2 is changed to connector J206 to provide a signal path from the new A9 board to the A2 board.

TEXT CHANGES

Pages iii & iv List of Illustrations

CHANGE: Figure 4-9 to Figure 4-9A and:

ADD: Figure 4-9B. Adjusting pulse generators outputs for checking clock qualifier operation.

ADD: Figure 8-17 Control function access chart.

Page 1-2 Table 1-1, External Clock Mode, Data Hold Time (Minimum), Supplemental Information Column:

ADD: 7 ns when Clock Qualifier is active.

Page 1-3 Table 1-1, Clock Qualifier, Setup Time, Supplemental Information Column:

CHANGE TO: 5 ns or less.

Page 1-3 Table 1-1, Clock Qualifier, Hold Time, Supplemental Information Column:

CHANGE TO: 30 ns or less.

Page 2-19 Figure 2-16, bottom numeral in bracket left of the word signature:

CHANGE: From 8 to 4.

Page 3-15 Following the Clock Gate paragraph:

ADD:

Clock Qualifier

When the T/C switch is in the C position, the external qualifier signal acts as a clock qualifier for parallel acquisitions.

DESCRIPTION

The Clock Qualifier signal is sampled by the external clock source as selected in the parallel menus. Because U205 samples on falling edges, the $\overline{\text{EXT CLK}}$ (EXT CLK) signal is used to sample the EXT = ↑ (EXT = ↓) clock qualifier for pin 12 (pin 2) of U206.

Page 3-15 Triggered Gate, lines 4 through 7.

CHANGE TO:

.... jumper P224 is connected to pins 2 and 3, U224A latches after reset and one memory cycle.

When U224A has its set and reset inputs high, the word.......

Page 3-17 Right column, last five lines:

CHANGE TO:

....$\overline{\text{Store/Sig Stop}}$ gate on diagram 6. Flip Flop U256B produces the Data Pos Count Carry signal. When the STOP key is pressed, the Stop signal sets U256A, producing a low on the Store line. This low stops the data acquisition process. The high on the $\overline{\text{Store}}$ line is used by the MPU.

Page 3-28 Figure 3-19, description in box at lower right:

CHANGE: Second line to read: THE FE FLAG IS SET WHEN A

Page 3-28 Figure 3-20

MOVE: Bracket and words SYNCHRONOUS MODE ONLY* down one position (opposite SYN CHARACTER 1 and SYN CHARACTER 2).

DELETE: All of footnote *1 and change prefix for footnote *2 to *1.

Page 4-1 At end of Calibration Interval paragraph:

ADD:

NOTE

If a Word Recognizer probe is not available and will not be used with the 308, any Performance Check or Adjustment Procedure Step requiring a Word Recognizer probe may be skipped.

Page 4-2 Item 20 Word Recognizer Probe

ADD: Superscript and Footnote:

[2] Optional accessory included with Option 1. Required only if the intended application of the 308 requires a Word Recognizer Probe.

DESCRIPTION

Page 4-3 Index of Performance Checks, following Trigger Delay Counter 4-16

ADD: Clock Qualifier 4-16

Page 4-5 Between Step 7 title and Step 7, part a text:

ADD: NOTE

Diagnostic 5 may be performed either with or without the Word Recognizer probe.

Page 4-10 Equipment Required

DELETE: The last item: Active probe (Item 20)

Page 4-16 Equipment Required

CHANGE: Quantity for tenth line (Item 15) from 2 to 3.

Page 4-16 Step 13 title

CHANGE TO:

13. Trigger Delay Counter Check and Clock Qualifier Check.

Page 4-16 Step 13, part f, Pulse Generator Channel 2 (Item 4) Delay Time

CHANGE TO: Adjust as shown in Figure 4-9A.

Page 4-16 Step 13, following part g CHECK sentence:

ADD:

h. Add a third Dual Binding Post Adapter (item 15) to the test setup shown in Figure 4-8. Connect this adapter to the EXTERNAL TRIGGER QUALIFIER INPUT connector on the 308. Connect the ungrounded post on this adapter to the ungrounded post on the other two adapters in the setup.

i. Set test equipment as in part f, except refer to Figure 4-9B rather than 4-9A.

j. Press EXT = , then 1.

NOTE

The display should show EXT = 1

k. Press START, then STOP

CHECK- the display is filled with all high data.

l. Press EXT =, then X.

CHECK- the display shows EXT = X.

DESCRIPTION

m. Press START

CHECK- the display shows both high data and low data.

n. Press EXT =, then 0.

CHECK- the display shows EXT = Ø

o. Press START, the STOP

CHECK- the display is filled with all low data.

p. Remove the adapter and ground wire added in Step 13, part h.

If no other Performance Check is to be performed, disconnect the test setup and set the POWER switch to OFF.

Page 4-18 Change existing Figure 4-9 number to read 4-9A and add the following Figure 4-9B.

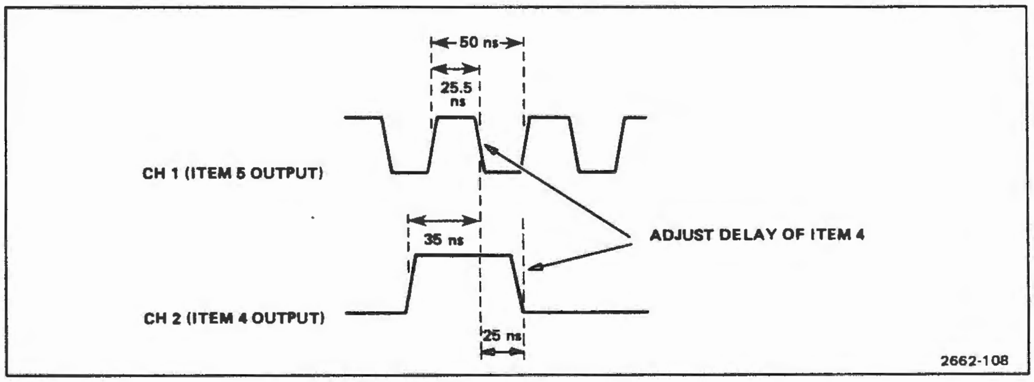


Figure 4-9B.Adjusting pulse generators outputs for checking Clock Qualifier Operation.

Page 4-29 Step 4, part c.

CHANGE TO:

c. Set the VAR/TTL switch to TTL.

Page 4-31 Step 5

DELETE: The existing Step 5, part j and

ADD: The following parts j through p:

j. Press the STOP key seven times.

k. Press the 3 key.

l. CHECK- Screen displays OK in inverse video (adjust R335 if necessary).

m. Press the STOP key.

n. Press the 4 key.

o. ADJUST- DC BALANCE R335 slowly just to the point where the screen displays OK in inverse video.

p. If no other adjustments are to be performed, disconnect test setup and set the 308 POWER switch to OFF.

DESCRIPTION

Page 4-35 Step 7, part b

CHANGE TO:

b. Set the VAR/TTL switch to TTL and press the following keys in the sequence listed:

SIGNATURE	Press once
	Press three times

Page 6-1

CHANGE: The part number for the P6046 probe to 010-6406-01.

Page 7-3

ADD:

A9 670-6794-00 CKT BOARD ASSY:QUALIFIER

See attached partial diagram 4 and Fig. 8-3B for the A9 board circuitry. (In some early serial numbers the A9 board may not be present and components from it are added directly on the A2 board).

C168 281-0775-00 CAP.,FXD,CER DI:0.1UF,20%,50V

C168 is added to the A1 DATA INPUT BOARD from base of Q164 to ground (see diagram 3).

C205 281-0775-00 CAP.,FXD,CER DI:0.1UF,20%,50V

C205 is added on the new A9 QUALIFIER board between pins 7 and 14 of U205 and U206 (see attached partial diagram 4 and Fig. 8-3B A9 QUALIFIER board.

Page 7-12

ADD:

U205 156-1447-00 MICROCKT,DGTL,SN74S113N

DIAGRAMS SECTION CHANGES

TROUBLESHOOTING TREE 1

REPLACE with the attached copy.

TROUBLESHOOTING TREE 2

REPLACE with the attached copy.

Table 8-2 Device Error Reference Number F.

DELETE: U226

Product: 308 SERVICE Date: 1-3-80 Change Reference: C1/180

DESCRIPTION

Table 8-5 Part D. Signature

REPLACE with the following:

Table 8-5 (cont)

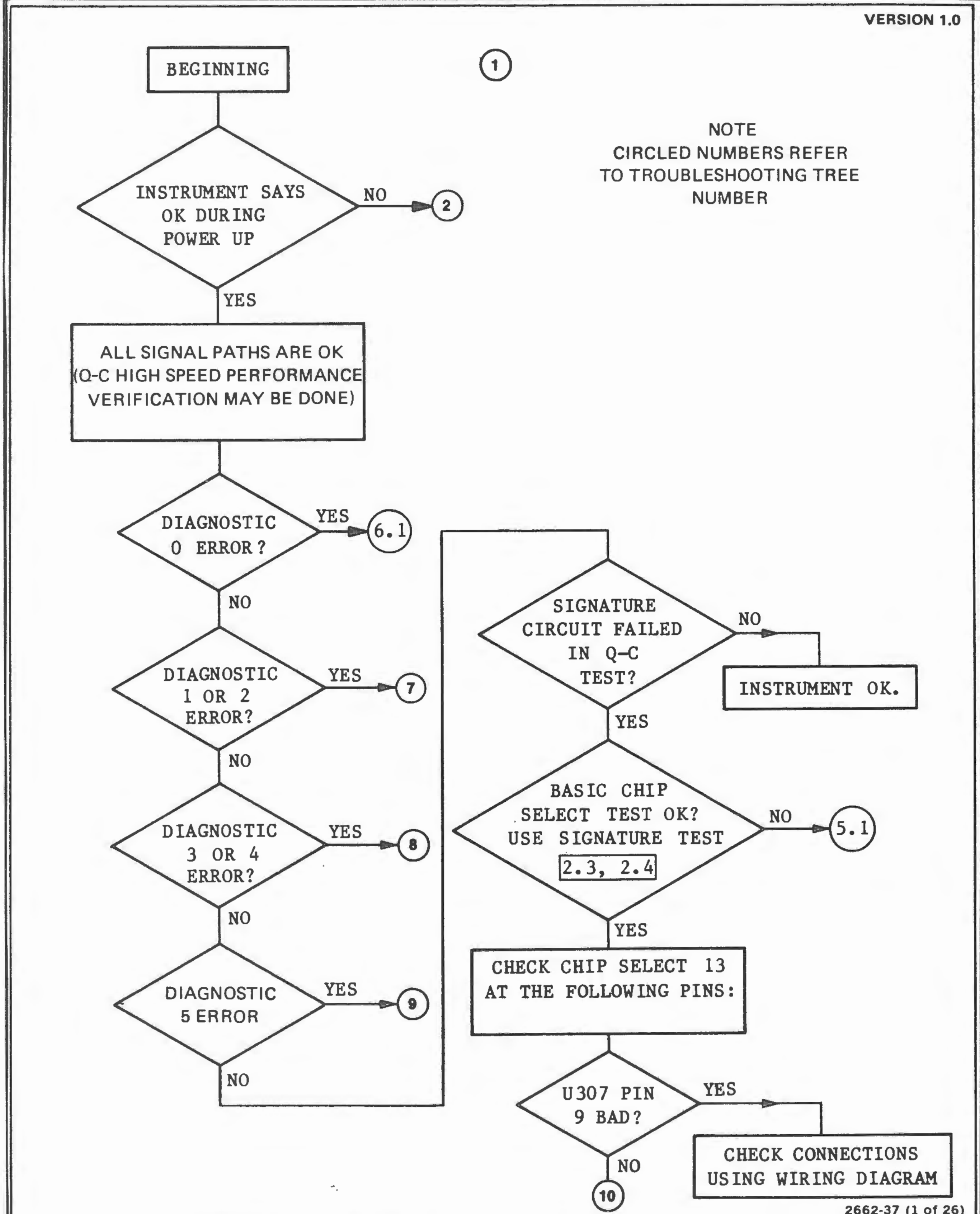
D. Signature

Component Circuit Number	Component Pin Number	Signature	Bus Line Number	
U400	3	0000		
U400	6	0000		
U400	12	UUUU	Ø	
U400	13	5555	1	
U400	14	CCCC	2	
U400	15	7F7F	3	DATA
U400	16	5H21	4	BUS
U400	17	OAFA	5	
U400	18	UPFH	6	
U400	19	52F8	7	
U400	21	HC89	8	
U400	22	2H70	9	
U400	23	HPPO	10	
U400	24	1293	11	ADDRESS
U400	25	HAP7	12	BUS
U400	26	3C96	13	
U400	27	3827	14	
U400	31	0001		
U400	32	0001		
U400	35	0001		
U400	36	0001		
U400	38	0000		
U400	39	0000		
U400	40	0001		
U410	2	UUUU	Ø	
U410	5	5555	1	
U410	6	CCCC	2	
U410	9	7F7F	3	ADDRESS
U410	12	5H21	4	BUS
U410	15	OAFA	5	
U410	16	UPFH	6	
U410	19	52F8	7	
U412	1	755U		
U412	5	U3H5		
U412	6	0996		
U412	7	6H49		

NOTE

When the Troubleshooting Tree calls for testing a Data Bus Line, use the same Clock, Start, and Stop connections specified in this table. The Data Acquisition probe should be placed on the point described in the Troubleshooting Tree.

DESCRIPTION

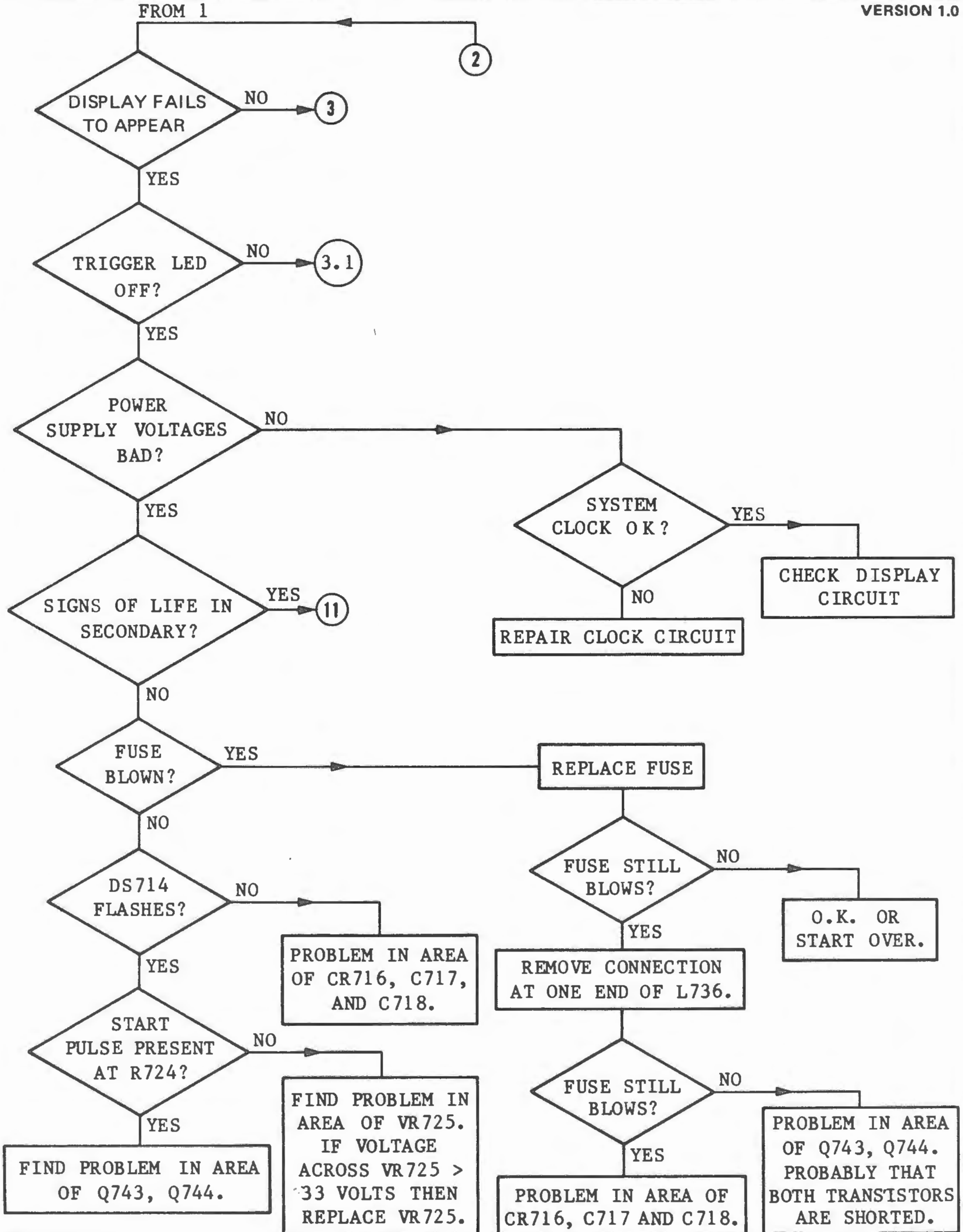


TROUBLESHOOTING TREE 1

Product: 308 SERVICE Date: 1-3-80 Change Reference: C1/180

DESCRIPTION

VERSION 1.0



2662-37 (2 of 26)

Product: 308 SERVICE Date: 1-3-80 Change Reference: C1/180

DESCRIPTION

Table 8-6	Part D Signature
CHANGE:	U396 pin 6 Signature to F61H
Table 8-7	Part B
CHANGE:	Instruction to read: 1. Perform Diagnostic 6
Table 8-8	Setup Check Signature
ADD:	C. At left of title
Table 8-9	Part A.
ADD:	Instructions: 1. Connect Serial/Signature Probe to +5V
Table 8-9	Part B.
DELETE:	Number 2 Instruction.
Table 8-9	Part D.
DELETE:	First two lines pertaining to U226
CHANGE:	U252 pin 2 Signature to 75UA
	U252 pin 5 Signature to 9FA8
Table 8-10	Part C.
CHANGE:	Signature to 11PH
Table 8-13	Part A, Data Acquisition Probe Connections
CHANGE:	Second line to read: Start-U407 Pin 5
Table 8-13	Part D.
CHANGE:	Pin number for first U492 entry from pin 1 to pin 2.
CHANGE:	Footnote b3. to read:

3. Jumper is inserted on P404-1 and P404-2 to hold the MPU with that display.

Figure 8-2	(Back of Diagram 1)
ADD:	NOTE: C168, R160 and R182 are located on the back of the board.
Diagram 3	Lookup Table
ADD:	C168 1F 4G
Diagram 3	Schematic, location 1F
ADD:	C168, 0.1 UF from base of Q164 to ground.
Figure 8-3	Back of Diagram 3
CHANGE:	U206 at 4D to read J206
CHANGE:	Existing Figure 8-3 number to 8-3A

Product: 308 SERVICE Date: 1-3-80 Change Reference: C1/180

DESCRIPTION

ADD: New Figure 8-3B as follows:

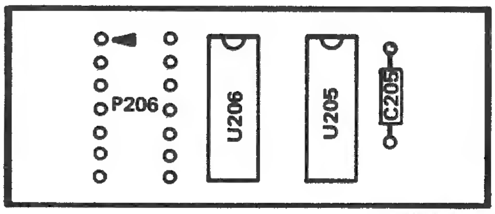


Figure 8-3B. A9 Qualifier board component locations.

Diagram 4 Lookup Table

ADD: J206 3B 4D

DELETE: U206A and U206B entries (U206 is moved to the A9 board).

Diagram 4 Schematic

CHANGE: A portion of the circuitry around location 2B per the attached partial diagram 4.

Diagram 11 Lookup Table

CHANGE: The following entries to read:

C745	1G	7B
DS714	3B	2H
RT707	3A	3H
RT708	3A	3H
S702	4A	4G

ACCESSORIES Tab page

DELETE: Entries for:

010-6406-01

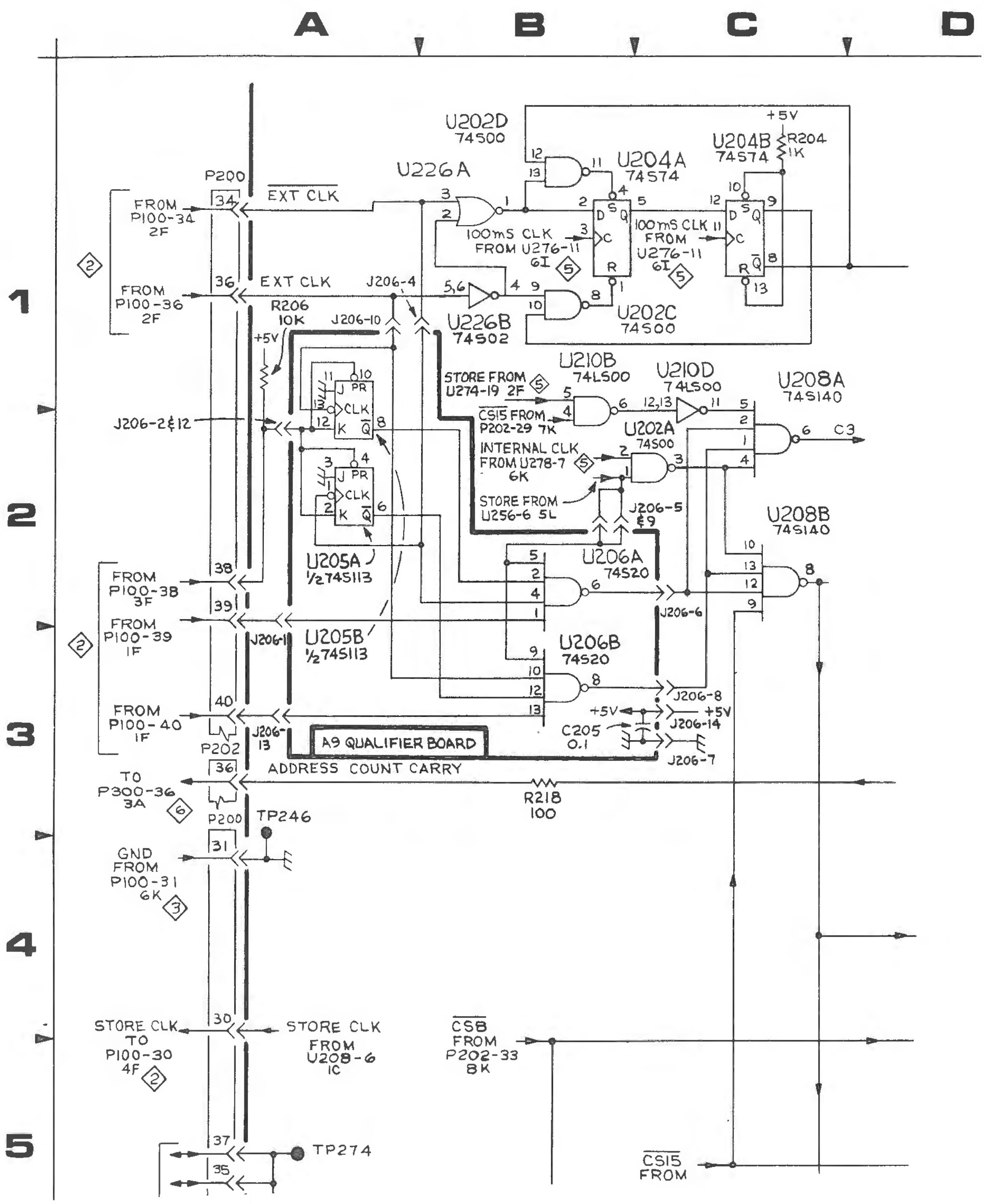
103-0013-00

070-2748-00

Product: 308 SERVICE Date: 1-3-80 Change Reference: C1/180

DESCRIPTION

PARTIAL ◇4 ACQUISITION MEMORY & TRIGGER DELAY



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MANUAL CHANGE INFORMATION

Date: 2-19-80 Change Reference: C3/280

Product: 308 SERVICE (EFF SN AS LISTED BELOW) Manual Part No.: 070-2662-00

DESCRIPTION

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGES

CHANGE TO:

		EFF SN		REF
C862	283-0594-00	300314	CAP.,FXD,MICA DI:0.001UF,1%,100V	PC 34
R862	315-0623-00	300314	RES.,FXD,CMPSN:62K OHM,5%,0.25W	PC 34
U430	160-0768-00	300399	MICROCIRCUIT,DI:2K BYTE, ROM,S4216B	PC 32
U432	160-0769-00	300399	MICROCIRCUIT,DI:8K BYTE, ROM A,S4264,MOS	PC 32
U434	160-0770-00	300399	MICROCIRCUIT,DI:8K BYTE, ROM B,S4264,MOS	PC 32
U486	160-0797-00	300399	MICROCIRCUIT,DI:2K BYTE, ROM,PROGRAMMED,S4216	PC 32

C862 and R862 are located on the A8 SECONDARY POWER SUPPLY board and are shown on POWER SUPPLY & FAN diagram 11.

DIAGRAMS SECTION CORRECTIONS

Diagram 2 Lookup Table (also applies to Figure 8-2)

CHANGE TO:

C105	9F	2D
C150	8F	2G
J185	7H	5D
R120	3D	2A
U132F	5C	2B

Diagram 4 Lookup Table

CHANGE TO:

U220	3F	4B
U222	8F	4C

28134

Product: 308 SERVICE Date: 2-19-80 Change Reference: C3/280

DESCRIPTION

Diagram 6 Lookup Table (also applies to Figure 8-4)

CHANGE TO:

C390	6J	3D
U386C	4K	3G

ADD:

U303B	1I	4A

Diagram 7 Lookup Table (applies to Figure 8-5)

CHANGE TO:

S560	1I	1F
S562	3I	3F

Diagram 8 Lookup Table (also applies to Figure 8-6)

CHANGE TO:

P410	6C	2D
U422	2E	4E
U452A to U452B	7B	4B
U452B to U452C	7B	4B

Diagram 11 Lookup Table (also applies to Figures 8-8 & 8-9)

REMOVE:

CR725	3E	1C

CHANGE TO:

C717	1C	7F
CR745	2F	1G
C884	7E	3E
S700	4A	CHASSIS

ADD: (For A7 Board)

VR725	3E	1C

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MANUAL CHANGE INFORMATION

Date: 1-25-80 Change Reference: C2/180

Product: 308 SERVICE (SN AS LISTED BELOW) Manual Part No.: 070-2662-00

DESCRIPTION

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGES

CHANGE TO:		SN		REF
C617		300184	SELECTED WITH C618 FOR CORRECT HORIZ. SIZE	PC 30
C733	290-0744-00	300244	CAP.,FXD,ELCTLT:3.3UF,+50-10%,160V	PC 19
C874	283-0339-00	ALL SN	CAP.,FXD,CER DI:0.22UF,10%,50V	PC 09
L672	108-0949-00	ALL SN	COIL,RF:FIXED,48UH(NOMINAL VALUE)	PC 20
L821	108-0949-00	300101-300183	COIL,RF:FIXED,48UH(NOMINAL VALUE)	PC 20
L821	SPECIAL	300184-UP	COIL,RF:FIXED,5UH	PC 31
Q610	151-1087-00	300314	TRANSISTOR:SILICON,NPN,2SC1364	PC 25
Q645	151-1087-00	300314	TRANSISTOR:SILICON,NPN,2SC1364	PC 25
Q656	151-1087-00	300314	TRANSISTOR:SILICON,NPN,2SC1364	PC 25
R345	315-0101-00	ALL SN	RES.,FXD,CMPSN:100 OHM,5%,0.25W	PC 05
S710	260-1300-00	300259	SWITCH,SLIDE:DPDT,3A,125VAC	PC 26
ADD:				
C821	290-0807-00	300184-UP	CAP.,FXD,ELCTLT:1000UF,+100-10%,10V	PC 31
REMOVE:				
C884	281-0773-00	300184	CAP.,FXD,CER DI:0.01UF,10%,100V	PC 31
R884	315-0153-00	300184	RES.,FXD,CMPSN:15K OHM,5%,0.25W	PC 31

NOTE:

P404 is referred to as S404 and P407 is referred to as S407 in some portions of the instrument and manual.

R345 affects the A3 SERIAL & SIGNATURE board and SERIAL & SIGNATURE DATA ACQUISITION diagram 6.

C617, L672, Q610, Q645 and Q656 affect the A6 CRT CIRCUIT board and CRT CIRCUIT diagram 10.

C733 and S710 affect the A7 PRIMARY POWER SUPPLY board; C874, L821, C821, C884, and R884 apply to the A8 SECONDARY POWER SUPPLY board; all affect POWER SUPPLY & FAN diagram 11.

At SN 300184, R887 is disconnected from the +5V filtered source (junction of L821-C822) and is connected to the +5V unfiltered source (cathode of CR815A). C821 is added in parallel with C820, L821 becomes a modified part with a value of 5 UH.